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Exploring Personal and Contextual Variables of the Global Entrepreneurship Monitor through the Rasch Mathematical Model

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Abstract: This article studies the variables of entrepreneurship at the regional (countries) level proposed by the Global Entrepreneurship Monitor (GEM) in its periodic global reports. This response to the suggestions and concerns of various authors is related to the need to analyze the theoretical foundation of the variables used by GEM. The validity and reliability of GEM data for the scientific study of entrepreneurship are also analyzed. Finally, the potential of GEM data to manage entrepreneurship variables at the country level is studied. Data from the GEM global report and the fifty countries for which data are available on all variables are used in the study. The methodology used is the Rasch mathematical model, a valuable alternative to the Classical Theory of the Test. The results confirm the theoretical validity of GEM data, its validity and reliability for the development of scientific studies, and its potential for managing entrepreneurship variables at the country level. Both the methodology used and the conclusions obtained constitute novel contributions to this field.

Keywords: global entrepreneurship monitor; personal variables; contextual variables; rasch model; regional entrepreneurship



Citation: Martínez-González, J.A.; Kobylinska, U.; Gutiérrez-Taño, D. Exploring Personal and Contextual Variables of the Global Entrepreneurship Monitor through the Rasch Mathematical Model. *Mathematics* **2021**, *9*, 1838. <https://doi.org/10.3390/math9161838>

Academic Editor: David Carfi

Received: 8 July 2021

Accepted: 2 August 2021

Published: 4 August 2021

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1. Introduction

Entrepreneurship is a multidimensional, global process in which the result is the creation of a new company [1–3]. The Global Entrepreneurship Monitor (GEM) defines entrepreneurship as “any attempt at a new venture or new business creation, such as self-employment, a new business organization or the expansion of an existing business” [4] p. 22. As entrepreneurship is essential to economic growth, sustainable development, and employment creation [5–7], the process of creating a new company has become a critical research field [8–10].

Over the last decade, researchers have made efforts to identify the factors on which entrepreneurship depends in a regional (e.g., local, country) context [11–14]. It has been shown that entrepreneurship in a specific region is relatively stable due to the temporal stability of certain variables (e.g., culture) [15–17]. Thus, it has been suggested that entrepreneurship in a regional context can be self-reinforcing [18–20]. There are two lines of research about the variables that favor entrepreneurship in a regional context [21,22]. Within the Contextual approach, environmental factors (e.g., education, culture) are the most influential elements in the entrepreneurial process [23–25]. By contrast, studies using the Human Capital approach have focused on the attributes of entrepreneurs (e.g., competencies, attitude) [26–28]. Both approaches have been used in entrepreneurship studies at the regional level by researchers and institutions [9,12,13]. At the institutional level, the reports on country level entrepreneurship produced by the GEM (www.gemconsortium.org) (accessed on 16 March 2021) stand out [29–31]. The GEM uses a temporal approach to prepare its annual reports in which both contextual and personal factors interact and

influence entrepreneurship [14,32,33]. It is an exception because in most regional studies on entrepreneurship, only personal or contextual variables are used, not both [33,34]. It should be noted that in the GEM approach, the contextual variables influence the formation of the personal variables [35–37].

Since its implementation, the methodology used by GEM has been improved, and its reports have been recognized as the best source of valid and reliable data to carry out comparative studies on entrepreneurship at the country level [38–40]. In addition, GEM has led to an increase in the number of descriptive and predictive quality and impact articles that use the databases and reports from this institution [37,39,41].

Despite its recognition, various authors have expressed concern about certain aspects of the GEM model. Firstly, the need to provide a better theoretical foundation for the personal and contextual variables of entrepreneurship used by GEM has been highlighted [42–44]. Secondly, some authors have suggested the limitation of the validity and reliability of GEM's data, in turn slowing down the development of quality studies using data from global reports. Thirdly, several researchers suggest deepening the relationship between entrepreneurship's personal and contextual variables within countries and joint comparative studies [33,34]. In addition, limitations of the GEM model have been pointed out in the literature regarding the study of entrepreneurship of a particular country in an integrated context of countries and variables [41–46]. Finally, the need to check whether countries with different levels of entrepreneurship have different values concerning personal and contextual variables has been highlighted [9].

Thus, this study puts forward five objectives in response to the suggestions mentioned above:

1. To analyze the theoretical foundation of entrepreneurship's personal and contextual variables included in the GEM model by comparing the GEM model of variables with the most prominent studies in the literature of this field;
2. To determine the validity, reliability, and one-dimensional nature of the GEM model;
3. To study the GEM model's potential to globally analyze the entrepreneurship process concerning the overall number of countries and variables under evaluation;
4. To evaluate the GEM model's use of comparative entrepreneurship studies of a specific country in an overall and benchmarking framework;
5. To analyze any differences concerning the variables between countries with a high TEA (Total early-stage Entrepreneurial Activity) and countries with a low TEA. TEA is the most relevant result indicator proposed by the GEM, and is defined as the percentage of the 18–64 population who are either a nascent entrepreneur or owner-manager of a new business.

The country selected for the fourth analysis is Italy. This country has been chosen because it occupies the last place in the GEM ranking (50/50) and has the lowest TEA level, according to data from the 2019/2020 report. Furthermore, the Italian economy has not yet fully recovered from the financial crisis of 2008 and the subsequent internal recession of 2011–2013, and there are no excellent short-term prospects for entrepreneurship [3].

In addition, the Rasch model (RM) is used in this study to achieve objectives 2 to 5. It is a practical methodology for studying entrepreneurship at the regional level and constitutes alternative methods, such as the Classical Test Theory [47,48]. Through this methodology, a global and integrated model is generated to which the initially observed data are adjusted to study entrepreneurship in a global framework of variables and countries. Therefore, this study evaluates the limitations and criticisms of the GEM model by other authors.

2. Literature Review

Most of the studies on entrepreneurship in a country context have focused on the personal variables on which this process depends, with studies of contextual variables or those that include both types of variables being proportionally fewer [49–51].

2.1. Personal Variables of Entrepreneurship

The study of entrepreneurial intention stands out in the literature, being the intention generally considered by authors as the dependent variable in their studies of predictive and causal models. Intention is the variable that best predicts the behavior of creating a new company [52–54]. Entrepreneurial intention is defined as the state of mind that directs and guides a person's attention, experience, actions, goal setting and entrepreneurial behavior [9,51,53].

Most existing models predict that entrepreneurial intention has been based on the Theory of Planned Behavior (TPB) of Ajzen [55], due to its high predictive power [9,53,56]. Within TPB, entrepreneurial intention depends on attitude, perceived behavioral control and subjective norm [57,58]. Attitude refers to a person's predisposition towards creating a company [59,60]. Entrepreneurial perceived behavioral control refers to the subjective evaluation of a person's entrepreneurial ability, resources, and possibilities [2,51,61]. Subjective norm involves the perceived acceptance or rejection of an idea from influential people (e.g., family and friends) to start an entrepreneurial process [27,62,63].

