



# The profile of the innovative entrepreneur in Mexico

## *El perfil del emprendedor innovador en México*

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### Abstract

For a country, it is essential to know the qualities that an innovative entrepreneur must possess to generate policies that promote the appropriate profiles and, in turn, foster development. This paper is aimed at outlining the innovative entrepreneur profile for the case of a developing country such as Mexico, contrasting the results with the theory, and finding a difference in the profile of a developed country. The study uses Global Entrepreneurship Monitor data and applies nonlinear parametric models. The results indicate that young adults with high educational achievement and international capabilities have more probability to undertake and innovate. Moreover, it is desirable they perform in industries like manufacturing or information and communications, and dispose of enough income, whereas variations in the motivation of individuals do not affect the results. It is also important to develop the profiles with a gender perspective.

*JEL Code:* L26, M13, M21

*Keywords:* entrepreneurship; innovation; nonlinear parametric models; productivity

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## Resumen

Para un país es esencial conocer las cualidades que un emprendedor innovador debe poseer para generar las políticas que impulsen los perfiles adecuados y a su vez fomenten el desarrollo. El artículo tiene como objetivo delinear el perfil del innovador emprendedor para el caso de un país en desarrollo como México, realizar contrastes con la teoría y encontrar diferencias de perfil con respecto a un país desarrollado. El estudio utiliza datos del Monitor Global de Emprendimiento y aplica modelos paramétricos no lineales. Los resultados indican que adultos jóvenes con alto nivel educativo y con capacidades de internacionalización tienen más probabilidades de emprender e innovar. A su vez, es deseable que se desempeñen en industrias de manufactura y de información y comunicaciones y que dispongan de suficiente ingreso; mientras que variaciones en la motivación del individuo no afecta los resultados. Es también importante desarrollar los perfiles con perspectiva de género.

*Código JEL:* L26, M13, M21

*Palabras clave:* emprendedurismo; innovación; modelos paramétricos no lineales; productividad

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## Introduction

There is a group of countries that have experienced a fast advance in innovation, science and technology over the last decade; they concur on policies to support research and development, entrepreneurial activities, and human capital formation, and evolve within an environment of strong institutions and governance. These countries have converged in an economic and development paradigm denominated knowledge economy and have achieved long-term growth.<sup>1</sup>

A literary body of economic growth postulates points out innovation enhancement as a strategic factor to counteract economic stagnation, among them are Kaldor's laws (1966, 1967), the balance of payments constrained growth model (Thirlwall, 1979), the endogenous growth theory (Lucas, 1988; Romer, 1994), and the endogenous Schumpeterian theory (Aghion y Howitt, 1998; Aghion, 2004).

From this theoretical approach, innovation enhancement boosts technology development, fosters exports and import substitution, and leads a country towards the knowledge economy. To encourage this process, developing and emerging economies require to foster the formation of entrepreneurs based on innovation, and hence, each country must outline the profile of the innovative entrepreneur according to its own characteristics, to create programs to facilitate the formation of pertinent skills.

The profile that a person must have to undertake has different characteristics from that of a person who, in addition to the undertaking, innovates. This is because innovative entrepreneurs create, diffuse, and use knowledge, generate enterprises that boost the industrialization of the economy, foster

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<sup>1</sup> Within this group of countries, Korea, Israel and Singapore stand out, for example.

technological improvement, introduce new products and technologies, and eventually generate long-term economic growth and sustainable development (Koellinger, 2008; Block, et al., 2017; Malerba and McKelvey, 2020; Hudek and Hojnick, 2020).

Moreover, the profile of the innovative entrepreneur is different in developed countries than in emerging economies, due to significant variations in issues related to age (Ruiu and Breschi, 2019), availability of income and financing (Peris-Ortiz et al. 2018 and Crudu, 2019), and motivation (Stoica, et al. 2020).

As far as Mexico is concerned, few efforts have been made to define the profile of the innovative entrepreneur involving a national scope and comprising a diversity of variables, some studies have been conducted by sampling university students or graduates (Guerrero et al., 2018; Portuguez Castro et al., 2019) or to know the profile of the entrepreneur without considering innovative skills (Carreón Gutierrez, 2021). However, according to our understanding, a national profile of the innovative entrepreneur, which can serve as a reference to target programs that promote the desired profile, has not been developed yet. In this context, there is also a lack of literature on the topic for the case of emerging economies.

With the above in mind, the main problem that arises is to build a profile distinguishing the features and skills of the innovative entrepreneur and not only of the entrepreneur, taking in to account the specific characteristics of an emerging economy, and contributing to solve the lack of definition of a national profile in Mexico, in particular, and in developing countries in general.

In this context, the objective of the paper is to outline the profile of an entrepreneur with innovative skills in a national scope, for a developing country such as Mexico, involving economic, demographic, and motivation features, capturing differences in comparison to the profile in a developed country and contrasting results with theories and formulated hypothesis.

The information source to build the profile is the Global Entrepreneurship Monitor (GEM), which carries out survey-based research on entrepreneurship directly from adult entrepreneurs across countries on annual basis. The data for the study focus on Mexico, contains information from 2011 to 2015 and comprise 1,771 observations. The analysis is conducted through binary choice models using logit and probit functions.

To distinguish between entrepreneur and innovative entrepreneur we use a dependent binary variable that takes the value of one for those involved in entrepreneurial activity and indicates that their product or service is new to at least some customers and that few/no businesses offer the same product, and zero otherwise. The variable is appropriate to obtain probabilities the entrepreneurs have to provide innovative products or services based on a set of determinant variables.

The main contribution of the paper is that it presents the profile of the innovative entrepreneur for an emerging economy, for the case of Mexico, comprising economic, demographic and motivation variables, contrasts results with the hypothesis and relevant theories, and finds differences from the profile of developed countries. The study implies that the profile represents a starting point to outline a public policy that promotes this type of skills in the formation of human capital.

