International Journal of Business Innovation and Research

ISSN online: 1751-0260 - ISSN print: 1751-0252
https://www.inderscience.com/ijbir

Aspirations and intellectual property in the worldwide entrepreneurship ecosystem

Diego Araujo Reis, Fábio Rodrigues de Moura, Iracema Machado de Aragão

DOI: 10.1504/IJBIR.2020.10052904

Article History:
Received: 06 February 2020
Accepted: 04 December 2020
Published online: 18 January 2023

Aspirations and intellectual property in the worldwide entrepreneurship ecosystem

Diego Araujo Reis,
Fábio Rodrigues de Moura and
Iracema Machado de Aragão

Cidade Univ.,
Campus São Cristóvão,
Prof. José Aloísio de Campos. Av.,
Marechal São Cristóvão, Rondon, s/n,
Jardim Rosa Elze, 49100-000,
São Cristóvão, Sergipe, Brazil
Email: diegoaraujoreis@hotmail.com
Email: fabiromoura@gmail.com.br
Email: aragao.ufs@gmail.com
*Corresponding author

Abstract: Entrepreneurship and intellectual property ecosystems are a systematic and multifaceted phenomenon. The analysis of these ecosystems is essential to gain an understanding of how they might be related, especially at the country level. Our investigation has identified a lack of studies that empirically assess the possible relationship between these two ecosystems. We aim to evaluate the linkage between entrepreneurship and the intellectual property ecosystems. The aspirations sub-index of the Global Entrepreneurship Index and the US Chamber International IP Index are used as a proxy for the entrepreneurial and intellectual property ecosystem, respectively. We estimate a panel data model and use a quantile regression model with fixed effects to test the hypothesis that the intellectual property ecosystem affects aspirations in the global entrepreneurship ecosystem. This study analyses these ecosystems from a different perspective, and the results are potentially important for policymakers who seek to improve entrepreneurship and intellectual property.

Keywords: Global Entrepreneurship Index; US Chamber International IP Index; intellectual property ecosystem; panel data; quantile regression; entrepreneurship ecosystem; aspirations; innovation; start-up.

Reference to this paper should be made as follows: Reis, D.A., de Moura, F.R. and de Aragão, I.M. (2023) 'Aspirations and intellectual property in the worldwide entrepreneurship ecosystem', *Int. J. Business Innovation and Research*, Vol. 30, No. 1, pp.102–128.

Biographical notes: Diego Araujo Reis is a PhD in the Program of Postgraduate in Intellectual Property Science (PPGPI) of the Federal University of Sergipe (UFS). His is a Legislative Analyst (Economist) of the Sergipe State Legislative Assembly (ALESE). He holds a degree in Economics and a Master in Regional Development from UFS. Has experience in the area of economy, entrepreneurship and innovation.

Fábio Rodrigues de Moura is a Professor at the Department of Economics and Program of Postgraduate in Economics, Federal University of Sergipe. Has experience in applied economics and quantitative methods.

Iracema Machado de Aragão is a Professor in Department of Business Administration and Program of Postgraduate in Intellectual Property Science (PPGPI), Federal University of Sergipe. He holds a Master's degree and a Doctorate in Administration from the University of São Paulo. He has experience in the area of administration, with emphasis on entrepreneurship (parks and incubators of technology-based companies, business model, intellectual property and regional development).

This paper is a revised and expanded version of a paper entitled 'Aspirations and intellectual property in the worldwide entrepreneurship ecosystem' presented at 10th European Conference on Intangibles and Intellectual Capital (ECIIC), University of Chieti-Pescara, Pescara, Italy, 23–24 May 2019.

1 Introduction

Entrepreneurship is the search to generate value through the creation or expansion of economic activity. Entrepreneurs are responsible for the creative process, using their accumulated knowledge and skills (OECD, 2008). Knowledge is a decisive and central productivity factor in new business models. It is recognised that entrepreneurship boosts employment, productivity, innovation, economic growth and development (Schumpeter, 1934; Acs and Audretsch, 1988; Barro, 1991; Hoffman, 2007; Van Praag, 2007; Lafuente et al., 2016; Kastelle et al., 2018; Nogueira et al., 2019; Baron and Harima, 2019).

Schumpeter (1934) and Østergaard and Marinova (2018) argue that innovative entrepreneurs create new products, services, and processes in search of extraordinary profits and favourable positions in the market. Having met some specific requirements, innovation can be legally protected by intellectual property legislation, which guarantees a privileged monopolist position for a certain period.

In the theory of intellectual capital, intellectual property is a component of structural capital associated with the intangible elements of a company's organisational culture, business processes, and the ability to innovate. Companies and countries adopt the strategy of protecting creative production as a mechanism of economic appropriation. Entrepreneurship is also an important intangible asset (Rao, 2016), which could be influenced by the environment protecting intellectual property rights. Measuring these variables and how they relate is not a simple task.

Since the start of the 21st century, entrepreneurship and intellectual property have been increasingly investigated in theoretical and empirical studies, resulting in a considerable evolution and better understanding of the concept (Reynolds et al., 2005; Choong, 2008; Acs et al., 2009, 2014; Bjuggren et al., 2012; Cătălin et al., 2017; Itanyi, 2018; Reis et al., 2019). As the debate has matured, metrics and indicators for measuring entrepreneurship and intellectual property have been developed, including a systemic and ecosystem approach, allowing comparison between regions and countries.

Several surveys have evaluated the entrepreneurship ecosystem using different approaches. Østergaard and Marinova (2018) investigated the relationship between human capital and the entrepreneurship ecosystem. Bischoff and Volkmann (2018)

discuss the entrepreneurship ecosystem from the perspective of sustainability.

Pawitan et al. (2019) studied the relationship between entrepreneurship ecosystems and national competitiveness. Kalhor et al. (2019) carried out an experiment that allowed to show how an institutional change can affect the entrepreneurship ecosystem. Mittal and Madan (2020) estimated the impact of financing patterns on the business performance of e-startups. These studies have become relevant contributions and serve as a reference for innovative research.

Discussing entrepreneurship and intellectual property at the country level is crucial, and the literature some methodologies have been proposed that aim to measure entrepreneurship and intellectual property ecosystems, such as The Global Entrepreneurship Index (GEI) and the US Chamber International IP Index (IPI).

Created in 2011, the GEI comprises a combination of multiple dimensions of the business environment. The GEI classifies the data into three primary areas: attitudes, abilities, and aspirations. Positive attitudes are necessary for competent individuals to choose entrepreneurship rather than alternative occupations. Ability reflects the quality of new undertakings while aspirations reflect the potential of enterprises to achieve rapid growth and high productivity. The focus of this methodology is on entrepreneurship by opportunity.

Since 2012, the IPI has assessed the performance of intellectual property systems in several countries. Created by the Global Innovation Policy Center (GIPC), the index consists of eight specific categories of the intellectual property environment (patents; copyrights; trade secrets; commercialisation of IP assets; enforcement; systemic efficiency; membership in and ratification of international treaties).

Our investigation has identified a lack of studies that address the possible connections between the entrepreneurship ecosystem and the intellectual property ecosystem. Do these two ecosystems interact? To answer that, we use the aspirations sub-index of the GEI as a proxy for the entrepreneurial ecosystem, and the IPI as a proxy for the intellectual property ecosystem. We aim to evaluate the relationship between the IPI and the aspirations sub-index based on country data between 2012 and 2018.

We understand that as the intellectual property ecosystem evolves, it can interfere in the strategies and the stimulus that individuals and organisations face in carrying out entrepreneurial activities. Do higher levels of robustness in the intellectual property ecosystem result in greater entrepreneurial aspirations?

We estimate a linear panel data model and a quantile regression model in a panel data framework to test the hypothesis that the intellectual property ecosystem, proxied by the IPI, affects the aspirations' results in the GEI. We control for the GEI abilities sub-index, GEI attitudes sub-index, gross domestic product per capita based on purchasing power parity (GDP PPP), gross capital formation, and the particular effect of different regions on aspirations.

We propose the construction of an unprecedented model which tests whether the entrepreneurial aspirations of countries is affected or not by the rules of intellectual property. We adopted the quantile regression method, which allows a more informative assessment of the causal relationship. Our study analyses the GEI and the IPI from a different perspective, and the results are potentially important for policymakers who seek to improve the entrepreneurship and intellectual property ecosystems.

2 Entrepreneurship and intellectual property ecosystems

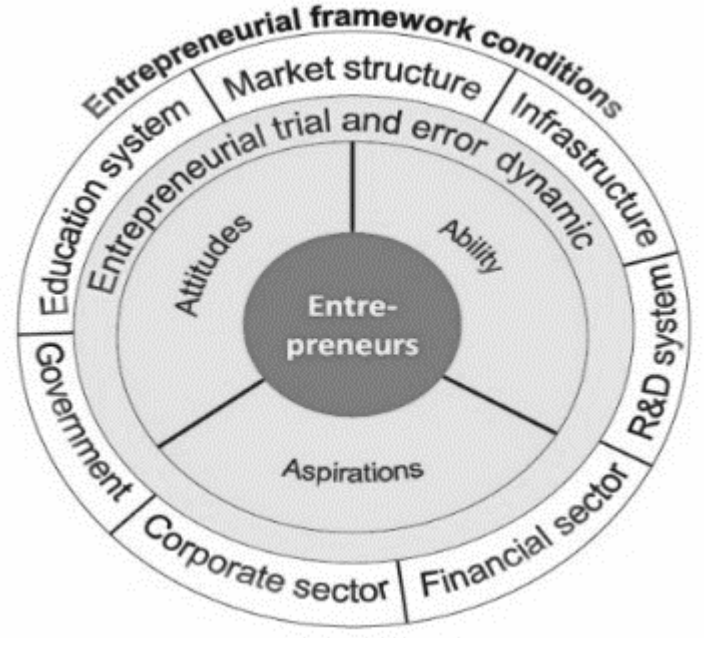
The current discussion on entrepreneurship reveals that the external environment plays a key role in the emergence of opportunity entrepreneurship (Autio and Thomas, 2013; Acs et al., 2014). That is, the literature recognises the relevance of the systemic component of the entrepreneurship ecosystem.