In addition, various authors have focused on other personal variables due to their direct or indirect influence on entrepreneurial intention. This has been due to the difficulty in understanding or predicting intention through a small number of variables, given the complexity of human behavior [9,53]. Firstly, regarding motivation, all the reasons that motivate an entrepreneur to create a company are classifiable as internal (e.g., desire for independence and autonomy) or external (e.g., desire to increase income or obtain social status) [64–67]. Personal values are the principles that guide human behavior and are also essential predictors for entrepreneurial intention [68,69]. Therefore, differences in values produce various entrepreneurial intentions and activities [70–72].

Personality is defined as the stable aspects of an individual (e.g., extraversion, emotional stability, sincerity) that influences their behavior [73–76]. Therefore, different types of entrepreneurs represent different personality sets [76,77]. Competencies also influence the entrepreneurial intention and achievement of an entrepreneur [78–81]. Entrepreneurial competencies (e.g., identifying opportunities) are defined as a multidimensional clusters made up of values, knowledge, attitudes, and skills necessary to successfully create a company [82–84]. Finally, the literature highlights the process of entrepreneurial role adoption by the subject that she or he observes in a family member, which largely explains the succession process [85–87].

2.2. Contextual Variables of Entrepreneurship

In addition to personal variables, entrepreneurship at the regional level also requires contextual factors, also called external or extrinsic variables [8,88]. Entrepreneurship takes place in a specific environment, and certain environmental factors are more favorable than others [20,89]. There is no consensus in the literature regarding the universally accepted contextual factors that influence entrepreneurship, although they are usually classified as formal institutional and informal institutional [90–92]. From a formal institutional perspective, the importance of government policies and programs, infrastructure and market development are highlighted [93–95]. The role of the educational system has also been highlighted because it allows for the development of an entrepreneurial vocation, values related to self-employment, entrepreneurial competencies and entrepreneurial intention [96–98].

The informal institutional context of entrepreneurship is particularly represented by culture, which develops over time through the adoption and internalization of norms, beliefs, practices and customs [99,100]. Cultural diversity can help explain regional differences in entrepreneurship because the decision to create a company is shaped by the cultural context in which it takes place [21,101,102]. It has been found, for example, that individualistic cultures favor entrepreneurship more than collectivist cultures, since in the former, people put their own interests before group interests [103,104].

2.3. The Personal and Contextual Variables of Entrepreneurship Proposed by the Global Entrepreneurship Monitor

According to GEM, the decision to create a company depends on the entrepreneur's perceptions and intentions within a favourable context [3]. Therefore, according to GEM, entrepreneurship depends on the interaction between contextual and personal variables [30,40].

The set of personal variables proposed by GEM are called "Entrepreneurial behavior and attitudes indicators". Information on these variables is obtained through the Adult Population Survey (APS), a unique and comprehensive questionnaire administered to a minimum of 2000 adults in each GEM country [3]. All of the personal variables included in GEM reports refer to mean percentages of the 18–64 population and are based on the perceptions and statements of the population.

Among the personal variables proposed by GEM, "Entrepreneurial Intention" stands out. It is defined as the percentage of the population who intend to start a business within three years [3]. In addition, "Perceived Capabilities" is a variable similar to what researchers term perceived behavioral control and self-efficacy. GEM defines this variable as the population who believes they have the required skills and knowledge to start a business [2,51]. The same happens with the variable "Ease of Starting a Business", closely linked to gender differences and defined as the percentage of the population who agree that it is easy to start a business in their country [105]. The variable "Innovative Capacity" is a kind of subjective norm and is defined as the percentage of the population who agree that other people think they are highly innovative [62,63,106]. The GEM model includes two personal variables related to values and motivation. First, "High Status to Successful Entrepreneurs" represents the percentage of the population who agree with the statement that, in their country, successful entrepreneurs receive high status. On the other hand, "Entrepreneurship as a Good Career Choice" is defined as the percentage of the population who agree with the statement that in their country, most people consider starting a business as a desirable career choice [3]. GEM also includes three personal variables related to competencies. The first is "Perceived Opportunities", which refers to the percentage of the population who see good opportunities to start a firm in the area where they live. The literature considers entrepreneurial competence to be essential [50,107]. The second variable related to competencies proposed by GEM is called "Vision". It is defined as the percentage of the population who agree that every decision they make is part of their long-term career plan. This variable integrates decision-making and planning, which are two essential entrepreneurial competencies [108,109]. The third variable related to competencies is termed "Fear of Failure", which refers the percentage of the population who indicate that fear of failure would prevent them from setting up a business. This variable is related to risk tolerance, self-regulation and resilience, whose influence on entrepreneurship has been verified [81,110,111]. Finally, GEM includes in its reports the variable "Knowing a Startup Entrepreneur". This refers to the percentage of the population who personally know someone who has started a business in the last two years. It is essential because, according to the Social Learning Theory [112], individuals learn specific entrepreneurial values and behaviors from other people (e.g., family), which act as models [85,113,114].

Regarding the contextual variables of entrepreneurship, GEM includes them in its reports under the name of "Entrepreneurial framework conditions" [115]. These variables can be considered an essential part of business creation and directly influence entrepreneurial opportunities, competencies and preferences. The source of information is the National Experts Survey, a part of the standard GEM methodology similar to other surveys that capture expert judgments to evaluate specific national conditions [3,40,115].

As in the literature, the contextual variables of GEM can be divided into formal institutional or informal institutional. Regarding the formal institutional framework, GEM includes three variables related to government actions. These variables are "Governmental Policies: Support and Relevance", "Government Policies: Taxes and Bureaucracy", and "Government Entrepreneurship Programs" [3]. The first variable refers to the importance and general support that the government provides for entrepreneurship through policy-

making. The second refers to the degree to which tax policies and bureaucracy can facilitate or slowdown entrepreneurship. The third variable refers to government programs that directly promote entrepreneurship at the national, regional or municipal level. These three variables are relevant for entrepreneurship since government support for entrepreneurship is considered a fundamental aspect in the literature, particularly in new small and medium-sized enterprises [116–118].