The structure of the paper is as follows: Section 2 comprises a review of studies related to entrepreneur profiles, justifies the need to conduct this study and constructs the hypothesis. Section 3 bounds the theoretical framework. Section 4 develops the econometric methodology to outline the innovative entrepreneur profile. Section 5 provides comments on the econometric outcome, and finally, concluding remarks and a summary of the results are presented in Section 6.

## **Literature background and hypothesis building**

Relevant research explores different perspectives of the entrepreneur profile. Liñán et al. (2013) analyze data for 56 countries from GEM over the period 2001-2011, using structural equation models, they study the role of cultural values and entrepreneur's motivation, besides macroeconomic variables, in explaining the total entrepreneurial activity, and find that autonomy values, only in higher income countries, and egalitarianism boost entrepreneurial activity.

Loué (2018) examines the profile of exporter entrepreneurs by analyzing the relationship between firm internationalization practices and the profiles or competencies of firm owners; he conducts a methodology based on a quantitative survey of a sample group of 283 entrepreneurs established in France both exporters and non-exporters, in small and medium-sized enterprises (SMEs), the statistical analysis highlights the level of education, studies abroad, international experience on business, and collaboration within an international team as factors to promote a subsequent firm internationalization process.

Dickel and Eckardt (2020) investigate the social entrepreneur profile using data from 601 students in Germany and find that women are more likely to translate positive desirability into social entrepreneurial intentions, and sustainability orientation enhances the intent to become a social entrepreneur.

In most cases the studies do not address the innovative aspect of the entrepreneur, the study of Koellinger (2008), was a pioneering analysis on the topic, he utilized data from GEM over three years, 2002-2004, containing information on the innovativeness of nascent entrepreneurs in 30 countries and conducted logit estimations; according to his results, educational attainment, unemployment and self-confidence are significantly associated with entrepreneurial innovativeness; at the time he argued that no further studies existed on the prevalence of innovative entrepreneurs across countries.

The economic literature on the profile characterization of the entrepreneur involves both cross-country and single-country studies. There exists a vast difference in motivation to start a business across countries (Liñan et al., 2013); Koellinger, op. cit. stresses the significant variation across countries in the distribution of innovative forms of entrepreneurship; in this respect, it is worthy to conduct specific country-cases studies to outline more accurate profiles; however, the single-country studies focus on developed countries and there is little research on developing countries.

In the case of Mexico, there have been efforts to explore entrepreneurial determinants, Guerrero et al. (2018) analyze the causes of start-ups creation, using microdata of a constrained population stratum represented by graduates from a specific private educational multi-campus institution across 21 cities in Mexico; Guerrero and Urbano, (2020) explore the determinants and the consequences of entrepreneurial innovation projects within enterprise-university collaborations in Mexico. However, to our best knowledge, do not exist studies focusing on tracing innovative entrepreneurs' profiles using national scope samples in México; this paper hence, contributes to filling the gap in the topic.

The appropriate description of an entrepreneurial and innovative profile should mainly involve motivation, demographic, and economic factors. In this respect, we incorporate in the study a set of demographic variables including the age, gender, income and education level of the entrepreneur; a set of economic variables such as the internationalization and the economic activity of the firm; and the individual motivation to undertake the business.

The justification to incorporate these factors is because they are commonly explored in the literature and hence, we can contrast our results with those from previous studies. We also can formulate a hypothesis and adopt theories to contrast results. Moreover, there is information available in GEM to build the variables. Finally, the sum of these factors provides a general approach with a national scope and is not constrained to a specific sector of the population.

For every one of these factors, we formulate a hypothesis and pose theories regarding their association with innovative entrepreneurial formation based on the literature background. Subsequently, the hypotheses are tested through econometric analysis, and the results are contrasted with the theories.

### *Hypothesis formulation*

The probability to start a business seems to increase with age up to a threshold point (between 35 and 44 years) and to decrease thereafter; hence, the effect of age on the probability of becoming an entrepreneur is non-linear and follows an inverse U-shaped curve (Parker, 2009; Ruiu and Breschi, 2019). However, according to Ruiu and Breschi, older individuals are not less likely to innovate than younger individuals, an explanation they provide is that older individuals are characterized by higher barriers to

entrepreneurship both in terms of opportunity costs and time to collect the rewards; hence, they are induced to start a business only when they have discovered a significant opportunity to innovate. On the other hand, older individuals do not seem to lose innovative capacity in rapidly aging countries or developed countries, because these countries encourage a sustaining old-age innovative entrepreneurship policy while developing countries have limitations to keep these policies and hence, older people have fewer incentives to innovate.

The hypothetical point of view above rejects the argument that older people are more innovative than younger ones in developing countries. Another body of literature points out that young people are more disposed to start a business and even take the risk to innovate than older people because they are in a process of building their wealth, livelihood and occupation; thus, they tend to have less income than the older and therefore have less to lose (Koellinger, 2008) and are less risk averse. In addition, younger entrepreneurs find it easier to extend their activities and innovate due to their greater open-mindedness and cosmopolitan profile (Favré-Bonté and Giannelloni, 2007, Loué, 2018).

Ruiu and Breschi (2019) support the argument of the existence of more probability of younger people innovating than older people, they theorize that an individual who opts for wage labor receives income at the same time at which he/she performs his/her activity. However, an individual who opts for starting a new firm does not receive income instantaneously; rather, he or she receives a stream of future returns. Future returns delay more when the new business incorporates innovation, because it takes longer to penetrate the market and consolidate the innovation process. Hence, younger individuals who are more likely to collect the rewards of starting a new firm are also more likely to prefer firm creation, and the probability increases when the firm incorporates innovation, as for older people it represents the further time to obtain benefits. This leads to Hypothesis 1:

H01: Younger entrepreneurs innovate more than older entrepreneurs.

