International Review of Entrepreneurship, Article #1523, 14(1): pp. 1-24.

Human Capital as a Driver of Innovation Among Necessity-Based Entrepreneurs

Pourya Darnihamedani[1]
NEOMA Business School, France and Erasmus School of Economics, Erasmus University Rotterdam, the Netherlands

Jolanda Hessels
Erasmus School of Economics, Erasmus University Rotterdam, the Netherlands

Abstract. Although often treated as one group, necessity-based entrepreneurs are heterogeneous in terms of their backgrounds, ambitions and performance. For instance, some of them introduce new products or services to the market while others do not. To gain more insights into this heterogeneity, this paper investigates the drivers of innovation among necessity entrepreneurs taking a human capital perspective. We apply various two stage probit models correcting for potential selection biases (in particular for entry into entrepreneurship) using individual-level data for over 80 countries from the Global Entrepreneurship Monitor (GEM) from 2002 to 2011. We find that necessity entrepreneurs with high levels of formal education are more likely to be involved in product and process innovations. Furthermore, our results suggest that prior entrepreneurship experience is not or at best weakly related to innovation whereas perception of entrepreneurial skills is positively related to (product) innovation.

Keywords: necessity entrepreneurship, product innovation, process innovation, human capital, Global Entrepeneurship Monitor (GEM).

Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

1. Introduction

Entrepreneurs are assumed to be the source of innovation and creativity by many scholars and policy-makers. Audretsch and Thurik (2001) argued that entry stimulates existing companies and (other) entrants to innovate, mainly as a result of increased competition. Thus, entry often means more competition over customers. Existing companies, in order to keep up with rivals, either provide new products to the market or provide current products through different channels (Drucker, 1985, p. 50). Although entrepreneurs may stimulate competition and

1. Pourya Darnihamedani, NEOMA Business School, Mont-Saint-Aignan, France. Tel: +33 (0)2 32 8257 00. Email: pourya.darnihamedani@neoma-bs.fr and Jolanda Hessels, Erasmus School of Economics, Erasmus University Rotterdam, the Netherlands, Tel: +31 10 4081437. Email: hessels@ese.eur.nl

innovation in the market, they are not equally engaged in innovation. Recent empirical findings suggest that some entrepreneurs demonstrate a higher propensity to engage in innovation than other entrepreneurs (Poschke, 2013; Anokhin and Schulze, 2009; Block et al., 2015). According to these studies, start-up conditions (e.g., the reasons an entrepreneur has to start a business) are one of the main determinants of engagement in innovative activities. This is mainly because such conditions can influence the future trajectory of the firm for a long period of time (Baron and Ensley, 2006).

Triggered by empirical observations such as the Global Entrepreneurship Monitor (GEM) study, a number of researchers have pointed to two differing groups of entrepreneurs with dissimilar start-up conditions and potentially diverging macro-economic impacts i.e., opportunity versus necessity based entrepreneurs (Schjoedt and Shaver, 2007; Acs et al., 2005; McMullen et al., 2008). The first group corresponds with the view that entrepreneurs create their venture based on discovering and exploiting an opportunity, and the second group of entrepreneurs are those who have been pushed by unpleasant conditions to start their own business (e.g., by a lack of alternative career options). Prior studies find that the reasons entrepreneurs had to start a business (i.e., necessity-based versus opportunity-based reasons) influence their strategic decisions such as their competitive and marketing strategies (Block et al., 2015; Baptista et al., 2014).

Although the distinction between necessity and opportunity entrepreneurs helped to better understand the diverging impact of start-up conditions on post-entry strategic decisions and performance of entrepreneurs, one often mentioned critique is that the opportunity-necessity distinction is too crude and does not do justice to the diversity in both groups' members (Williams and Williams, 2011; Block and Wagner, 2007). Prior studies assume that there is a correlation between start-up conditions, human capital and resource endowments (Block et al., 2015; Hessels et al., 2008). While this assumption may be partly true, it does not point to the heterogeneity existing within the sub-groups of necessity (or opportunity) entrepreneurs. Individuals with diverse background (e.g., high or low levels of education) may lose their job and start a business out of necessity. Such diverse backgrounds can differently influence individuals' entrepreneurial behavior and decisions.

Thus, besides inter-group differences between necessity and opportunity entrepreneurs, there may be intra-group dissimilarities that may also play an important role for strategic decisions of entrepreneurs. We argue that studying sub-groups of necessity (or opportunity) entrepreneurs with heterogeneity in terms of individual characteristics (e.g., human capital) can explain a considerable amount of entrepreneurs' behavior and decisions. Engagement in innovation is an important early-stage entrepreneurial decision that is influenced by individual characteristics of the entrepreneur, next to his/her startup conditions. Individual characteristics, such as human capital factors, can

influence the creativity, critical thinking ability and propensity of finding and realizing a novel idea by the entrepreneur.

We build our arguments mainly on human capital theory to investigate the determinants of innovation among necessity entrepreneurs. Human capital theory implies that investments in human capital would enable someone to produce economic value in the future (Becker, 1993; Schultz, 1959). Entrepreneurship studies (Baptista et al., 2014; Davidsson and Honig, 2003) have found that higher amounts of human capital help individuals to find and exploit more novel business opportunities. Some recent findings indicate that human capital may be important for the productivity of necessity entrepreneurs. Block and Sandner (2009) for example, found that opportunity entrepreneurs stay longer in self-employment than necessity entrepreneurs, mainly due to higher levels of education. They suggest that if necessity entrepreneurs are provided with higher levels of human capital (i.e., education), they will be better prepared for self-employment and will eventually survive longer.