Additionally, in the formal institutional framework, GEM includes two contextual variables related to infrastructures for entrepreneurship. First, “Commercial and Legal Infrastructure” refers to the presence of property rights, commercial, accounting and other legal and assessment services and institutions that support or promote the entrepreneurial process. Second, “Physical Infrastructure” means the ease of access to physical resources (e.g., communication, transportation). In this way, GEM considers the importance of infrastructures in the literature [119,120]. Likewise, considering the relevance given to the market in the literature on entrepreneurship [121,122], GEM includes two variables related to these aspects. The first is called “Internal Market Dynamics”, and this is related to the level of fluctuation in markets from year to year. The second is “Internal Market Openness (Market Burdens or Entry Regulation)”, which is the extent to which new firms are free to enter existing markets. GEM also reflects the significance given to education in the literature on entrepreneurship. GEM considers education through two variables [123]. “Entrepreneurial Education at School Stage” means the extent to which entrepreneurship training is incorporated within the education system at primary and secondary levels. “Entrepreneurial Education at Post School Stage” refers to the extent to which entrepreneurship training is incorporated in higher education. It also includes two more contextual variables within the formal institutional context. The variable “Entrepreneurial Finance” refers to the availability of financial resources for small and medium enterprises, a fundamental variable for this type of companies in times of economic crisis and pandemic [124,125]. The second is “R&D Transfer”, a contextual variable that has also been considered in the literature on entrepreneurship [115,126]. This is defined as the extent to which national research and development will lead the entrepreneurship process.

According to the literature, GEM considers the informal institutional context mainly through the lens of culture and social norms [39,127]. In the GEM model, the informal institutional variable related to the context is called “Cultural and Social Norms”, which is the extent to which social and cultural norms encourage or enable actions leading to new business activities [3].

Considering the literature review and the GEM proposal, Table 1 includes a synthesis of entrepreneurship’s personal and contextual variables.

According to the authors’ proposals, GEM also considers the informal institutional context, mainly through culture and social norms on entrepreneurship [39,127]. In the GEM model, the informal institutional variable related to the informal institutional context is called “Cultural and Social Norms”, which is the extent to which social and cultural norms encourage or allow actions leading to new business activities [3].

Table 1. Personal and contextual variables of entrepreneurship. Comparison between the literature and the Global Entrepreneurship Monitor proposal.

Entrepreneurship Variables in the Literature	Entrepreneurship Variables in the Global Entrepreneurship
(a) Personal variables	(a) Entrepreneurial behaviour and attitudes indicators
Intention	Entrepreneurial Intentions
Attitude	-
Perceived behavioural control	Perceived Capabilities
Subjective norm	Ease of Starting a Business
Motivation	Innovative Capacity
Personal values	High Status to Successful Entrepreneurs
Personality	Entrepreneurship as a Good Career Choice
	-
Competencies	Perceived Opportunities
	Vision
Family role adoption	Fear of Failure
(b) Contextual variables	Knowing a Startup Entrepreneur
	(b) Entrepreneurial framework conditions
Government policies and programs	Governmental Policies: Support and Relevance
	Government Policies: Taxes and Bureaucracy
	Government Entrepreneurship Programs
Infrastructures	Commercial and Legal Infrastructure
	Physical Infrastructure
Market development	Internal Market Dynamics
	Internal Market Openness
Education	Entrepreneurial Education at School Stage
-	Entrepreneurial Education at Post School Stage
Culture	Entrepreneurial Finance
	R&D Transfer
	Cultural and Social Norms

3. Research Methodology

3.1. Data Collection, Variables and Sample Profile

The data have been obtained from the Global Entrepreneurship Monitor (GEM) platform (www.gemconsortium.org) (accessed on 18 February 2021), similarly to other authors [41,127]. Specifically, the information included in the 2019/2020 Global Report and the databases available in Excel for 2019 have been used, which is the latest data available on the GEM website when this study was carried out (www.gemconsortium.org, accessed on 15 March 2021). The latent variable (not observed) can be established as the “assessment and importance of personal and contextual variables of entrepreneurship at the country level”. The variables observed are the ten personal variables (entrepreneurial behavior and attitudes indicators) and the twelve contextual variables (entrepreneurship framework conditions) included in the 2019/2020 Global Report (Table 1). The data on personal variables refer to average percentages by country, and in the case of the contextual variables, they refer to scale data. The percentage data were converted to scalars to homogenize the measurements of both groups of variables and following the indications of Linacre [48].

Regarding countries, the fifty countries for which data are available for all variables ($N = 50$) have been included. In particular, and to achieve the fourth objective of this study, Italy has been selected. This country was chosen because it ranks 50/50 in the ranking of countries, considering the TEA (Total early-stage Entrepreneurial Activity) indicator. In addition, Italy occupies the last place in the ranking of countries if the valuations of all the variables are accounted for [3].

3.2. Data Analysis

The Rasch model (RM) [128] has been used to apply the Winsteps-4.8.0 program [129]. More specifically, the ordered categories model [130] has been used, which is ideal for the treatment of information from ordinal scales [47,131,132]. Due to the one-dimensional

principle of RM, the variables must be measuring a single latent dimension [133,134]. RM proposes that the observed data can be explained based on the ease of countries in valuing the entrepreneurship variables (β) highly, and the difficulty of the entrepreneurship variables to be highly valued by the countries (δ) [135–137]. The β and δ values refer to the logit scale and can vary from minus to plus infinity, usually being in the range from -5.00 to $+5.00$. Conventionally, point 0 corresponds to the mean of the variables [138,139]. The calculations of the logit measurements β and δ are carried out by the maximum likelihood method through the PROX and JMLE algorithms [135,140,141]. Figure 1 represents, on a linear continuum, the parameters β and δ . Due to the interval properties of the logit scale, the interpretation of the differences in the scale is the same in all the measured attributes [135,142]. Therefore, equal differences between a country and a variable correspond to identical probabilities of a correct answer [47,135,143].

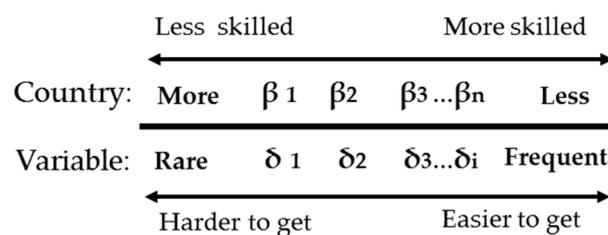


Figure 1. The Rasch methodology continuum of the latent variable.

In the RM context, the probability of a certain category of variable “*i*” by country “*n*” would be [47,135,144]:

$$P[X_{ni} = x] = \frac{1}{\gamma} e^{[x(\beta_n - \delta_i) - \sum_{k=1}^x \tau_{ki}]}$$

being:

n: Country

i: Variable

γ : Sum of all possible numerators that arise according to the number of categories of the variables

ki: category of variable “*I*” assumed by country “*n*”

τ : Thresholds of the categories. The number of thresholds is equal to the number of categories minus one.