The presence of culturally preestablished roles may lead women to attach a low value to an entrepreneurial carrier, they also face challenges, including balancing work and family commitment (Busaibe et al., 2017). From this point of view, women might undertake less than men (Verheul et al, 2005; Thébaud, 2010). In terms of innovation, leadership and innovation stereotypes affect the capacity of eligible women to achieve innovative and leadership positions in organizations despite increasing evidence showing that men and women can perform equally well (Busaibe et al., 2017). The culturally preestablished role might also reduce innovation probabilities for women in comparison to men.

Further research has found a different effect of gender on entrepreneurship and innovation in developing countries. In this respect, Hoang et al. (2021) find that the number of females starting or running new businesses is higher than males in developing countries; however, they show that female-started or -controlled firms are less likely to produce innovation. On the other hand, Ruiu and Breschi

(2019) do not observe a gender gap in the probability of having introduced an innovation. Therefore, their finding suggests that once women become entrepreneurs, they are just as innovative as men.

The effect of gender on the probability of innovating is diverse in the literature. As for the case of Mexico, there is evidence pointing out the competitive advantage of women to innovate. According to CIMAD (2013), in Mexico, three out of five SMEs newly opened are commanded by women, 99 percent of women who required a loan to invest in SMEs pay fully, women have higher tertiary education graduation rates than men (21% compared to 18%) and they obtain better marks. Thus, women can pursue better training than men and have better conditions to obtain entrepreneurial loans and therefore, they may have better features to undertake and innovate. In this context, Hypothesis 2 is:

H02: Entrepreneur women tend to innovate more than men.

Higher real wages increase the opportunity cost for self-employment and can reduce entrepreneurial activity (Bjornskov and Foss, 2006; Liñan et al., 2013); moreover, innovative business ideas with high risk and uncertainty are more likely to be pursued by individuals with lower income, as they have 'less to lose' (Koellinger, 2008). However, in developing countries, weaknesses in the financial and banking system, make it more difficult to obtain loans for those who want to start an innovative business with high risk; hence, innovative entrepreneurs, in most cases must finance their ideas through their own resources, and therefore they require higher revenue and wealth.

The argument of weak structures to encourage innovative entrepreneurship in countries with less income is supported by Peris-Ortiz et al. (2018) and Crudu (2019); they argue that countries with higher GDP per capita tend to have more innovative entrepreneurs than lower-income countries, because allocate large amounts for innovation and entrepreneurial policies and have a framework of innovation-friendly policies. In contrast, lower-income countries have weak financial structures to provide loans and constrained policies to boost innovation.

Moreover, innovative firms require more resources than non-innovative firms because the innovation process demands experimentation and time to introduce new products and services in the market before obtaining profits; thus, the entrepreneur funders of the innovative firms require additional funding in the longer-term (Matulova, 2020), but in developing countries this founding mainly has to be provided by the funders.

With the above in mind, it is more likely that people, with their own income and wealth, in developing countries can conduct innovative entrepreneurial projects. In this context, the relationship between income and innovative entrepreneurship is tested as follows in Hypothesis 3:

H03: In developing countries such as Mexico, there is a positive relationship between income and innovative entrepreneurship.

The ability to innovate and identify business opportunities requires leading knowledge in the fields of invention, it implies that individuals be well-trained or too experienced to be truly inventive (Delmar, 2006, Koellinger, 2008). The knowledge spill over theory of entrepreneurship states that new knowledge represents a crucial source of entrepreneurial opportunities and that a greater amount of knowledge tends to be associated with higher innovation and start-up rates (Audretsch and Lehmann, 2005; Del Bosco et al., 2019).

Ruiu and Breschi (2019) support the view that education plays a positive role in entrepreneurial selection, but in particular, they find that the probability of seeing an entrepreneur introducing innovation depends on a higher level of education. They state that those who graduated from university or those with postgraduate education have more probability of introducing an innovation than an entrepreneur with lower educational achievement.

In the literature seems to be a consensus on the positive relationship between education and entrepreneurship, but in terms of innovation, recent literature tends to support the statement that a greater amount of knowledge, specifically graduate or postgraduate educational achievement, is associated with innovative entrepreneurship. Thus, Hypothesis 4 is:

H04: The creation of innovative business is positively related to greater knowledge as graduate education or postgraduate education.

The exporter entrepreneur is more competitive, has international competencies, a broader vision of international needs and higher educational attainment and hence, has more capabilities to innovate (Loué, 2018). Furthermore, those who innovate become more competitive and are more likely to enter international markets. Most of the literature suggests a positive association between innovation and internationalization or the ability to export (Xie and Li, 2013; Azar and Ciabuschi, 2017). However, the previous literature has failed to recognize the effect of each type of innovation on firms' internationalization.

Saridakis, et al., (2019) extend the analysis in the literature by providing empirical evidence regarding the role of three types of innovation, goods, services and process, and the role of radical innovation in the exporting of entrepreneurs owning SMEs. Consistent with previous studies they find that innovative entrepreneurs are more likely to export than non-innovative entrepreneurs. In addition, their findings show that goods innovation is more strongly associated with the propensity to export than service or process innovation. When differentiating between degrees of novelty, the results indicate that entrepreneurs owning SMEs and introducing radical innovation that is new to the market/industry are more likely to export than non-innovative small and medium entrepreneurs.

Henley and Song (2020) address the issue of exploiting innovation to stimulate exporting activity and they find a direct link in the case of micro-entrepreneurs. In this context, the analysis in the



literature has shown that regardless of the size of the firm the entrepreneur owns, micro, small and medium enterprise, the innovative entrepreneur is more likely to export and internationalize the firm than the non-innovative entrepreneur.

