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Research Article

Should Age and Education be taken into account to Innovate?

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Abstract: This paper seeks to fill a gap in the literature on youth entrepreneurship, by developing a model that shows a distinction between young people and the elderly. The purpose of this article is to test, first, the impact of education on the ability to innovate, and then test the interaction of the age of the entrepreneur on the relationship between education and innovation. Using data from 67 countries participating in the GEM (Global Entrepreneurship Monitor) program, this paper uses a linear regression to explore the impact of age innovation on the relationship between education and innovation. GEM data shows that education has an impact on innovation, but that there is a tendency for young people to turn their education more into innovation.

I. INTRODUCTION

Innovation and entrepreneurship are linked by the same desire for creativity, while talking about developing new products, new services, new processes or new organizations. They are both considered as fundamental drivers of the economy. Indeed, they are today unanimously recognized as vital phenomena for post-industrial societies, by their contribution to the regeneration and development of economies. Entrepreneurship drives the economy of many nations whose growth is largely driven by the rate and the rythm of innovation and the creation of businesses or activities. Therefore, it concerns all countries, all categories and all generations of individuals in each country. Neo-Schumpeterian models of growth, which believe that the main cause of growth is innovation, gives a major role to knowledge. Education is thus considered to be at the origin of development.

We often have the tendency to associate age with experience and experience with competence. Liang, Wang & Lazear [1] recall that entrepreneurship requires creativity and business acumen: to become an entrepreneur, an individual must have a business idea to launch, but to make this new business a success, it requires other skills, which are generally only acquired through training. Creativity may decline with age, but business skills increase with experience in senior positions. If a country's workforce is old, then entrepreneurship is penalized. In fact, seniors are less innovative and because they occupy key positions at the top of the hierarchy, they prevent young workers from acquiring business skills. In short, the older a society becomes, the more the aggregate rate of entrepreneurship is likely to decline. Indeed, the analysis of data from the Global Entrepreneurship Monitor suggests that a year's increase in the median age of a country decreases the rate of new business creation by 2.5 percentage points.

Thus, age and education appear to have a significant impact on innovation and consequently on country growth. The purpose of this article is therefore, in a first step, to analyze the effect that education might have on the entrepreneur's ability to innovate. In a second step, it is a question of checking if the age of the entrepreneur has an impact on his capacity to innovate. Finally, we will discuss the influence of age and education on innovation, when they interact together and simultaneously.

The article will be organized in four parts. The first part is devoted to the literature of age and entrepreneur education influence on innovation. It leads to the formulation of research hypotheses. The second part devoted to the research protocol details the methodology used and the database. The third part focuses on the testing of research hypotheses. Part four discusses the key findings, limitations of research and future perspectives, and proposes recommendations for the promotion of innovation.

II. Littérature Review & Hypotheses

The choice to study the education variable is explained by the fact that it is considered as one of the main factors to judge the level of growth and development of a country. Kaushik et al. [2] state that there is a correlation between the level of education and the economic status of a nation. Apart from its macro-economic importance, education is also, on a more personal level, associated with a higher social status. In fact, it is often considered in many countries as a social lift. On the other hand, the impact of education is also felt on innovation, which is an essential asset for business competitiveness.

The innovative spirit of entrepreneurs can be explained by several factors, but culture remains one of the most important criteria. Indeed, some countries tend to innovate more than others (we can cite the example of Israel or the United States

of America where the rate of introduction of new patents is one of the highest in the world). These countries are characterized by a more pronounced masculinity and individualism according to the Hofstede & al. [3]. However, innovation does not depend only on these cultural variables. It is also a function of human capital, in other words workers' knowledge as well as their level of education.

In order to improve entrepreneurial activity and more particularly innovation, companies are therefore focusing more and more on education. In fact, the universities, secondary or even primary institutions integrating programs related to the entrepreneurial culture within their programs are no longer counted. Some countries go even further, inculcating the culture of initiative from an early age. One example is the Canadian program, "Entrepreneurial Adventure", which encourages entrepreneurship in kids garden. Such programs aim to root a culture of risk-taking, creativity, opportunity detection, leadership, etc. Although it is a question of studying the essence of entrepreneurship in this study (i.e. innovation), entrepreneurial courses or programs are not addressed to conceptualize the education variable. The latter will be operationalized thanks to the number of years of education followed since the first grade. It is widely recognized that the quality of the education system generally has a positive influence on entrepreneurs' innovative capacity by improving their human capital, skills and creativity (Schott & Sedaghat, [4]). However, no researches study the effect of the number of education years, on the ability to innovate.

