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Research Article

Evaluation of the Global Entrepreneurship Index validity

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Abstract

Purpose: our objective is to assess whether the Global Entrepreneurship Index (GEI) is a valid methodology for measuring the national systems of entrepreneurship. **Theoretical framework**: we use the structural equation modeling (SEM) as a theoretical lens to evaluate the Global Entrepreneurship Index. **Design/methodology/approach**: to achieve the research objective, we perform structural equation modeling to measure the formative model of GEI, using the SmartPLS 3.0 software, in order to verify the convergent validity of the constructs; the collinearity of indicators and their relevance for measuring entrepreneurship. **Findings**: the results obtained show that the sub-indices and indicators are adequate to measure entrepreneurship. However, we identified that there is a need to replace the micro-level components of the opportunity perception and networking indicators which provide distorted results of what is understood as productive or high impact entrepreneurship. **Research, practical and social implications**: the main contributions of our study are directed to the indicators' developers. We suggest the use of components that capture aspects associated with high-impact or technology-based entrepreneurship instead of any attempt to create a new business, as our results indicate that generic components provide short-sighted results on the state of entrepreneurship, hampering comparative studies at the country-level. **Originality/value**: although the GEI is based on the OECD recommendations for the construction of composite indicators (indices), we have not identified any studies (not even performed by the GEI developers) on the validity of the index as a methodology for measuring entrepreneurship.

Keywords: National Systems of Entrepreneurship. Entrepreneurial Ecosystems. Composite Index.

Resumo

Objetivo: avaliar se o Global Entrepreneurship Index (GEI) é uma metodologia válida para mensurar os sistemas nacionais de empreendedorismo. **Método**: modelagem de equações estruturais, com a utilização do software SmartPLS 3.0, a fim de mensurar o modelo formativo do GEI, e verificar a validade convergente dos construtos, a colinearidade dos indicadores e sua relevância para o empreendedorismo. **Originalidade/Relevância**: ainda que o GEI se baseie nas recomendações da OCDE para a construção de indicadores compostos (índices), nenhum estudo (nem mesmo elaborado pelos desenvolvedores do GEI) foi encontrado sobre a validade do índice como metodologia de mensuração do empreendedorismo. **Resultados**: os subíndices e os indicadores analisados se mostraram adequados para mensurar o empreendedorismo, embora haja a necessidade de substituir os componentes de nível micro dos indicadores "opportunity perception" e "networking", tendo em vista os resultados distorcidos apresentados do que se entende como empreendedorismo produtivo. **Contribuições teóricas/metodológicas**: as principais contribuições deste estudo estão direcionadas aos desenvolvedores de indicadores, pois é sugerido o uso de componentes capazes de capturar aspectos associados ao empreendedorismo de alto impacto e de base tecnológica, em vez da criação de um novo negócio. Isso se dá porque componentes genéricos fornecem resultados míopes sobre o estado do empreendedorismo, prejudicando, assim, estudos comparativos em nível de país.

Palavras-chave: Sistema Nacional de Empreendedorismo. Ecossistema de Empreendedorismo. Índice Composto.

INTRODUCTION

In the search for gains in economic growth and competitiveness, many countries have stimulated entrepreneurship through supportive public policies (Farinha *et al.* 2020; Salman, 2016). Policymakers, however, must define the type of enterprise, whose creation and development they intend to promote (Autio & Rannikko, 2016; González-Uribe & Reyes, 2021), and then prioritize the removal of barriers and strengthening of facilitators of entrepreneurship (Kaya & Persson, 2019).

Entrepreneurship is a dynamic process of resource mobilization for the exploration of opportunities, perceived in the operationalization of a new business, whose growth and performance potential is moderated by the behavior and competence of the entrepreneurs, and affected by contextual and institutional factors (Ács *et al.,* 2014). From this perspective, therefore, policies must be formulated from a systemic view of entrepreneurship, which considers the interactions between individuals and the context (Ács *et al.,* 2014).

The approach of entrepreneurial ecosystems makes it possible to identify such interactions and capture exchanges between the stock of entrepreneurial capital, knowledge and socioeconomic, political, institutional, industrial and technological contexts (Lafuente *et al.,* 2016). Known as the National Entrepreneurship System (NSE), this approach enables policymakers to measure interactions between individuals and context, and to implement national entrepreneurship policies (Szerb *et al.*, 2020).

To capture the complex and multifaceted interactions between entrepreneurs and context, and portray the NSE, Ács & Szerb (2009) formulated the Global Entrepreneurship Index (GEI), which became the first entrepreneurship composite index (ECI). The GEI differs from other indices, such as the Global Entrepreneurship Monitor (GEM) and Doing Business, because it is not limited to measuring just one aspect of entrepreneurship, such as the characteristics of entrepreneurs/businesses or contextual factors, but combines individual and contextual aspects, thereby providing both micro and macro perspectives.

Since 2011, researchers associated with the GEI have annually published studies on entrepreneurship at the country level, and the index has been used as an analytical framework to understand this phenomenon from a systemic perspective, in countries and/or regions (Ács & Correa, 2014; Atiase *et al.,* 2018; Ha & Hoa, 2018, Szerb *et al.,* 2014; Szerb & Trumbull, 2018).

Despite the use and wide dissemination of this ranking and, consequently, the indicators selected and organized to portray and monitor entrepreneurial ecosystems at the national level, there are still no studies that validate this methodology as a way of measuring entrepreneurship. Attempts to show the validity and reliability of this methodology were limited to correlation matrices between the indicators that make up the GEI (see Ács & Szerb, 2009). These tests attest to the correlation between the indicators, but do not emphasize their importance for the construction of the sub-indices, nor do they validate the methodology.

Given this gap, the question is: Are the Global Entrepreneurship Index (GEI) indicators valid and reliable, from a statistical point of view, to measure entrepreneurial activity at the country level? To answer this question and assess whether the GEI is, in fact, a valid methodology for measuring national entrepreneurship systems, in this study, a sophisticated statistical technique known as Structural Equation Modeling (SEM) was applied to the indicators of the GEI, through the SmartPLS software, as the SEM provides information that explains the relationships between multiple variables (Hair *et al.*, 2017) and their factors/dimensions, thus performing the analysis of the measurement model. With this, it will be possible to identify if the GEI has plausibility, that is, if it can be validated as a methodology capable of measuring, in fact, what it proposes, that is, the entrepreneurial ecosystems.

In addition to this introduction, this article presents: an overview of entrepreneurship systems; the synthesis of the Global Entrepreneurship Index; the methodological procedures used; the results found, and the discussion derived from them; final considerations and suggestions for future studies.

NATIONAL SYSTEMS OF ENTREPRENEURSHIP IN PERSPECTIVE

In the NSE approach, the emphasis is on high-impact entrepreneurship – activity that contributes to the generation of jobs and the advancement of sectors in which technologies and market development are at less advanced stages (Ács *et al.,* 2018a). In these cases, despite the uncertainty involved, entrepreneurs usually assume central roles in defining new technological trajectories, creating markets and establishing technological standards (Lattacher *et al.*, 2021).

Micro level

Entrepreneurship represents a link between technical knowledge and products and services, and the entrepreneur is the one who explores market opportunities and brings relative balance to the markets (Lafuente *et al.*, 2020). Therefore, this individual must be able to recognize opportunities and exploit them, adding value to the economic environment (Chang & Chen, 2020). The motivations for entrepreneurship vary between the need to generate income, due to the lack of jobs, and the possibility of improving the income already received (Cervelló-Royo *et al.*, 2020 among others.