According to the resource-based view theory, a firm is considered a distinct entity with a diverse bundle of intangible and tangible resources. At the center of the intangible resources, much emphasis is placed on the entrepreneur's ability to innovate as a determinant of the internationalization of the firm (Schoonhoven, et al., 1990; Barney, 1991).

With the above in mind, the literature points out a positive association between the innovative entrepreneur and their ability to export or internationalize their firm, from both empirical and theoretical perspectives. Therefore Hypothesis 5 is presented as follows:

H05: There is a positive association between innovative entrepreneurs and exporter entrepreneurs.

According to heterodox theories or postulates comprising Kaldor's laws (1966, 1967), the balance of payments constrained growth model (Thirlwall, 1979), endogenous growth theory (Lucas, 1988; Romer, 1994), and endogenous Schumpeterian theory (Aghion y Howitt, 1998; Aghion, 2004), the manufacturing sector is correlated to sustained growth because enhances productivity, this process is possible because the manufacturing sector innovates more than the primary or the service sectors.

On the other hand, there is research in the relevant literature indicating that the innovative entrepreneur develops more in the sectors in which sound industrial policy targets innovation and human capital endowment. In this respect, Grilli et al. (2022) investigate the effect of comprehensive industrial policy intervention focusing on innovative firms and the composition of innovative entrepreneurs in terms of human capital formation; in particular the study analyses the impact of lowering entry and growth barriers to innovative entrepreneurship and compares the 'before' and 'after' of the reform. They show that policy reform that decreases barriers to innovative entrepreneurship in specific industries was particularly able to push individuals towards the creation of new innovative ventures and to attract entrepreneurs endowed with greater human-specific capital to the industry targeted than what occurred before the reform.

The analysis is oriented to test in which industries the entrepreneur innovates more; the study comprises a vector of industry dummy variables to find which industries are more associated with innovative entrepreneurship. In this context, we keep the hypothesis of heterodox theories commented on above and hence, Hypothesis 6 is as follows:

H06: Entrepreneurs innovate more in the manufacturing sector than in the service and primary sector.

GEM classifies the entrepreneur's motivation to start a business into two types: i) opportunity motivation, which emerges due to the pertinence and expedience visualized in the market. ii) necessity motivation, which occurs due to unemployment or dissatisfaction with the previous or current job. The opportunity entrepreneurs plan their entry into the market, they tend to join their area of expertise, depend less on the socioeconomic environment, and are more associated with growth aspirations and self-confidence (Wennekers et al., 2005, Liñán et al., 2013); while the necessity entrepreneurs depend more on improvisation and the need to find an alternative way of subsistence.

Entrepreneurship recently has been acknowledged as an important route to achieving innovation and sustainable development. Empirical results have shown the linkage of entrepreneurship with sustainable development and innovative activities when the entrepreneurial activity is opportunity-driven; in contrast, the necessity-driven entrepreneurial activity negatively affects innovation and sustainable development (Hudek and Hojnick, 2020).

Stoica, et al. (2020) explore whether the effect of different types of entrepreneurship on innovation and growth can differ according to the stage of economic development of a country. They find that opportunity-driven entrepreneurship is a key factor in stimulating economic growth and innovation in high-income and transition countries.

With the above in mind, opportunity-driven entrepreneurs can possess more features to innovate than necessity-driven entrepreneurs; furthermore, this effect can be more stimulating in transition economies such as Mexico. On these bases, we formulate Hypothesis 7 regarding motivation:

H07: The opportunity entrepreneur is more likely to innovate than the necessity entrepreneur.

## **Theoretical framework bounding**

The theoretical approach in this study has to be bound from two perspectives. First, must be oriented to an innovative profile of the entrepreneur and not just to the features an entrepreneur has to possess. Second, is oriented to differentiate the profile of the innovative entrepreneur in a developing country from that in a developed one. In this respect and from the discussion raised above, the theoretical framework of the study is as follows:

The hypothesis that younger entrepreneurs innovate more than older ones is based on the theorization formulated by Ruiu and Breschi (2019), Koellinger (2008), Favré-Bonté and Giannelloni (2007) and Loué (2018). That is, future returns delay more when the new business incorporates innovation, because it takes longer to penetrate the market and consolidate the innovation process, in this respect, younger individuals who are more likely to collect the rewards of starting a new firm are also more likely to prefer firm creation, and the probability increases when the firm incorporates innovation. This approach

does not hold in developed countries, according to the theoretical perspective from Ruiu and Breschi, 2019, because they encourage a sustaining old-age innovative entrepreneurship policy, hence older people do not lose innovative capacity while developing countries have limitations to keep these policies.

The hypothetical point of view indicating that the culturally preestablished role might reduce innovation probabilities for women in comparison to men (Busaibe et al., 2017; Verheul et al, 2005; Thébaud, 2010; Busaibe et al., 2017), and the theorization that this approach might be reinforced in developing countries, as customs and habits prevail in marginalized regions, is not proposed in the study. Instead, we adopt a theoretical approach pointing out more probability for women to innovate, as in emerging economies such as Mexico, women perform better in higher education and have better credit backgrounds than men (CIMAD, 2013).

In terms of the relationship between income and innovative entrepreneurship, we adopt the theoretical point of view that this relationship is positive in developing countries because lower-income countries have weak financial structures to provide loans and constrained policies to boost innovation (Peris-Ortiz et al., 2018; Crudu, 2019). As a result, individuals have to use their own income and wealth to innovate. This is the opposite perspective to those arguing that higher real wages in developed countries increase the opportunity cost for self-employment and reduce entrepreneurial activity (Bjornskov and Foss, 2006; Liñan et al., 2013), or innovative business ideas with high risk are more likely to be pursued by individuals with lower income, as they have 'less to lose' (Koellinger, 2008).