A. *Education affects innovation*

From a logical point of view, we expect the relationship between education and innovation to be positive. The popular belief is that an academic curriculum guarantees a capacity for innovation higher than average. However, we note that most innovative entrepreneurs nowadays didn't follow long studies.

A generally accepted finding is that education facilitates the learning of new skills and stimulates creativity and innovation. In the business world, for example, the majority of large firms with important R&D activities tend to employ more people with higher levels of education (or with a fair number of university degrees). In the literature, the relationship between education and innovation has been the subject of many studies. A generally accepted finding is that education facilitates the learning of new skills and stimulates creativity and innovation (Vila & al. [5] Education is at the root of two different aspects of an entrepreneur: one practical and the other artistic (or creative). In fact, the education followed by the entrepreneur allows him, on one hand, to know how to make use of certain tools and methods of work, thanks to the technical skills acquired; and on the other hand, to stimulate his creativity and imagination.

According to Baumol [6], there is a difference between entrepreneurs who innovate and entrepreneurs who invent (the latter are being more focused on the creative aspect than the first). Indeed, according to him, the level of education is at the origin of the distinction between the two types of entrepreneurs.

This research examines the effect that education might have on the entrepreneur's ability to innovate. This leads us to formulate our first hypothesis:

H1: Education has a positive impact on innovation

B. *Age affects innovation*

Age is a parameter often taken into account in entrepreneurship studies. Indeed, according to Becker's [7] time allocation theory, there is an age limit, after which the willingness to create new activities by an individual, declines. The more the individual gets older, the more time factor becomes important; so the value we give to time is a function of age. In other words, older are the entrepreneurs, less innovation investments will be significant.

The Harada [8] study showed that there is a negative relationship between an entrepreneur's probability of success and his age, but does not provide an explanation. The least capacity to innovate of seniors could be an explanatory element according to him.

In this article, it is a question to test if the age of the entrepreneur has an impact on his ability to innovate. Hence the hypothesis H2:

H2: Age has a negative impact on innovation

C. *The interaction effect of age on the education-innovation relationship*

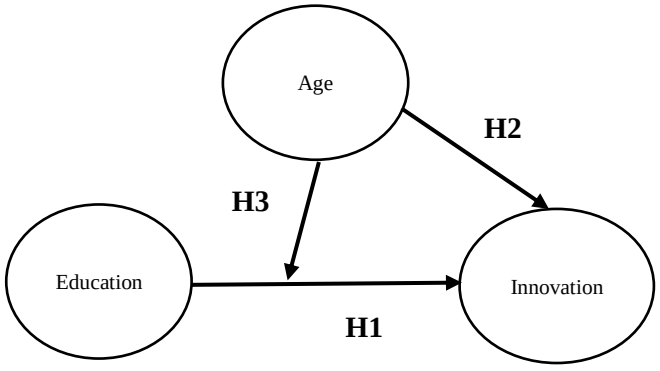
The impact of education on innovation is affected by age. In fact, young entrepreneurs have just left school, so they have a fresher memory than older entrepreneurs. Age and education variables have, in theory, an influence on innovation, when they interact together simultaneously. In other words, it is a question to test if young entrepreneurs aged between 18 and 24 years tend to make better use of their education to innovate than older people (between 35 and 64 years).

We can therefore cite the following hypothesis:

H3: The younger people more than older people turn their education into innovation

The conceptual model of our research is as follows:

Figure 1 : Conceptual model



III. Research Protocol

Through our study, we seek to confirm the positive impact of education on innovation and specify the nature and intensity of this relationship in interaction with the age of the entrepreneur. Our unit of analysis is the entrepreneur, this research is positioned therefore, at a micro-economic level. Data is collected from a number of countries, each of them has several contractors.

Innovation is an individual behavior specific to the entrepreneur, education is considered a personal antecedent. The impact of education (numerical variable) on innovation (numerical variable) will be tested and estimated by linear regression.