Our paper aims at investigating the conditions in which necessity entrepreneurs innovate in terms of product and process innovations. Hence, focusing on the role of human capital investment, which is among the most important influencers of entrepreneurial decisions (Davidsson and Honig, 2003), we try to understand to what extent and in what ways necessity entrepreneurs may decide to devote time and efforts to innovation.

Throughout the paper, among different possible definitions of entrepreneurship, we perceive entrepreneurship as business creation or new organizational development in line with Gartner (1985). The outline of the paper is as follows: first, we develop a number of hypotheses based on prior literature. Subsequently, the data and methodology to test the hypotheses are discussed. Since we suspect that there may be a self-selection bias (mainly because those who select into entrepreneurship might have higher levels of human capital than those who do not select into entrepreneurship), we adopt Heckman bi-probit models to correct for such a bias. After describing and discussing the regression results, we present main conclusions and highlight some (policy) implications.

2. Theory and Hypotheses

Necessity entrepreneurs and innovation

Prior studies investigate determinants of innovative entrepreneurship using environmental and individual perspectives. Considering the environmental determinants, a number of scholars refer to the knowledge spillover theory of entrepreneurship and argue that entrepreneurs exploit innovative opportunities using new knowledge that was created, but not exploited, by incumbent firms (Acs et al., 2009; Agarwal et al., 2007; Ghio et al., 2015). According to these scholars, entrepreneurs convert new and unexploited knowledge into what Arrow

(1962) calls economic knowledge (Acs et al., 2008). Scholars who focus on individual determinants of innovative start-ups have used the product and process innovation dichotomy to understand what types of innovative activities could be undertaken (Adner and Levinthal, 2001; Romero and Martinez-Roman, 2012; Dakhli and De Clercq, 2004). When innovation is oriented toward introducing a new product (or service) to customers, it is labeled as product innovation and when it is oriented toward introducing new procedures or technologies to create value, it is considered as process innovation (Utterback, 1978; Adner and Levinthal, 2001). Because product and process innovations differ in terms of nature and requirements, we believe that this distinction provides us with a clearer picture of how start-up companies innovate.

While several studies have investigated the propensity of small and young firms to innovate versus that of large firms (Acs and Audretsch, 1987; Acemoglu et al., 2014), the propensity to innovate of sub-groups of entrepreneurs with different start-up conditions has received far less attention so far. Koellinger (2008), as an exception, using GEM data for 2002-2004, found that individuals who were formerly unemployed, are more likely to start innovative than (purely) imitative ventures. He argues that individuals in loss are usually more inclined to take risks to get back to their reference point. Their inclination to innovation can be attributed to their extra effort to get back to their income reference point. Thus, necessity entrepreneurs are mainly under survival pressure and hence may, at least to some extent, tend to engage in innovative activities.

However, other studies, arguing that start-up conditions can influence the preparation of the entrepreneur for the new venture, found quite different results (Block et al., 2015, Aldrich and Martinez, 2015). Necessity entrepreneurs have lower access to resources important for creating a new venture and they must make do with whatever resources they can access (Aldrich and Martinez, 2015). Thus, necessity entrepreneurs as compared to non-necessity entrepreneurs are less ready, in terms of prior human and social capital investments, to start a business (Block and Wagner, 2010). Necessity entrepreneurs are also less prepared to start a new venture compared to non-necessity entrepreneurs in terms of gathering resources for starting a new venture. The main reason for this is that necessity entrepreneurs experience substantial time pressure to find income sources (Block and Wagner, 2007). So a rational choice for necessity entrepreneurs is to imitate some other firms in the industry. This is mainly because learning is a slow process while information search is costly and time consuming (Aldrich and Martinez, 2015).

As mentioned earlier, the distinction between product and process innovation is useful to understand how start-ups and small firms can be involved in innovative activities. Necessity entrepreneurs may not be able to find novel business opportunities and even if they do, we suspect that identified opportunities are not the main stimulators for them to start a business. In fact, for necessity entrepreneurs, who are pushed into entrepreneurship due to a lack of

income sources, being novel and innovative has possibly a lower priority compared to having a reliable source of income and to making the new business survive. This may discourage necessity entrepreneurs from engagement in product innovation since innovation is a risky path with possible unknown, or even undesirable, outcomes. In addition, and because of lower investments in human capital (Block and Sandner, 2009) and of being less prepared for entrepreneurship (Block and Wagner, 2010), necessity entrepreneurs may be less cognitively "open" than other entrepreneurs to novel business opportunities in the market.

Regarding process innovation, we suspect that necessity entrepreneurs are less likely to access information regarding new technologies or procedures. This is partly because necessity entrepreneurs have, on average, made lower investments in human capital compared to other entrepreneurs (Baptista et al., 2014). In addition, necessity entrepreneurs may have limited access to start-up capital (Van Stel et al., 2007). Such a financial constraint can make the adoption of new technologies even more difficult for necessity entrepreneurs. New technologies and procedures could be expensive and necessity entrepreneurs may not be able to afford these because of limited access to financial resources.

In spite of being pushed into entrepreneurship, necessity entrepreneurs may still be prone to innovation if they benefit from the right set of skills and knowledge. In the following sub-sections, we investigate the role of general and entrepreneurship-specific human capital factors to understand how these factors can influence necessity entrepreneurs' engagement in innovation.[2]

Human capital factors and innovativeness of necessity entrepreneurs

Becker (1993, p. 246) argues, based on evidence from American college and high school graduates, that college graduates seem to be more "able" than high-school graduates even after controlling for the effect of college education. According to Davidsson and Honig (2003), having the requisite human capital -defined as the stock of knowledge, capabilities, social and personality traits, embodied in the ability to carry out labor so as to produce economic value- such as relevant skills and training, is crucial for opportunity identification and exploitation. Audretsch et al. (2006) argue in the context of small and young firms that a firm's capability to exploit knowledge relies mainly on entrepreneurs' and managers' human capital. Hence, the role of human capital for finding new opportunities and for innovation has been recognized in the entrepreneurship literature.