The Rasch model has several advantages that have been highlighted in the literature. Firstly, RM has a more realistic character because through the RM methodology, an ideal model is designed in which the GEM data must fit [136,144,145]. Thus, if GEM data fit the model obtained, these data have the characteristics of the model. On the contrary, if GEM data do not fit the generated model, they do not acquire the characteristics of the model [47,134,146]. Secondly, it is unnecessary to assume that the data follow a normal distribution [47,134,135]. Thirdly, specific objectivity means that the difference between the two countries should not depend on variables, and the difference between two variables does not depend on the countries [135,147,148]. In addition, several authors have also highlighted RM’s robustness for small samples and the statistical quality of the analyses [48,149]. Finally, RM is an ideal model to develop comparative analyses (benchmarking) related to objectives 3 and 4 of this study, as the GEM model facilitates such work. Benchmarking is a method of comparative evaluation of countries whose primary purpose is to establish priorities and objectives [135,150,151]. Although its use in entrepreneurship is limited, the technique has attracted considerable attention in this field [152,153].

4. Results and Discussion

The results of this study are presented below according to the order of the objectives proposed. It is important to note that all the variables are jointly considered a single dimension within the Rasch model (particularly in objectives 2 to 5), and therefore both groups of variables are not analyzed separately. The separate study of both groups of variables would assume that there are two dimensions, not one, something which the data do not confirm.

4.1. Theoretical Foundation of the Personal and Contextual Variables of the Global Entrepreneurship Monitor (Objective 1)

This first objective tries to contrast the theoretical foundation of the variables included in the GEM model, as some authors have suggested [42–44]. First it should be noted that GEM does not provide a rigorous theoretical foundation for its personal and contextual variables in its global reports. However, as deduced from the comparison between the literature review carried out in this study and the GEM reports, it can be noted that there is a notable parallel between authors' studies and the GEM proposal, which is synthesized in Table 1. It is true that, in addition to parallelism, there are also discrepancies, which are related to the names of the both personal and contextual variables, their content and their measurement. For example, the personal variables proposed by GEM are measured as percentages, while in the literature, scales are preferred. Additionally, GEM does not include the variables "attitude" or "personality" in its reports, two variables that are widely referenced in the literature. Regarding contextual variables, GEM devotes as much or more attention to them than in the literature since studies in the literature carried out with contextual variables are scarce, focus on one or two contextual variables, and do not usually address personal variables. Therefore, it can be affirmed that although there are some discrepancies, the personal and contextual variables included in the GEM model are, from a theoretical point of view, very similar to the proposals of other authors in the literature on this field of study.

4.2. Statistical Significance of the Global Entrepreneurship Monitor (Objective 2)

To achieve the second objective and determine the statistical significance of the GEM model, a series of analyses have been carried out, which are considered critical in the context of RM [48]. In doing so, we attend to the suggestions and concerns of some authors [42–44].

4.2.1. Analysis of the Existence of a Single Dimension

Within the RM, the presence of unidimensionality is a fundamental requirement [48,154,155]. If other dimensions exist, as many isolated analyses as existing dimensions should be carried out [149,156,157]. In the context of RM, the verification of unidimensionality is carried out by analyzing the principal components of the residuals (PICAR) of the variables. Other dimensions with which the variables could have a high correlation can be verified [135,158,159]. To analyze unidimensionality, Linacre proposes the following criteria [47,48]:

1. The percentage of unexplained variance in the first test must be less than the percentage of variance explained by the items;
2. The variance explained by the items must be four times higher than the unexplained variance in the first test;
3. The unexplained variance in the first test must be less than 3 (in values) and less than 5%;
4. The variance explained by the measures must be greater than 50%.

According to Table 2, only the third criterion is unfulfilled, and only moderately so. Therefore, the unidimensional character of the construct is admitted [47,48,135]. Since a single dimension that includes all personal and contextual variables has been confirmed, the study from here is carried out on the set of personal and contextual variables, not for each of the two groups.

Table 2. Dimensionality data.

Content	Eigenvalue	Observed
Total Raw Variance in Observations	40.23	100%
Raw Variance Explained by Measures	22.55	55.30%
Raw Variance Explained by Items	17.07	35.30%
Unexplained Variance in 1st Contrast	3.26	5.30%

4.2.2. Summary Statistics

First, the fit (validity) of the GEM data were analyzed [47,48,135]. The MNSQ and ZSTD indicators were observed using the INFIT and OUTFIT tests. MNSQ is the non-standardized mean square of the residuals generated by the difference between the observations and the model estimate. It is calculated using chi-square statistics, and the values must be within the interval (0.50, 1.50) ($p < 0.05$), with 1 being the expected mean value [132,135,154]. The ZSTD (standardized quadratic mean) refers to the normalized MNSQ values with mean 0 and variance 1 [149,158,159].

The OUTFIT indicator is sensitive to unexpected observations of variables whose difficulty is very different from the country’s capacity. The INFIT indicator is sensitive to unexpected observations of the variables whose difficulty is close to that of the country’s capacity [135,156,157]. Tables 3 and 4 show that the MNSQ statistics (INFIT and OUTFIT) reached a value of 1 or very close to 1, both for the variables and for the countries, which shows fit or validity. It is confirmed by the ZSTD statistic (INFIT and OUTFIT) since they are in the interval (−1.9, +1.9). Therefore, it can be affirmed that the observed data of the variables and countries of the GEM model conform to the model proposed by RM [135,158,159].

Table 3. Variables summary statistics.

	Total Score	Count	Measure	Model S.E.	INFIT		OUTFIT	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	115.6	50.0	0.00	0.25	1.00	−0.33	0.99	−0.37
Max	161.0	50.0	3.53	0.29	2.45	5.34	2.44	5.33
Min	61.0	50.0	−2.76	0.24	0.36	−4.36	0.35	−4.41
Real RMSE = 0.27		True SD = 1.29			Separation = 4.82		Country Reliability = 0.97	
Model RMSE = 0.25		True SD = 1.30			Separation = 5.27		Country Reliability = 0.99	
Variable Raw Score-To-Measure Correlation = −1.00								

Table 4. Countries summary statistics.

	Total Score	Count	Measure	Model S.E.	INFIT		OUTFIT	
					MNSQ	ZSTD	MNSQ	ZSTD
Mean	50.9	22.0	1.24	0.37	0.99	−0.13	1.00	−0.14
Max	69.0	22.0	3.77	0.39	2.11	2.98	2.05	2.83
Min	39.0	22.0	−0.40	0.37	0.18	−4.20	0.18	−4.16
Real RMSE = 0.40		True SD = 0.78			Separation = 1.96		Variable Reliability = 0.81	
Model RMSE = 0.37		True SD = 0.80			Separation = 2.16		Variable Reliability = 0.83	
Country Raw Score-To-Measure Correlation = 1.00								
Cronbach’s Alpha (KR-20) Country Raw Score “Test” Reliability = 0.82 SEM = 2.76								

Next, to determine the reliability or replicability of the GEM model, the indicators “Person reliability” and “Country reliability” were analyzed. These indicators were calculated from the true standard deviation (TRUE SD) and the square root of the mean of the errors (RMSE) [47,48,135]. As the values were greater than 90%, both in the case of the countries and the variables, it can be said that the model is accurate. Finally, the value of

the alpha coefficient was higher than 70% ($\alpha = 0.82$), and the correlations between the data of the GEM report and the logit measures were adequate (-1.00 in the case of the variables and $+1.00$ in the case of the countries) [149,158,159]. Therefore, it can be stated that the GEM model conforms to the generated RM and is very reliable.