A. Sample

Our study takes care of a random sample which counts 153,103 entrepreneurs, defined and identified as those who own and manage a business in creation or in activity. Based on a standardized questionnaire provided by the GEM consortium, respondents are asked about their participation and attitudes towards entrepreneurship, especially if they own and run a business. The entrepreneurs are spread across 67 countries: Algeria, Angola, Argentina, Australia, Bangladesh, Barbados, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Egypt, Ecuador, El Salvador, Estonia, Ethiopia, Ghana, Greece, Guatemala, Hungary, Indonesia, Iran, Ireland, Israel, Jamaica, Jordan, Latvia, Lebanon, Malaysia, Mexico, Morocco, Namibia, Nigeria, Pakistan, Palestine, Peru, Philippines, Poland, Portugal, Puerto Rico, Romania, Saudi Arabia, Singapore, South Africa, South Korea, Suriname, Sweden, Syria, Taiwan, Thailand, Tonga, Trinidad and Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United States, Uruguay, Venezuela, Vietnam, Yemen and Zambia.

This sample, enough representative, will allow us to generalize the results to entrepreneurs around the world.

B. Data collect

The Global Entrepreneurship Monitor (GEM) is an international project that studies and evaluates entrepreneurial activities around the world. The main objective of this project is to better understand the relationship between entrepreneurship and economic growth through an empirical analysis of the entrepreneurial phenomenon in different countries and over several years.

Data from all participating countries are harmonized and are collected on an annual basis through two main sources: the Adult Population Survey (APS) and the National Expert Survey (NES). The survey of adult populations is conducted during the same period (usually between April and June) in all participating countries.

Based on a standardized questionnaire provided by the GEM consortium, respondents are asked about their participation and attitudes towards entrepreneurship, especially if they own and run a business. GEM does not measure at the company level, but at the level of the individuals. It examines the role, the behaviour of the individuals, in relation with entrepreneurial attitudes, activities and ambitions.

In order to test our research hypotheses, we defined the variable to explain, innovation, and two other explanatory variables, age and education. The operationalization of the variables used in the study, is presented in the following paragraphs.

C. Variables operationalization

Variable to explain: innovation

The measurement of innovation aims to capture the multidimensional facets of innovation. In our case, innovation is broadly designed to include both process innovation, namely the novelty of the technology used in the production of goods or services, and product innovation, that is in others words, the novelty of the product or service offered to customers, as well as the uniqueness among the producers (Zhao, [9]). However, organizational innovation is not taken into account in this study.

In order to measure innovation, the following questions were asked:

• "The technologies or procedures required for this product or service have been available for less than a year, or between one and five years, or more than five years? " NEWTEC

• "Do all, some or none of your potential customers consider this product or service as new and unfamiliar? "NEWCST

• "At the moment, are there many, few or none other companies that offer the same products or services to your potential customers? " COMPET

The answer to each question is given on a three-point scale, ranging from low, medium, to high innovation.

We found that the three measures of innovation are positively correlated, with inter-correlations around 0.2 (with similar averages and differences) (Table 1). The fact that they are positively correlated between them allows us to combine them into a single index. Thus the index of innovation can be defined as the average of the three variables, with a scale from 1 to 3. The innovation is then operationalized through this index.

The index of innovation will be defined as the average of the three variables, with a scale from 1 to 3.

Table 1: Correlations between the three measures of innovation

		NEWTEC	NEWCST	COMPET
NEWTEC	Correlation Pearson	1	.197**	-.113**
	Sig (bilateral)		.000	.000
NEWCST	Correlation Pearson	.197**	1	-.200**

	Sig (bilateral)	.000		.000
COMPET	Correlation Pearson	-.113**	-.200**	1
	Sig (bilateral)	.000	.000	

the correlation is significant at the 0.01 level (bilateral)

The innovation index has been used in the annual reports of the Global Entrepreneurship Monitor. It has also been used in academic research to study the impacts of the characteristics of individuals and firms on innovation in the Middle East.

However, it should be noted that the three components of the index are weakly correlated, innovation can be considered as a broad and multidimensional construct, and the three measures represent three dimensions of innovation, which can be analyzed separately.

Explanatory variables: education and age

Education is measured by the number of years of formal education. The entrepreneurs surveyed are between 18 and 64 years old. Three age groups were defined [18-24], [25-34] and [35-64]. We retain as juniors entrepreneurs under 18, as is the case for the few researches on youth entrepreneurship (Lorrain & Raymond [10]). We only consider the chronological age, the age felt not being taken into account.

IV. Results

In the next section, we will analyse the effect of education and age on innovation. Next, the effect of age interaction on the relationship between education and innovation.

