Older entrepreneurs-by-necessity using fuzzy set methods: differences between developed and developing countries

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Older entrepreneurs-by-necessity using fuzzy set methods: differences between developed and developing countries*

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Abstract
In this paper, we empirically analyze the individual characteristics that drive older workers to become entrepreneurs, more by necessity than desire, providing evidence of the differences between developed and developing countries. While OLS models do not provide any meaningful conclusions, Qualitative Comparative Analysis and fuzzy set logic, at the country level, using GEM 2014 Global Individual micro-data, show the importance of the various combinations of high and/or low values of skills, opportunities, entrepreneurial perceptions, peer effects, and satisfaction with life and income. This indicates how entrepreneurship may be a potential source of income for older workers, in a range of contexts. Further, we find that all the possible combinations of higher values of the latter features are necessity conditions.

Keywords: Entrepreneurship, Older individuals, Fuzzy Set Qualitative Comparative Analysis, GEM data.

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1. Introduction

Entrepreneurship is an activity that is traditionally associated with economic growth and development, and public policies and institutions have consequently devoted efforts to promote such activity (Minniti, 2008; Shane, 2009). Furthermore, the recent economic crisis has increased the role of entrepreneurship as a driver of development and economic recovery. It is well stablished in the literature that institutions and the environment play a major role in determining entrepreneurship (i.e., the institutional theory, North, 1990). However, entrepreneurship by necessity has not been found to benefit from the actions of institutions (Fuentelsaz et al., 2015). In this context, individual attributes may play an important role in determining what forces workers to become entrepreneurs by necessity.[1] For instance, although some authors have found that entrepreneurship is generally associated with younger individuals (Schott and Bagger, 2004; Kelley, 2009; Wennekers et al., 2010), third-age entrepreneurship cannot be considered as a marginal activity (Kautonen, 2008; Kautonen et al., 2011).[2] Further, Kautonen (2008) reveals that the entrepreneurial activity of the elder population is an under-researched area and needs to be studied more deeply. Thus, the present paper bridges this gap, addressing the question of what are the individual characteristics that determine entrepreneurial behavior, by necessity, of older individuals, providing empirical evidence for both developed and developing countries.

We use the Global Entrepreneurship Monitor (GEM) 2014 Global Individual database, "the world's foremost study of entrepreneurship" (http://www.gemconsortium.org), and GEM experts provide to the scientific community high quality data and reports in order to analyze, promote, and understand global entrepreneurial activity (see Singer, Amoros and Moska, 2015, for a recent report on GEM analyses). Regarding the methodology, because classical quantitative regression analyses may offer a limited range of results, and causal effects cannot be derived from them, we develop a fuzzy set Qualitative Comparative Analysis (fsQCA). FsQCA is a qualitative technique designed to find causal relationships, which offers a different

[1] Several concepts of entrepreneurship have appeared in the literature, but - especially in the last decade - a classification from the perspective of different motivations for becoming an entrepreneur has generated much interest. This classification is consolidated in the work of Reynolds et al. (2003), who distinguish between opportunity-driven and necessity-driven entrepreneurs (that is, between those who take advantage of a business opportunity, and those who have no other alternative for work).

[2] In this line, Block and Koellinger (2009) find that youth is associated with entrepreneurial satisfaction and, consequently, age is positively related to necessity in Germany.

perspective from regression analyses (Woodside, Ko and Huan, 2012; Ragin and Stand, 2014). These techniques complement classical analyses and help to find different results that, otherwise, could not be captured. From the point of view of inference and economic policy, fsQCA represents a major advantage, since it allows us to analyze causality, which cannot be determined using cross-sectional quantitative models. Fuzzy set logic is an underused tool in economic and business issues, although it has recently gained in importance (see Roig-Tierno, Kun-Huang and Ribeiro-Soriano, 2016). In spite of that, few analyses have used this technique to study entrepreneurship (e.g., Beynon, Jones and Pickernell, 2016; and Kuckertz, Berger and Mpeqa, 2016). To the best of the authors' knowledge, only Coduras et al. (2015) and Velilla and Ortega (2017) have applied this to GEM data, and none have studied necessity entrepreneurship.