The transformation of these opportunities into real businesses depends on the attitudes, preferences (Beynon et al., 2020) and aspirations of individuals, that is, the perspectives of contribution to the socioeconomic contexts in which they are inserted (Cieślik *et al.,* 2018). In addition to these factors, to recognize and exploit opportunities and establish competitive advantages, entrepreneurs need to have skills and education (Amorós *et al.*, 2021; Tavassoli *et al.*, 2021).

Entrepreneurs should not be considered as isolated agents, even at the micro level, because they often access networks to obtain tangible and intangible resources (Lassalle *et al.*, 2020), as well as being influenced by culture, through of values and norms that act as catalysts or barriers to their entrepreneurial behavior (Bogatyreva *et al.,* 2019). Culture influences the degree of openness of entrepreneurs to share ideas and experiences with other people with similar interests, and can, in this way, even influence the career options of individuals (Asante & Affum-Osei, 2019). This denotes that analyzing entrepreneurship from a systemic perspective is inevitable.

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Macro level

Literature has advanced towards understanding the contextual conditions that affect entrepreneurial activity (Sternberg *et al.*, 2019). One of the first aspects considered is associated with the institutional context, understood as the collective of formal and informal norms that shape the behavior of individuals in economic systems econômicos (Ács *et al.*, 2018a).

The creation of companies also involves the dynamics of productive structures, such as changes or maturity of technologies, industrial growth (Malerba & Pisano, 2019), characteristics of market demand and the competitive environment (Zheng & Du, 2020), and availability of complementary resources (Stam & Van de Ven, 2021).

These macro conditions are linked to countries' levels of development. For example, growth in gross domestic product (GDP) per capita can promote entrepreneurial activity by providing demand sophistication (Fredström *et al.*, 2021; Hamdi-Kidar & Vellera, 2018). On the other hand, some researchers negatively relate general entrepreneurial activity to GDP per capita growth (Ali, Kelley, & Levie, 2020; Udimal *et al.*, 2020), due to the possibility that opportunity costs are higher in the employment-entrepreneurship relationship, and the intensity of competition inhibits potential (Cervelló-Royo *et al.*, 2020).

Complementary resources are relevant to the quality and configuration of the entrepreneurial environment, such as: (a) the availability of financing or financial resources (Dutta & Meierrieks, 2021); and the managerial experience provided by investors to entrepreneurs (Omri, 2020).

In this sense, science, technology and innovation institutions (universities, technology transfer offices, R&D institutes, science parks and incubators) are elements that influence the creation of technology-based tecnológica (Buenstorf & Costa, 2018; Fuster *et al.*, 2019; Sousa-Ginel *et al.*, 2021; Xie *et al.*, 2018), providing human, financial and administrative support (Huynh *et al.*, 2017; Steruska *et al.*, 2019).

Entrepreneurship systems

Combining micro and macro perspectives, the NSE approach assesses the trajectory of new business development, by observing the systemic factors that influence entrepreneurial activity (Lafuente *et al.*, 2020); recognize the bottlenecks that inhibit entrepreneurship; and identify areas that need intervention (Szerb *et al.*, 2020).

Such an approach emerges from the critique of the National Innovation Systems (NIS) of the 1990s, one of the main trends in industrial economics in innovation studies (Edquist, 1997; Freeman, 1995; Lundvall, 1992; Nelson, 1993), whose merits in understanding which factors affect the emergence and diffusion of innovations are undeniable. They influenced a whole generation of scholars and policy makers in terms of propositions related to the formulation, implementation and evaluation of science, technology and innovation policies. These, in part, according to their precursors, were responsible for the economic recovery of countries after the Second World War (Dosi, 1982; Freeman, 1995; Kline & Rosenberg, 1986).

On the other hand, authors related to the conception of the NSE, which later evolved and established itself with the use of the concept of entrepreneurial ecosystems, argue that the theory of the NIS neglected the role of the individual and entrepreneurial action as central elements in the generation of innovations, as it emphasized the firm (the company) as the main, if not exclusive, agent or locus of the innovative process (Bruns *et al.*, 2017; Isenberg, 2010; Mason & Brown, 2014; Roundy *et al.*, 2018; Spigel & Harrison, 2018; Stam, 2015).

According to these authors, Schumpeter's pioneering insights, in the model known as "Schumpeter – Mark I" (Schumpeter, 1949, 2011, [1934]), in which the innovation process was described as one of creative destruction and led by the entrepreneur, were progressively forgotten. For Schumpeter, in that model, the innovation trigger was not triggered by the controlling actors of the production process in search of the new, but by the entrepreneur (entrepreneur) who, when realizing the potential of such inventions, assumed the risk of development, that is, of the transformation of inventions into innovations for extraordinary profit. Thus, according to this author, the entrepreneur "educates" customers in the demand for new products and processes.

Thus, in view of the exploratory nature of entrepreneurial activity and the limitations of NIS in incorporating entrepreneurs, the entrepreneurial ecosystem approach defines that (Ács *et al.*, 2014, p. 479):

> A National System of Entrepreneurship is the dynamic, institutionally embedded interaction between entrepreneurial attitudes, ability, and aspirations, by individuals, which drives the allocation of resources through the creation and operation of new ventures.

The central idea of the NSE, then, is to bring the entrepreneur back to the literature on innovation and economic development, through the revaluation of individual action as the center of the processes of innovation and economic prosperity. On the other hand, it is interesting to note how the resumption of focus on entrepreneurship influenced the literature that deals with innovation and growth strategy, from the perspective of the company, leading to the development of the field of studies on corporate entrepreneurship (Kuratko, 2009; Kurato & Covin, 2008; Landström *et al.*, 2015).

Due to the tendential limitation of institutions and consolidated companies in generating ruptures in development trajectories, due to the fear of harming their positions in the economic scenario, the approach of entrepreneurial ecosystems considers innovation as the result of the interaction between institutional actors (context) and individuals. Thus, in the absence of initiative to recognize opportunities and to mobilize resources for new businesses, the institutional context is not capable of influencing the aspirations of individuals regarding the creation of high-impact companies. On the other hand, an inadequate institutional context results in companies that do not significantly contribute to the socioeconomic scenario (Kuratko, 2009; Kurato & Covin, 2008; Landström *et al.*, 2015). It is worth mentioning, in this sense, that a systematic review of the literature on entrepreneurial ecosystems, from the perspective of the importance of its measurement, is presented by Leendertse *et al.* (2021).

In short, the entrepreneurial ecosystem approach considers the creation of companies as the result of a process influenced by interdependent systemic factors, which affect the

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life cycle and performance of start-up firms (Ács *et al*., 2018a).To this end, it assesses the development trajectories of high-impact organizations in countries, based on contextual and individual aspects of entrepreneurship (Szerb *et al*., 2020). In terms of policy formulation, such an approach goes beyond "market failures", as it encompasses social and systemic aspects that affect entrepreneurship (Inácio Jr. *et al*., 2021).

GLOBAL ENTREPRENEURSHIP INDEX (GEI)

The GEI was developed to measure the quality of entrepreneurial systems at the country level, through measures of attitudes, skills and entrepreneurial aspirations, individually (micro level), as weights in adjusting the importance of contextual and institutional factors (macro level), in regulating the quality of the dynamics of entrepreneurship.

The GEI conceptual model assumes that entrepreneurs allocate resources to exploit perceived opportunities. However, the resource mobilization process is influenced by contextual/institutional factors (Lafuente *et al*., 2020). Examples of this are the quality and dynamics of interactions between science, technology and innovation institutions (STI) and entrepreneurs, which regulate the potential for innovation. In this way, low interaction directly impacts the ability to innovate in new ventures. Therefore, macro-level factors are institutional and contextual moderators of entrepreneurs' attitudes, skills and aspirations.