This study takes as theoretical background the spillover theory to explain the relationship between education and innovation, the theory argues that the ability to innovate and identify business opportunities requires leading knowledge in the fields of invention. The paper complements this theoretical approach with the idea that a greater amount of knowledge tends to be associated with higher innovation, and start-up rates (Audretsch and Lehmann, 2005; Del Bosco et al., 2019). This is because developing countries require to compensate for the deficit in quality education with higher or even postgraduate education to achieve innovative skills.

The positive relationship between internationalization and innovation is supported in this study by the resource-based view theory (Schoonhoven, et al., 1990; Barney, 1991). However, the theory fails to explain any differentiation between developing and developed countries or the level of internationalization that benefits more entrepreneurship and innovation.

The hypothesis that entrepreneurs innovate more in the manufacturing sector is in keeping with heterodox theory, in particular Kaldor's law (1966, 1967). The development of this industry also implies the improvement of the terms of trade and the rate of return of capital (Thirlwall, 1979; Lucas, 1988; Romer, 1994), which creates preconditions for more innovation. Nevertheless, rapid growth and innovation of other industries in recent times might reveal that other sectors are also associated

significantly with innovative entrepreneurship; it is also interesting to know whether this can happen in developing countries, which lag behind in industrialization in different sectors.

There is consensus in the relevant literature that opportunity-driven entrepreneurial activity is linked to innovative entrepreneurship (Hudek and Hojnick, 2020). However, in developing countries, the necessary motivation can be a determinant of innovation too, because of the lack of unemployment insurance, low pay jobs, and high unemployment rates. Recent research has shown that opportunity-driven entrepreneurship is a key factor in stimulating economic growth and innovation in both high-income and transition countries (Stoica, et al. (2020). In this context, the study keeps the theorization pointing out opportunity-driven entrepreneurship as a determinant of innovation.

## **Econometric approach**

The analysis comprises a binary dependent variable ( $Y$ ), it takes the value of one for those entrepreneurs whose product or service is considered new and unfamiliar by some or all of their potential customers, and zero otherwise. Due to the nature of the variable, the analysis is conducted through binary choice models, with which we can estimate the probability ( $P$ ) of being an innovative entrepreneur given a vector of explanatory variables ( $X$ ), that is,  $P = E(Y_i = 1/X_i)$ , the conditional expectation of  $Y_i$  given  $X_i$  is a conditional probability  $P_i$ . The marginal or incremental effect of the explanatory variables ( $X$ ) on the probability that the event will occur, in our study is the entrepreneur is innovative, does not remain constant throughout; that is to say, probabilistic models are not linear in the parameters. In addition,  $0 \leq E(Y_i = 1/X_i) \leq 1$ , in other words, the conditional expectation or conditional probability lies between 0 and 1. Under these characteristics, our probability model cannot be estimated through a standard OLS approach, since it assumes that  $P_i$  increases linearly with  $X$  and the estimated values of  $P_i$  exceed 0 and 1.

With the above in mind, we conduct two probability models, logit and probit, which satisfy two features: 1) nonlinearity in the parameters, as the estimated values of  $P_i$  converge asymptotically to 0 and 1 at decreasing marginal changes and 2) do not exceed the boundaries 0-1. This kind of model is appropriate for our study because the probability of being or not an innovative entrepreneur tends to have negligible changes at both low and high values of  $X$  or in any of the boundaries, and accelerates at intermediate values of the explanatory variables. Previous studies related to the profile of the entrepreneur have also applied these models (Koellinger, 2008, Loué, 2018, Marques, 2019).

In a linear model, the conditional probability  $P_i$  is expressed as in Equation 1:

$$P = E(Y_i = 1/X_i) = \beta_1 + \beta_2 X_i \tag{1}$$

but, applying a cumulative logistic distribution function we have the logit model, as represented in Equation 2:

$$P = E(Y_i = 1/X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \quad (2)$$

where,  $P_i$  ranges from 0 to 1, and  $P_i$  is not linearly related to  $X_i$ . The model estimates the log of the odds ratio, also called the logit  $L = \ln (P_i / 1 - P_i)$ , which equals  $Z = \beta_1 + \beta_2 X_i$ . After some algebraic calculations,  $P_i$  in Equation 2 can be expressed as follows:

$$P_i = \frac{e^z}{1 + e^z} \quad (3)$$

the probability an entrepreneur innovates at given values of  $X$ , is computed by taking the antilog of the estimated logit and substituting values in Equation 3.

By applying the normal cumulative distribution (NCDF) function, it is obtained the probit model. In this case, the probability of an entrepreneur innovating depends on an unobservable utility Index  $I_i$ , determined by the vector of explanatory variables  $X_i$ , which is positively related to the value of  $P_i$ . There exists a threshold level of the index, represented by  $I_i^*$ , such that if  $I_i$  exceeds or is equal to  $I_i^*$ , the entrepreneur will innovate; the probability that it occurs is represented in Equation 4:

$$P_i = E(Y_i = 1/X_i) = P_i(I_i^* \leq I_i) = P_i(Z_i \leq \beta_1 + \beta_2 X_i) = F(\beta_1 + \beta_2 X_i) \quad (4)$$

the probit model also satisfies the two features we require for our estimation. The probability an entrepreneur innovates at given values of  $X$ , is computed by taking the inverse of the NCDF in Equation 4. (Gujarati, 2003)

The original equation to estimate is presented in Equation 5:

$$\begin{aligned} \text{innovation}_i = & \alpha_i + \beta_1 \text{age}_i + \beta_2 \text{gender}_i + \beta_3 \text{income}_i + \beta_4 \text{education}_i + \beta_5 \text{internat}_i + \beta_6 \text{econact}_i \\ & + \beta_7 \text{motivation}_i + \varepsilon_i \end{aligned} \quad (5)$$

where innovation is the dependent variable as outlined before. The model contains four demographic variables: age, gender, income and education level of the entrepreneur; two economic variables: internationalization (internat) and the economic activity of the firm (econact); and motivation,

which accounts for the causes that led the entrepreneur to start the business.  $\beta_1$  to  $\beta_7$  are the parameters to estimate, the sub-index  $i$  represents the individuals, and  $\varepsilon_i$  is the error term.