We argued earlier that human capital theory can provide useful insights into understanding the possible heterogeneity among necessity entrepreneurs in terms of their innovative performance. In the following sub-sections, we argue how some of the most important human capital factors (i.e., formal education, prior

2. We recognize that many (but not all) arguments provided in the discussion below apply to opportunity entrepreneurs as well.

entrepreneurship experience and entrepreneurial skills) can influence the innovative performance of necessity entrepreneurs.

Formal education

Prior studies do not look into the role of formal education for the innovative propensity of entrepreneurs who are pushed into entrepreneurship. However, there has been some evidence in the literature that formal education can increase necessity entrepreneurs' likelihood to innovate. First, higher levels of educational attainment would lead to the development of sets of skills that are useful across a wide range of occupational alternatives and show a significant positive relation with entrepreneurs' venture growth (Gimeno et al., 1997). Honig (1996) found that having a higher level of education associates positively with higher profitability among Jamaican entrepreneurs and specifically attending college or university made the biggest difference for this. Second, higher levels of formal education (e.g., engineering, marketing) can increase the knowledge and abilities of entrepreneurs (Davidsson and Honig, 2003). There are some critiques, however, on the positive relationship between education and entrepreneurs' propensity to innovate. It has been argued that the skill sets that are critical to the success of entrepreneurs may not be the same as those qualifications which are taught in formal education (Casson, 2003). In fact, it can be doubted whether formal education can be used as a proxy for entrepreneurial ability (Parker, 2009, p. 117) as it can, for example, make it difficult for individuals to see opportunities outside their domain of expertise. In addition, one may argue that formal education is very broad and does not provide cutting-edge industry specific knowledge which might be necessary for innovative entrepreneurship.

In spite of these arguments, we argue that a high level of education provides individuals with the capacity to absorb knowledge and facilitates awareness of the possibility to bring novel commercial ideas to the market. Moreover, in some fields such as technical (i.e., engineering) or pharmaceutical fields there is a close link between academic education and knowledge of or insights into designing new products (Parker, 2009). Thus, we suspect that higher levels of education are in fact vital for necessity entrepreneurs in order to come up with new ideas.
Furthermore, a high level of education equips individuals with explicit and tacit knowledge (e.g., a better command of foreign languages, specialization in a technical field) required to absorb new industrial and technological trends (Unger et al., 2011). Additionally, a high level of formal education enhances the analytical skills of individuals to choose a suitable production technology from several available technologies. Thus, we believe that formal education can be helpful for entrepreneurs in order to adopt new production processes or technologies.

Therefore we propose the following hypotheses:

Hypothesis 1a: Necessity-based entrepreneurs who have attained higher levels of formal education are more likely to conduct product innovation than necessity-based entrepreneurs who have attained lower levels of formal education.

Hypothesis 1b: Necessity-based entrepreneurs who have attained higher levels of formal education are more likely to conduct process innovation than necessity-based entrepreneurs who have attained lower levels of formal education.

Prior start-up experience

Prior entrepreneurship experience is an important channel to gain entrepreneurship-specific human capital. Although same industry experience has been investigated as a determinant of self-employment in several studies (Cassar, 2014; Martin et al., 2013), prior entrepreneurship experience has received hardly any attention as a possible determinant of innovation (Koellinger, 2008; Cassar, 2014; Ucbasaran et al., 2011). Prior entrepreneurship experience indicates whether and to what extent individuals have invested time and resources in setting up and running businesses in the past. Prior entrepreneurship experience may indicate that a person fits better in with the entrepreneurial environment than with traditional employment (Markman and Baron, 2003; Koellinger et al., 2015; Zhao et al., 2010). We argue that such experience is likely to bring alertness towards business opportunities as well as to help necessity entrepreneurs to assess opportunities more meticulously (i.e., based on what they learned from previous start-up experiences) (Davidsson and Honig, 2003). Gruber et al. (2012) in a recent study of German technology-based start-ups found that entrepreneurial experience has a positive and significant effect on entrepreneurs' opportunity recognition in the market. Moreover, empirical findings of Bates (1995) show that entrepreneurial experience can help the self-employed to have precise estimations of their abilities, which can help them to know which opportunities may be exploitable and which ones may lead to failure.

Finally, prior start-up experience helps individuals to develop marketing, managerial, planning and problem solving skills which, in turn, lead them to become "jack-of-all-trades" (Lazear, 2005). Furthermore, individuals with prior start-up experience may be better able to exploit novel ideas and commercialize new products. Entrepreneurs with prior experience of setting up a new business may have the tacit as well as explicit knowledge of characteristics of available production technologies (e.g. their price and quality) if they start their new business in the same sector. This knowledge can help them to better assess new available production technologies and machineries in order to utilize them.

Therefore we propose:

Hypothesis 2a: Necessity-based entrepreneurs who have prior start-up experience are more likely to conduct product innovation than necessity-based entrepreneurs who do not have such experience.

Hypothesis 2b: Necessity-based entrepreneurs who have prior start-up experience are more likely to conduct process innovation than necessity-based entrepreneurs who do not have such experience.