We analyze the differences between developed and developing countries, in terms of entrepreneurial behavior by necessity of third-age workers, using the following variables of the GEM data: skills to be an entrepreneur, opportunities to become an entrepreneur, peer effects, entrepreneurial perception, income satisfaction, and life satisfaction, all aggregated at the country level. We find that, while regression analyses do not yield significant results, fsQCA offers a range of causal determinants of high levels of entrepreneurship by necessity among older individuals, for both developed and developing countries. In particular, the developed countries are characterized by the role of high levels of skill, fewer opportunities, and different combinations of high and low satisfaction. On the other hand, in the developing countries, more complex patterns emerge, indicating the importance and complexity of entrepreneurship due to necessity. Furthermore, we find that, in both developed and developing countries, high levels of all the possible combinations of the selected features are necessarily derived from high levels of entrepreneurship by necessity.

Thus, our contribution is threefold. First, we analyze entrepreneurship by necessity among the third-age population, using qualitative techniques that are underused in the literature. Second, our results contribute by identifying certain aspects of the entrepreneurial behavior of older workers that may have gone unnoticed in classical cross-sectional models. This is important because it facilitates an understanding of the complex phenomenon that is entrepreneurship (Coduras et al, 2015). Finally, fsQCA results deal with causal relationships, which is especially important in developing efficient and effective policies (Naudé, 2016).

The rest of the paper is organized as follows: Section 2 describes the data and the fuzzy set transformation, Section 3 sets out our empirical strategy and results, and Section 4 contains our main conclusions.

2. Data and variables

2.1. Data

We use the GEM Global Individual data for the year 2014 to analyze the relationship between entrepreneurship by necessity among older individuals, and a series of individual attributes related to individual entrepreneurial behavior. The database is produced annually by GEM and contains information on nine groups of variables of national, socio-economic characteristics related to the encouragement of entrepreneurship. This data is based on surveys filled out by respondents from a range of countries, using stylized questions. (More information can be found in http://gemconsortium.org/wiki.) The advantage of using this source is that GEM is the leading global entity analyzing entrepreneurship, and the data is elaborated and processed by experts in the field. Further, GEM's definition of entrepreneurs, and entrepreneurs by necessity, avoids sample selection.

We transform the variables into dummies, and maintain the mean value of each, by country. That way, for each country, we define the mean value of the corresponding variables. We sample individuals over age 55, living in the following 28 developed countries: United States, Russia, Greece, the Netherlands, Belgium, France, Spain, Hungary, Switzerland, Sweden, Norway, Poland, Germany, Mexico, Chile, Japan, Korea, China, Canada, Portugal, Luxembourg, Ireland, Finland, Estonia, Slovenia, the Czech Republic, Slovakia, and Israel; ad in the following 28 developing countries: South Africa, Romania, Peru, Argentina, Brazil, Colombia, Malaysia, Indonesia, the Philippines, Singapore, Thailand, Vietnam, India, Iran, Lithuania, Latvia, Croatia, Bosnia and Herzegovina, Macedonia, Guatemala, Panama, Ecuador, Surinam, Uruguay, Puerto Rico, Trinidad and Tobago, Jamaica, and Taiwan.

The variable of interest is the fact of being an entrepreneur by necessity or, in our country-level aggregated context, the probability of being an entrepreneur by necessity, conditioned on being over age 55. It is important to note that the GEM data directly characterizes those individuals who are entrepreneurs by necessity (the GEM dummy