According to Acs and Szerb (2009, 2012) and Acs et al. (2009, 2013), the entrepreneurship ecosystem consists of complex collaborative networks of dynamically interacting systems and subsystems within a set of dependencies and inter-dependencies which is continuously changing.

The GEI (2015) explains that the entrepreneurship ecosystem is a constellation of entrepreneurial activities that contribute to a healthy business dynamic in a locality or country. In an entrepreneurship ecosystem we might expect the availability of specialised resources (physical capital and human capital) to contribute to high-growth entrepreneurial activity, usually provided not only by public-sector agencies, but also by private-sector operators (GEI, 2015).

In the entrepreneurship ecosystem, individuals incorporate business attitudes, abilities, and aspirations in a dynamic interaction process (Acs et al., 2014). Figure 1 illustrates the theoretical concept of the entrepreneurship ecosystem.

Figure 1 The entrepreneurship ecosystem



Source: GEI (2017)

Innovative entrepreneurs are the core of the system, and they are characterised by having varied levels of business abilities and aspirations. They start a business activity in search of perceived opportunities that are validated in the process of trial and error (GEI, 2017). In addition, entrepreneurship is regulated by a series of structural conditions (market,

infrastructure, R&D system, financial sector, the corporate sector, government, educational system). The GEI report (2017) explains that a healthy entrepreneurship ecosystem generates an efficient allocation of resources and increases total factor productivity (TFP) through innovation (Acs et al., 2014).

Aghion (2017) proposes a new Schumpeterian theory of economic growth, where innovative entrepreneurs generate growth, business investment responds to incentives (influenced by economic policies and institutions) and innovations replace old technologies. Following Schumpeter (1934), the GEI (2017) assigns the entrepreneur the responsibility of coordinating scarce resources and the activities needed to create innovative high-growth start-ups. This innovative entrepreneur will guarantee that the invention has some usefulness and contributes to increasing productivity and economic growth. In this regard, Baumol and Strom (2007), Parker (2009) and Aidis and Estrin (2013) recognise the role of institutions in the entrepreneurship ecosystem: institutions determine the rules of the game, including the relevance of intellectual property rights.

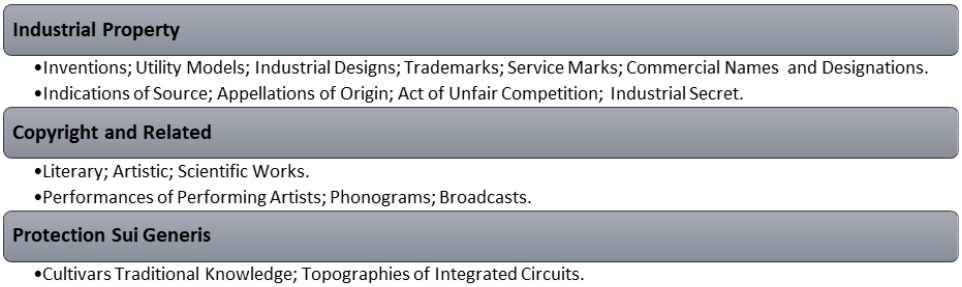
There is a growing literature that states that intellectual property is an important incentive mechanism for the market. A robust intellectual property system allows innovative entrepreneurs to invest in their business, assuring that the production of new goods, processes, services, etc., may be protected, as long as the results of their creations meet the requirements of the legislation.

The general concept of intellectual property is directly related to the legal rights which result from intellectual activity in the industrial, scientific, literary, and artistic fields. The World Intellectual Property Organization (WIPO) explains that the protection of intellectual property grants the creators the moral and economic rights of their creations, also granting the public the right to access such creations, promoting creativity and fair trade. The WIPO (1967, Article 2, p.viii) defines intellectual property in detail:

> "Intellectual property shall include rights relating to: literary, artistic and scientific works; performances of performing artists, phonograms and broadcasts; inventions in all fields of human endeavour; scientific discoveries; industrial designs; trademarks, service marks and commercial names and designations; protection against unfair competition; and all other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields."

In summary, intellectual property is divided into three branches (industrial property; copyright and related; Protection Sui Generis). Figure 2 shows what results of human creation are part of the intellectual property.

Figure 2 Components of industrial property and copyright and related



Source: The authors' based on WIPO (2004)

Table 1 Concept of forms of protection

Protection	*Concept*
Patent	It is a document, issued, upon application, by a government office, which describes an invention and creates a legal situation in which the patented invention can normally only be exploited (manufactured, used, sold, imported) with the authorisation of the owner of the patent.
Utility models	It is merely a name given to certain inventions that are sometimes described as devices or useful objects.
Industrial designs	Refers to the right granted in many countries, pursuant to a registration system, to protect the original ornamental and non-functional features of an industrial article or product that result from design activity.
Trademarks	Is any sign that individualises the goods of a given enterprise and distinguishes them from the goods of its competitors. A trademark can be protected on the basis of either use or registration.
Service marks	Are signs that enable the consumers to distinguish between the different services. These signs are called service marks and fulfill essentially the same origin-indicating and distinguishing function for services as trademarks do for goods.
Indication of source	This means any expression or sign used to indicate that a product or service originates in a country, a region or a specific place.
Appellation of origin	means the geographical name of a country, region or specific place which serves to designate a product originating therein the characteristic qualities of which are due exclusively or essentially to the geographical environment, including natural or human factors or both natural and human factors.
Protection against unfair competition	Any act of competition contrary to honest practices in industrial or commercial matters constitutes an act of unfair competition.
Industrial secret	It is defined as any information relating to a production method, a sales method or any other information on technology or business that is unknown to the public.
Copyright	Includes every production in the literary, scientific and artistic domain, whatever the mode or form of expression. For a work to enjoy copyright protection, however, it must be an original creation.
Related rights	Protection of artists in their performances, producers of phonograms e broadcasting organisations, who assist intellectual creators to communicate their message and to disseminate their works to the public at large, is attempted by means of related rights.
Cultivars	It is a form of intellectual property right granted to the breeder of a new plant variety.
Traditional knowledge	Involves protecting expressions of traditional cultures and traditional forms of creativity and innovation against unauthorised adaptation, reproduction and subsequent commercialisation of traditional.
Topographies of integrated circuits	Means a product, in its final form or an intermediate form, in which the elements, at least one of which is an active element, and some or all of the interconnections are integrally formed in and/or on a piece of material and which is intended to perform an electronic function,

Source: The authors, based on WIPO (2004)

The WIPO (2004) explains which inventions are new solutions to technical problems. Industrial designs are aesthetic creations determining the appearance of industrial products. Trademarks, service marks, commercial names and designations, including indications of source and appellations of origin are signs transmitting information to consumers. Scientific discoveries are the recognition of phenomena, properties or laws of the material universe not yet recognised and capable of verification.

The WIPO (2004) argues that copyright consists of methods of public communication, including printed publications, sound and television broadcasting, films for public exhibition in cinemas and computerised systems for the storage and retrieval of information. Copyright deals with the rights of intellectual creators (books, paintings, drawings, music, poems, etc.).

Table 1 shows the general forms of intellectual property protection. The intellectual property laws ensure certain time-limited rights, according to the legislation of each country. Through intellectual property, companies may increase the visibility of new products (goods, processes, services), register their brand, optimise the value of their creations, and protect themselves against unfair competition.

The intellectual property system has inputs and outputs. Inputs relate to creative and inventive human production that seeks legal protection for their creations. Outputs relate to an effective profusion of protected creations. Helfer (2009) and Contreras-Jaramillo (2017) argue that the intellectual property system is a complex web of explanations and rules. Singh (2005) explains that the intellectual property system comprises several components, transactions, and numerous interdependencies. The system also involves the articulation and interaction of several public and private agents.

The WIPO seeks to promote an international intellectual property system that protects the public interest while rewarding and stimulating creativity and innovation. Vasconcelos and Silva (2018) agree that the protection of intellectual property is a fundamental factor that supports the national growth process. Alikhan and Mashelkar (2006) highlight the necessity to improve information regarding the positive techno-economic effects of intellectual property rights protection on enterprise competitiveness and economic growth.

In short, laws and other legal provisions rule the intellectual property system. This system can be viewed as an ecosystem, especially when we consider that its legal architecture and performance may change due to the influence of mutually interacting economic, governmental, institutional and social actors. This ecosystem of intellectual property, as it evolves or recedes, objectively interferes with the individuals' strategies and aspirations.

The theory of entrepreneurship ecosystems is well developed. We are motivated to understand how entrepreneurship and intellectual property ecosystems can interact. To do so, we rely on the methodologies for measuring ecosystems, provided by bodies that have credibility on the topic.

2.1 Global Entrepreneurship Index

The GEI was introduced in 2014 by the Global Entrepreneurship Network (GEN), following an earlier version between 2011 and 2013 (GEDI). It is an annual index that measures the entrepreneurship ecosystems of several countries. In 2018, the index was calculated for 137 countries. The GEI assumes that the entrepreneurship ecosystem at a socioeconomic level exhibits self-organisation, stability, and sustainability. For each

country, the data contains variables related to 14 sub-areas, which generate three sub-indices (attitudes, abilities, and aspirations) that result in the GEI (Table 2).