Two of the explanatory variables are binomial:

- gender, it takes the value of 1 for women (female) and 0 for men; and
- motivation, it takes the value of one for those who start a business to pursue an opportunity in the market, and 0 for those who become entrepreneurs pushed by unemployment or dissatisfaction with their previous job (Liñan et al. 2013).

The other explanatory variables are categorical, they take more than two options, and for every category, we built a dichotomous variable. To prevent multicollinearity we take one or more categories as the benchmark in every set of categorical variables, in other words, one or more of the dichotomous variables are discarded from the model. The variables are:

- age, comprises five ranges of age 18-24, 25-34, 35-44, 45-54 and  $\geq 55$ , the latest is the benchmark,
- income considers three income categories, low, middle, and high, the rejected variable is 'low income',
- education involves five educational levels, none, some secondary (primary), secondary degree (secondary), post-secondary (tertiary) and postgraduate (graduated), in this case, the benchmark is 'some secondary',
- internationalization, is measured as the proportion of the entrepreneur's customers who normally live outside the country, comprises seven ranges, none, 1-9, 10-24, 25-49, 50-74, 75-89, and  $\geq 90$  percent of costumers live abroad, the discarded variable is 'no costumers live abroad', and
- economic activity, classifies one activity in the primary sector, agriculture, forestry, and fishing (primary); two activities in the secondary sector, mining and construction (miningcons), and manufacturing (manufactur); and nine activities in the tertiary or service sector. The model includes the primary and secondary activities and five service activities: i. utilization, transport, storage (transstor), ii. retail trade, hotels and restaurants (rethotres), iii. information and communication (infocom), iv. government, health, education, social services (govheledu), and v. personal consumer services (perconser); the other four: i. wholesale trade, ii. financial intermediation, real estate activities, iii. professional services, iv. administrative services are discarded and left as the benchmark.

The criteria to set the benchmark categories is based on choosing those dichotomous variables whose coefficients are more statistically different than the others. In the case of 'economic activity', we also consider as rejection criteria those categories that have less weight in the economy.

The results are presented in Table 1. We do not report logit and probit coefficients, instead, we display the marginal effects on the dependent variable at the mean of the explanatory variables X. The marginal effects are interpreted as the increase or decrease in the probability an entrepreneur has to innovate when the binary variables change in option, the marginal effect is computed concerning the benchmark.

Table 1  
 Marginal effects on the possibility the entrepreneur has to innovate

Variable	LOGIT		PROBIT	
	Marginal effects	Statistic Z	Marginal effects	Statistic Z
Age				
18-24	0.132	(2.42)*	0.131	(2.41)*
25-34	-0.063	(-1.31)	-0.062	(-1.3)
35-44	-0.044	(-0.92)	-0.044	(-0.93)
45-54	-0.014	(-0.27)	-0.015	(-0.29)
Gender				
female	0.072	(2.85)*	0.070	(2.82)*
Income				
Middle	0.110	(3.27)*	0.107	(3.21)*
High	0.100	(3.01)*	0.098	(2.98)*
Education				
None	0.067	(1.43)	0.067	(1.43)
Secondary	0.005	(0.2)	0.006	(0.21)
Tertiary	0.092	(1.54)	0.089	(1.49)
graduated	0.195	(1.99)*	0.194	(1.98)*
% customers abroad				
≥ 90	0.263	(0.97)	0.256	(0.95)
75-89	0.306	(1.79)**	0.276	(1.67)**
50-74	0.281	(2.13)*	0.275	(2.08)*
25-49	-0.077	(-0.75)	-0.071	(-0.7)
10-24	0.016	(0.25)	0.015	(0.24)
1-9	-0.065	(-1.41)	-0.067	(-1.44)
Economic activity				
primary	0.119	(0.81)	0.121	(0.82)
miningcons	0.030	(0.27)	0.030	(0.26)
manufacture	0.134	(2.34)*	0.132	(2.34)*
transstor	-0.039	(-0.43)	-0.041	(-0.46)
rethotres	-0.012	(-0.27)	-0.011	(-0.26)
Infocom	0.228	(2.49)*	0.221	(2.42)*
govheledu	-0.045	(-0.79)	-0.045	(-0.79)
perconser	0.092	(0.67)	0.092	(0.67)
Motivation				
Opportunity	0.010	(0.37)	0.010	(0.38)

Notes: Dependent variable: the probability that the entrepreneurs whose product or service is considered new and unfamiliar by some or all of their potential customers. \*Statistically significant at 5 percent, \*\*statistically significant at 10 percent.

Source: own computation

The difference in coefficients and their level of significance between the logit and probit models is negligible. Nevertheless, in order to select the most robust estimation, we obtain the statistics from Akaike and Bayesian information criteria, the results are reported in Table 2. The model with the smaller statistics is more convenient than the other. In this case, both statistics have smaller values in the logit model and therefore, we interpret the results on the basis of this estimation.

Table 2  
Information criteria

	Logit		Probit
AIC	2372.512	AIC	2373.106
BIC	2520.454	BIC	2521.047

Source: own computation

## Comments on the results

According to the information presented in Table 1, we obtain the following results:

In the set of variables representing age, only the range from 18 to 24 is statistically different from the benchmark and enters the equation with a positive sign. Young entrepreneurs between 18 and 24 years old have 13 percent more probability to innovate than those who are 55 or more. The other ranges of age do not vary significantly in relation to the benchmark. It indicates that the youngest entrepreneurs are more innovative, and from 25 years or so, the generations innovate less and in similar proportions.