variable “tea09nec”, labeled as being “involved in necessity early-stage entrepreneurial activity”). For instance, the fsQCA methodology requires a selection of a relatively small number of features, due to the exponentially-increasing computational costs (given *n* features, fsQCA analyzes all the 2^n combinations). The independent variables selected for the analysis are the following, all representing individual-level attributes: 1) “Skills”, measuring the self-evaluation of individuals regarding their own entrepreneurial skills (Kotsova, 1997; Minniti, 2009; Levie and Autio, 2013; Brixiova et al., 2015; Kyrö, 2015). 2) “Opport”, measuring whether individuals consider that there are opportunities for them to start a business in the short terms. These variable aims to capture the combination of both necessity and opportunity motivations to begin an entrepreneurial activity (Reynolds et al., 2013). 3) “Peer”, measuring peer effects, i.e., whether knowing other entrepreneurs may determine the entrepreneurial behavior of workers (Holcomb et al., 2009; Gimenez-Nadal et al., 2016; Okumura and Usui, 2016). In the same line, the ‘learning by seeing’ has been found to determine the entrepreneurial behavior of individuals (Blumberg and Pfann, 2015; Viinikainen et al., 2016). 4) “Perception”, measuring individuals’ perceptions of the social valuation of entrepreneurship (Minniti, 2005; Terjesen and Szerb, 2008; Roskruge et al., 2016). 5) “Satinc”, and 6) “Satlife”, measuring individuals’ satisfaction with their income and their life, respectively. These two features are important in order to model entrepreneurial activity, since such activity can depend on the financial and, consequently, psychological status of individuals (Sobel, 2008; Dawson et al., 2015; Molina et al., 2016).

Table 1 shows summary statistics of the variables, for both developed and developing countries. We find that, on average, only 1.8% of the older individuals in the sample are necessity entrepreneurs, in the developed countries, vs. 3.8% in the developing countries. Further, 29.8% (51.8%) of individuals in the developed (developing) countries consider themselves to have the required skills to be entrepreneurs, and 25.3% (29.3%) think that there will be opportunities to start a business in the short term, and 24.4% of individuals in the developed countries have contact with entrepreneurs, vs. 32.2% in the developing countries. These data show how, in the developing countries, there is greater confidence about entrepreneurship, in line with the higher levels of entrepreneurship. Further, there is also a higher social perception in the developing countries (25.8% of older individuals think that there is a

high social perception of entrepreneurs) than in the developed countries (16.9%). On the other hand, regarding the satisfaction features, Table 1 shows how individuals in the developing countries are more satisfied with their income (23.8%, vs 8.2% in the developing countries), and with their lives (74.1% vs. 61.7%, respectively).

2.2. Fuzzy sets

A fuzzy set is a type of variable that measures, in the range (0, 1), the degree of belonging to a group, or the fulfilment of a characteristic. The difference from a categorical variable is that a fuzzy set constitutes a continuum of scores, and is not restricted to a fixed number of categories. Because of that generalization, some authors have used fuzzy sets rather than classical variables, due to their greater degree of precision as a modelling tool (Velilla and Ortega, 2017). It is important to define the middle point, 0.5, as the inflexion point in the fulfilment/belonging process, because this value constitutes the point at which an observation is neutral for the corresponding characteristic.

Fuzzy sets are defined from the aggregated variables following Ragin's (2007) direct method (Coduras, Clemente and Ruiz, 2015; Velilla and Ortega, 2017). This methodology is based on three key measures for each variable: the inflexion point (the median value of the original variable, corresponding to the score 0.5 of the fuzzy set), and the upper and lower bounds of belonging, which are defined as the first and ninth deciles of the original variable. Deviations to the medians are calculated, and also a ratio, defined as a quotient, dependent on medians and percentiles and depending on which values are greater or lower than the median. The product of the latter ratios and the deviations from the median are defined as the log-odd ratios, which are then transformed into the fuzzy set scores by an exponential transformation. A schedule of this process is shown in Figure 1. Table 1 shows summary statistics of the fuzzy sets, for both developed and developing countries. It is observed that the mean values are around 0.5, which comes from the definition of the fuzzy set scores.

3. Empirical analysis

We now analyze, using econometric and statistical models, the entrepreneurial behavior of individuals motivated by necessity, providing evidence of the differences between developed and developing countries. Following Coduras, Clemente and Ruiz (2015) and Velilla and Ortega (2017), we first propose a classical quantitative regression analysis and, then, compare results with a fuzzy set Qualitative Comparative Analysis. We propose the following model:

$$\text{Necessity entrep.} = f(\text{skills, opport, peer, perception, satinc, satlife}). \quad (1)$$