Table 2 Composition of the GEI

Sub-index	*Pillars*	*Conception*
Attitudes sub-index	Opportunity perception Start-up skills Risk acceptance Networking Cultural support	Captures entrepreneurial attitudes given some important institutional variables. It involves the entrepreneurial opportunities the population perceives, weighted by economic freedom and property rights; the start-up abilities the population perceives, weighted by the quality of education; risk acceptance, that is, the fear of failure in entrepreneurship, combined with a measure of a country's risk; entrepreneurial support networks (ease of access); how the population view entrepreneurs in terms of status and career choice and how the corruption level affects this view.
Abilities sub-index	Opportunity start-up Technology absorption Human capital Competition	Measures important entrepreneur characteristics that determine to what extent new start-ups will have the potential to grow, such as: motivation based on opportunity rather than based on necessity (weighted by the combined effect of taxation and the quality of government services); the potential of start-up activity (combined with the ability to absorb new technology); the educational level of entrepreneurs (weighted by the percentage of start-ups founded by individuals with academic degree or secondary education, by a measure of the entrepreneur's propensity to training their employees, and by labour freedom); the level of product exclusivity or start-up market exclusivity, combined with the market power as well as the effectiveness of competitive regulations.
Aspiration sub-index	Product innovation Process innovation High growth Internationalisation Risk capital	Captures the distinctive and qualitative aspects of the entrepreneurial activity: the tendency of companies to create new products, weighted by a country's ability to transfer technology; the use of new technologies for start-ups, combined with Gross Domestic Expenditure on Research and Development (GERD) and the potential of a country to perform applied research; percentage of high-growth companies that intend to hire at least ten employees and plan to grow by more than 50% in five years; the availability of venture capital and the sophistication of business strategies; the degree of internationalisation, measured by the company's export potential and weighted by the country's economic complexity; the informal investment at earlier stages and a measure of the depth of capital markets.

Global Entrepreneurship Index

Source: The authors' own based on GEI (2017)

Szerb (2017) observes that the GEI is based on a holistic view of different aspects of the entrepreneurship ecosystem. The Index's methodology consists of constructing

sub-indices at several levels. The Entrepreneurial attitudes sub-index captures how a country thinks about entrepreneurship. The second sub-index is about abilities. The third sub-index is about aspirations. The index and its sub-indices are quantitative measures that range between 0 and 100, whereby the higher the score, the more developed the entrepreneurship ecosystem.

2.2 The US Chamber International IP Index

Created in 2012, the IPI measures the performance of intellectual property ecosystems at a country level. In 2018, the index monitored 50 countries. According to Table 3, the index has 40 indicators distributed over eight specific categories (Figure 3). These categories evaluate the change and robustness of intellectual property through political, legislative, regulatory and enforcement parameters.

GIPC (2018) expects that a proper and legal architecture of intellectual property, which encourages and protects creators, will have positive effects on creativity and, consequently, on entrepreneurial aspirations. The cumulative score of the Index ranges from a minimum of 0 to a maximum of 40. Each indicator can score values between 0 and 1. Indicators are scored using three distinct methods: binary, numerical, and mixed (GIPC, 2018). We use the US Chamber International IP Index (IPI) a proxy for the intellectual property ecosystem.

Table 3 Composition of the IPI

Category 1: Patents, related rights, and limitations
Patent term of protection.
Patentability requirements.
Patentability of computer-implemented inventions.
Pharmaceutical-related patent enforcement and resolution mechanism.
Legislative criteria and active use of compulsory licensing of patented products and technologies.
Patent term restoration for pharmaceutical products.
Membership in Patent Prosecution Highways (PPHs).
Patent opposition.
Category 2: Copyrights, related rights, and limitations
Copyright (and related rights) term of protection.
Legal measures that provide necessary exclusive rights that prevent infringement of copyrights and related rights (including Web hosting, streaming, and linking).
Expeditious injunctive-style relief and disabling of infringing content online.
Availability of frameworks that promote cooperative action against online piracy.
Scope of limitations and exceptions to copyrights and related rights.
Digital rights management legislation.
Clear implementation of policies and guidelines requiring that any proprietary software used on government ICT systems should be licensed software.

Table 3 Composition of the IPI (continued)

Category 3: Trademarks, related rights, and limitations
Trademarks' term of protection (renewal periods).
Ability of trademark owners to protect their trademarks: requisites for protection.
Legal measures that provide necessary exclusive rights to redress unauthorised uses of trademarks.
Availability of frameworks that promote action against the online sale of counterfeit goods.
Industrial design term of protection.
Legal measures that provide necessary exclusive rights to redress unauthorised use of industrial design rights.
Category 4: Trade secrets and related rights
Protection of trade secrets.
Regulatory data protection (RDP) term.
Category 5: Commercialisation of IP assets
Barriers to market access.
Regulatory and administrative barriers to the commercialisation of IP assets.
IP as an economic asset.
Category 6: Enforcement
Physical counterfeiting rates.
Software piracy rates.
Civil and procedural remedies.
Preestablished damages and/or mechanisms for determining the number of damages generated by the infringement.
Criminal standards including minimum imprisonment and minimum fines.
Effective border measures.
Transparency and public reporting by customs authorities of trade-related IP infringement.
Category 7: Systemic efficiency
Coordination of IP rights enforcement efforts.
Consultation with stakeholders during IP policy formation.
Educational campaigns and awareness-raising.
Category 8: Membership in and ratification of international treaties
WIPO Internet Treaties.
Singapore Treaty on the Law of Trademarks.
Patent Law Treaty.
At least one free trade agreement with substantive and/or specific IP provisions such as chapters on IP and separate provisions on IP rights provided it was signed after WTO/TRIPS membership.

Source: The authors, based on GIPC (2018)

2.3 Empirical literature

There is a vibrant literature that investigates entrepreneurship from different perspectives with a relevant theoretical and empirical focus (Mavi and Afshar, 2017; Sengupta, 2018; Silva et al., 2018; Bagheri and Akbari, 2019; Urban and Verachia, 2019; Roy and Mohanty, 2020).

The studies we mapped present heterogeneous discussions and results. Initially, we present the debate on the use of GEI in scientific research, as the literature on entrepreneurial ecosystem has been previously discussed. The debate on intellectual property will be discussed later. Acs and Szerb (2009) were the precursors of the Global Entrepreneurship Index (GEINDEX) and provided evidence that entrepreneurship across countries is positively related to economic development.

Bulut et al. (2013) examined six methodologies that measure entrepreneurship and innovation, as follows: Innovation Union Scoreboard – IUS; Global Entrepreneurship Monitor – GEM, Global Innovation Index – GII; Innovation Capacity Index – ICI; Global Entrepreneurship Index – GEI; World Competitiveness Yearbook – WCY.

Acs et al. (2014) introduce a new concept of national entrepreneurship systems, which function like resource allocation systems. Resources are driven by the pursuit of opportunities at the individual level, whose activity and outcomes duration are governed by the specific characteristics of institutions in each country. Ghazinoory et al. (2014) used the GEI data to investigate the influence of different social capital dimensions on the national innovation system (NIS) in 34 countries.

Using the GEI and the Knowledge Entrepreneurship Index (KEI), Nataraajan and Angur (2014) identified a significant positive impact of business activity on quality of life (QoL). Lafuente et al. (2016) tested the efficiency of the hypothesis of the knowledge spillover theory of entrepreneurship. The authors used a Global Entrepreneurship and Development Index (GEDI) database and macroeconomic data from World Bank databases, covering 63 countries in 2012. Through the application of data envelopment analysis, the authors found that knowledge formation responds to market opportunities. Another important finding is that higher levels of efficiency require a healthy national system of entrepreneurship from which knowledge spills over.

Inácio et al. (2016) studied the Brazilian entrepreneurship ecosystem using the GEI and discovered that institutional interaction in Brazil is of low-to-middle quality. Szerb et al. (2016) explain how the GEI methodology is projected to identify the shape of National Entrepreneurship Systems. Jovanovic et al. (2017) studied and compared the metrics of composite indices used in technology management – TM: the global competitiveness index – GCI, GII, and the GEI. Cătălin et al. (2017) investigated the evolution of the GEI in the top ten countries between 2015 and 2017 and found an absolute dominance of the USA and the growing presence of European countries. Szerb (2017) examined the possibilities for developing Hungarian entrepreneurship with the help of the GEI and identified the following weaknesses: opportunity recognition, product innovation, financing, and competition.

Acs et al. (2018) empirically investigated whether entrepreneurship and institutions, combined in an ecosystem, could explain the differences in economic growth in 46 countries between 2002 to 2011. Through the analysis of an aggregate production function, the concept of national entrepreneurship systems (NSE) and GEI data, the authors explain that the entrepreneurial ecosystem influences economic growth. Atiase et al. (2018) investigated the role of four critical resources (credit, electrical energy,

contract enforcement, and political governance) in explaining the entrepreneurship quality and the business support in Africa (response variables). The authors estimated OLS regressions with the GEI data for 35 countries.

Other studies have also used and explored GEI, such as Abu-Shanab and Osmani (2019), Alfalih (2019), Galvao and Pinheiro (2019), Komlosi et al. (2019), Saberi and Hamdan (2019), Szerb and Trumbull (2018), Tasnim and Afzal (2018), Inacio et al. (2020), Ionescu et al. (2020) and Quillas et al. (2020).

We group the literature on the intellectual property system into three major areas. The first is that which theoretically evaluates the development of the intellectual property system, and the reasoning for protecting intellectual property rights and their various enforcement mechanisms (Helfer, 2009; Forsyth, 2016; Denoncourt, 2018; Itanyi, 2018). The second area assesses the performance of intellectual property systems at the country level, such as Chiang (1995), Khan and Sokoloff (2001), Sarkissian (2008), Kato (2014), Elmahjub (2016), Garaventa and Wegbrait (2017), Vasconcelos and Silva (2018), Yu (2018), Demiralp et al. (2018) and Maldonado-Sada et al. (2019). The third area refers to studies that relate the intellectual property system to innovative entrepreneurship. Dan and Chunyan (2006) explored the role of the intellectual property system on the technological innovation of enterprises. The authors state that the system should be fully compromised in motivating the technological innovation of enterprises.