A. Effect of education and age on innovation

The following table provides the results of the linear regression conducted on our sample data.

Table 2: Effects of education and age on innovation

Linear regression	
Education	.089
Age (between 18 and 24)	.037
Age (between 35 and 64)	-.071

We hypothesized in H1 that education has a positive influence on innovation. The correlation between education and innovation being 0.089, we can argue that hypothesis H1 is validated. In other words, more the entrepreneur has years of experience, easier will be his capacity to innovate.

According to hypothesis H2, age would have a negative impact on innovation. The linear regression we performed on the two age groups provides two different results. In fact, the correlation between the group of young entrepreneurs (those aged between 18 and 24) and innovation is positive (0.037); while the correlation between education and the group of older entrepreneurs (between 35 and 64 years old) is negative (-0.071). This shows that the hypothesis H2 is partially validated.

B. Age interaction effects on the relationship

In the next section, we will examine the effect of age interaction on the relationship between education and innovation. The following table presents the results.

Table 3: Effects of age interaction on the relationship between education / innovation

Linear regression	
Education * Age (between 18 and 24)	.023
Education * Age (between 35 and 64)	-.051

We note from the previous table that the interaction of the group of young entrepreneurs on the relationship (education / innovation) is positive while that in the group of older entrepreneurs is negative. This shows that the hypothesis H3 is partially confirmed. These results show that there is a greater tendency for young entrepreneurs to innovate (compared to the 25 to 34 age group).

V. Conclusion

The results of the study using GEM data show that more the entrepreneur has years of education, easier will be his ability to innovate. Indeed, almost all companies that invest heavily in R&D tend to recruit highly qualified people, supposed to be guarantors of the ability to innovate of the company. This result confirms the majority of writings in the field.

This study leads to practical implications for entrepreneurs and those responsible for their support. The most important recommendation would be to maintain or improve the skills of individuals throughout their lives (as in the case of life long learning programs). Related measures would make possible the limitation of the cognitive decline associated with aging but also the facility of the adoption of new tools. Any inactivity periods, particularly at the end of professional life, must not lead to skills loss. Training or activities to maintain intellectual and physical activities and also the fact of being close to technological developments, are essential. Strengthening intergenerational transfers of know-how can also be a way to explore, in somehow to combine fluid and crystallized intelligences.

The other predictable result is the impact of age on innovation that is different across the age group studied. For the group of entrepreneurs aged between 18 and 24, the relationship between age and innovation is positive, while the relationship is negative for the 35-64 age group. The results prove, in this case, that younger the entrepreneur is, more his creativity is developed. Conversely, the innovative spirit of the entrepreneur decreases with age. The fact that young entrepreneurs tend to innovate more than others can be explained by the fact that young people are more able to master information and communication technologies, which are supposed to be one of the driving forces behind innovation (especially technological innovation).

Other explanations can also clarify the results found. On one hand and from a purely gerontological point of view, the cognitive losses of seniors due to aging lead to a decrease in their ability to adapt to innovative technologies or innovations. On the other hand, the older entrepreneur is often reluctant to adopt innovative technologies, and as a result he becomes frustrated when it comes to training in these new technologies. As a result, the business created by this older entrepreneur is less innovative since he is at the beginning of the entrepreneurial venture. This lower capacity to innovate can have consequences for the success of senior entrepreneurs: several studies have shown that the survival of young companies is largely dependent on their ability to innovate (Cefis & Marsili [11]).

In addition, the GEM data show that the interaction of the group of young entrepreneurs on the education / innovation relationship is positive while that on the group of older entrepreneurs is negative. Given that the years of study of senior entrepreneurs are far behind, it is therefore normal to find that they tend to innovate less than young entrepreneurs.

These results are of course potential sources of bias as the innovative nature of the products or technologies proposed or used by entrepreneurs is based on their own statements. However, as Koellinger [12] suggests, innovation is a subjective concept that depends on the observer's point of view. This limitation is even more important in studies of generation differences, where the perception of innovation may be affected by the age of the respondent. It should not be forgotten that this study is based on the actual age of the entrepreneurs and not on the age felt or subjective. However, it may differ from the actual age, especially for seniors, depending on the state of health, life expectancy or the place of seniors in society.

In conclusion, it is important to keep in mind that being 50 years old today is not comparable to being 50 years old ten years ago, especially in terms of entrepreneurship and innovation. The results from the GEM should therefore be interpreted with caution and positioned in the current context.

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