The GEI is composed of 14 indicators aggregated into three sub-indices: (1) attitudes (ATT) – associated with indicators that measure the entrepreneurial behavior of the adult population (from 18 to 64 years old) in a country; (2) skills (ABT) – provide a picture of the characteristics of entrepreneurs with high impact potential, measured by metrics associated with motivation to undertake, the technological intensity of the business, the level of education of the entrepreneurs, and the uniqueness of a product and /or service offered, compared to competitors; and (3) entrepreneurial aspirations (ASP) – which deal with high-impact entrepreneurial activity, which spreads new technologies, and generates wealth and jobs (Table 1). This impact is measured by the entrepreneurial ambitions of: internationalization, growth (of jobs), technological innovation, and the availability of venture capital to finance the expansion of new businesses.

Each of the 14 indicators is the result of the combination of an individual variable and an institutional variable, both of which capture the context of each of the participating countries. The individual variables – obtained from the annual adult population survey (APS), carried out by the GEM (Bosma *et al*., 2020) – describe the entrepreneurial behavior of the population and the characteristics of early-stage entrepreneurship. The institutional variables, in turn, made available by international organizations (World Economic Forum, Heritage Foundation, World Bank, Unesco, among others), identify the context of entrepreneurs (market dynamics, existence of services and policies to support entrepreneurship, quality of teaching and research institutions, among others).

By combining variables representing the micro and macro levels, the GEI goes beyond the existing entrepreneurship indices, which are limited to measuring only one of the levels, such as the Doing of Business and the National Expert Survey, which assess only the constraints of entrepreneurship; and the GEM and Kauffman surveys, which look only at entry rates and entrepreneurial attitudes.

Table 1
Global Entrepreneurship Index Structure

	Pillars	Individual variable	Institutional variable
Entrepreneurial Attitudes (ATT)	*(Pillar_1): Opportunity perception*	Opportunity recognition	Freedom and property
	measures perceived opportunity, economic freedom and intellectual property rights.		
	(Pillar_2): Startup skills	*Skill perception*	*Education*
	Measures startup skills and the quality of the education system.		
	(Pillar_3): Risk acceptance	Risk perception	Country risk
	Combines the inhibiting effect of fear of failure with an assessment of country risk.		
	(Pillar_4): Networking	Know entrepreneurs	Agglomeration
	Measures the size of the network of entrepreneurs and their ability to access and mobilize resources.		
	(Pillar_5): Cultural support	Career status	Corruption
	Combina a percepção da população sobre os empreendedores e os níveis de corrupção		
Entrepreneurial Skills (ABT)	*(Pillar_6): Opportunity startup*	Opportunity motivation	Governance
	Measures the proportion of entrepreneurs per opportunity, and the effect of taxation and government services.		
	(Pillar_7): Technology absorption	Technology level	Technology absorption
	Measures the proportion of technology-based entrepreneurs in relation to the level of technology absorption of firms.		
	(Pillar_8): Human capital	Educational level	Labor market
	Measures the proportion of entrepreneurs with higher education, the expenditures of firms on training, and the characteristics of the labor market.		
	(Pillar_9): Competition	Competitors	Competitiveness
	Measures the level of uniqueness of products, the characteristics of competition and the effects of antitrust regulation.		
Entrepreneurial Aspirations (ASP)	*(Pillar_10): Product innovation*	New product	Technology transfer
	Proportion of entrepreneurs offering new products to some of their customers, combined with the technology transfer capacity of firms in a country.		
	(Pillar_11): Process innovation	New technology	Science
	Proportion of entrepreneurs using new production technologies, expenditure on R&D, and quality of science and technology institutions.		
	(Pillar_12): High growth	Gazelle	Finance and strategy
	Measures the proportion of entrepreneurs with high growth expectations, availability of venture capital and sophistication of business strategies.		
	(Pillar_13): Internationalization	Export	Economic complexity
	Measures the proportion of internationalized entrepreneurs and the level of economic complexity of a country.		
	(Pillar_14): Risk capital	Informal investment	Depth of capital market
	Combines the level of informal funding and the depth of the capital market.		

Note : In parentheses are the codes used in the in SEM.
Source: Elaborated by authors from Ács *et al.* (2018a).

Like the GEI, the Index of Dynamic Entrepreneurship (IDE) also measures the micro and macro levels of entrepreneurship but does not provide diagnoses about the entrepreneurial attitudes of the population and the quality of entrepreneurship, that is, whether they are innovative, technology-based and/or or export-oriented.

The GEI results in a composite indicator, developed according to the international recommendations of the OECD,

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discussed in detail in its manual "Handbook on Constructing Composite Indicators: Methodology and User Guide" (OECD, 2008).

A prominent element in the GEI is the so-called "penality for bottleneck", which is not found in any other aggregate indicator. It is the procedure based on the assumption that the performance of a system is dependent on its bottleneck, that is, the overall performance is determined by its weakest link. Thus, countries with greater imbalances among the ten pillars have, as a result, a smaller GEI.

METHODOLOGY

Data

To evaluate the training model of the GEI, data from the index itself, available on the website http://thegedi.org/, belonging to The Global Entrepreneurship and Development Index (GEDI), responsible for studies on entrepreneurship, were used.

The sample consists of 137 countries, referring to the GEI 2018 report (Ács *et al.*, 2018a), and for each one, data were collected concerning the 14 entrepreneurship indicators of the GEI 2017 and 2018, and from all available countries, creating its own database (which can be accessed at: https://doi.org/10.25824/redu/IXXOZ4).

The use of data from two editions was necessary to verify the consistency of the model, in relation to the two measurements in time, and if there are differences between the evaluation periods (2017 and 2018).

Structural Equations Modeling (SEM)

To achieve the research objective, a multivariate statistical treatment of data was applied through the SEM. According to Hair *et al.* (2017), the SEM is suitable for assessing how well a model is able to explain the multifaceted aspects of a phenomenon. To perform it, the SmartPLS 3.0 software was used, which, according to Gudergan *et al.* (2008), analyzes the suitability of models, as it organizes a Confirmatory Factor Analysis (CFA) to assess how much each indicator fits a model. (Hair *et al.*, 2017).

To apply the SEM in the GEI, the first step is to build a diagram of causal relationship paths, representing the three sub-indices of entrepreneurship (ATT, ABT and ASP), called constructs or latent variables (LV) by the SEM literature.

Before modeling, however, confirmatory tetrad analysis (CTA) was performed for each LV to assess whether the measurement model was formative or reflective (Gudergan *et al.*, 2008). The results (Apêndice 1) show that all constructs (ATT, ABT and ASP) have non-null tetrads, indicating that the measurement model is formative (Hair *et al.*, 2017), as predicted in theory for building formative indicators (OECD, 2008).

After confirming the nature of the model, the path diagram was constructed (Figure 1), based on the measurement scheme of formative models. For that, all constructs were connected using the weighting scheme "factor weighting", where each arrow is estimated as a correlation between the latent variables

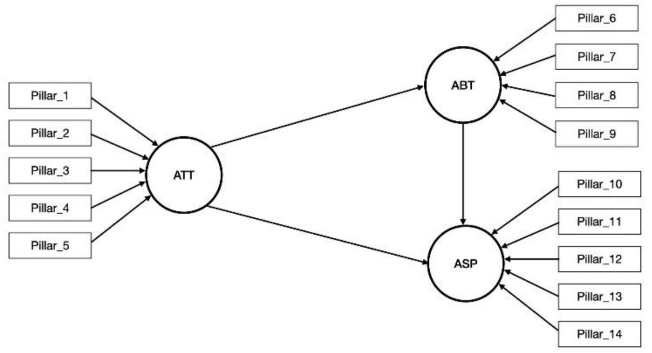

Figure 1
Path diagram
Note: Elaborated by authors (2021).