Acs et al. (2009) found evidence that the exploitation of knowledge through patents is negatively related to entrepreneurial activity. These authors argue that the lower the ability of entrepreneurs to appropriate new knowledge, the more likely knowledge will spread to others, as predicted by the knowledge spillover theory of entrepreneurship.

Gu (2009) studied intellectual property in private enterprises based on the Independent Innovation perspective. The author argues that the protection of the intellectual property is important to encourage independent innovation of private enterprises and to optimise the environment for innovation. Gu (2009) suggests that it is necessary to improve the jurisdictional function of protecting the intellectual property of private enterprises.

Fini et al. (2010) investigated academic entrepreneurship and the intellectual property system. They analysed a sample of 11,572 professors and found that much of academic entrepreneurship occurs outside the university's intellectual property system. The authors reported that two-thirds of the businesses started by academics are not based on disclosed and patented inventions. Yong and Sheng (2014) analysed the intellectual property rights of high-level entrepreneurs in Zhejiang Province, China. The authors used a Logistic model and discovered that enterprises benefit from patents, that the patent agencies favour enterprises, and that the government supports the corporate patent professionals. Yong and Sheng (2014) also discovered that the entrepreneur's knowledge of foreign patent applications was relatively weak.

Nogueira et al. (2019) used a dataset of 80 Spanish firms between 2004 and 2014. These authors use a panel data fixed effects estimator and panel data quantile regressions to overcome the problems of regression techniques focused on the average firm. The results showed that R&D expenditure impacts sales growth and that the market value of patents is related to firm growth.

The theoretical aspects provide a better specification of the characteristics of entrepreneurship and intellectual property. In addition, the presentation of empirical literature provides an adequate perception of how studies have already addressed the theme of entrepreneurship and intellectual property in various contexts. The most

important thing, however, was to verify the objectives and the various methodological approaches already applied in the literature to guide the direction of the present study. The empirical literature provides some valuable insights as well as highlights the absence of studies assessing the results of the IPI. We found no studies that assessed the relationship between aspirations and IPI in the entrepreneurship ecosystem from global indexes.

3 Methodology

This is a quantitative study based on documentary research. Econometric methods are applied in order to test the central hypothesis of this study. Information about the sample design and the empirical strategy is provided in the following subsections.

3.1 Sample design

Our sample was constructed based on the availability of the GEI sub-indices and the IPI. The GEI sub-indices and the IPI are available in the GEN and GIPC annual reports; the GEI data is available from 2011 to 2018, and the IPI data from 2012 to 2018. Table 4 shows the coverage of the two indices. Over the years an increasing number of countries are now measured by the indexes. We note that the IPI index has less coverage, however, it monitors most important countries.

Table 4 Number of countries mapped by the GEI and the IPI

Index	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
GEI[a]	71	79	118	120	130	132	137	137
IPI[b]	-	9	-	25	30	38	45	50
Countries in the sample	Algeria; Argentina; Australia; Brazil; Brunei Darussalam; Canada; Chile; China; Colombia; Ecuador; Egypt; France; Germany; Hungary; India; Indonesia; Israel; Italy; Japan; Kenya; Korea, Republic of; Malaysia; Mexico; Nigeria; Pakistan; Peru; Philippines; Poland; Russian Federation; Saudi Arabia; Singapore; South Africa; Spain; Sweden; Switzerland; Taiwan; Thailand; Turkey; Ukraine; United Arab Emirates; UK; US; Venezuela, Bolivarian Republic of; Vietnam.							

Notes: [a]The GEI data for 2011 to 2013 correspond to the previous version (GEDI), which varied between 0 and 1. To reconcile the earlier version with the current one, the data for 2011 to 2013 were multiplied by 100. For more information on the methodology, and the imputation process, see the annual reports.
[b]In 2013, the IPI did not publish data.

Source: The authors' own.

The current year GEI publication is always based on the country data for the past two years. Thus, for estimation purposes, we adjust the GEI sub-indices by two years (2009 to 2016). The current year IPI is always based on country data for the past year. Likewise, we decided to adjust that index by one year (2011 to 2017).

Given the modifications and the discontinuity in the GEI structure and the absence of the IPI results for some years, we decided to use all available data (both time series and cross-sectional data), resulting in an unbalanced panel framework. In addition to the GEI sub-indices (aspirations – ASP; abilities – ABI; attitudes – ATT), we control for gross domestic product per capita based on purchasing power parity (GDP international dollars

based on the 2011 ICP round) and gross capital formation in % of GDP (GCF), obtained from the World Bank.

The GEI covers a population of around 6.99 billion in 137 countries, which corresponded to a GDP of USD 112.50 trillion in 2017 (at constant values – base year 2011). In 2017, the IPI corresponded to a global population of around 5.81 billion in 45 countries and a GDP of USD 101.28 trillion (at constant values – base year 2011). The indices include countries on the five main continents, which increases the global perception of their results. As it deals with a strategic theme for the development of countries, it is relevant to investigate the entrepreneurship and intellectual property ecosystems from the perspective of their connections.

3.2 Empirical model

To empirically evaluate the effect of the IPI on the GEI aspirations, we use two strategies. First, we estimate a linear panel data model to assess the effect of the IPI on the average GEI aspirations. Second, we use a quantile regression model for panel data to capture specific information on the heterogeneous effect of the IPI across the GEI distribution.

3.2.1 Linear panel data estimator

We expect a positive relationship between IPI and the entrepreneurs' aspirations. This analysis proposes the estimation of the following regression equation:

$$ASP_{it} = \beta_0 + \beta_1 IPI_{it} + \beta_2 ATI_{it} + \beta_3 HAB_{it} + \beta_4 GCF_{it} + \beta_5 GDP_{it} + C_i + \varepsilon_{it}$$

The model was estimated using log variables (the coefficients are elasticities), according to the robustness procedure adopted by Acs et al. (2018). i is the cross-section index for the sample countries, t is the index for the annual observations of each country, C_i is a term that captures specific unobserved and time-invariant effects in each country, and ε_{it} is the idiosyncratic error term.

The countries' unobservable heterogeneity can be modelled using a one-way error component $u_{it} = C_i + \varepsilon_{it}$, where C_i is estimated via fixed or random effects. In the fixed effects model it is assumed $E(C_i\varepsilon_{it}) = E(X_{it}\varepsilon_{it}) = 0$, $E(C_iX_{it}) \neq 0$ and $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$. In the random effects model we have $C_i \sim IID(0, \sigma_C^2)$, $\varepsilon_{it} \sim IID(0, \sigma_\varepsilon^2)$, $E(C_i\varepsilon_{it}) = 0$, $E(C_iX_{it}) = 0$, $E(u_{it}u_{js}) = \sigma_C^2 + \sigma_\varepsilon^2$ if $i = j$ and $t = s$, $E(u_{it}u_{js}) = \sigma_C^2$ if $i = j$ and $t \neq s$. The random effects model assumes zero covariance between the regressors and the unobservable heterogeneity. If there is a correlation between the individual effects and the regressors, the fixed effects model produces consistent estimates of coefficients (BALTAGI, 2005). The Hausman specification test will be used to support the decision between n the fixed and random effects model.

Data that combine cross-section and time-series usually present a complex structure in the variance-covariance matrix of the disturbances, e.g., heteroscedasticity among individuals, $E(\varepsilon_{it}^2) = \sigma_i^2$, cross-section dependence, $E(\varepsilon_{it}\varepsilon_{jt}) = \sigma_{ij}$, and serial correlation, $E(\varepsilon_{it}\varepsilon_{is}) = \omega_{ts}$. In the presence of non-spherical disturbances, the panel estimator is inefficient and the standard errors are biased. Therefore, we test for the presence of non-spherical disturbances. In this scenario, we use a robust covariance matrix estimator

(Greene, 2000; Wooldridge, 2013) and the Driscoll and Kraay's (1998) estimator. Hoechle (2007) implemented Driscoll and Kraay's (1998) non-parametric variance-covariance estimator, which is robust for general forms of autocorrelation, heteroscedasticity and cross-section dependence. Monte Carlo simulations by Hoechle (2007) show that the properties of the Driscoll and Kraay estimator on finite samples are better, including large panels with few time observations.

3.2.2 Quantile regressions model

We assume that the IPI has a distinct effect across the conditional distribution of the response variable. Following Bache et al. (2013), we estimate a quantile regression model unconditional with fixed effects in a panel data setting. In addition to controlling for time-invariant unobserved heterogeneity, a panel data quantile regression may assess the effect of a particular covariate across different quantiles of the response variable, resulting in a more informative and robust inference. We estimate the following panel data model:

$$\begin{aligned} ASP(\tau)_{it} = {} & \beta_0(\tau) + IPI_{it}\beta_1(\tau) + ABI_{it}\beta_2(\tau) + ATT_{it}\beta_3(\tau) + GCF_{it}\beta_4(\tau) \\ & + GDP_{it}\beta_5(\tau) + EUR_{it}\beta_6(\tau) + NAC_{it}\beta_7(\tau) + LCN_{it}\beta_8(\tau) + CSA_{it}\beta_9(\tau) \\ & + SEAO_{it}\beta_{10}(\tau) + NAWA_{it}\beta_{11}(\tau) + SSF_{it}\beta_{12}(\tau) + D_k + s_i\pi + \varepsilon_{it}. \end{aligned} \quad (1)$$

where i is the index for countries and t is the index for years. The time-invariant unobserved effects are controlled by the covariate vector s_i generated by repeated measurements of the time-varying covariates (time-invariant covariates, such as geographic region, are not used to construct s_i). In general, s_i is constructed using the t-means (averages over time) of the time-varying covariates. This allows for unobserved characteristics to correlate with covariates. In addition, the unobserved effects can affect both the scale and location of the response distribution. The s_i vector enters linearly in the criterion function and the unobserved effects are allowed to vary with each quantile.