Entrepreneurial skills

Entrepreneurs in a Schumpeterian sense are those who develop new marketable products out of inventions and "get things done" by turning an idea or scientific knowledge into "new combinations of means of production" (Schumpeter, 1934, p. 74). In this view, scientific knowledge has no or little economic impact per se unless efforts of some entrepreneurs, relying on their knowledge and skills, are made to turn it into new products/services or new ways to deliver a product/service. Entrepreneurial skills and knowledge can be considered as wide range of abilities and the comprehension needed for entrepreneurs to turn inventions and scientific knowledge into innovative products/services or in new ways of producing or delivering a service (Pyysiäinen et al., 2006).

The possession of entrepreneurial skills and knowledge is vital to commercialize the unexploited slacks of knowledge produced in research centers or R&D labs as implied by the knowledge spill-over theory of entrepreneurship (Audretsch and Keilbach, 2004; Acs et al., 2008). In case of necessity entrepreneurs, we believe that they have had less time and resource endowments to prepare to start their own business as discussed above. We argue that entrepreneurial skills can help necessity entrepreneurs with their preparation for marketing activities, in terms of finding and convincing customers, which may be critical to exploit an innovative idea.

Additionally, necessity entrepreneurs that have entrepreneurial skills and knowledge may have a better understanding of how to form a new firm and how to organize the value chain of activities (e.g., inbound and outbound logistics, procurement, infrastructure). Such knowledge and skills may assist necessity entrepreneurs to form the organization needed to exploit an opportunity. Moreover, such skills can help necessity entrepreneurs to obtain financial resources (e.g., venture capital) due to, for example, the ability to successfully present the business idea (Pena, 2002). In addition, entrepreneurial skills can help necessity entrepreneurs to obtain a network of entrepreneurs or (skilled) employees as such skills may facilitate social networking with peers (Bosma et al., 2004). This is particularly important for necessity entrepreneurs because these entrepreneurs are pushed to start a new business and they have had little time and resources to find and exploit a novel idea. Access to financial and human resources, subsequently, may help necessity entrepreneurs to find and exploit new business ideas as well as new production technologies. Hence, we propose the following hypotheses:

Hypothesis 3a: Necessity-based entrepreneurs who perceive to have entrepreneurial skills are more likely to conduct product innovation than necessity-based entrepreneurs who do not perceive to have such skills.

Hypothesis 3b: Necessity-based entrepreneurs who perceive to have entrepreneurial skills are more likely to conduct process innovation than necessity-based entrepreneurs who do not perceive to have such skills.

3. Data and Methodology

Data

We use annual individual-level data of 89 countries that participated in the adult population survey (APS) carried out as part of the Global Entrepreneurship Monitor (GEM) project from 2002 to 2011. Some of these countries participated in the GEM project every year like the US or the Netherlands while other countries participated only in some years. GEM, as the world's largest entrepreneurship study, is an annual assessment of entrepreneurial activity, aspirations and attitudes of individuals across a wide range of countries (Reynolds et al., 2005). The GEM survey collects data about different aspects of entrepreneurship such as entrepreneurs' activities, ambitions, motivations, and about some aspects related to their human capital profiles which make GEM a suitable dataset to use for our research (Reynolds et al., 2002).

The total GEM sample for 2002-2011 includes 680,372 observations for individuals which include employees, entrepreneurs, unemployed individuals, students and retirees. Of these observations 62,347 individuals are early-stage entrepreneurs (9.2%) i.e., entrepreneurs who have started their business in the last 42 months as well as individuals who are setting up their businesses (i.e., nascent entrepreneurs). Our descriptive statistics (Table 1) show that a considerable percentage of early-stage entrepreneurs (45.3%) state that they provide new or relatively new products or services to the market or that they employ new or relatively new (less than five years old) technologies or procedures (31.6%). Additionally, a substantial rate of entrepreneurs (40%) has had university education. Moreover, Table 1 shows that a very high rate of entrepreneurs (86.1%) believe that they have the necessary entrepreneurial skills, knowledge and experience for setting up a business. Tables 2 and 3 show the descriptive statistics for necessity and non-necessity entrepreneurs. If we compare Table 2 with Table 3, we notice that product innovation on average occurs slightly less frequent among necessity entrepreneurs as compared to non-necessity entrepreneurs, whereas there is no difference in the extent of process innovation among the two groups. In addition, non-necessity entrepreneurs attain higher levels of education but they, on average, less often have start-up experience.

Table 1: Descriptive statistics and correlations for the full sample of early-stage entrepreneurs (N=62,347)

	Mean	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1. Innovation (product and/or process innovation)	0.578	0.494								
2. Product innovation	0.453	0.498	0.759***							
3. Process innovation	0.316	0.465	0.576***	0.171***						
4. Necessity entrepreneurs	0.242	0.428	-0.041***	-0.064***	0.003***					
5. Low level of education	0.289	0.442	-0.051***	-0.059***	-0.035***	0.132***				
6. Medium level of education	0.311	0.465	0.006	-0.020**	0.012***	0.044***	-0.405***			
7. High level of education	0.400	0.482	0.051***	0.070***	0.019***	-0.157***	-0.495***	-0.594***		
8. Prior start-up experience	0.105	0.182	0.032***	0.027***	0.033***	0.036***	0.016***	-0.004***	-0.010***	
9. Entrepreneurial skills	0.861	0.499	0.006**	0.019***	-0.015*	-0.078***	-0.048***	-0.011***	0.053***	0.036***

*** denotes significance at 1%; ** denotes significance at 5%; * denotes significance at 10%.

Table 2: Descriptive statistics and correlations for the sub-sample of necessity entrepreneurs (N=23,859)