Evaluation of formative measurement model

To evaluate the formative measurement model (FMM), according to the recommendations of Hair *et al.* (2017), three steps were followed:

(1) evaluation of the convergent validity of the FMM, carried out through the correlation of a formative orientation construct with a single global item - the average value of the indicators of this same construct (to be convergent, the result must be 0.70 or higher);

(2) evaluation of the indicators' collinearity, to identify whether there is redundancy between them – which occurs through high correlations (≥ 5) between indicators of the same construct; and

(3) evaluation of the significance, relevance and level of contribution of each of the formative indicators of the construct, through the bootstrapping technique, which measures the external weight of each indicator (relative importance) and its external load (absolute importance).

When the weight of an indicator is significant (it has a statistical t value greater than 1.65, 1.96 or 2.57), there is empirical support for it to remain in the FMM (Hair *et al.*, 2017). On the other hand, if the weight is not significant, but the value of the external load is relatively high and statistically significant (≥ 0.50), the indicator must be maintained. However, if the external weight is not significant and the external load is relatively low (<0.50), the indicator can be removed from the FMM.

RESULTS

The convergent validity of the latent variables was verified by redundancy analysis of each construct, with the original formative construction marked as "original", and the single-item construction as "global". All path coefficients were higher than the recommended limit of 0.70, which indicates that the LVs exhibit convergent validity (Figure 2).

The assessment of the collinearity of the indicators was performed using the variance inflation factor (VIF), and resulted in values lower than 5.0 - indicative of the absence of redundancy, which does not require the correction of collinearity problems, the removal or merging of indicators (Table 2).

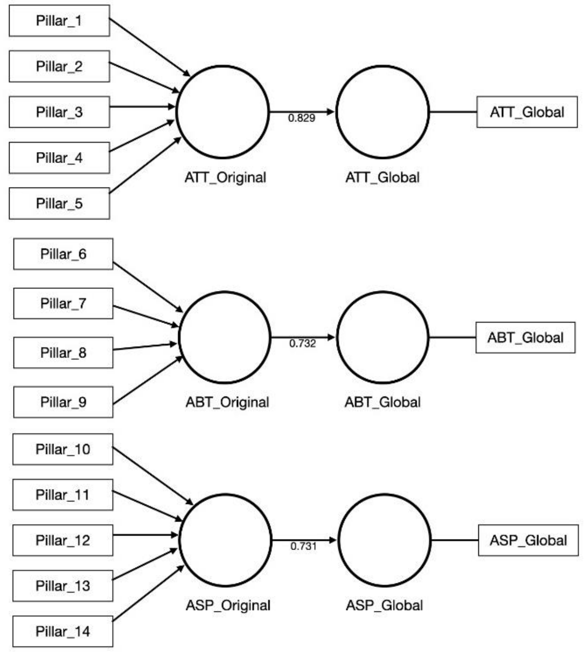

Figure 2
Convergent validity
Note: Elaborated by authors (2021).

Table 2
Variance inflation factor (VIF), external weights and loads

Pillar	VIF	External weights (External loads)	*t* Statistic	*p* value	BCa Confidence Interval [2,5%; 97,5%]
1	3,911	-0,084 (0,817)	0,867$^{(ns)}$	0,397$^{(ns)}$	[-0,283; 0,104]
2	1,483	0,198 (0,663)	2,89***	0,005**	[0,065; 0,344]
3	2,610	0,528 (0,923)	5,614***	0,000***	[0,334; 0,700]
4	1,822	0,052 (0,683)	0,658$^{(ns)}$	0,508$^{(ns)}$	[-0,098; 0,209]
5	3,511	0,465 (0,890)	5,392***	0,000***	[0,229; 0,649]
6	3,981	0,488 (0,958)	6,658***	0,000***	[0,343; 0,625]
7	2,776	0,370 (0,911)	5,725***	0,000***	[0,237; 0,499]
8	1,955	0,128 (0,752)	2,323**	0,021**	[0,034; 0,251]
9	2,624	0,120 (0,829)	1,906*	0,055*	[-0,007; 0,239]
10	1,731	0,037 (0,654)	0,572$^{(ns)}$	0,559$^{(ns)}$	[-0,090; 0,156]
11	2,416	0,347 (0,883)	5,194***	0,000***	[0,220; 0,481]
12	2,532	0,135 (0,800)	1,704*	0,087*	[-0,027; 0,280]
13	2,415	0,319 (0,880)	3,366***	0,001***	[0,134; 0,508]
14	2,959	0,317 (0,887)	2,673***	0,008**	[0,089; 0,557]

Notes : ns = not significant;
* = significant at 10% ($t \geq 1.65$; $p < 0.1$);
** = significant at 5% ($t \geq 1.96$; < 0.05);
*** = significant at 1% ($t \geq 2.57$; $p < 0.001$).
Elaborated by authors (2021).

Regarding the results of the evaluation of the indicators and the relative importance (external weights), in terms of significance and relevance, only three of them showed low significance regarding the t statistic. They are: *Pillar_1* (-0.084); *Pillar_4* (0.052); and *Pillar_10* (0.037). As for the absolute importance, represented by the values of external loads, all indicators showed values greater than 0.50, thus proving to be significantly relevant for the FMM (Table 2).

To achieve the results related to the consistency of the measurement model, based on data from two GEI editions (2017 and 2018), the permutation method was used, by calculating the MICOM test (measurement invariance of composite models), which evaluated the invariance of the FMM (Bido & Da Silva, 2019) in the years analyzed (Table 3 e Table 4). All permutation p-values are non-significant (p>0.05), which confirms the inexistence of differences between the two observed periods (Table 3 e Table 4).

Table 3
Permutation p-values for the constructs of the years 2017 e 2018

Constructs	ATT	ABT	ASP
Original correlation	0,995	0,992	0,979
Correlation permutation average	0,971	0,983	0,976
5.0%	0,932	0,957	0,932
Permutation p-values	0,942	0,701	0,475
Original average difference	0,011	-0,035	-0,050
Permutation Mean Difference	-0,006	-0,003	-0,001
Confidence interval	[-0,249; 0,228]	[-0,246; 0,232]	[-0,234; 0,237]
Permutation p-values	0,922	0,678	0,766
Original variation	0,009	-0,127	-0,042
Permutation average variance	0,002	-0,001	0,003
Confidence interval	[-0,338; 0,357]	[-0,376; 0,354]	[-0,305; 0,303]
Permutation p-values	0,947	0,500	0,788

Note: Elaborated by authors (2021).

Table 4
Permutation p-values for the correlation relationship between the pillars and the constructs of the years 2017 e 2018

Pillar	Original values 2017	Original values 2018	(2017-2018) Original difference	(2017-2018) Permutaion difference	Confidence interval	Permutation p-values
1	-0,066	-0,085	0,018	-0,002	[-0,281; 0,262]	0,907
2	0,147	0,198	-0,051	-0,003	[-0,202; 0,206]	0,618
3	0,562	0,528	0,033	0,002	[-0,278; 0,259]	0,821
4	0,072	0,052	0,020	0,002	[-0,217; 0,259]	0,862
5	0,420	0,465	-0,046	0,000	[-0,255; 0,269]	0,728
6	0,579	0,488	0,091	0,000	[-0,213; 0,204]	0,407
7	0,314	0,370	-0,056	-0,001	[-0,163; 0,169]	0,535
8	0,110	0,128	-0,018	0,001	[-0,192; 0,181]	0,838
9	0,113	0,120	-0,007	-0,002	[-0,201; 0,196]	0,942
10	0,174	0,037	0,138	-0,001	[-0,183; 0,183]	0,181
11	0,289	0,347	-0,057	-0,006	[-0,231; 0,234]	0,546
12	0,057	0,135	-0,079	0,000	[-0,239; 0,260]	0,501
13	0,274	0,319	-0,045	0,002	[-0,239; 0,260]	0,732
14	0,361	0,317	0,043	0,004	[-0,329; 0,360]	0,808

Note: Elaborated by authors (2021).