The model was estimated using log variables. Dummy variables D_k capture the particular effect of different regions on aspirations. The regions follow the United Nations criteria: EUR = Europe; NAC = North America; LCN = Latin America and the Caribbean; CSA = Central and Southern Asia; SEAO = Southeast Asia, East Asia, and Oceania; NAWA = Northern Africa and Western Asia; SSF = Sub-Saharan Africa. Table 4 shows that the number of countries in the GEI and IPI varies annually. The estimator proposed by Bache et al. (2013) allows for unbalanced panels.

4 Results

First, we present the sample descriptive statistics. Second, we show the results for the linear panel data regression. Third, we describe the sample quantiles and analyse the results of the quantile regression.

4.1 Descriptive statistics

Entrepreneurial aspirations (ASP) averaged 45.07 (SD = 22.73) and the index that measures the robustness of the intellectual property ecosystem (IPI) has an average score

of 16.44 (SD = 7.40). The average levels of entrepreneurial attitudes (ATT) and abilities (ABI) were 43.59 (SD = 18.74) and 44.18 (SD = 21.40), respectively. The average gross fixed capital formation (as a percentage of GDP) was 24.58 (SD = 7.17), while countries' average GDP was U$ 29,068.23 (SD = U$20,363.00).

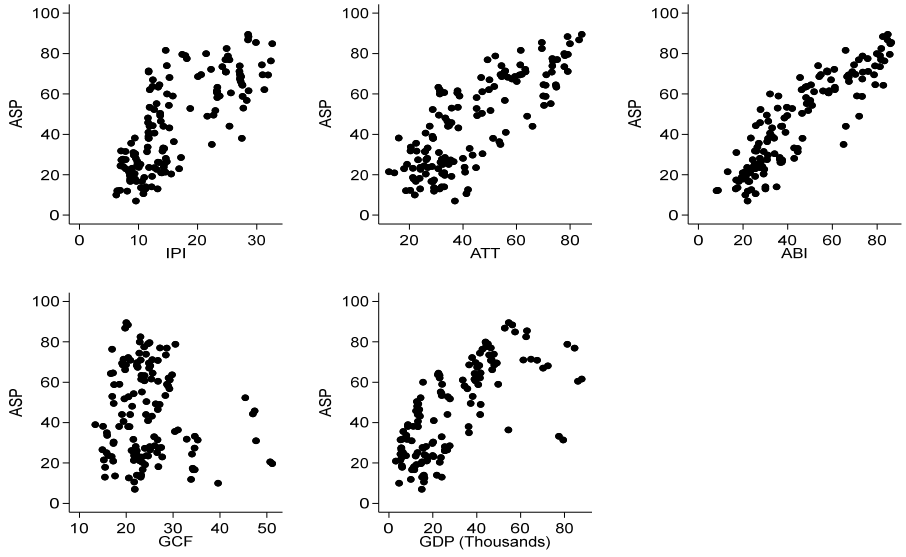
Table 5 Descriptive statistics (2011 to 2016)

Statistics	*ASP*	*IPI*	*ATT*	*ABI*	*GCF*	*GDP*
Average	45.07	16.44	43.59	44.18	24.58	29,068.23
Median	44.00	13.83	37.90	37.30	23.30	23,371.05
Standard deviation	22.73	7.40	18.74	21.40	7.17	20,363.00
Minimum	7.00	6.24	12.33	8.10	13.40	3,155.94
Maximum	89.50	32.62	84.40	86.38	51.14	87,855.58
Observations	145	145	145	145	135	140

Source: The authors' own.

Table 5 indicates that the average and median of entrepreneurial aspirations are higher than the average and the median of entrepreneurial attitudes and skills. From the minimum and maximum results we can observe that there is high heterogeneity in the data of the sample countries.

Figure 3 Dispersion of variables in the period (2011 to 2016)



Source: The authors' own.

Figure 3 shows the scatter diagram used to describe the relationship between two numerical variables. In short, the entrepreneurial aspiration variable is contrasted with the other variables (IPI, ABI, ATT, GCF and GDB). Through the mass of observation data, it is possible to extract that the dependent variables are linearly associated with entrepreneurial aspirations, except for the GCF variable, which presents a moderately declining trend line.

We also note, in Figure 3, that the dependent variable entrepreneurial aspirations has a better linear fit when associated with entrepreneurial skills and attitudes, including with the intellectual property ecosystem, measured by the IPI. This linear association is preliminary evidence that the higher the IPI, ATT and ABI, the greater the results of ASP in the global entrepreneurship ecosystem.

We deepened an analysis of the relationship between entrepreneurship and intellectual property ecosystems through econometric modelling. Below we present the results of the regressions in two strategies (data estimator in linear panel and quantis regression model).

4.2 Linear panel data estimation

The Hausman test indicates that the Random Effects Model estimates are inconsistent (Table 6). The Greene and Wooldridge test indicates the presence of heteroscedasticity and autocorrelation in the disturbances.

Table 6 Test results used to identify non-spherical errors

Test	*Value*	*Null*
Hausman	$chi^2 = 32.74$ p = 0.0000	Random effects are consistent and efficient
Wooldridge for autocorrelation	F = 30.388 p = 0,0000	No first order serial correlation
Greene for heteroscedasticity	W = 3.5E+28 p = 0.0000	Homoscedasticity between groups

Source: The authors' own.

Table 7 Estimation results for panel data

ASP	*Random effects (RE)*	*Fixed effects (FE)*	*FE robust*	*FE Driscoll Kraay*
IPI	0.5908***	0.4761***	0.4761**	0.4761*
	(0.123)	(0.171)	(0.188)	(0.249)
ATT	0.1469	0.5344***	0.5344***	0.5344***
	(0.130)	(0.152)	(0.140)	(0.153)
ABI	0.5173***	0.2145	0.2145	0.2145***
	(0.147)	(0.173)	(0.170)	(0.074)
GCF	–0.1412	–0.466**	–0.466	–0.4660***
	(0.147)	(0.202)	(0.325)	(0.108)
GDP	–0.0288	1.3761***	1.3761***	1.3761***
	0.088	0.326	0.483	0.179

Notes: Asterisks denote the significance level: *10%; **5%; ***1%. Standard errors are given in parentheses.

Source: The authors' own

The estimate results in Table 7 confirm the positive and significant relationship between IPI and aspirations. Therefore, strengthening the intellectual property ecosystem raises the level of countries' entrepreneurial aspirations, i.e., it stimulates the entrepreneurs' desire to initiate and promote their creative productions.

In addition, the control variables also have a significant and positive effect on entrepreneurial aspirations, except for gross capital formation. Entrepreneurial attitudes and abilities contribute to higher levels of aspiration on average, and increasing countries' per capita GDP also positively affects the mean level of aspirations.

4.3 Quantile regression results

Table 8 presents the descriptive statistics on country distribution quantiles unconditional (10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, and 90%). There is a high heterogeneity in the results of all variables, especially when comparing the 10% quantile value with the 90% quantile value. Take for example the entrepreneurial aspirations of the countries in the 10% quantile, its value is 17.00, while the value in the 90% quantile is 75.57. The same can be observed for IPI in which the country score in the 10% quantile is 8.56, while the 90% quantile is 27.57, on a scale from 0 to 40. Another example, the GDP per capita result, the quantile 10% is $6,557.52, while on the other hand, the 90% quantile is $56,333.01, thus revealing the great inequality in wealth levels among the countries in the sample.

Table 8 Descriptive statistics for the quantiles (2011 to 2016)

Quantile	*ASP*	*IPI*	*ATT*	*ABI*	*GCF*	*GDP*
10%	17.00	8.56	22.56	21.29	17.13	6,557.52
20%	22.99	9.77	26.83	25.29	19.49	12,051.90
30%	26.74	11.63	31.00	27.72	21.14	14,563.36
40%	32.52	12.42	33.12	31.76	22.26	17,113.21
50%	44.00	13.83	37.90	37.30	23.21	23,371.05
60%	53.15	15.17	45.18	46.48	24.37	27,732.67
70%	61.99	21.59	54.03	57.24	25.91	39,707.90
80%	68.76	24.81	62.26	67.32	28.08	45,199.35
90%	75.57	27.57	73.32	78.92	33.89	56,333.01

Source: The authors' own.

Table 9 Distribution of entrepreneurial aspirations in 2016

Aspirations quantile	*Countries*
0% to 10%	Venezuela, Bolivarian Republic of; Brazil; Indonesia; Ecuador
10% to 20%	Nigeria; Russian Federation; Algeria; Kenya; Pakistan; Mexico
20% to 30%	Philippines; Argentina; Peru; Vietnam
30% to 40%	Thailand; Malaysia; Ukraine
40% to 50%	Brunei Darussalam; India; Saudi Arabia; Spain; Egypt; South Africa; Colombia
50% to 60%	Hungary; Poland; Italy
60% to 70%	Chile; Korea, Republic of; Turkey; China; Singapore
70% to 80%	Japan; United Arab Emirates
80% to 90%	Germany; Sweden; Taiwan; Australia; Israel; France; UK; Canada; USA; Switzerland

Source: The authors' own.