4.2.3. Rating Scale (Summary of Category Structure)

RM converts GEM data from variables into categories. Linacre [48] proposes the following guide to analyze that structure. First, the variables must correlate to at least 30% with the latent variable. Table 5 shows that all the correlations between variables are greater than 0.30 (Corr. > 30%). It is noteworthy in Table 5 that the variables are ranked in increasing order: variable PEI is the one that has obtained the lowest valuation for the group of countries ($RMTS_{PEI} = 61$; $RMM_{PEI} = 3.53$ logits), while variable CPI is the one with the highest valuation and has been obtained for the group of countries ($RMTS_{CPI} = 161$; $RMM_{CPI} = -2.76$ logits). It can be seen that the RM classifies all the variables, taking into account that they form a single dimension. RM does not classify personal variables on the one hand and contextual variables on the other. The case of two dimensions would be the object of another study. However, the result (Table 5) shows that a personal variable (PEI: Entrepreneurial Intentions) has been the one that has obtained the lowest valuation and a contextual variable (CPI: Physical Infrastructure) has obtained the most valuation.

Second, it was found that three categories include at least ten observations (Freq. ≥ 10) (Table 6) [48]. Additionally, the percentages of the observations (Freq. %) reflect a regular distribution of the categories and a monotonous change in the measurements. Fourth, the values of the MNSQ-OUTFIT indicator are less than 2, thus disregarding the existence of “noise”, that is, the absence of more misinformation than information. Fifth, the scarce presence of irregularities in the passage from one category to another was found when the “Andrich Threshold” parameter was examined.

Finally, as the categories imply the measures ($C \rightarrow M$) and the measures imply the categories ($M \rightarrow C$), a coherent distribution of the categories was verified. The parameter “ $M \rightarrow C$ ” revealed that the percentage of measurements expected to produce observations in a category was adequate. The parameter “ $C \rightarrow M$ ” expressed the percentage of observations corresponding to a category produced by the measures corresponding to that category was also adequate. As both parameters were greater than 40% in categories 2 and 3, the consistency between the scale and the sample was verified. Finally, it was found that the advancement step from one category to another is between 1 and 5 logits (Moral, Rebollo, Valiente and López, 2019; Cho, Jang, Kwak and Kim, 2020; Choi, Ham, Han and Ryu, 2020). Therefore, as can be seen in Table 6 and according to the above, it can be stated that the category structure is adequate.

Therefore, contrary to what some authors suggest about the low statistical significance of the GEM model data [42–44], the results demonstrate the opposite. GEM data regarding all personal and contextual variables are valid, reliable, and constitutes a single dimension.

Table 5. Variables analysis results.

Number	Variables	RM Total Score	RM Measure (Logits)	RM Correl. with LV	Importance
1	PEI: Entrepreneurial Intentions	61	3.53	0.38	Low
2	PFF: Fear of Failure	83	1.94	0.41	
3	CES: Entrepren. Educ. at School	89	1.57	0.60	
4	PES: Ease of Starting a Business	100	0.90	0.51	
5	CTB: GP Taxes and Bureaucracy	105	0.61	0.61	
6	CRD: R&D Transfer	107	0.49	0.50	
7	PKS: Knowing a Startup Entrepreneur	110	0.31	0.47	
8	PPO: Perceived Opportunities	111	0.25	0.69	
9	CSR: GP Support and Relevance	111	0.25	0.50	
10	CMO: Internal Market Openness	111	0.25	0.56	
11	PIC: Innovative Capacity	112	0.20	0.37	Medium
12	CGP: Government Entrepr. Programs	117	−0.10	0.46	
13	CEF: Entrepreneurial Finance	119	−0.21	0.47	
14	CPE: Entrepren. Educ. at Post School	119	−0.21	0.56	
15	PPC: Perceived Capabilities	122	−0.39	0.45	
16	CLI: Commercial and Legal Infrastruc.	125	−0.56	0.42	
17	CSN: Cultural and Social Norms	125	−0.56	0.56	
18	PVI: Vision	129	−0.79	0.35	
19	CMD: Internal Market Dynamics	130	−0.85	0.37	High
20	PCC: Entrep. as a Good Career Choice	139	−1.38	0.59	
21	PHS: High Status to Successful Entrep.	157	−2.50	0.52	
22	CPI: Physical Infrastructure	161	−2.76	0.36	Very high
	Mean	115.6	0.00	-	

Table 6. Category structure.

Categ.	Freq. (Count.)	Freq. (%)	Obsvd. Average	OUTFIT MNSQ	Andrich Threshold	Category Measure	Coherence	
							M → C	C → M
1	149	14	−2.57	1.05	NONE	−4.06	74%	33%
2	514	47	−1.01	0.88	−2.92	−1.49	62%	81%
3	379	34	0.40	0.97	−0.04	1.47	65%	59%
4	58	5	1.70	1.16	2.96	4.10	69%	16%

4.3. The Global Entrepreneurship Monitor's Potential to Analyze Entrepreneurship Globally and in the Overall Context (Objective 3)

The third objective is based on the concerns of some authors to analyze the potential of the GEM model to deepen the relationship between entrepreneurship's personal and contextual variables within a country study [33,34]. To achieve the third objective, a Wright map and the Guttman scalogram have been used [47,135,144]. As seen in Figure 2, Wright's map integrates all the countries on the left and all the variables on the right. The countries and variables, in this case, present a distribution very close to the normal distribution, although this is not a requirement in the RM. Concerning the 22 entrepreneurship variables proposed by GEM (right side of the Map), it is observed that the personal variable PEI ("Entrepreneurial Intentions") has been the least valued variable by all countries, while the personal variable PHS (High status for successful entrepreneurship") and the contextual variable CPI ("Physical infrastructure") have been the most valued by the sample of countries. This result can be seen with more precision in Table 5. Regarding the 50 countries (left side of the Map), India and Qatar are the countries that have valued the set of variables the most, while Puerto Rico and Italy are the countries that have valued the set of personal and contextual variables the least.