	Mean	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Innovation	0. 541	0.498							
2. Product innovation	0.441	0.496	0.728***						
3. Process innovation	0.316	0.464	0.625***	0.172***					
4. Low level of education	0.307	0.461	-0.059***	-0.057***	-0.035***				
5. Medium level of education	0.324	0.468	0.037***	0.011**	0.037***	-0.563***			
6. High level of education	0.314	0.464	0.024***	0.049***	-0.002**	-0.465***	-0.469***		
7. Prior start-up experience	0.118	0.322	0.015**	0.011	0.024***	0.023***	-0.010**	-0.014***	
8. Entrepreneurial skills	0.826	0.379	0.011	0.021***	-0.014	-0.057***	0.023***	0.036***	0.066***

*** denotes significance at 1%; ** denotes significance at 5%; * denotes significance at 10%.

Table 3: Descriptive statistics and correlations for the subsample of non-necessity entrepreneurs (N=38,488)

	Mean	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Innovation	0.592	0.491							
2. Product innovation	0.473	0.499	0.768***						
3. Process innovation	0.317	0.465	0.561***	0.172***					
4. Low level of education	0.216	0.411	-0.044***	-0.050***	-0.037***				
5. Medium level of education	0.309	0.462	-0.016*	-0.025*	0.005*	-0.361***			
6. High level of education	0.443	0.497	0.052***	0.065***	0.027***	-0.494***	-0.632***		
7. Prior start-up experience	0.100	0.295	0.039***	0.035***	0.036***	0.006***	-0.004**	-0.001***	
8. Entrepreneurial skills	0.873	0.332	-0.002	0.012***	-0.016***	-0.029***	-0.019***	0.043***	0.029***

*** denotes significance at 1%; ** denotes significance at 5%; * denotes significance at 10%.

Dependent variables

Innovation is the dependent variable. Product innovation is a dummy variable which takes the value 1 when, according to the respondent, *all* or *some* of their customers consider the product or service new and otherwise it takes the value 0. Process innovation is also a dummy variable which takes the value 1 when the respondent indicates that the technologies or procedures used have been available for *less than five years*. Otherwise, if the technologies or the procedures that are used are indicated to be older, the value 0 is assigned to the process innovation variable.

Independent variables

The human capital indicators (formal education, prior start-up experience and entrepreneurial skills) are defined as follows. Formal education is defined by three dummy variables for low, medium and high levels of education. These levels indicate that respondents have had some secondary school education (low), finished secondary school education (medium) or finished tertiary (i.e., university) education (high). In the regression analysis we include dummy variables for high and medium education and use low education as the reference category. Prior start-up experience is a dummy variable coded 1 when an individual indicates to have, in the past 12 months, sold, shut down, discontinued or quit a business he/she owned and managed, and 0 otherwise. Entrepreneurial skills reflect to what extent people perceive to have the ability (i.e., skills, knowledge and experience required) to start and run a business. Thus, it is a dummy variable coded 1 when individuals think to have such skills and 0 otherwise.

Control variables

Several control variables are taken into account in our regression analysis, including gender (a dummy which takes the value 1 for males), age of the entrepreneur, age of the entrepreneur squared, knowing someone else who started

a business in the last two years, as well as year, industry and country dummies. Furthermore, the four following broad sectors have been included in the analysis using the GEM data: extractive (reference category), transforming, business services and consumer-oriented industries. The countries included in the analysis are listed in Appendix 1.

Selection variables

As we explain in the next section, we use a two-stage selection model to account for potential selection biases since our estimations for determining innovation are based on a sample of early-stage entrepreneurs. To include the decision to become an early-stage entrepreneur in our analyses, the selection model takes entrepreneurial entry as the dependent variable which is defined as whether someone is an early stage entrepreneur (i.e., someone who started a business in the last 42 months or who is actively involved in the process of starting a business) (value 1) or not (value 0).

Independent variables in the selection model have been chosen based on a literature review on individual level determinants of entrepreneurship. Human capital factors can make people entrepreneurially active since the enhancement of cognitive ability that results from higher amounts of human capital can influence the entrepreneurial career decisions of individuals (Parker, 2009). According to Evans and Leighton (1990) and Thurik et al. (2008), the employment status of individuals can influence their decisions to become an entrepreneur. Hence, we added a number of dummy variables based on a question from the GEM questionnaire asking about the employment status of individuals. The employment statuses of individuals are full-time employment, part-time employment, retired, homemaker, student and not working. Entrepreneurial networks can also increase the likelihood for individuals to choose for entrepreneurship (Bosma et al., 2004). Therefore, we added a variable to the selection model indicating whether someone personally knows an entrepreneur who recently (in the past two years) started a business which is a dummy and gets the value 1 for those who know such a person. Furthermore, a set of control variables including age, gender as well as year and country dummies have been added to the model.

Method

Given the binary nature of innovation, we use several two-stage probit regressions with selection estimations (i.e., a Heckman probit model). The main reason to use a regression model taking account of selection bias is that we believe there may be a selection bias when we try to assess whether entrepreneurs innovate, mainly because those who select into entrepreneurship may have a higher level of human capital in the form of formal education, prior start-up experience and entrepreneurial skills (Gimeno et al., 1997; Koellinger and Minniti, 2009; Koellinger et al., 2007). Individuals with less experience, fewer skills or lower levels of education are less likely to become an entrepreneur. This can cause

problems when we try to estimate the impact of human capital on necessity entrepreneurs' propensity to innovate as it could result in upward biased estimations for these relations. Heckman Correction and, in this case, Heckman Probit models can help to address this methodological concern. In addition, and although we have theoretical reasons to assume that there should be a selection bias for entry into entrepreneurship, we have statistically tested for the existence of a selection bias through several likelihood ratio tests. The likelihood ratio tests of rho (which compare the sum of the log likelihoods from selection and outcome models with the log likelihood of the probit model with sample selection) show that selection models are required (Table 4) as the likelihood ratio tests are significant at a 1% level. The Heckman Probit model is similar to other Heckman Correction models (Heckman, 1976; 1979; Puhani, 2000) and is suited in this case given the binary nature of our dependent variables. Hence, we have:

$$Prob(E = \mathbf{1}|Z) = \varphi(Z\gamma) \quad (1)$$

and

$$E = Z\gamma + u_{\mathbf{1}} \quad (2)$$

where E indicates entry into entrepreneurship (E=1 if the person is an entrepreneur and 0 otherwise), Z is the vector of explanatory variables (e.g., human capital, entrepreneurial networks), γ is a vector of unknown parameters and φ is the cumulative distribution function of the standard normal distribution. Estimation of the model yields results that can be used to predict the probability of entrepreneurship for each individual.