3.1. Regression analysis

We first estimate a linear OLS model of (1), i.e., a model of the probability of being an entrepreneur by necessity, as a function of the selected variables, differentiating between developing and developed countries. Columns 1 and 2 in Table 2 show estimates of the model for the developed and developing countries, respectively. It is observed that, for the developed countries, only opportunities and perception are related to necessity entrepreneurship, and opportunities are negatively related. This may be caused by the fact of analyzing entrepreneurship by necessity, indicating that those who are entrepreneurs because they consider that there are opportunities to start a new business do not belong to the group of necessity entrepreneurs. That is to say, opportunity and necessity may be disjointed motivations to become an entrepreneur. On the other hand, perception is found to be positively related to necessity entrepreneurship, indicating that, in countries where social consideration of entrepreneurship is higher, older individuals who cannot find an employer find entrepreneurship to be an alternative source of income.

In the case of the developing countries, any feature is found to be significantly associated with entrepreneurship due to necessity. This may indicate that, in these countries, older individuals that need income may become entrepreneurs ‘no matter what’, in line with the conclusions of Velilla and Ortega (2017) regarding macro-level variables.

3.2. Fuzzy set Qualitative Comparative Analysis

OLS models are characterised by certain restrictions, and can model only linear relationships, and it may be that different approaches would lead to different results. Using the fuzzy sets defined in the previous section, we propose an fsQCA model for developing and developed countries, to analyze the differences among both groups[3]. FsQCA is a qualitative technique that, using fuzzy set scores, aims to determine causal relationships between an outcome variable and the possible combinations of a series of features (Ragin and Stand, 2014). This kind of methodology is not better, nor worse than the classical quantitative approaches, but it does provide a different perspective that complements classical analyses and helps to find different results that, otherwise, could not be captured (Woodside, Ko and Huan 2012). In any case, from the point of view of inference and economic policy, fsQCA represents a major advantage since it allows us to analyze causality, which cannot be analyzed using cross-sectional quantitative models.

A complete description of fsQCA can be read in Ragin (2008). The sufficient conditions analysis is based on the identification of the causal relationships between the outcome variable and all the combinations of features, and the construction of a 'Truth Table' (Quine-McCluskey procedure). Then, each relationship is evaluated by its consistency, defined as follows:

$$\text{consistency}(X \Rightarrow Y) = \frac{\sum \min(X_i, Y_i)}{\sum X_i}, \tag{2}$$

where X_i represents the membership scores in a combination of features, and Y_i the membership scores of the outcome variable (see Kosko and Isaka, 1993; Ragin, 2006; Smithson and Verkuilen, 2006). On the other hand, the sufficient condition analysis is also based on the identification of consistencies, now defined as:

$$\text{consistency}(Y \Rightarrow X) = \frac{\sum \min(X_i, Y_i)}{\sum Y_i}, \tag{3}$$

with X_i and Y_i as above. For both types of analysis, the cutoff consistency value that determines the causal relevant relationships is fixed at 0.75, with this value being dependent on the degree of stringency of solutions (generally between 0.7 and 0.8; Ragin, 2008).

[3] We use the fsQCA 2.5 free software (Ragin and Stand, 2014).

Table 3 shows the different results of the sufficient conditions analysis, using the Quine McCluskey algorithm, for the developed and developing countries. It must be noted that the sign "~" indicates "low levels of the fuzzy set". We find that, for the developed countries, four sufficient conditions emerge:

1) Low levels of skill, no opportunities, low perception, and low life- and income-satisfaction. That means that individuals with low levels of wellbeing may be entrepreneurs even when they do not exhibit entrepreneurial behavior.

2) Lower valuation of skills, high perception of entrepreneurship, high presence of peer effects, and low incomes.

3) Analogous to 2), but with a higher valuation of life. 2) and 3) indicate that, in countries where older individuals have a low evaluation of their incomes, or highly value their life, entrepreneurship by necessity is derived. This is clear, since individuals with low incomes may establish a business in order to improve their income. On the other hand, individuals with a higher life-satisfaction may be entrepreneurs by necessity, but can also be motivated by their good conditions of life, since entrepreneurship is a risk activity.

4) High valuation of skills and opportunity, peer effects, and high income satisfaction, and low entrepreneurial perception and life satisfaction. This pattern may indicate that skills and opportunity are not completely disjointed options, in contrast with the deductions made from the regression analysis estimates: under certain circumstances (the influence of peer effects, and comfortable incomes, but an uncomfortable life), individuals may be entrepreneurs by necessity only if they consider they have the opportunity to do so.