DISCUSSION

The results of the FMM evaluation show that all LVs have convergent validity; however, with regard to the significance and relevance of the indicators, Pilar_1, Pilar_4 and Pilar_10 have non-significant external weights. Even so, they have significant external loads (>0.5), which suggests the permanence of the indicators in the FMM, as long as there is empirical support for this.

Pillar_1 is composed of the variables "opportunity recognition" and "business and property". The first (individual) measures the population's perception of opportunities to undertake; and the second (institutional), provided by the Economic Freedom Index (EFI), captures the effects of the regulatory environment on entrepreneurship and private property rights.

When looking at the EFI database, it can be noted that developed countries are characterized by the quality of the regulatory environment; the GEM database, in terms of the individual variable, shows that underdeveloped and developing countries have greater opportunities to undertake (from the point of view of the adult population), compared to developed countries.

This is, therefore, a limitation of the GEM, given that the research considers any type of entrepreneurship, not necessarily productive, innovative and/or knowledge intensive. Thus, there is no differentiation between perceived opportunities in high-tech sectors and low-productivity opportunities (such as selling homemade cakes, for example, due to the scarcity of quality jobs

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and the need to earn income to survive). This methodological option, therefore, provides distorted results of what could be understood as productive or high-impact entrepreneurship.

Although there is theoretical support for maintaining *Pillar_1*, since opportunities are the core of entrepreneurship (Wood & Mckinley, 2017), some authors (Neill *et al.*, 2017; Welter & Alvarez, 2015) argue that it is necessary to distinguish them between discovery and creation. On the other hand, measuring only the opportunities perceived in technology sectors would generate new results, being able to identify the ability of an economic system to favor entrepreneurs (Radosevic & Yoruk, 2013).

Although the focus on the perception of entrepreneurial opportunities in technological sectors penalized less developed countries, a change in this indicator would minimize the distortions of results, when comparing countries at different stages of development. For example, the United States has 0.73 points in the variable "recognition of opportunities", while Chad, the last place out of 137 countries, has a performance of 0.94, surpassing the United States, the first place in the GEI ranking. In this context, this variable may indicate that Chad's economic system generates more opportunities (perceived by the population of that country) to undertake than the US system. These results distortions would be minimized if the indicator captured other aspects of opportunity perception, especially those related to technology.

Pillar_4, consisting of the individual variables "known entrepreneurs" and institutional "agglomeration", assesses the ease of meeting an entrepreneur, the ability to connect individuals, the degree of urbanization and the quality of the countries' infrastructure. Several researchers (Audretsch & Belitski, 2017; Belitski & Desai, 2016; Bosma & Sternberg, 2014; Stam & Van de Ven, 2021) claim, in this sense, that urban environments, with quality infrastructure, drive innovative and high-quality entrepreneurship growth, due to agglomeration economies (Krugman, 1991). Thus, knowledge flows are denser in cities, where different skills and resources are concentrated, and they become more accessible. In addition, these environments facilitate market access (Lattacher *et al.*, 2021).

Likewise, entrepreneurs known by the majority of the population become models and successful references for potential entrepreneurs, acting as leaders, in strengthening the NSE (Stam & Van de Ven, 2021; Sternberg *et al.*, 2019).

There is, therefore, theoretical support for maintaining *Pillar_4*, despite the low significance of the indicator, which is associated with the methodological limitations of the GEM, for which any individual involved in the creation of a new business is considered an entrepreneur, whether he is dedicated to an activity with the potential to become a unicorn, be it a subsistence activity.

This becomes clearer when comparing the United States and Mauritania (number 136 in the ranking of 137 countries), regarding the variable "known entrepreneurs". The first country has a score of 0.57; and the second, 1.0 point, indicating that there are more entrepreneurs in Mauritania than in the United States.

Although less developed countries have larger "stocks" of entrepreneurs than more developed ones (Ács *et al.*, 2014), quantity does not represent quality, as they are primarily need-oriented entrepreneurs (Autio & Fu, 2014; Lederman *et al.*, 2014), with low visibility and/or less known than innovative entrepreneurs. As a result, they find it more difficult to access the same resources and knowledge flows held by an innovative new (Kantis *et al.*, 2018; Ordeñana *et al.*, 2019).

With regard to *Pillar_10*, the low external weight can be attributed to the characteristics of the GEI database, which measures entrepreneurship in 137 countries, most of which are characterized by economic systems based on factors of production or efficiency, which are known dependence on the global economy and the importation of technology. Only a small number of countries diffuse the technology, through knowledge-intensive activities and business sophistication and demand (WEF, 2017). Thus, when using a relatively large database on entrepreneurial innovation, in which most countries have few innovative initial entrepreneurs, it is expected to obtain low significance.

Pillar_10, then, due to the institutional variable "technology transfer", which measures the quality of a country's science and technology system (Ács *et al.*, 2018b), has theoretical support, which guarantees the their stay in the FMM. According to some researchers (Belitski & Desai, 2016; De Bernardi & Azucar, 2020; Malerba & McKelvey, 2020; Radosevic & Yoruk, 2013), the quality of the innovation environment drives the creation of new innovative companies. On the other hand, the individual variable "new product", which measures whether entrepreneurs introduce new products to some of their customers, combined with the institutional variable that assesses the "quality of the S&T system", represent an advance in relation to the indexes of entrepreneurship that provide a diagnosis of the quality of the innovation environment, but do not inform whether innovation actually occurs.

To assess the NSE, for example, the IDE uses metrics, such as the S&T platform and the business structure, to assess the quality of the S&T system and the technological maturity of established companies (Kantis *et al.*, 2018). However, it is not possible to correlate these metrics with the proportion of innovative entrepreneurs, as the FDI only includes an entrepreneurship indicator, which measures the growth orientation of new businesses, not whether they are innovative.

Assessing the proportion of early entrepreneurs who innovate is relevant to support decision makers in formulating policies that minimize market failures associated with knowledge externalities, inducing investments and facilitating the dissemination of knowledge (Ács *et al.*, 2016).

CONCLUSION

In this research, it was asked whether the GEI indicators are relevant and significant to measure the performance of the NSE. To obtain the answers, the SEM and the evaluation procedures related to the FMM were used – configuration through which the indicators form/cause the construct (phenomenon). The results showed that all constructs have convergent validity and the indicators are not redundant.

When evaluating based on external weights, *Pillar_1*, *Pillar_4* e *Pillar_10* showed low significance. On the other hand, in terms of relevance, given the value obtained in the examination of external loads, the indicators proved to be significant.

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As it is a relevant metric to assess the quality of entrepreneurship, this article suggests the permanence of *Pillar_10*. However, it is necessary to replace the individual variables of *Pillar_1* and *Pillar_4*, in which entrepreneurship encompasses any attempt to create a new business, including from autonomous activities to the expansion of an existing business (GEM, 2017). Because of this, they provide distorted results, based only on quantity, not measuring the quality and impacts of entrepreneurship.

From the perspective of these variables, therefore, as a suggestion to the developers of indicators or policymakers, this article recommends the elaboration of more specific questions, in order to avoid, as a parameter to measure the visibility of entrepreneurs, the use of negligible forms of entrepreneurship. for economic growth or that do not constitute references for new business models (Feld, 2012; Ordeñana *et al.*, 2019).

By validating the GEI and suggesting the replacement of some components, this research methodologically contributes to studies proposing regional and/or local applications of the aforementioned index. To avoid distorted results, however, it is recommended to limit the scope of evaluation to effectively productive forms of entrepreneurship.