The selection equation has entry into entrepreneurship as the dependent variable. Entry into entrepreneurship is defined as whether individuals are involved in early-stage entrepreneurship (i.e., nascent entrepreneurship and young business ownerssship) or not.

The second stage (the outcome model), has the following form:

$$I^{*} = \varphi(X\beta + u_{\mathbf{2}}) \quad (3)$$

Where I^{*} denotes entrepreneurs' propensity to innovate. It is assumed that error terms $u_{\mathbf{1}}$ and $u_{\mathbf{2}}$, have normal distributions and are homoscedastic. Furthermore, error terms are correlated, $corr(u_{\mathbf{1}}, u_{\mathbf{2}}) = \rho$. When standard probit techniques are applied to equation (3), it yields biased results, while the Heckman probit model provides consistent, asymptotically efficient estimates for all parameters in such models (Van de Ven and Van Praag, 1981).

Results

We develop four models to test the hypotheses. Model I and model II (Table 4) use the same set of independent variables for their dependent variables (product and process innovation, respectively) for the full sample of entrepreneurs.

Subsequently, in model III, we focus on the role of human capital factors among necessity entrepreneurs in order to analyze their relationship with product innovation. The last model (model IV) investigates the relationship between the human capital factors and process innovation among the group of necessity entrepreneurs. It should be noted that models I and II take account of the selection into entrepreneurship whereas the last two models take account of the selection into necessity entrepreneurship.

Our results indicate that necessity entrepreneurs are less likely to be innovative in terms of introducing new products or services than non-necessity entrepreneurs (composed of opportunity-based entrepreneurs and entrepreneurs who started up their business with mixed motivations) (model I, Table 4). Since the product innovation variable is a dummy variable, the interpretation of the marginal effect is rather straightforward. Hence, when someone is a necessity entrepreneur, a marginal effect of -5.8% percentage points is reported. This means that evaluated in the sample means, the predicted probability of product innovation moves from 0.44 to 0.38 when the person is a necessity entrepreneur as compared to a non-necessity entrepreneur. However, we find an insignificant negative relation between necessity entrepreneurship and process innovation. Our results thus indicate that there is no significant difference in the propensity to be involved in process innovation between the group of non-necessity entrepreneurs (mainly composed of opportunity-based entrepreneurs) and necessity entrepreneurs.

Models I and II in Table 4 also show the relation of human capital indicators (i.e., (level of) formal education, prior start-up experience, and entrepreneurial skills) with innovation for the full sample of entrepreneurs i.e., including both necessity and non-necessity entrepreneurs. Although we have not developed any hypotheses regarding the relationship between the human capital factors and innovation for the full sample of entrepreneurs, we will briefly discuss some of the results. In general, human capital factors, except for entrepreneurial skills, seem to be equally important for process and product innovations. Formal education and prior start-up experience show significant positive relationships with both types of innovation. Entrepreneurial skills have a significant positive relationship with product innovation, while it shows no significant relationship with process innovation.

With regard to hypotheses 1a and 1b, our analysis supports that having a higher level of formal education (as opposed to having a low level of education) is positively and significantly related to product and process innovations among necessity entrepreneurs (models III and IV). Thus these hypotheses are accepted. Hypotheses 2a and 2b anticipated a positive role of prior start-up experience for product and process innovations among necessity entrepreneurs. Prior start-up experience has a positive relationship with process innovation which is significant at 10% level whereas its relationship with product innovation is not significant. Hence, hypothesis 2a is not supported but hypothesis 2b is weakly supported.

Finally, hypotheses 3a and 3b foresaw positive relationships between the attainment of entrepreneurial skills and both product and process innovations among necessity entrepreneurs. Hypothesis 3a indicating a positive relationship between perceived entrepreneurial skills and product innovation is supported by our analysis. However, we found that entrepreneurial skills are not significantly related to process innovation so we reject hypothesis 3b.

Regarding the control variables, we find that gender is not significantly related to necessity entrepreneurs' propensity to innovate (models III and IV of Table 4). In addition, age associates significant and negatively with innovation which is decelerating considering the positive sign of the coefficient for age-square. Entrepreneurial networks in the form of knowing another entrepreneur has a significant positive relationship with necessity entrepreneurs' propensity to introduce a new product but it has a significantly negative relationship with process innovation.

Regarding the selection variables (Table 4), after controlling for employment status, country and year dummies, we found for necessity entrepreneurs that a high level of education shows a significant negative association with selection into entrepreneurship. Prior start-up experience and entrepreneurial skills show a significant positive relationship with selection into entrepreneurship. Lastly, knowing someone else who started a business demonstrates a significant positive relation with (necessity) entrepreneurial entry.