In this respect, the results satisfy Hypothesis 1, stressing that the youngest entrepreneurs innovate more than the older ones. The disaggregation at different age levels allowed us to identify which particular range of age tends to be more innovative in our sample. Our outcome suggests that the youngest adults have more capabilities to undertake and innovate, and they even manage to overcome difficulties such as lower income barriers. Outstanding business people created their firms and launched disruptive innovations when they were less than 25, this is the case of Steve Jobs, Mark Zuckerberg, Elon Musk and Bill Gates, among others.

Our results are consistent with previous studies pointing out more skills of young people to innovate than older ones (Favré-Bonté and Giannelloni, 2007, Loué, 2018); but are opposite to those obtained by Ruiu and Breschi (2019) who argue that older individuals are not less likely to innovate than younger individuals, however, they stress that this pattern occurs in developed countries and not in countries with lower income.

The results on the gender variable indicate that women entrepreneurs innovate 7 percent more than men. This is consistent with Hypothesis 2. On the other hand, the literature tends to point out opposite results in the sense that there is no significant difference between gender in the pursuit of innovative new



ventures (Cowden and Tang, 2017) or that men have a more general entrepreneurial attitude than the woman (Sastre-Castillo et al., 2015). This latter pattern is due to women's underrepresentation in productive and innovation activities; barriers in access to education, employment and entrepreneurship for women; and lack of gender perspective in policies towards innovation and entrepreneurship (Liberda and Zajkowska, 2017).

An explanation for this contrasting evidence for a developing economy, the case of México, is that women perform better professional training and create stronger loan backgrounds than men, as outlined before, and to some extent that in Mexico existed sound social and entrepreneurial programs with gender perspective up to 2018.

Middle- and high-income entrepreneurs have 11 and 10 percent more probability to innovate respectively than low-income ones. This outcome satisfies Hypothesis 3, that is to say, people require more income to start a business and to innovate. Previous studies have also reached the conclusion that income is a determinant of innovative entrepreneurship (Hessels, et al., 2008; Romero and Martínez-Roman, 2012), and that innovative entrepreneurship requires more funding than the mere act of undertaking (Matulova, 2020). For a developing country, this finding can be explained because entrepreneurs with supportive wealth or capital and additional income earning can have more elements to keep the business operating, innovating and counteracting risks, in the absence of attractive loans or alternative financing sources. This study contributes to the analysis by comparing the effect of three income levels in a developing economy.

Entrepreneurs with postgraduate training have nearly 20 percent more probabilities to innovate than those with primary education. The effect of the none, secondary and tertiary education on entrepreneurial innovation does not vary significantly in relation to the benchmark, primary education. This result partially meets Hypothesis 4 since the positive relationship between educational level and the dependent variable is more significant for the case of highly skilled entrepreneurs. At other levels of education, the effect is lower and varies indistinctively among them. The literature highlights the role of education as a determinant of innovative entrepreneurship (Romero and Martínez-Roman, 2017, Block, et al., 2017)); in particular there exist findings approaching our results, by stating that experimentation with new ideas and the risky introduction of innovative products occurs more often among well-educated and post-graduate entrepreneurs (Sorgener, et al., 2017, Malerba and McKelvey, 2020). The result partially satisfies the spillover theory and supports the theorization that a greater amount of knowledge is associated with higher innovation. In a developing country, the innovative entrepreneur might require postgraduate education to compensate for the deficit in education quality at previous educational levels.

The positive effect of the percentage of customers living abroad (internationalization) on the dependent variable is reflected in the ranges from 50 to 74 and 75 to 89 percent, as their corresponding

coefficients are positive and statistically different from 'no customers living abroad', in these cases the probability to become an innovative entrepreneur increases 28 percent and 31 percent respectively in relation to the benchmark. The effect of the other ranges of internationalization does not vary significantly in relation to no internationalization and does not increase as the percentage does. In this sense, Hypothesis 5 is partially satisfied, as the benefit of internationalization improves gradually from 50 to 89 percent and then stops.

An explanation for this outcome is that those firms in México with around the totality of their sales abroad are maquiladoras, whose main role is assembling specific components of a product and putting them abroad to continue the production process in cross-border production networks; this manufacturing stage is carried out by predominantly unskilled workers and therefore, is a routinely process implying no innovations. A positive relationship between internationalization and innovative entrepreneurship has also been found in previous studies (Hessels, et al., 2008, Lamotte and Colovic, 2014. Kunday and Şengüler, 2015). The article finds additional information to that provided by the resource-based view theory by finding the level of internationalization that benefits entrepreneurship and innovation in a developing country.

The manufacturing variable has a positive and statistically significant coefficient, the entrepreneurs in this sector have 13 percent more probability to innovate than those in the set of service variables chosen as the benchmark, and the result is in keeping with the orthodox theory commented in the study. The variables in the primary, mining and construction sectors, besides four of five variables in the service sector are not statistically different from the benchmark. In this context, Hypothesis 6 is satisfied. It is worth noting that the variable on information and communications is also positive and statistically significant, entrepreneurs in this service activity have 23 percent more probability to innovate than those in the service activities included in the benchmark.

This result illustrates how manufacturing is now competing in innovation with knowledge-intensive services activities and shows that sustained development, supported by innovation, is beyond industrialization and should be based as well on other knowledge-intensive sectors. The result on the manufacturing variable is consistent with the relevant literature, as studies on innovative entrepreneurship focus mainly on the manufacturing sector, due to the relative capacity of the sector to innovate (Leal-Rodríguez, et al. 2017, Matsunaga, 2019) and with official reports highlighting the potential of entrepreneurship in the manufacturing sector to innovate (The Executive Office of the President, 2014).

The coefficient from the variable on motivation shows that those entrepreneurs who start a business due to the opportunities they visualize in the market have the same probability to innovate as those who start a business for necessity. In other words, the effect of the two motivation variables on the probability to become an innovative entrepreneur is not statistically different. This outcome rejects

Hypothesis 7 and the theoretical view highlighting the prevalence of the opportunity factor as an innovation determinant.