The Guttman scalogram (Table 7) includes information on the categories, not on the logits, with greater precision than the Wright map. By practice motives, Table 7 only offers the information for the first and last five countries in the ranking. The columns represent the GEM variables, which are ordered from left to right, from highest to lowest score received by the group of countries, with the number assigned to them in the left column in Table 5. As can be seen, Variable 22 (CPI: Physical Infrastructure) is the one that has obtained the highest valuation by the group of countries, while variable 1 (PEI: business intentions) is the one that has obtained the lowest valuation. The countries are presented in Table 7 from highest to lowest rating, with India being the country that has obtained the highest rating concerning the set of variables, and Italy the lowest, as can be seen in the Wright map (Figure 2). Therefore, Table 7 shows the relative position of a country and the valuations of the variables in a global and overall framework with greater precision. For example, in Italy's case, the country has valued variables 18 (PVI: Vision) and 11 (PIC: Innovative Capacity) to a greater extent than the four countries that precede it in the ranking, although overall it occupies the last position. At the other end of the ranking, India has obtained a valuation of variable 22 (CPI: Physical Infrastructure) lower than the valuation obtained by the four countries that follow it in the ranking, but the country occupies first place in the ranking concerning set of variables and countries. Concerning the third objective of this study, it can be affirmed that the GEM model, through the Rasch model, enables a global study of entrepreneurship about the variables and countries included in its reports and newspapers. Together with other complementary data, this information makes it possible to identify variables and groups of variables for further investigation in greater depth or influence the promotion of entrepreneurship in a given country. It can be seen that both in the Wright map and in the Guttman scalogram, the personal and contextual variables occupy places with high and low scores.

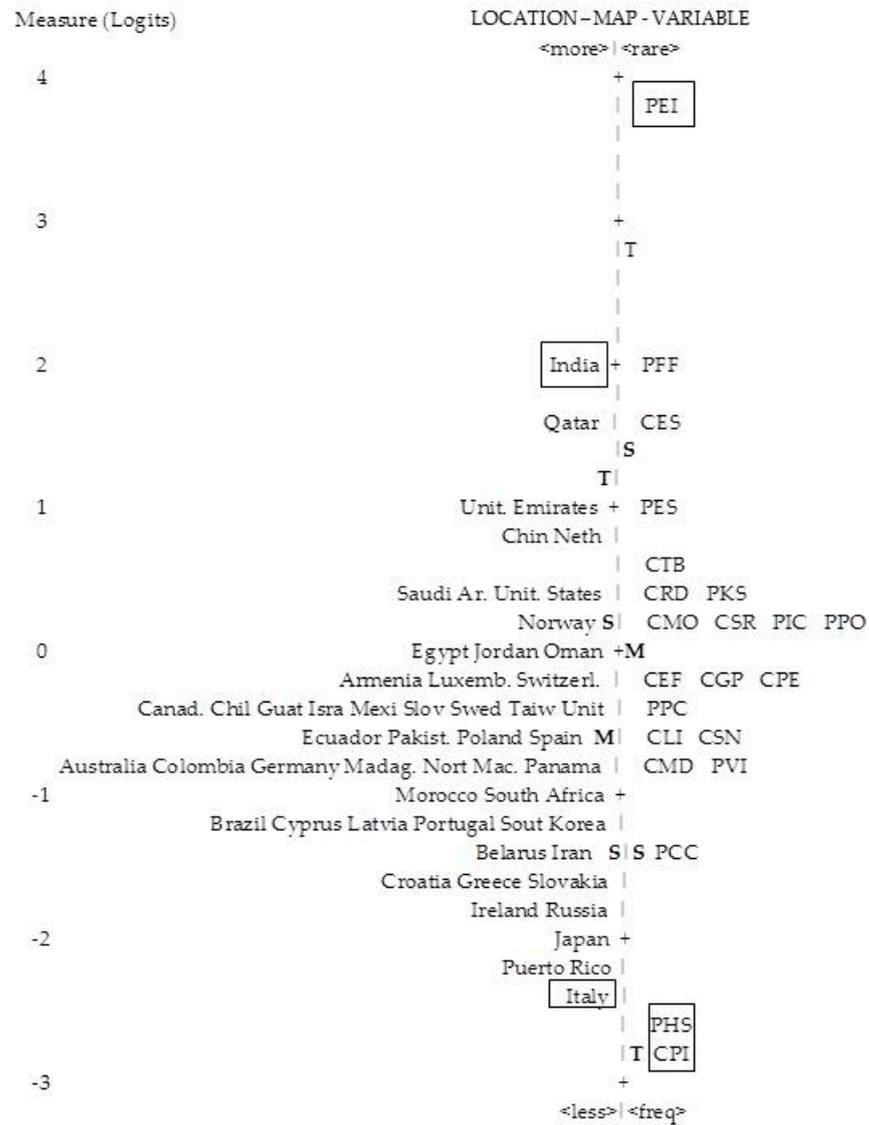


Figure 2. The Wright map.

Table 7. Guttman scalogram.

Country/Variable	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
1 India	3	4	4	3	3	3	3	4	3	3	3	3	4	3	3	3	3	3	4	3	3	1
2 Qatar	4	4	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	2
3 U.A. Emirates	4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	2	3	3	3	2	1	
4 China	4	3	4	3	2	3	3	2	3	3	3	2	3	3	3	2	3	3	4	3	1	1
5 Netherlands	4	4	3	3	3	3	3	3	3	3	3	2	3	3	3	3	3	3	1	2	2	1
...
...
46 Ireland	3	3	3	3	1	2	2	1	2	2	2	1	1	2	2	2	2	2	1	2	2	1
47 Russia	3	1	1	3	1	2	2	1	2	2	2	1	1	2	2	2	2	2	1	2	2	1
48 Japan	4	3	1	3	1	2	2	1	3	2	2	1	1	3	2	1	2	2	1	1	2	1
49 Puerto Rico	3	1	1	2	1	2	2	2	2	2	2	1	2	2	2	2	2	2	3	2	1	1
50 Italy	2	2	1	3	3	2	2	2	2	2	2	3	1	1	2	2	2	1	1	1	1	1

4.4. Comparative Study of the Variables of the Entrepreneurship of the Global Entrepreneurship Monitor in the Context of the Rasch Model. The Case of Italy (Objective 4)

The fourth objective of this study is related to the potential of the GEM model to analyze entrepreneurship in a particular country in an integrated context of countries and variables [41,46]. First, an analysis using PKMAPs (Figure 3) identifies those variables of GEM entrepreneurship that constitute strengths and weaknesses of a country, in this case, Italy. PKMAPs are graphical representations of the individual diagnostic report of the results in countries and variables’ global and general context. The PKMAPs constitute a very useful source of information on the relationship between the country and the GEM variables [47,135,144]. The PKMAP graphs show the scores achieved and unachieved by a country according to the model generated by RM (not in the original data), whether they were expected or unexpected, and concerning the personal and contextual variables of the GEM entrepreneurship. Figure 3 shows that Italy obtained higher scores than expected by the model in the ten variables included in the upper left quadrant (“Hard levels reached”). They constitute strengths for Italy in entrepreneurship, most of which referred to contextual variables. However, most of these variables have obtained the lowest valuation by the group of countries, as shown in Table 5. On the contrary, it was expected that Italy would obtain, according to the model generated, a higher score than that obtained in the variables PIC, PVI, PCC and PHS, which are included in the lower right quadrant of Figure 3 (“Easy levels not reached”). Therefore, these variables are all personal and constitute the weaknesses of Italy’s entrepreneurship, according to the generated model. Except for the PIC variable, the rest have been highly valued by the group of countries (lower part of Table 5). This information is complemented by the Wright map (Figure 2) and the Guttman scalogram (Table 7). Therefore, the results confirm that the GEM model of entrepreneurship variables are valid for studying entrepreneurship in a specific country, in a global and integrated framework of variables and countries.