Table 4: Results of the (bi-probit) two-stage regression analysis with product and process innovation as the dependent variables

	Innovation among the full sample of entrepreneurs					Innovation among the sub-sample of necessity entrepreneurs				
	Product innovation (model I)		Process innovation (model II)		Entrepre-neurial entry (selection model)	Product innovation (model III)		Process innovation (model IV)		Entrepre-neurial entry (selection model)
Predicted probabilities	0.44		0.32			0.39		0.33		
	Marginal effect (%)	Coefficient	Marginal effect (%)	Coefficient	Coefficient	Marginal effect (%)	Coefficient	Marginal effect (%)	Coefficient	Coefficient
Necessity entrepreneurship	-5.8%	-0.177***	-0.6%	-0.022		NA	NA	NA	NA	
Human capital factors										
Medium level of education [a]	2.6%	0.079***	1.9%	0.068***	0.009	1.0%	0.041	2.3%	0.117***	-0.081***
High level of education [a]	6.1%	0.186***	3.8%	0.136***	0.007	2.3%	0.089**	3.6%	0.187***	-0.218***
Prior start-up experience	3.8%	0.115***	3.9%	0.141***	0.316***	1.9%	0.074	2.3%	0.116*	0.308***
Entrepreneurial skills	7.9%	0.238***	1.5%	0.055	0.754***	5.6%	0.219***	6.3%	0.093	0.490***
Control Variables										
Gender: male	-0.5%	-0.016	1.2%	0.043***	0.051***	-0.01%	-0.0001	-1.0%	-0.007	-0.034***
Age of entrepreneur	-0.6%	-0.018***	-0.3%	-0.011**	0.012***	-0.4%	-0.017**	-0.5%	-0.027***	0.012***
Age-squared	0.05%	0.0002***	0.02%	0.0007	-0.0002***	0.4%	0.015	0.6%	0.031**	-0.018***
Knowing someone who started a business	4.2%	0.127***	2.5%	0.088***	0.324***	2.4%	0.092***	-2.3%	-0.119***	0.185***
Industry dummies [a]										
Transforming	5.4%	0.164***	1.6%	0.059*		4.6%	0.179***	1.6%	0.083	
Business services	7.3%	0.222***	4.6%	0.169***		6.3%	0.247***	3.8%	0.194***	
Consumer-oriented	6.7%	0.202***	2.0%	0.073**		5.5%	0.214***	3.0%	0.157***	
Employment status: part-time work [a]					0.027					-0.068***
Employment status: retired, disabled					-0.465***					-0.536***
Employment status: homemaker					-0.509***					-0.556***
Employment status: student					-0.626***					-0.663***
Employment status: not working					0.435***					0.153***
Country dummies		Included		Included	Included		Included		Included	Included
Year dummies		Included		Included	Included		Included		Included	Included
Constant		-0.797***		6.325***	-1.929***		-1.098***		8.910***	-2.446***
Sample size		61,842		61,045	680,372		23,535		23,096	640,608
Likelihood Ratio test (rho=0)		5.50**		6.63***			7.74***		9.02***	

*** denotes significance at 1%; ** denotes significance at 5%; * denotes significance at 10%.
[a] Reference categories are low level of education (education level), extractive industries (industry), and full-time work (employment status).

4. Discussion and Conclusion

This paper aims to shed light on the conditions under which necessity entrepreneurs are more likely to innovate. Despite the considerable amount of attention for innovative activity in the entrepreneurship literature and that many entrepreneurs start their own businesses due to necessity-based reasons, it has remained unknown what factors stimulate innovative activities among this group of entrepreneurs. This is mainly due to the fact that studies on the relation between innovation and entrepreneurship have not focused on heterogeneity within the

sub-groups of entrepreneurs with similar start-up motivations (e.g., Koellinger, 2008). This study, by taking an individual level approach, is, to the best of our knowledge, the first micro-level study which investigates entrepreneurs' propensity to innovate by distinguishing between subgroups of necessity and non-necessity entrepreneurs. In addition, the two stage probit regression with Heckman correction which is used in this paper to take possible selection bias (for entry into entrepreneurship) into account, has not been used in other similar micro-level studies on the relationship between entrepreneurship and innovation (Koellinger, 2008; Zhao, 2005; Schaltegger and Wagner, 2011).

Our study looks into the role of human capital factors, particularly formal education, prior start-up experience, and entrepreneurial skills, for the innovative performance of necessity entrepreneurs. Reviewing the literature has shown that these factors are among the main variables predicting entrepreneurs' stock of tacit and explicit knowledge (Polanyi, 1967; Davidsson and Honig, 2003; Marvel and Lumpkin, 2007). According to our results, formal education positively relates to necessity entrepreneurs' propensity to innovate (i.e. product and process innovations). In line with Becker (1993), we believe that formal education associates with necessity entrepreneurs' level of cognitive development enabling them to consider or test "new combinations of means of production". The role of formal education is interesting to observe in our analyses as it has a negative influence on the entry of necessity entrepreneurs but a positive influence on their innovativeness. This suggests that education discourages the entry in the form of necessity entrepreneurship because on average, higher educated individuals are not pushed to start a business due to unpleasant conditions. Nevertheless, we found a significant positive relationship between formal education and necessity entrepreneurs' propensity to introduce new products or services to the market. As argued, higher levels of formal education, e.g., a background in engineering or pharmacy, provide a wide range of skills and knowledge that are required for designing new products (Parker, 2009). In addition, higher levels of education signal the qualification of the entrepreneur which can be important for entrepreneurs when trying to find external financing and to convince investors about new ideas. Our findings also show a significant positive relationship between formal education and process innovation. This is mainly because formal education may expose necessity entrepreneurs to new production technologies and, again, signal the qualification of the entrepreneur that may help to acquire the financing needed to obtain such technologies.