In addition, this study contributes to the entrepreneurship literature, as it is the first to assess the validity of the GEI, using the SEM method. So far, research has correlated the index with indicators – a procedure that does not allow identifying whether it is valid as a methodology or as a model for measuring NSE.

For future research, we suggest the validation of other entrepreneurship indices, such as FDI; and the evaluation of the GEI over time, using techniques such as data envelopment analysis (DEA) and the Malmquist index (Bogetoft, 2012), to measure the efficiency of the countries' EE.

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Conflict of interest statemen

The authors declare that there is no conflict of interest.

Authors' statement of individual contributions

Papéis	Contribuições			
	Dionisio EA	Silva D	Carvalho RQ	Inacio Jr. E
Conceptualization	■			■
Methodology	■	■		■
Software	■	■		■
Validation	■	■		■
Formal analysis	■	■		■
Investigation	■			■
Resources	N.A.			
Data Curation	■			■
Writing - Original Draf	■	■	■	■
Writing - Review & Editing	■		■	■
Visualization				■
Supervision			■	■
Project administration				■
Funding acquisition	■			

REFERÊNCIAS

Ács, Z. J., Åstebro, T., Audretsch, D., & Robinson, D. T. (2016). Public policy to promote entrepreneurship: a call to arms. *Small Business Economics*, *47*(1), 35-51. https://doi.org/10.1007/s11187-016-9712-2

Ács, Z. J., Autio, E., & Szerb, L. (2014). National Systems of Entrepreneurship: Measurement issues and policy implications. *Research Policy*, *43*(3), 476-494. https://doi.org/10.1016/j.respol.2013.08.016

Ács, Z. J., & Correa, P. (2014). Identifying the Obstacles to High-Impact Entrepreneurship in Latin America and the Caribbean. *GMU School of Public Policy Research Paper*, (5), 1-48. https://doi.org/10.2139/ssrn.2534412

Ács, Z. J., Estrin, S., Mickiewicz, T., & Szerb, L. (2018a). Entrepreneurship, institutional economics, and economic growth: an ecosystem perspective. *Small Business Economics*, *51*(2), 501-514. https://doi.org/10.1007/s11187-018-0013-9

Ács, Z. J., & Szerb, L. (2009). The Global Entrepreneurship Index (GEINDEX). *Foundations and Trends® in Entrepreneurship*, *5*(5), 341-435. https://doi.org/10.1561/0300000027

Ács, Z. J., Szerb, L., Autio, E., & Lloyd, A. (2018b). *The Global Entrepreneurship Index 2018*. The Global Entrepreneurship and Development Institute. New York: Springer International Publishing. https://doi.org/10.1007/978-3-030-03279-1

Ali, A., Kelley, D. J., & Levie, J. (2020). Market-driven entrepreneurship and institutions. *Journal of Business Research*, *113*, 117-128. https://doi.org/10.1016/j.jbusres.2019.03.010

Amorós, J. E., Cristi, O., & Naudé, W. (2021). Entrepreneurship and subjective well-being: Does the motivation to start-up a firm matter? *Journal of Business Research*, *127*, 389-398. https://doi.org/10.1016/j.jbusres.2020.11.044

Asante, E. A., & Affum-Osei, E. (2019). Entrepreneurship as a career choice: The impact of locus of control on aspiring entrepreneurs' opportunity recognition. *Journal of Business Research*, *98*, 227-235. https://doi.org/10.1016/j.jbusres.2019.02.006

Atiase, V. Y., Mahmood, S., Wang, Y., & Botchie, D. (2018). Developing entrepreneurship in Africa: investigating critical resource challenges. *Journal of Small Business and Enterprise Development*, *25*(4), 644-666. https://doi.org/10.1108/JSBED-03-2017-0084

Audretsch, D. B., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: establishing the framework conditions. *The Journal of Technology Transfer*, *42*(5), 1030-1051. https://doi.org/10.1007/s10961-016-9473-8

Autio, E., & Fu, K. (2014). Economic and political institutions and entry into formal and informal entrepreneurship. *Asia Pacific Journal of Management*, *32*(1), 67-94. https://doi.org/10.1007/s10490-014-9381-0

Autio, E., & Rannikko, H. (2016). Retaining winners: Can policy boost high-growth entrepreneurship? *Research Policy*, *45*(1), 42-55. https://doi.org/10.1016/j.respol.2015.06.002

Belitski, M., & Desai, S. (2016). Creativity, entrepreneurship and economic development: city-level evidence on creativity spillover of entrepreneurship. *Journal of Technology Transfer*, *41*(6), 1354-1376. https://doi.org/10.1007/s10961-015-9446-3

Beynon, M. J., Jones, P., & Pickernell, D. (2020). Country-level entrepreneurial attitudes and activity through the years: A panel data analysis using fsQCA. *Journal of Business Research*, *115*, 443-455. https://doi.org/10.1016/j.jbusres.2019.11.021

Bido, D. de S., & Da Silva, D. (2019). SmartPLS 3: especificação, estimação, avaliação e relato. *Administração: Ensino e Pesquisa*, *20*(2), 488-536. https://doi.org/10.13058/raep.2019.v20n2.1545

Bogatyreva, K., Edelman, L. F., Manolova, T. S., Osiyevskyy, O., & Shirokova, G. (2019). When do entrepreneurial intentions lead to actions? The role of national culture. *Journal of Business Research*, *96*, 309-321. https://doi.org/10.1016/j.jbusres.2018.11.034

Bogetoft, P. (2012). *Performance Benchmarking*. New York: Springer. https://doi.org/10.1007/978-1-4614-6043-5

Bosma, N., Hill, S., Ionescu-Somers, A., Kelley, D., Levie, J., & Tarnawa, A. (2020). *Global Entrepreneurship Monitor: 2019/2020 Global Report*. London: Global Entrepreneurship Research Association and London Business School. Retrived from https://www.babson.edu/media/babson/assets/global-entrepreneurship-monitor/2019-2020-GEM-Global-Report.pdf

Bosma, N., & Sternberg, R. (2014). Entrepreneurship as an urban event? Empirical evidence from European cities. *Regional Studies*, *48*(6), 1016-1033. https://doi.org/10.1080/00343404.2014.904041

Bruns, K., Bosma, N., Sanders, M., & Schramm, M. (2017). Searching for the existence of entrepreneurial ecosystems: a regional cross-section growth regression approach. *Small Business Economics*, *49*(1), 31-54. https://doi.org/10.1007/s11187-017-9866-6

Buenstorf, G., & Costa, C. (2018). Drivers of spin-off performance in industry clusters: Embodied knowledge or embedded firms? *Research Policy*, *47*(3), 663-673. https://doi.org/10.1016/j.respol.2018.01.015

Cervelló-Royo, R., Moya-Clemente, I., Perelló-Marín, M. R., & Ribes-Giner, G. (2020). Sustainable development, economic and financial factors, that influence the opportunity-driven entrepreneurship. An fsQCA approach. *Journal of Business Research*, *115*, 393-402. https://doi.org/10.1016/j.jbusres.2019.10.031

Chang, Y.-Y., & Chen, M.-H. (2020). Creative entrepreneurs' creativity, opportunity recognition, and career success: Is resource availability a double-edged sword? *European Management Journal*, *38*(5), 750-762. https://doi.org/10.1016/j.emj.2020.03.004

Cieślik, J., Kaciak, E., & Van Stel, A. (2018). Country-level determinants and consequences of overconfidence in the ambitious entrepreneurship segment. *International Small Business Journal: Researching Entrepreneurship*, *36*(5), 473-499. https://doi.org/10.1177/0266242617748201

De Bernardi, P., & Azucar, D. (2020). Innovation and Entrepreneurial Ecosystems: Structure, Boundaries, and Dynamics. In *Innovation in Food Ecosystems: Entrepreneurship for a Sustainable Future* (pp. 73-104). New York: Springer International Publishing. https://doi.org/10.1007/978-3-030-33502-1_3

Dosi, G. (1982). Technological paradigms and technological trajectories. *Research Policy*, *11*(3), 147-162. https://doi.org/http://dx.doi.org/10.1016/0048-7333(82)90016-6

Dutta, N., & Meierrieks, D. (2021). Financial development and entrepreneurship. *International Review of Economics & Finance*, *73*, 114-126. https://doi.org/10.1016/j.iref.2021.01.002

Edquist, C. (1997). *Systems of Innovation: Technologies, Institutions, and Organizations* (1st ed.). London, England: Pinter Publisher Ltd.