Table 10 Quantile regression results using the CRE estimator

ASP	*Quantile*								
	0.1	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*	*0.7*	*0.8*	*0.9*
IPI	0.2479	0.366	0.1052	–0.2049	0.3453	0.6211**	0.7242***	0.6448***	0.8132***
	(0.499)	(0.273)	(0.252)	(0.322)	(0.404)	(0.274)	(0.166)	(0.159)	(0.221)
ATT	1.7721**	1.1912**	1.0601	–0.6406	–0.1494	0.173	0.2917	0.5778***	0.1426
	(0.695)	(0.559)	(0.721)	(0.558)	(0.319)	(0.326)	(0.205)	(0.147)	(0.260)
ABI	–1.5026	0.2731	0.203	1.4883***	1.0343**	0.5421	0.6942*	0.2045	0.6192***
	(0.942)	(0.491)	(0.522)	(0.537)	(0.447)	(0.588)	(0.368)	(0.222)	(0.166)
GCF	0.0538	–1.2127***	–0.0996	–1.6449***	0.4713	0.0762	0.5243*	–0.2701	0.6571*
	(0.597)	(0.412)	(0.443)	(0.552)	(0.554)	(0.352)	(0.297)	(0.452)	(0.373)
GDP	4.7405***	1.535**	0.9266	2.0579**	1.1478	1.5615**	–0.148	–0.1162	–0.2289
	(1.612)	(0.763)	(0.643)	(0.814)	(0.744)	(0.640)	(0.418)	(0.229)	(0.160)
EUR	0.2861	–0.0549	–0.0992	–0.4301**	–0.2844	–0.5983***	–0.3860*	–0.2596**	–0.0609
	(0.386)	(0.199)	(0.143)	(0.170)	(0.214)	(0.184)	(0.205)	(0.115)	(0.119)
LCN	0.6055	–0.0659	–0.0944	–0.2585	0.2643	–0.4463*	–0.3516***	–0.4074***	–0.095
	(0.395)	(0.186)	(0.149)	(0.217)	(0.270)	(0.232)	(0.093)	(0.123)	(0.150)
NAC	0.1715	–0.4409**	–0.3912***	–0.568***	–0.1996	–0.5453***	–0.3821*	0.0535	0.8395***
	(0.460)	(0.203)	(0.140)	(0.191)	(0.233)	(0.198)	(0.201)	(0.293)	(0.294)
NAWA	0.9511**	0.1063	0.2548	0.3208	0.5712**	0.2266	0.0856	–0.1533	–0.2286***
	(0.463)	(0.222)	(0.220)	(0.276)	(0.275)	(0.224)	(0.141)	(0.099)	(0.071)
SEAO	0.0751	0.07	–0.0648	–0.6331***	–0.217	–0.3312***	–0.3072***	–0.2686**	–0.1053
	(0.277)	(0.154)	(0.210)	(0.185)	(0.138)	(0.084)	(0.062)	(0.111)	(0.085)
SSF	0.681	–0.0194	–0.1094	0.0707	0.2136	–0.5646*	–0.3765**	–0.2574**	–0.0256
	(0.499)	(0.247)	(0.161)	(0.250)	(0.400)	(0.330)	(0.165)	(0.125)	(0.100)

Notes: Asterisks denote the significance level: *10%; **5%; ***1%.
Bootstrapped standard errors are given in parentheses.

Source: The authors' own

Table 9 presents the approximate distribution of each country's entrepreneurial aspiration in 2016. As noted, the developed countries are distributed around the highest quantiles, while developing countries are distributed in the lower quantiles.

Table 10 shows the estimation results for the quantile regression model. In general, the effect of the US Chamber International IP Index is positive and significant in the upper quantiles. This result demonstrates the importance of the intellectual property system in determining the entrepreneurial aspirations in the right tail.

This result supports the arguments of Dan and Chunyan (2006), Gu (2009) and Yong and Sheng (2014) on the relevance of intellectual property for entrepreneurial activities. The legal architecture of intellectual property, which encourages and protects creators, has a positive effect on decisions to create economic value through start-ups in higher quantiles.

Furthermore, the magnitude of the IPI effect tends to increase as we move to higher quantiles. Thus, it is reasonable to assume the hypothesis that countries with different levels of entrepreneurial aspirations respond differently to their intellectual property ecosystems.

The control variables also capture some important effects on aspirations. The effect of attitudes is positive and significant in the 10%, 20%, and 80% quantiles. The effect of abilities is positive and significant in the 40%, 50%, 70% and 90% quantiles. Gross capital formation (GCF) and aspirations are negatively related in lower quantiles, while GCF is significant and positively related to aspirations in the 70% and 90% quantiles. It is important to highlight the significant and positive effect of GDP per capita on aspirations in the 10%, 20%, 40% and 60% quantiles.

To test the robustness and the stability of the coefficients, we also estimate a second equation without the IPI. The results can be found in the Appendix. The exclusion of the intellectual property ecosystem has a substantial effect on the behaviour of GDP in determining entrepreneurial aspirations, while the effect of the other covariates remain relatively stable. Except for the 70% quantile, GDP is significant and positively related to aspirations in all quantiles. Thus, the inclusion of the proxy for the intellectual property ecosystem controls for the GDP effect on aspirations.

With regard to the regional dummies (base level CSA – Central and South Asia), we estimate a negative effect for all regions, except for North America (NAC) in the 90% quantile and Northern Africa and Western Asia (NAWA) in the 10% and 20% quantiles. These results indicate that new and specific policies are needed to reverse the declining trend in the overall outcome of entrepreneurship aspiration.

5 Concluding remarks

Our study explores the linkage between IPI and aspirations in the entrepreneurship ecosystem. We contribute to the empirical and theoretical literature by using two evaluation models to assess how countries' business aspirations are affected or not by intellectual property rules. We also use the quantile regression method for a more informative and reliable evaluation of the results.

We find that IPI has a positive effect on the average entrepreneur's aspirations. However, this effect is heterogeneous across the quantiles of the response distribution. We have sufficient evidence to state that the intellectual property ecosystem contributes to increasing aspirations in higher quantiles.

This study contributes to the discussion on intellectual property by presenting evidence that the intellectual property ecosystem, proxied by the IPI, has a direct effect on the stimulation that players have to initiate their creative productions. An intellectual property ecosystem may inspire confidence.

The results have a relevant practical implication. Greater protection of intellectual property rights can encourage entrepreneurs to aspire to more innovations. However, countries located in the lower quantiles have not experienced a causal relationship between ASP and IPI. We speculate that the non-significant result for countries in the lower quantiles may be linked to the predominance of entrepreneurship due to necessity, or low levels of skills.

Our findings require the attention of public and private authorities and economic development agencies as aspirations can be maximised by improving the intellectual property ecosystem, as an integral part of business strategy, especially in developing countries.

It is important to highlight the limitations of the indices (IPI and GEI), as well as their strengths. These are composite indices that evolve and combine groups of variables, and there may be associated restrictions which do not capture some information relating to these phenomena (Intellectual Property and Entrepreneurship), especially given the complexity of countries. However, these indices are important for decision makers as they somehow seek to reproduce relevant information for the monitoring and better management of the intellectual property and entrepreneurship ecosystem.

Finally, while the number of countries in the sample is relatively small, our results also suggest that the intellectual property ecosystem and the entrepreneurship ecosystem interact. They should be further investigated to investigate the benefits of this interaction.

The results shown in this study must be contrasted with new research. As a suggestion for future articles, alternative methodological approaches, such as dynamic panels, have the potential to be a relevant contribution to the theme.

Acknowledgements

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001. We are grateful for the support given by the State Agency to support Research and Technological Innovation of Sergipe (FAPITEC/SE/BRAZIL), Program of Postgraduate in Intellectual Property Science (PPGPI/UFS) and Program of Postgraduate in Economic (NUPEC/UFS).

References

Abu-Shanab, E.A. and Osmani, M. (2019) 'E-government as a tool for improving entrepreneurship', *International Journal of Electronic Government Research (IJEGR)*, Vol. 15, No. 1, pp.36–46, doi:10.4018/IJEGR.2019010103.

Acs, Z.J. and Audretsch, D.B. (1988) 'Innovation in large and small firms – an empirical analysis', *American Economic Review*, Vol. 25, No. 78, pp.678–690.

Acs, Z.J. and Szerb, L. (2009) 'The Global Entrepreneurship Index (GEINDEX)', *Foundations and Trends in Entrepreneurship*, Vol. 5, No. 5, pp.341–435.

Acs, Z.J. and Szerb, L. (2012) *Global Entrepreneurship Index*, Edward Elgar, Cheltenham, UK.

Acs, Z.J., Autio, E. and Szerb, L. (2014) 'National systems of entrepreneurship: measurement issues and policy implications', *Research Policy*, Vol. 43, No. 3, pp.476–494.

Acs, Z.J., Braunerhjelm, P., Audretsch, D.B. and Carlsson, B. (2009) 'A knowledge spillover theory of entrepreneurship', *Small Business Economics*, Vol. 32, pp.15–30.

Acs, Z.J., Estrin, S, Mickiewicz, T. and Szerb, L. (2018) 'Entrepreneurship, institutional economics, and economic growth: an ecosystem perspective', *Small Business Economics*, Vol. 51, No. 2, pp.501–514.

Acs, Z.J., Szerb, L. and Autio, E. (2013) *Global Entrepreneurship Index*, Edward Elgar, Cheltenham, UK.

Aghion, P. (2017) 'Entrepreneurship and growth: lessons from an intellectual journey', *Small Business Economics*, Vol. 48, No. 1, pp.9–24.

Aidis, R. and Estrin, S. (2013) 'Institutions, incentives and entrepreneurship', in Acs, Z., Szerb, L. and Autio, E. (Eds.): *The Global Entrepreneurship and Development Index 2013*, Edward Elgar, UK.

Alfalih, A.A. (2019) 'Investigating critical resource determinants of start-ups: an empirical study of the MENA region', *Cogent Economics & Finance*, Vol. 7, No. 1 [online] https://doi.org/10.1080/23322039.2019.1628494.

Alikhan S. and Mashelkar R. (2006) *Intellectual Property and Competitive Strategies in 21st Century*, Aditya Books Pvt. Ltd, New Delhi.

Atiase, V.Y., Mahmood, S., Wang, Y. and Botchie, D. (2018) 'Developing entrepreneurship in Africa: investigating critical resource challenges', *Journal of Small Business and Enterprise Development*, Vol. 25, No. 4, pp.644–666.

Autio, E. and Thomas, L. (2013) 'Innovation ecosystems: implications for innovation management', in Dodgson, M., Phillips, N. and Gann, D.M. (Eds.): *The Oxford Handbook of Innovation Management*, Oxford University Press, DOI: 10.1093/oxfordhb/9780199694945.013.012.