For the case of the developing countries, six sufficient conditions for high-necessity entrepreneurial levels among the elderly are found:

1) High levels of skills and life satisfaction, low levels of opportunities, perception, and income satisfaction. This is a clear result of how older individuals turn to entrepreneurship to get income, if they consider to have the skills, and their life is sufficiently satisfied to tolerate the risk entailed.

2) Low level of skills and life satisfaction, and high levels of opportunities, perception, and peer effects. This condition shows how the four latter features may counteract the low skills factor, overcoming its importance.

3) Low levels of skill, peer effects, and income satisfaction, and high levels of opportunities, perception, and life satisfaction. This shows again the role of well-being, which, when combined with perception and opportunities, leads individuals with low income to find in entrepreneurship a way to increase their wealth, even with low skills, in line with 2).

4) High levels of all features, except for low income-satisfaction. This result gives empirical support to the condition in which all the features imply what is theoretically assumed.

5) High levels of skill, low levels of opportunities, perception, and life satisfaction, and no peer effects.

6) Analogous to 5), but switching life-satisfaction for income- satisfaction. These two latter results highlight again that skills are a powerful determinant of entrepreneurship.

Table 4 shows the results of the necessary conditions analysis, using all possible combinations of the features, by groups of 4.[4] It is observed that all 15 possible combinations are necessary conditions, for both the developed and the developing countries. That is to say, being a country that *belongs* to the group of countries with high levels of entrepreneurship by necessity in the third age, implies that at least four of the six features considered are also at high levels.

4. Conclusions

While entrepreneurship is a complex (though heavily analyzed) phenomenon, generally associated with youth, older workers also constitute a meaningful segment of the entrepreneur community. Further, the behavior of older entrepreneurs has been barely analyzed in comparison with the latter. Prior evidence shows that third- and prime-age workers may see entrepreneurship from different perspectives, leading to different mechanisms behind their respective entrepreneurial behaviors (Kautonen, 2008; Kautonen et al., 2011).

Under these circumstances, in this paper we empirically analyze, using the GEM 2014 Global Individual database aggregated at country level, the entrepreneurial

[4] Software restrictions do not allow us to develop a necessary conditions analysis with a higher number of fuzzy sets per group.

behavior by necessity of third-age workers, showing empirical differences between the developed and developing countries. Using both OLS quantitative models, and fuzzy set Qualitative Comparative Analysis, we find that, while the former do not show any meaningful results, several entrepreneurial patterns emerged from the latter. High valuation of skills and low perception of opportunities, combined with high and low entrepreneurial perceptions and income- and life-satisfaction, determine the level of entrepreneurship by necessity in the developed countries. This may help to identify those third-age workers who are more prone to start a business, with the subsequent consequences at the institutional level. However, patterns in the developing countries are more complex, indicating that entrepreneurship among the third-age workers may be a more common choice for those who cannot find an employer.

One limitation of the analysis may emerge from the fact that fsQCA is computationally and conceptually limited to small groups of independent variables. Thus, unobserved heterogeneity may play an important role, with any un-considered variables significantly determining the necessity-entrepreneurial behavior of older workers.

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Figure 1. Ragin's direct method pseudo-code

For each variable X_i {
    $\text{Median}_i = \text{median}(X_i)$
    $\text{P1}_i = \text{percentile}(X_i, 1)$
    $\text{P9}_i = \text{percentile}(X_i, 9)$
    For each observation j {
        $\text{Deviation}_{ij} = X_{ij} - \text{Median}_i$
        $\text{Ratio}_{ij} = 3/(\text{P9}_i - \text{Median}_i)$ if $\text{Deviation}_{ij} > 0$
        $\text{Ratio}_{ij} = 3/(\text{Median}_i - \text{P1}_i)$ if $\text{Deviation}_{ij} < 0$
        $\text{Logodd}_{ij} = \text{Deviation}_{ij} * \text{Ratio}_{ij}$
        $\text{Fuzzy-set score}_{ij} = \exp(\text{Logodd}_{ij})/(1 + \exp(\text{Logodd}_{ij}))$
        }
    }

Note: this scheme is a particular case of Ragin's (2007) direct method to define fuzzy sets.