Farinha, L., Lopes, J., Bagchi-Sen, S., Sebastião, J. R., & Oliveira, J. (2020). Entrepreneurial dynamics and government policies to boost entrepreneurship performance. *Socio-Economic Planning Sciences*, *72*, 100950. https://doi.org/10.1016/j.seps.2020.100950

Feld, B. (2012). *Startup Communities: Building an Entrepreneurial Ecosystem in Your City*. New Jersey, USA: John Wiley & Sons.

Fredström, A., Peltonen, J., & Wincent, J. (2021). A country-level institutional perspective on entrepreneurship productivity: The effects of informal economy and regulation. *Journal of Business Venturing*, *36*(5), 1-15. https://doi.org/10.1016/j.jbusvent.2020.106002

Freeman, C. (1995). The national system of innovation in historical perspective. *Cambridge Journal of Economics*, *19*(1), 5-24.

Fuster, E., Padilla-Meléndez, A., Lockett, N., & Del-Águila-Obra, A. R. (2019). The emerging role of university spin-off companies in developing regional entrepreneurial university ecosystems: The case of Andalusia. *Technological Forecasting and Social Change*, *141*, 219-231. https://doi.org/10.1016/j.techfore.2018.10.020

GEM. (2017). Global *Report 2016/17*. Global Entrepreneurship Research Association. Retrived from https://www.gemconsortium.org/file/open?fileId=49812

González-Uribe, J., & Reyes, S. (2021). Identifying and boosting "Gazelles": Evidence from business accelerators. *Journal of Financial Economics*, *139*(1), 260-287. https://doi.org/10.1016/j.jfineco.2020.07.012

Gudergan, S. P., Ringle, C. M., Wende, S., & Will, A. (2008). Confirmatory tetrad analysis in PLS path modeling. *Journal of Business Research*, *61*(12), 1238-1249. https://doi.org/10.1016/j.jbusres.2008.01.012

Hair, J. F., Hult, T. G., Ringle, C. M., & Sarstedt, M. (2017). *Primer on Partial Least Squares Structural (PLS-SEM)* (2nd ed.). Thousand Oaks, California, USA: Sage Publications Inc.

Hamdi-Kidar, L., & Vellera, C. (2018). Triggers entrepreneurship among creative consumers. *Journal of Business Research*, *92*, 465-473. https://doi.org/10.1016/j.jbusres.2018.07.018

Huynh, T., Patton, D., Arias-Aranda, D., & Molina-Fernández, L. M. (2017). University spin-off's performance: Capabilities and networks of founding teams at creation phase. *Journal of Business Research*, *78*, 10-22. https://doi.org/10.1016/j.jbusres.2017.04.015

Inácio Jr., E., Dionisio, E. A., Fischer, B. B., Li, Y., & Meissner, D. (2021). The global entrepreneurship index as a benchmarking tool? Criticisms from an efficiency perspective. *Journal of Intellectual Capital*, *22(*1*)*, 190-212. https://doi.org/10.1108/JIC-09-2019-0218

Isenberg, D. J. (2010). How to Start an Entrepreneurial Revolution. *Harvard Business Review*, *88*(6), 40-50.

Kantis, H., Federico, J., & García, S. I. (2018). *Opening the black box of ecosystem diversity around the globe: The Index of Dynamic Entrepreneurship (IDE)* (1st ed.). Santa Fé, Argentina: Asociación Civil Red Pymes Mercosur.

Kaya, M. C., & Persson, L. (2019). A theory of gazelle growth: Competition, venture capital finance and policy. *The North American Journal of Economics and Finance*, *50*, 101019. https://doi.org/10.1016/j.najef.2019.101019

Kline, S. J., & Rosenberg, N. (1986). An Overview of Innovation. In R. Landau & N. Rosenberg (Eds.), The Positive Sum Strategy: Harnessing Technology for Economic Growth (275-306). Washington, USA: National Academy of Sciences.

Krugman, P. (1991). Increasing returns and economic geography. *The Journal of Political Economy*, *99*(3), 483-499.

Kuratko, D. F. (2009). The entrepreneurial imperative of the 21st century. *Business Horizons*, *52*(5), 421-428. https://doi.org/10.1016/j.bushor.2009.04.006

Kurato, D. F., & Covin, J. G. (2008). The concept of corporate entrepreneurship. In V. K. Narayanan & G. G. O'Connor (Eds.), *Encyclopedia of technology and innovation management* (pp. 207-214). New Jersey, USA: Blackwell Publishers.

Lafuente, E., Ács, Z. J., Sanders, M., & Szerb, L. (2020). The global technology frontier: productivity growth and the relevance of Kirznerian and Schumpeterian entrepreneurship. *Small Business Economics*, *55*(1), 153-178. https://doi.org/10.1007/s11187-019-00140-1

Lafuente, E., Szerb, L., & Ács, Z. J. (2016). Country level efficiency and national systems of entrepreneurship: a data envelopment analysis approach. *The Journal of Technology Transfer*, *41*(6), 1260-1283. https://doi.org/10.1007/s10961-015-9440-9

Landström, H., Åström, F., & Harirchi, G. (2015). Innovation and entrepreneurship studies: one or two fields of research? *International Entrepreneurship and Management Journal*, *11*(3), 493-509. https://doi.org/10.1007/s11365-013-0282-3

Lassalle, P., Johanson, M., Nicholson, J. D., & Ratajczak-Mrozek, M. (2020). Migrant entrepreneurship and markets: The dynamic role of embeddedness in networks in the creation of opportunities. *Industrial Marketing Management*, *91*, 523-536. https://doi.org/10.1016/j.indmarman.2020.04.009

Lattacher, W., Gregori, P., Holzmann, P., & Schwarz, E. J. (2021). Knowledge spillover in entrepreneurial emergence: A learning perspective. *Technological Forecasting and Social Change*, *166*, 1-13. https://doi.org/10.1016/j.techfore.2021.120660

Lederman, D., Messina, J., Pienknagura, S., & Rigolini, J. (2014). *Latin American Entrepreneurs: many firms but little innovation*. Washington, D.C., USA: The World Bank. https://doi.org/10.1596/978-1-4648-0012-2

Leendertse, J., Schrijvers, M., & Stam, E. (2021). Measure Twice, Cut Once: Entrepreneurial Ecosystem Metrics. *Research Policy*, Online. https://doi.org/10.1016/j.respol.2021.104336

Lundvall, B.-Å. (1992). *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning* (1st ed.). London: Pinter Publishers.

Malerba, F., & McKelvey, M. (2020). Knowledge-intensive innovative entrepreneurship integrating Schumpeter, evolutionary economics, and innovation systems. *Small Business Economics*, *54*(2), 503-522. https://doi.org/10.1007/s11187-018-0060-2

Malerba, F., & Pisano, G. P. (2019). Innovation, competition and sectoral evolution: an introduction to the special section on Industrial Dynamics. *Industrial and Corporate Change*, *28*(3), 503-510. https://doi.org/10.1093/icc/dtz017

Mason, C., & Brown, R. (2014). *Entrepreneurial ecosystems and growth-oriented enterprises*. Berlin: OECD Publishing.