Bache, S.H.M., Dahl, C.M. and Kristensen, J.T. (2013) 'Headlights on tobacco road to low birthweight outcomes: Evidence from a battery of quantile regression estimators and a heterogeneous panel', *Empirical Economics*, Vol. 44, No. 3, pp.1593–1633.

Bagheri, A. and Akbari, M. (2019) 'Entrepreneurship research in Iran: a systematic review of the empirical studies', *International Journal of Business Innovation and Research*, Vol. 18, No. 2, pp.208–241.

Baltagi, B. (2005) *Econometric Analysis of Panel Data*, 3rd ed., John Wiley & Sons, New York.

Baron, T. and Harima, A. (2019) 'The role of diaspora entrepreneurs in start-up ecosystem development – a Berlin case study', *International Journal of Entrepreneurship and Small Business*, Vol. 36, Nos. 1–2, pp.74–102.

Barro, R.J. (1991) 'Economic growth in a cross section of countries', *Quarterly Journal of Economics*, Vol. 106, No. 2, pp.407–443.

Baumol, W.J. and Strom, R.J. (2007) 'Entrepreneurship and economic growth', *Strategic Entrepreneurship Journal*, Vol. 1, Nos. 3–4, pp.233–237.

Bischoff, K. and Volkmann, C.K. (2018) 'Stakeholder support for sustainable entrepreneurship – a framework of sustainable entrepreneurial ecosystems', *International Journal of Entrepreneurial Venturing*, Vol. 10, No. 2 [online] https://doi.org/10.1504/IJEV.2018.092714.

Bjuggren, C.M., Johansson, D. and Stenkula, M. (2012) 'Using self-employment as proxy for entrepreneurship: some empirical caveats', *International Journal of Entrepreneurship and Small Business*, Vol. 17, No. 3, pp.290–303.

Bulut, C., Mutlu, E.E. and Nazli, M. (2013) 'Innovation and entrepreneurship assessment initiatives: a critical view', *Proceedings of the European Conference on Entrepreneurship and Innovation*, Hogeschool University Brussel, Brussels, Belgium.

Cătălin, G., Sorin-George, T. and Răzvan, P. (2017) 'Entrepreneurship in the world: the analysis of the Global Entrepreneurship Index in the period 2015–2017', *Economic Sciences Series*, Vol. 18, No. 2, pp.1–18.

Chiang, J.T. (1995) 'Technology policy paradigms and intellectual property strategies – 3 national models', *Technological Forecasting and Social Change*, Vol. 49, No. 1, pp.35–48.

Choong, K.K. (2008) 'Intellectual capital: definitions, categorization and reporting models', *Journal of Intellectual Capital*, Vol. 9, No. 4, pp.609–638.

Contreras-Jaramillo, J.C. (2017) 'The theoretical apparatus of intellectual property's traditional system', *Vniversitas*, Vol. 66, No. 135, pp.99–130.

Dan, L. and Chunyan, Z. (2006) 'Research on the role of intellectual property system in technological innovation of enterprises', *3rd International Conference on Innovation and Management*, Wuhan.

Demiralp, B., Morrison, L. and Zayed, S. (2018) 'On the commercialization path: entrepreneurship and intellectual property outputs among women in STEM', *Technology and Innovation*, Vol. 19, pp.707–726.

Denoncourt, J. (2018) *Intellectual Property, Finance and Corporate Governance*, Routledge, London.

Driscoll, J. and Kraay, A.C. (1998) 'Consistent covariance matrix estimation with spatially dependent data', *Review of Economics and Statistics*, Vol. 80, No. 4, pp.549–560.

Elmahjub, E. (2016) 'Intellectual property and development in the Arab world: a development agenda for Libyan intellectual property system', *Arab Law Quarterly*, Vol. 30, No. 1, pp.1–33.

Fini, R., Lacetera, N. and Shane, S. (2010) 'Inside or outside the IP system? Business creation in academia', *Research Policy*, Vol. 39, No. 8, pp.1060–1069.

Forsyth, M. (2016) 'Making the case for a pluralistic approach to intellectual property regulation in developing countries', *Queen Mary Journal of Intellectual Property*, Vol. 6, No. 1, pp.3–26.

Galvao, A. and Pinheiro, M. (2019) 'Psychological coaching as a driver to enhance the networking capabilities of young entrepreneurs', *Tourism & Management Studies*, Vol. 15, No. 1, pp.81–89 [online] http://dx.doi.org/10.18089/tms.2019.150107.

Garaventa, C.A. and Wegbrait, P. (2017) 'Integration in intellectual property in Latin America', in Siew-Kuan, E. and Austin, G.W. (Eds.): *International Intellectual Property and the ASEAN Way: Pathways to Interoperability*, pp.291–302, Cambridge University Press.

Ghazinoory, S., Bitaab, A. and Lohrasbi, A. (2014) 'Social capital and national innovation system: a cross-country analysis', *Cross Cultural Management*, Vol. 21, No. 4, pp.453–475.

Global Entrepreneurship Index (GEI) (2015) *The Global Entrepreneurship Index 2015*, Global Entrepreneurship and Development Institute (GEDI) and Global Entrepreneurship Network (GEN), Washington, DC, USA.

Global Entrepreneurship Index (GEI) (2017) *The Global Entrepreneurship Index 2017*, Global Entrepreneurship and Development Institute (GEDI) and Global Entrepreneurship Network (GEN), Washington, DC, USA.

Global Innovation Policy Center (GIPC) (2018) *U.S. Chamber International IP Index*, 6 ed., Global Innovation Policy Center.

Greene, W.H. (2000) *Econometric Analysis*, 4 ed., Nova Jersey, Prentice-Hall.

Gu, J. (2009) 'Study on intellectual property issues of private enterprises based on the independent innovation perspective', *Proceedings of the Second China Private Economy Innovation International Forum*, American Scholars Press, Marietta.

Helfer, L. (2009) 'Regime shifting in the international intellectual property system', *Perspectives on Politics*, Vol. 7, No. 1, pp.39-44.

Hoechle, D. (2007) 'Robust standard errors for panel regressions with cross-sectional dependence', *The Stata Journal*, Vol. 7, No. 3, pp.281–312.

Hoffman, N.A.A. (2007) *A Framework for Addressing and Measuring Entrepreneurship*, Entrepreneurship Indicators Steering Group, Paris.

Inácio Júnior, E., Autio, E., Morini, C., Gimenez, F.A.P. and Dionisio, E.A. (2016) 'Analysis of the Brazilian Entrepreneurial Ecosystem', *Desenvolvimento em Questão*, Vol. 14, No. 37, pp.5–36.

Inacio Junior, E., Dionisio, E.A., Fischer, B.B., Li, Y. and Meissner, D. (2020) 'The global entrepreneurship index as a benchmarking tool? Criticisms from an efficiency perspective', *Journal of Intellectual Capital* [online] https://doi.org/10.1108/JIC-09-2019-0218.

Ionescu, G.H., Firoiu, D., Pîrvu, R., Enescu, M., Rădoi, M.I. and Cojocaru, T.M. (2020) 'The potential for innovation and entrepreneurship in EU countries in the context of sustainable development', *Sustainability*, Vol. 12, No. 18 [online] https://doi.org/10.3390/su12187250.

Itanyi, N. (2018) 'Enforcing intellectual property rights in Nigerian courts', *Law and Development Review*, Vol. 11, No. 2, pp.627–645.

Jovanovic, M., Rakicevic, J., Jaksic, M.L., Petkovic, J. and Marinkovic, S. (2017) 'Composite indices in technology management: a critical approach', in Jeremic, V. Radojicic, Z. and Dobrota, M. (Eds.): *Emerging Trends in the Development and Application of Composite Indicators*, IGI Global, Hershey, PA.

Kalhor, E., Ashourizadeh, S. and Schøtt, T. (2019) 'An experiment of institutional change in the ecosystem of entrepreneurship: easing sanctions against Iran', *European Journal of International Management*, Vol. 13, No. 4 [online] https://doi.org/10.1504/EJIM.2019.100811.

Kastelle, T, King, S., Verreynne, M. and Kambouris, P. (2018) 'Experiences using a science-based Lean Launch Pad program and its impact on national innovation system evolution', *International Journal of Entrepreneurship and Small Business*, Vol. 35, No. 3, pp.356–370.

Kato, H. (2014) 'Future issues of the intellectual property system in japan in consideration of a decade of pro-patent policy', *Proceedings of the Portland International Conference on Management of Engineering & Technology (PICMET)*, Kanazawa.

Khan, B.Z. and Sokoloff, K.L. (2001) 'History lessons – the early development of intellectual property institutions in the United States', *Journal of Economic Perspectives*, Vol. 15, No. 3, pp.233–246.

Komlosi, E., Pager, B. and Markus, G. (2019) 'Entrepreneurial innovations in countries at different stages of development', *Foresight and STI Governance*, Vol. 13, No 4, pp.23–34, DOI: 10.17323/2500-2597.2019.4.23.34.

Lafuente, E., Szerb, L. and Acs, Z.J. (2016) 'Country level efficiency and national systems of entrepreneurship: a data envelopment analysis approach', *The Journal of Technology Transfer*, Vol. 41, No. 6, pp.1260–1283.

Maldonado-Sada, M.T., Caballero-Rico, F.C and Ruvalcaba-Sanchez, L. (2019) 'Challenges for the academic spin-offs in Mexico as a result of the economic valorization of RD & I from the universities', *CienciaUAT*, Vol. 14, No. 1, pp.85–101 [online] https://doi.org/10.29059/cienciauat.v14i1.1136

Mavi, R.K. and Afshar, Z.A. (2017) 'The relationships between social capital and organisational entrepreneurship at small and medium enterprises of Zanjan province', *International Journal of Business Innovation and Research*, Vol. 12, No. 4, pp.449–464.