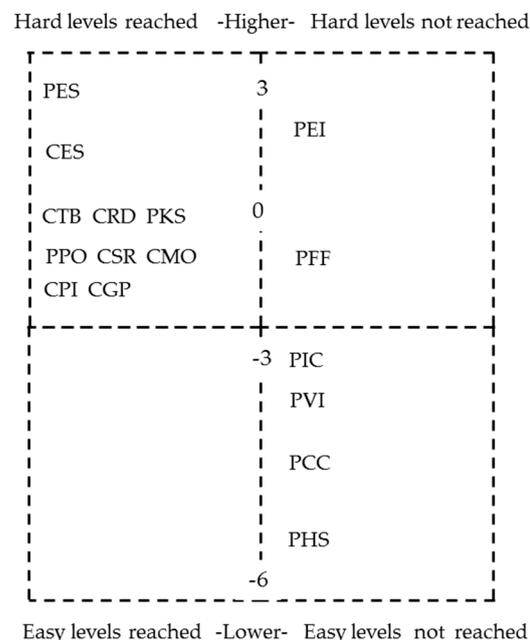


Figure 3. Italy PKMAP.

4.5. Differential Analysis of the Variables Based on the TEA Indicator (Objective 5)

In addition to the personal and contextual variables of entrepreneurship at the country level, GEM includes, for each country, some indicators of the results of the entrepreneurship process. Considering that GEM studies are descriptive, not predictive, the various indicators do not constitute dependent variables for GEM. However, GEM highlights that entrepreneurship at the country level depends on both personal and contextual vari-

ables. The most relevant result indicator proposed by GEM is the “Total early-stage Entrepreneurial Activity” (TEA). This subjective indicator of entrepreneurial behavior is defined as the percentage of the 18–64 population who are either a nascent entrepreneur or an owner-manager of a new business. The TEA indicator is an excellent criterion to identify whether countries with high and low TEA levels differently value the personal and contextual variables in creating a new company.

To determine if there are significant differences between countries with high and low levels of TEA, the RM proposes a DIF analysis. A DIF (differential functioning of a variable) exists when a variable has different levels of difficulty for two groups of countries [47,135,144]. The role of variables in entrepreneurial behavior, measured through the TEA, could be discussed if there were no significant differences in the evaluations of both groups of countries. Therefore, to analyze the existence of DIF, the sample of countries has been divided into two groups: group 1 with a TEA less than 10.69 points and group 2 with a TEA equal to or greater than 10.69 points. The TEA = 10.69 value is the one that leaves 50% of countries with a TEA lower than it and 50% of countries with a TEA higher than this value. The criteria proposed by Linacre [48] have been considered in order to perform the DIF analysis. First, to identify the presence of a DIF, the contrast of the difference (Dif contrast) between both groups of countries must be at least $+/- 0.50$ logits, and the statistical significance less than 0.05 ($p \leq 0.05$). The results show that, according to the data in Table 8, in the countries with the highest TEA, the variables PIC (Innovative Capacity), PVI (Vision) and PPC (Perceived Capabilities) tend to be valued higher. To the contrary, in countries with a lower TEA, the variables CLI (Commercial and Legal Infrastructures), CMD (Internal Market Dynamics), CMO (Internal Market Openness) and CEF (Entrepreneurial Finance) tend to be valued more. The results show that countries with high and low levels of TEA differ in the valuations of certain variables, both personal and contextual. In particular, it is noteworthy that countries with a higher level of TEA value certain personal variables higher, while countries with a lower TEA value certain contextual variables higher.

Table 8. DIF Contrast.

Variable	Dif Measure Group 1	Dif Measure Group 2	Dif Contrast	Prob.
PIC	1.14	−0.66	1.80	0.002
PVI	0.01	−1.58	1.59	0.024
PPC	0.50	−1.35	1.85	0.053
CEF	−0.60	0.13	−0.73	0.031
CLI	−0.97	−0.21	−0.76	0.038
CMD	−1.47	−0.32	−1.15	0.013
CMO	−0.11	0.60	−0.71	0.020

5. Implications

This study has highlighted the importance of entrepreneurship at the regional (country) level and the need for its study and joint analysis of personal and contextual variables on which this process depends [2,12,13]. In this context and considering the concerns and suggestions of other authors, this study analyzes the variables included in the Global Entrepreneurship Monitor (GEM). Concerns regarding GEM have been related to theoretical, methodological and practical aspects. First, this work studies the theoretical foundation of the personal and contextual variables of GEM entrepreneurship and their measurement and relationship (objective 1). Second, the statistical significance of all variables of the GEM model is analyzed, particularly its validity, reliability, and one-dimensional nature (objective 2). Third, the GEM model’s potential is studied to analyze the entrepreneurship process globally and in an overall context (objective 3). Fourth, the GEM model is used to evaluate the entrepreneurship variables of Italy in a comparative and overall context and through the process of benchmarking (objective 4). Fifth, whether there is any differ-

ence between countries with a high TEA and low TEA concerning the entrepreneurship variables (objective 5) has been studied. The results have led to the following theoretical, methodological and practical implications.

5.1. Theoretical Implications (Objective 1)

The suggestions of various authors to test the theoretical foundation of the entrepreneurship personal and contextual variables proposed by GEM have been addressed in this study [42–44]. The literature review carried out in this study allows us to affirm that there is an evident similarity at an overall level between the personal and contextual variables of GEM and those contained in the literature. Therefore, the GEM classification of personal and contextual variables regarding their number, denomination, content, and measurement is closely related to other authors' work in this field. However, at a higher level of detail, it is observed that some personal variables considered relevant by the literature are not considered by GEM (e.g., Attitude, Personality). Similarly, it should be noted that GEM includes, among its contextual variables, others that have been scarcely referenced in the literature (e.g., Entrepreneurial finance, R&D Transfer). It is also worth mentioning that GEM measures personal variables as the percentage of the population that agrees or disagrees with the statement of a specific item, while scales are used in the literature. On the contrary, the measurement of contextual variables using a scale is similar to that carried out by other authors. Additionally, GEM uses a descriptive methodology and does not causally relate the variables. In the literature, it is common to find causal studies that use the Structural Equation Methodology (SEM) to predict entrepreneurial intention. On the other hand, it is essential to highlight that GEM studies personal and contextual variables both jointly and at the country level, which is rare in the works of other authors. All of this implies that the GEM reports are helpful in complementing the theoretical aspects that authors develop on entrepreneurship variables when carrying out their studies in this field. Moreover, conversely, GEM can take these studies into account to update and enrich its theoretical model of personal and contextual variables.