Neill, S., Metcalf, L. E., & York, J. L. (2017). Distinguishing entrepreneurial approaches to opportunity perception. *International Journal of Entrepreneurial Behavior & Research*, *23*(2), 296-316. https://doi.org/10.1108/IJEBR-05-2016-0162

Nelson, R. R. (1993). *National innovation systems: a comparative analysis* (1st ed.). Oxford, UK: Oxford University Press.

OECD. (2008). *Handbook on Constructing Composite Indicators: Methodology and User Guide*. European Union: OECD Publishing.

Omri, A. (2020). Formal versus informal entrepreneurship in emerging economies: The roles of governance and the financial sector. *Journal of Business Research*, *108*, 277-290. https://doi.org/10.1016/j.jbusres.2019.11.027

Ordeñana, X., Vera-Gilces, P., Zambrano-Vera, J., & Amaya, A. (2019). Does all entrepreneurship matter? The contribution of entrepreneurial activity to economic growth. *Academia Revista Latinoamericana*

https://doi.org/10.14211/ibjesb.e2050

de Administración, 33(1), 25-48. https://doi.org/10.1108/ARLA-11-2018-0256
Radosevic, S., & Yoruk, E. (2013). Entrepreneurial propensity of innovation systems: Theory, methodology and evidence. *Research Policy*, *42*(5), 1015-1038. https://doi.org/10.1016/j.respol.2013.01.011
Roundy, P. T., Bradshaw, M., & Brockman, B. K. (2018). The emergence of entrepreneurial ecosystems: A complex adaptive systems approach. *Journal of Business Research*, *86*, 1-10. https://doi.org/https://doi.org/10.1016/j.jbusres.2018.01.032
Salman, D. M. (2016). What is the role of public policies to robust international entrepreneurial activities on economic growth? Evidence from cross countries study. *Future Business Journal*, *2*(1), 1-14. https://doi.org/10.1016/j.fbj.2016.02.001
Schumpeter, J. A. (1949). Economic Theory and Entrepreneurial History. In J. A. Schumpeter (Ed.), *Change and the Entrepreneur: postulates and patterns of entrepreneurial history* (pp. 63-84). Cambridge, MA, USA: Harvard University Press.
Schumpeter, J. A. (2011). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle* (1st ed.). New Jersey, USA: Transaction Publishers.
Shane, S. (2009). Why encouraging more people to become entrepreneurs is bad public policy. *Small Business Economics*, *33*(2), 141-149. https://doi.org/10.1007/s11187-009-9215-5
Sousa-Ginel, E., Franco-Leal, N., & Camelo-Ordaz, C. (2021). Knowledge conversion capability and networks as drivers of innovation in Academic Spin-Offs. *Journal of Engineering and Technology Management*, *59*, 101615. https://doi.org/10.1016/j.jengtecman.2021.101615
Spigel, B., & Harrison, R. (2018). Toward a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, *12*(1), 151-168. https://doi.org/10.1002/sej.1268
Stam, E. (2015). Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique. *European Planning Studies*, *23*(9), 1759-1769. https://doi.org/10.1080/09654313.2015.1061484
Stam, E., & Van de Ven, A. (2021). Entrepreneurial ecosystem elements. *Small Business Economics*, *56(2)*, 809-832. https://doi.org/10.1007/s11187-019-00270-6
Sternberg, R., Bloh, J. von, & Coduras, A. (2019). A new framework to measure entrepreneurial ecosystems at the regional level. *Zeitschrift Für Wirtschaftsgeographie*, *63*(2-4), 103-117. https://doi.org/10.1515/zfw-2018-0014
Steruska, J., Simkova, N., & Pitner, T. (2019). Do science and technology parks improve technology transfer? *Technology in Society*, *59*, 101127. https://doi.org/10.1016/j.techsoc.2019.04.003
Szerb, L., Ács, Z. J., Autio, E., Ortega-Argilés, R., & Komlósi, É. (2014). *REDI: The Regional Entrepreneurship and Development Index - Measuring regional entrepreneurship*. Luxembourg: Publications Office of the European Union. https://doi.org/10.2776/79241
Szerb, L., Ortega-Argilés, R., Ács, Z. J., & Komlósi, É. (2020). Optimizing entrepreneurial development processes for smart specialization in the European Union. *Papers in Regional Science*, *99*(5), 1413-1457. https://doi.org/10.1111/pirs.12536
Szerb, L., & Trumbull, W. N. (2018). Entrepreneurship development in Russia: is Russia a normal country? An empirical analysis. *Journal of Small Business and Enterprise Development*, *25*(6), 902-929. https://doi.org/10.1108/JSBED-01-2018-0033
Tavassoli, S., Obschonka, M., & Audretsch, D. B. (2021). Entrepreneurship in Cities. *Research Policy*, *50*(7), 104255. https://doi.org/10.1016/j.respol.2021.104255
Ha, N. T. T., & Hoa, L. B. (2018). Evaluating entrepreneurship performance in Vietnam through the global entrepreneurship development index approach. *Journal of Developmental Entrepreneurship*, *23*(01), 1–19. https://doi.org/10.1142/S1084946718500061.
Udimal, T. B., Luo, M., Liu, E., & Mensah, N. O. (2020). How has formal institutions influenced opportunity and necessity entrepreneurship? The case of brics economies. *Heliyon*, *6*(9), e04931. https://doi.org/10.1016/j.heliyon.2020.e04931
WEF. (2017). *The global competitiveness report 2017-2018*. Cologny, Suíça: The World Economic Forum.
Welter, C., & Alvarez, S. (2015). The state of opportunities: clarifying the transitions between opportunity types. *Management Decision*, *53*(7), 1398-1411. https://doi.org/10.1108/MD-07-2014-0466
Wood, M. S., & Mckinley, W. (2017). After the Venture: The Reproduction and Destruction of Entrepreneurial Opportunity. *Strategic Entrepreneurship Journal*, *11*(1), 18-35. https://doi.org/10.1002/sej.1238
Xie, K., Song, Y., Zhang, W., Hao, J., Liu, Z., & Chen, Y. (2018). Technological entrepreneurship in science parks: A case study of Wuhan Donghu High-Tech Zone. *Technological Forecasting and Social Change*, *135*, 156-168. https://doi.org/10.1016/j.techfore.2018.01.021
Zheng, S., & Du, R. (2020). How does urban agglomeration integration promote entrepreneurship in China? Evidence from regional human capital spillovers and market integration. *Cities*, *97*, 102529. https://doi.org/10.1016/j.cities.2019.102529

Appendix 1
Results of Confirmatory tetrad analysis (CTA)

Tetrads	Adjusted confidence interval	
	Low	High
Pillar_1, 2, 3, 4	-0,001	0,000
Pillar_1, 2, 4, 3	0,000	0,000
Pillar_1, 2, 3, 5	-0,001	0,000
Pillar_1, 3, 5, 2	-0,001	0,000
Pillar_1, 3, 4, 5	0,000	0,000
Pillar_6, 7, 8, 9	-0,001	0,000
Pillar_6, 7, 9, 8	0,000	0,000
Pillar_10, 11, 12, 13	-0,001	0,001
Pillar _10, 11, 13, 12	0,000	0,001
Pillar _10, 11, 12, 14	0,000	0,001
Pillar _10, 12, 14, 11	0,000	0,001
Pillar _10, 12, 13, 14	-0,001	0,001

Note: Elaborated by authors (2021).

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