Mittal, T. and Madan, P. (2020) 'Impact of financing patterns on business performance of e-startups in India: a research model', *International Journal of Business Innovation and Research*, Vol. 21, No. 4 [online] https://doi.org/10.1504/IJBIR.2020.105983.

Nataraajan, R. and Angur, M.G. (2014) 'Innovative ability and entrepreneurial activity: two factors to enhance 'quality of life'', *Journal of Business & Industrial Marketing*, Vol. 29, No. 6, pp.469–475.

Nogueira, M.A., Fernández-López, S., Gulías, M.J.R., Vivel-Búa, M. and Rodeiro-Pazos, D. (2019) 'The hidden effect of innovation on the growth of Spanish firms', *International Journal of Entrepreneurship and Small Business*, Vol. 37, No. 2, pp.167–189.

Organisation for Economic Co-operation and Development (OECD) (2008) *Defining Entrepreneurial Activity: Definitions Supporting Frameworks for Data Collection*, OCDE Statistics Working Paper.

Østergaard, A. and Marinova, S.T. (2018) 'Human capital in the entrepreneurship ecosystem', *International Journal of Entrepreneurship and Small Business*, Vol. 35, No. 3, pp.371–390.

Parker, S.C. (2009) *The Economics of Entrepreneurship*, Cambridge University Press, Cambridge.

Pawitan, G, Widyarini, M. and Nawangpalupi, C.B. (2019) 'The entrepreneurial ecosystem to foster competitiveness among enterprises: a national level analysis', *International Journal of Business and Globalisation*, Vol. 23, No. 2 [online] https://doi.org/10.1504/IJBG.2019.102461.

Quillas, C.I.L., Rodriguez, H.F.R. and Gonzalez-Campo, C.H. (2020) 'Formal institutions, human development and entrepreneurship: a comparative study between highly developed countries and member countries of the pacific alliance', *Revistas Académicas*, No. 36 [online] https://doi.org/10.17230/Ad-minister.36.3.

Rao, P.M. (2016) 'What do we know about entrepreneurship as an intangible asset?', *International Journal of Entrepreneurship and Small Business*, Vol. 27, No. 1, pp.40–51.

Reis, D.A., Moura, F.R. and Gomes, I.M.A. (2019) 'Attitudes, abilities and aspirations in the worldwide entrepreneurship ecosystem', *International Business Management*, Vol. 13, No. 9, pp.429–437 [online] http://dx.doi.org/10.36478/ibm.2019.429.437

Reynolds, P.D., Bosma, N. and Autio, E., (2005) 'Global entrepreneurship monitor: data collection design and implementation 1998–2003', *Small Business Economics*, Vol. 24, No. 3, pp.205–231.

Roy, S. and Mohanty, S.P. (2020) 'Microfinance models in improving 'quality of life': empirical analysis on Indian perspective', *International Journal of Business Innovation and Research*, Vol. 21, No. 1, pp.23–55.

Saberi, M. and Hamdan, A. (2019) 'The moderating role of governmental support in the relationship between entrepreneurship and economic growth: a study on the GCC countries', *Journal of Entrepreneurship in Emerging Economies*, Vol. 11, No. 2, pp.200–216 [online] https://doi.org/10.1108/JEEE-10-2017-0072

Sarkissian, A. (2008) 'Intellectual property rights for developing countries: lessons from Iran', *Technovation*, Vol. 28, No. 11, pp.786–798.

Schumpeter, J.A. (1934) *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*, Harvard University Press, Cambridge, MA.

Sengupta, S. (2018) 'Managerial decisions for innovation strategy of firms: implications for country level innovation', *International Journal of Business Innovation and Research*, Vol. 16, No. 2, pp.135–154.

Silva, M.S., Anholon, R., Rampasso, I.S., Quelhas, O.L.G., Filho, W.L. and Da Silva, D. (2018) 'Analysis of the Brazilian entrepreneurial ecosystem in the perception of business incubator professionals', *International Journal of Business Innovation and Research*, Vol. 16, No. 4, pp.507–530.

Singh, R. (2005) 'Building an efficient ecosystem', *Electronic Engineering Times*, No. 1392 [online] https://www.edn.com/building-an-efficient-ecosystem/?utm_source=eetimes&utm_medium=relatedcontent.

Szerb, L. (2017) 'A vállalkozói ökoszisztéma Magyarországon a 2010-es években – helyzetértékelés és szakpolitikai javaslatok', *Vezetéstudomány/Budapest Management Review*, Vol. 48, Nos. 6–7, pp.2–14.

Szerb, L. and Trumbull, W.N. (2018) 'Entrepreneurship development in Russia: is Russia a normal country? An empirical analysis', *Journal of Small Business and Enterprise Development*, Vol. 25, No. 6, pp.902–929 [online] https://doi.org/10.1108/JSBED-01-2018-0033.

Szerb, L., Komlósi, É. and Páger, B. (2016) 'Measuring entrepreneurship and optimizing entrepreneurship policy efforts in the European Union', *IFO Institute for Economic Research, CESifo DICE Report*, Vol. 14, No. 3, pp.8–23.

Tasnim, N. and Afzal, M.N.I. (2018) 'An empirical investigation of country level efficiency and national systems of entrepreneurship using data envelopment analysis (DEA) and the TOBIT model', *Journal of Global Entrepreneurship Research*, Vol. 8, No. 37 [online] https://doi.org/10.1186/s40497-018-0138-y.

Urban, B. and Verachia, A. (2019) 'Organisational antecedents of innovative firms: a focus on entrepreneurial orientation in South Africa', *International Journal of Business Innovation and Research*, Vol. 18, No. 1, pp.128–144.

Van Praag, M.C. (2007) 'What is the value of entrepreneurship? A review of recent research', *Small Business Economics*, Vol. 29, No. 4, pp.351–382.

Vasconcelos, C.R. and Silva, D.P. (2018) 'Analysis of the performance of the Brazilian intellectual property system: challenges and perspectives', *Journal of Management and Technology*, Vol. 18, No. 2, pp.172–1999.

Wooldridge, J.M. (2013) *Introductory Econometrics: A Modern Approach*, 5th ed., South-Western, Mason, OH.

World Intellectual Property Organization (WIPO) (1967) *Convention Establishing the World Intellectual Property Organization*, Signed at Stockholm.

World Intellectual Property Organization (WIPO) (2004) *WIPO Intellectual Property Handbook: Policy, Law and Use*, 2nd ed., No. 489.

Yong, Z. and Sheng, C. (2014) 'Analysis of intellectual property awareness and factors for young entrepreneurs', *Proceedings of the Zhejiang Province, International Symposium on Applied Engineering, Technical Management, and Innovation*, China.

Yu, P.K. (2018) 'When the Chinese intellectual property system hits 35', *Queen Mary Journal of Intellectual Property*, Vol. 8, No.1, pp.3–14.

Appendix

Table 11 Results for quantile regressions using the CRE estimator (without IPI index)

ASP	*0.1*	*0.2*	*0.3*	*0.4*	*0.5*	*0.6*	*0.7*	*0.8*	*0.9*
ATT	1.811***	1.2487**	1.0766	–0.6728	–0.0951	0.2705	0.4055*	0.679***	0.2703
	(0.698)	(0.557)	(0.725)	(0.559)	(0.329)	(0.333)	(0.209)	(0.158)	(0.283)
ABI	–1.5482*	0.2058	0.1836	1.526***	0.9708**	0.4278	0.5609	0.0858	0.4696***
	(0.921)	(0.487)	(0.530)	(0.539)	(0.450)	(0.588)	(0.363)	(0.218)	(0.155)
GCF	0.0392	–1.2342***	–0.1058	–1.6329***	0.451	0.0397	0.4817	–0.3081	0.6093
	(0.597)	(0.417)	(0.439)	(0.541)	(0.537)	(0.348)	(0.299)	(0.448)	(0.373)
GDP	5.0534***	1.9968**	1.0594*	1.7993***	1.5837***	2.3453***	0.7659	0.6974**	0.7972***
	(1.461)	(0.785)	(0.631)	(0.640)	(0.482)	(0.606)	(0.507)	(0.306)	(0.262)
EUR	0.3507	–0.1973	–0.1222	–0.1359	0.072	–0.408*	–0.3417**	–0.2252**	–0.0411
	(0.419)	(0.203)	(0.150)	(0.184)	(0.255)	(0.224)	(0.133)	(0.092)	(0.120)
LCN	0.6191	–0.0958	–0.0992	–0.1968	0.339	–0.4064	–0.3423***	–0.4002***	–0.0908
	(0.403)	(0.192)	(0.165)	(0.231)	(0.282)	(0.247)	(0.094)	(0.123)	(0.150)
NAC	0.1694	–0.4363**	–0.3905***	–0.5775***	–0.2111	–0.5515***	–0.3835*	0.0524	0.8388***
	(0.458)	(0.202)	(0.140)	(0.190)	(0.232)	(0.198)	(0.204)	(0.293)	(0.294)
NAWA	0.9293**	0.1544	0.2626	0.2215	0.4509*	0.1624	0.0706	–0.1649*	–0.2353***
	(0.449)	(0.214)	(0.176)	(0.241)	(0.251)	(0.191)	(0.114)	(0.094)	(0.072)
SEAO	0.0989	0.0175	–0.0733	–0.5247***	–0.0856	–0.261***	–0.2909***	–0.256**	–0.098
	(0.283)	(0.144)	(0.164)	(0.171)	(0.145)	(0.095)	(0.054)	(0.112)	(0.086)
SSF	0.718	–0.1009	–0.1226	0.2392	0.4177	–0.4556	–0.3511***	–0.2377**	–0.0143
	(0.521)	(0.255)	(0.227)	(0.303)	(0.433)	(0.366)	(0.134)	(0.118)	(0.101)

Notes: Asterisks denote the significance level: *10%; **5%; ***1%.
Bootstrapped standard errors are given in parentheses.

Source: The authors