In keeping with the hypothesis, the relevant literature tends to support the argument that opportunity entrepreneurs are more innovative than necessity entrepreneurs. (Acs, et al., 2008, Hessels, et al., 2008, Romero and Martínez-Román, 2012). However, these studies mainly focus on developed countries or include a few developing countries in their samples. An explanation for our result is that in developing countries like Mexico, there are social and economic weaknesses such as lack of unemployment insurance, high unemployment rates or low average wages and hence, people can start innovative businesses driven by these causes, in similar proportions to those led by opportunities in the market. In contrast, in developed countries, the social security system provides more protection to people and therefore, they have less need to turn to innovative entrepreneurship as an alternative source of income and subsistence.

## **Conclusions and summary of the results**

The development of an innovative entrepreneur's profile is a task requiring a boost by the government because in turn calls for proper skills, financial support and adequate socioeconomic conditions. The profile does not hold global features, it can vary from country to country regarding the level of development and structural conditions of every economy. In this context, it is important that every country identifies the most common characteristics of its innovative entrepreneur to create proper policies to develop individuals holding desirable features.

Most of the research to build the profile of the innovative entrepreneur has been conducted in developed countries, while in developing countries there is a gap in the matter. For the particular case of Mexico, and to our best knowledge, no studies are exploring the profile at the national level. Hence there is room in the literature to build a profile of the innovative entrepreneur with characteristics suitable for developing countries.

We test the profile on the bases of seven hypotheses formulated in the study and also contrast the results with a theoretical framework.

The results support the hypothesis that younger people innovate more than older ones, based on the theorization that future returns delay more when the new business incorporates innovation, and hence, younger entrepreneurs who are more likely to collect the rewards of starting a new firm are also more likely to prefer firm creation and the probability increases when the firm incorporates innovation. Our main finding is that innovation occurs more in people from 18 to 24 years. The result is contrasting with

the theoretical and empirical approach for developed countries, in which older people do not lose innovative skills due to sustaining old-age innovative entrepreneurship policy.

The theoretical approach stressing that the culturally preestablished role might reduce innovation probabilities for women in comparison to men, which is reinforced in developing countries, as customs and habits prevail in marginalized regions is not adopted in our hypothesis. Instead, we hypothesize that women innovate more than men because they obtain better performance in higher education and have a more reliable financial background. Our main finding is that the results support the hypothesis, and they diverge from the prevailing approach for developing countries.

Middle- and high-income people innovate more than low-income people, the outcome is supportive of the hypothesis that there is a positive relationship between income and innovative entrepreneurship. It also supports the theorization that lower-income countries have weak financial structures to provide loans and constrained policies to foster innovation, and hence, the entrepreneurs in most cases must finance themselves to innovate. Our main finding is that the result is opposite to the general approach in the literature with emphasis on developed countries, in which both low- and higher-income people can have similar opportunities to undertake an innovation by being supported by government programs.

The analysis shows that entrepreneurs with graduated educational levels innovate more than those holding lower educational achievement and it is in keeping with the hypothesis formulated in the study. To some extent, the result is consistent with the spill over theory, which states that a greater amount of knowledge tends to be associated with higher innovation, and this is what empirical results in the literature point out for developed countries. The difference with our results is that only the graduated educational level is statistically different from other educational levels in a developing country such as Mexico, and this finding is one of the main contributions of the paper. An explanation for this is that developing countries require to compensate for the deficit in quality education with higher or even postgraduate education to achieve innovative skills.

The resource-based view theory places the entrepreneur's ability to innovate as a determinant of the internationalization of the firm, and this is associated with the hypothesis of the paper stating that there is a positive relationship between innovative and exporter entrepreneurs. In this context, we might expect that internationalization is linearly associated with levels of innovation. However, our main finding indicates that only entrepreneurs with a level of internationalization between 50 and 89 percent are statistically and significantly associated with innovation. An explanation for this is that firms in Mexico or developing countries with around the totality of their sales abroad are mainly maquiladoras, and their routinely processes imply little or no innovation.

The hypothesis formulated in the study 'entrepreneurs innovate more in the manufacturing sector than in the service and primary sector', is supported by the heterodox theory explained in the paper, is also satisfied through our results, and is consistent with relevant literature. Moreover, we find that the sector of information and communications is also statistically related to innovation. This outcome is expected to occur both in developed and developing countries because is a worldwide growing knowledge-intensive sector.

The outcome rejects the hypothesis and the theoretical approach that the opportunity entrepreneur is more likely to innovate than the necessity entrepreneur because the effect of the two motivation variables on the probability to undertake and innovate is not statistically different. This hypothesis is more suitable for developed countries, but our main finding is that the necessity motivation is also a way to undertake innovation in emerging economies. This can happen due to social and economic weaknesses in developing countries, which causes people to undertake and innovate as a way to overcome their needs.

The paper has developed the profile of the innovative entrepreneur in a developing economy. In addition, it contrasts the results with theories prevailing in the relevant literature, tests the hypothesis formulated in the analysis, and finds exiting differences in profiles between developed and developing countries like Mexico. This is done by conducting a parametric analysis of the case of Mexico and contrasting the outcome with arguments and results in previous studies. In this respect, the study contributes to fill the gap in the development of the innovative entrepreneur profile for developing countries and particular Mexico.

Nevertheless, further research is needed. We propose to conduct a multicountry parametric analysis to contrast outcomes emerging from countries with different levels of development, it can be done either with microdata analysis, quantile regressions, panel data methodologies or some other type of parametric estimation. It is also required further research to explore managerial implications and policies to be undertaken by governments and organisations to foster innovative entrepreneurs' profiles in developing countries.

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