5.2. Methodological Implications (Objective 2)

This study has also responded to certain methodological limitations and questions that are still unanswered in the literature, particularly those related to the reliability and validity of the GEM model [44,45]. Using the Rasch model, it has been shown that the data on entrepreneurship variables provided by GEM are statistically valid, reliable and form a single dimension. Additionally, a model has been generated in which the GEM data fit significantly well. Therefore, GEM data are valid and reliable for use in reports and rigorous scientific studies on entrepreneurship at a country level [37,39]. However, it must be noted that the measures of the personal variables refer to percentages while those of the contextual variables refer to scales, which could constitute a limitation [45]. However, this constitutes a solvable short-term limitation for any researcher. Finally, the RM considers that the personal and contextual variables form a single dimension, which has its advantages but limits the study of both groups of variables separately.

5.3. Practical Implications (Objectives 3, 4 and 5)

First, researchers' suggestions to deepen the practical study of the personal and contextual variables that influence entrepreneurship have been followed in a comparative country, global and joint study [33,34]. The results show that using the Rasch model, the GEM data reflect entrepreneurial reality relative to the variables of each country in the joint framework of countries and variables. These results allow researchers and professionals to have a global and periodic map of variables and countries and a ranking to know and manage the variables of entrepreneurship.

Second, a response has been provided regarding the concern of some authors who have pointed out the limitations of the GEM model to study, through benchmarking, the entrepreneurship of a particular country in an integrated context of countries and

variables [41,46]. Using the case of Italy, it has been possible to demonstrate that, through the Rasch model, the variables for which a country is better or worse positioned in the ranking can be identified and managed. More specifically, the GEM model can identify and manage the personal and contextual variables that constitute strengths or weaknesses for entrepreneurship in each country.

Lastly, the literature has suggested the need to check whether specific outcome indicators, such as the TEA, make it possible to identify the variables with a high and low level in different countries [9]. Through the Rasch model, it has been found that countries with a higher level of TEA tend to value certain personal variables more than those countries with a lower TEA. By contrast, the countries with the lowest TEA tend to value certain contextual variables to a greater extent than the group of countries with the highest TEA. Therefore, it is possible that, in a given country, the management of both variables will increase its TEA indicator and improve entrepreneurship.

6. Conclusions

In the development of this study, the need expressed by numerous authors to deepen the study of personal and contextual variables of GEM that influence entrepreneurship in a country context has been taken into account. Regarding these aspects, some questions posed in the literature have been answered. The study's methodological, theoretical and practical implications have been commented on in the previous section, and the following conclusions can be drawn.

First, it is concluded the studies and reports on country entrepreneurship that are carried out, either by researchers or by institutions, must take into account the theoretical foundations existing in this field. In this way, results can be compared, the theoretical framework enriched, and decisions to promote entrepreneurship adopted with greater scientific rigor. All this means that the studies and reports that are developed on entrepreneurship must have valid theoretical content, while incorporating some contributions and considerations that are their own. This must be taken into account for both personal and contextual variables since entrepreneurship depends on both groups of variables. In fact, according to the GEM, contextual variables determine personal variables. This notion makes it possible to compare studies and advance in constructing knowledge about the personal and contextual variables of entrepreneurship at the regional level.

Second, it is concluded that the data on the personal and contextual variables of entrepreneurship at the country level that are used in the studies must have, in addition to a theoretical foundation, validity and reliability, as is the case of GEM. It is a fundamental methodological requirement to be able to develop rigorous and quality scientific studies on entrepreneurship. The GEM data have sufficient validity and reliability to be used in other quality scientific studies and to be able to make better decisions.

Third, it is essential to analyze the personal and contextual variables that influence entrepreneurship in a comparative global and overall context concerning countries and variables. It makes it possible to create a joint map of personal and contextual variables of entrepreneurship and observe the peculiarities of any country in an integrated framework. The GEM global reports allow such a country and global study of the variables while representing the relative entrepreneurial reality of each country within the set of countries and variables.

Fourth, it can be affirmed that the data regarding the personal and contextual variables of entrepreneurship relative to a country may be more relevant if they consider a set of variables and countries rather than if they are analyzed in absolute terms and isolation. In this sense, GEM studies allow benchmarking, that is, to study the personal and contextual variables of entrepreneurship in a specific country, for example, Italy, and thus be able to manage its strengths and weaknesses.

Finally, any study or report on the variables that influence entrepreneurship should be helpful in predicting entrepreneurship, or at least determining which variables characterize the countries with the highest and lowest rates of entrepreneurship. The GEM reports

make it possible to identify how variables with a high TEA differ from those with a lower TEA. This is essential for two reasons. First, the TEA, unlike entrepreneurial intention, is a variable that reflects actual entrepreneurial behavior, not future behavior. Studies based on this behavior are very scarce, and most existing ones aim to predict the entrepreneurial intention. Second, although causality between GEM and TEA variables has not been verified, such information suggests the need to promote those variables that distinguish countries with a higher TEA.

Despite the implications and conclusions of this study, this work is not without its limitations. First, GEM only offers information on the variables for a limited number of countries ($N = 50$). Second, the global GEM reports do not establish the causal relationship between entrepreneurship variables and entrepreneurial behavior (e.g., TEA, intention). Although the Rasch model constitutes a methodology with a high potential, it is descriptive and not causal. Third, although the study of the set of personal and contextual variables through the Rasch model is significant at a statistical, theoretical and practical level, the method used does not allow a separate study of both groups of variables; it should only be analyzed through the Rasch model if each group of variables has a one-dimensional nature. If so, the analyzes applied in this study should be carried out separately, considering each group of variables as a single dimension. This could be a potential line of future research. Another research line could be related to predicting the entrepreneurial behavior using other tools, such as regression analysis or the PLS methodology of structural equations. In addition, since the GEM offers aggregated data, such as those used in this study, it would be interesting to analyze the influence of certain key variables on the intention to undertake. It would be the case, for example, for the item NBMEDIA included in the GEM survey related to attitudes: “In your country, you will often see stories in the public media about successful new businesses”.

Author Contributions: Conceptualization, J.A.M.-G., D.G.-T. and U.K.; methodology, J.A.M.-G. and U.K.; software, J.A.M.-G. and D.G.-T.; validation, J.A.M.-G., D.G.-T. and U.K.; formal analysis, J.A.M.-G., D.G.-T. and U.K.; investigation, J.A.M.-G., D.G.-T. and U.K.; data curation, J.A.M.-G., D.G.-T. and U.K.; writing—original, U.K.; writing—review and editing, J.A.M.-G., D.G.-T. and U.K.; supervision, J.A.M.-G., D.G.-T. and U.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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