Table 1. Summary statistics

	Variables - Mean (S.D.)		Fuzzy sets - Mean (S.D.)	
Variables	Developed	Developing	Developed	Developing
Necessity entrepreneur	0.018	0.038	0.461	0.501
	(0.012)	(0.023)	(0.320)	(0.339)
Skills	0.298	0.518	0.488	0.479
	(0.348)	(0.421)	(0.334)	(0.415)
Opport	0.253	0.293	0.456	0.480
	(0.350)	(0.394)	(0.357)	(0.342)
Peer	0.244	0.320	0.453	0.468
	(0.344)	(0.404)	(0.334)	(0.369)
Perception	0.169	0.258	0.411	0.452
	(0.283)	(0.377)	(0.327)	(0.339)
Satinc	0.238	0.082	0.473	0.499
	(0.360)	(0.210)	(0.323)	(0.330)
Satlife	0.741	0.617	0.557	0.501
	(0.344)	(0.428)	(0.342)	(0.393)
Observations	28	28	28	28

Note: Standard deviations in parentheses.

Table 2. Regression model estimates

Variables	**(1)** **Developed**	**(2)** **Developing**
Skills	0.001	0.002
	(0.009)	(0.011)
Opport	-0.020***	0.041
	(0.007)	(0.030)
Peer	0.004	-0.011
	(0.008)	(0.012)
Perception	0.026**	-0.023
	(0.011)	(0.032)
Satinc	-0.005	-0.002
	(0.006)	(0.009)
Satlife	0.004	-0.013
	(0.006)	(0.010)
Constant	0.015***	0.043***
	(0.004)	(0.009)
Observations	28	28
R-squared	0.333	0.252

Note: Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table 3. FsQCA: sufficient conditions of necessity entrepreneurship

Conditions	Coverage	Consistency
A) Developed countries		Overall: 0.736
~skills*~opport*~perception*~satinc*~satlife	0.410	0.889
skills*~opport*peer*perception*~satinc	0.227	0.818
skills*~opport*peer*perception*satlife	0.292	0.773
skills*opport*peer*~perception*satinc*~satlife	0.205	0.932
B) Developing countries		Overall: 0.761
skills*~opport*~perception*~satinc*satlife	0.157	0.817
~skills*opport*peer*perception*~satlife	0.248	0.818
~skills*opport*~peer*perception*~satinc*satlife	0.188	0.822
skills*opport*peer*perception*~satinc*satlife	0.172	0.797
skills*~opport*~peer*~perception*~satlife	0.248	0.777
skills*~opport*~peer*~perception*~satinc	0.268	0.859

Note: Quine McCluskey algorithm. "~" represents lower levels of belonging to the correspondent feature group.

Table 4. FsQCA: necessary conditions of necessity entrepreneurship

	A) *Developed countries*		B) *Developing countries*	
Conditions	**Consistency**	**Coverage**	**Consistency**	**Coverage**
peer+satinc+satlife+perceptionn	0.816	0.484	0.802	0.533
opport+peer+perception+satinc	0.775	0.499	0.802	0.596
opport+peer+perception+satlife	0.772	0.505	0.788	0.564
opport+perception+satinc+satlife	0.792	0.483	0.822	0.539
opport+peer+satinc+satlife	0.815	0.484	0.829	0.545
opport+peer+perceptionn	0.918	0.528	0.866	0.588
skills+opport+peer+satinc	0.824	0.514	0.861	0.562
skills+opport+peer+satlife	0.826	0.512	0.903	0.551
skills+opport+perception+satinc	0.800	0.516	0.862	0.636
skills+opport+perception+satlife	0.814	0.515	0.905	0.599
skills+opport+satinc+satlife	0.852	0.501	0.881	0.568
skills+peer+perception+satinc	0.825	0.535	0.912	0.604
skills+peer+perception+satlife	0.827	0.512	0.885	0.572
skills+peer+satinc+satlife	0.865	0.498	0.917	0.555
skills+perception+satinc+satlife	0.853	0.502	0.890	0.545