There have been a number of papers in the literature about the possible association between prior start-up experience and the propensity to become an entrepreneur (Gimeno et al., 1997; Robinson and Sexton, 1994; Baron and Ensley, 2006). In line with these studies, we also find a strongly positive relationship between prior start-up experience and selection into entrepreneurship. We further investigated the importance of prior start-up experience for necessity entrepreneurs' propensity to innovate while considering

the selection bias for entry into entrepreneurship. Surprisingly, we found that prior start-up experience of necessity entrepreneurs does not significantly relate to their likelihood to conduct product innovations. One may argue that necessity entrepreneurs' previous entrepreneurship experience was possibly in the form of necessity-based and even imitative entrepreneurship because their current condition (i.e., being a necessity entrepreneur) probably results from prior disadvantaged labor market and income conditions (Block and Sandner, 2009; Baptista et al., 2014). This may imply that their prior entrepreneurship experience does not contribute much to creative thinking, possibly explaining the non-significant result.

Finally, necessity entrepreneurs' perception of having entrepreneurial skills and knowledge also shows a significant positive relation with product innovation in addition to its positive relation with entrepreneurial entry. Here the explanation could be that entrepreneurial skills may facilitate necessity entrepreneurs' propensity to innovate rather than to imitate. A higher perceived level of entrepreneurial skills can stimulate heterodox and creative thinking of entrepreneurs as it can partly reflect necessity entrepreneurs' ability and skills to possibly provide a different and "new combination of means of production" (Schumpeter, 1934, p. 74; Parker, 2009; Koellinger and Minniti, 2009). We know that necessity entrepreneurs, by definition, are pushed to start their business and that they are often less ready to start a new venture and have lower entrepreneurial ability than non-necessity entrepreneurs (Hinz, and Jungbauer-Ganz, 1999). Thus, when necessity entrepreneurs possess entrepreneurial skills, they are able to better prepare for entrepreneurship and for launching a successful venture. Necessity entrepreneurs, when they have required entrepreneurship-specific skills and knowledge, can be more prosperous in attracting financial means often needed to form an innovative venture.

Implications and Future Studies Suggestions

Several policy implications can be derived from our study. First, our results would suggest that governments aiming to increase the quality of the overall pool of entrepreneurs could facilitate networking with innovative entrepreneurs, e.g., as role models or mentors. Secondly, higher levels of formal education reduce the likelihood for someone to become a necessity entrepreneur, probably because higher education provides access to attractive job opportunities in paid employment. However, in case those who have become necessity entrepreneurs are higher educated, they are more likely to innovate than less educated necessity entrepreneurs. Hence, our findings imply that providing formal education opportunities for individuals not only results in lower rates of necessity entrepreneurs but, depending on the number of higher educated individuals entering necessity entrepreneurship, it may also increase the share of innovative entrepreneurs among the group of necessity entrepreneurs. Furthermore, our results show that entrepreneurship-specific human capital in the form of (self-

perceived) entrepreneurial skills and knowledge may facilitate innovation among necessity entrepreneurs. Although imitative entrepreneurs could certainly benefit economies, e.g., through spilling over knowledge and creating competition (Schmitz, 1989), excessive entry of imitative entrepreneurs can discourage the entry of innovative entrepreneurs since it may reduce entrepreneurial profit (Schumpeter, 1934; Wong et al., 2005). With this in mind, governments may decide to stimulate the development of entrepreneurial skills through tailored educational programs as entrepreneurs with such skills may be more likely to introduce new products or services to the market.

There are a number of possible avenues for future studies that we would like to highlight. First, scholars could seek to use more objective measures for innovation (e.g., sales of new products compared with total sales) as well as for human capital factors (e.g., years of work and industry-specific experience). Second, instead of a cross-sectional dataset, a longitudinal study could help to determine whether there is a causal relationship between being a necessity entrepreneur and performance of the venture or between human capital factors and necessity entrepreneurs' propensity to innovate. Third and finally, as an extension of the present study, future studies could also look into the role of other individual factors, e.g., risk taking attitude, over-optimism or the composition of the entrepreneur's social network for necessity entrepreneurs' propensity to innovate.

References:

Acemoglu, D., Akcigit, U., Celik, M. A. (2014). "Young, restless and creative: Openness to disruption and creative innovations". NBER Working Paper No. 19894. Cambridge MA: National Bureau of Economic Research.

Acs, Z., Arenius, P., Hay, M., Minniti, M. (2005). *Global Entrepreneurship Monitor 2004: Executive Report*. Babson College and London Business School, Babson Park/London.

Acs, Z., Audretsch, D. (1987). "Innovation, market structure and firm size". *The Review of Economics and Statistics*, *69*(4), 567-574.

Acs, Z., Braunerhjelm, P., Audretsch, D. B., Carlsson, B. (2009). "The knowledge spill-over theory of entrepreneurship". *Small Business Economics*, *32*(1), 15-30.

Acs, Z., Desai, S., Hessels, J. (2008). "Entrepreneurship, economic development and institutions". *Small Business Economics*, *31*(3), 219-234.

Adner, R., Levinthal, D. (2001). "Demand heterogeneity and technology evolution: Implications for product and process innovation". *Management Science*, *47*(5), 611-628.

Agarwal, R., Audretsch, D., Sarkar, M. B. (2007). "The process of creative construction: knowledge spillovers, entrepreneurship, and economic growth". *Strategic Entrepreneurship Journal, 1*(3-4), 263-286.

Aldrich, H., Martinez, M. A. (2015). "Why aren't entrepreneurs more creative?: Conditions affecting creativity and innovation in entrepreneurial activity". In Shalley, C., Hitt, M. A., Zhou, J (eds.). *The Oxford handbook of creativity, innovation, and entrepreneurship* (pp. 445-456). Oxford University Press, New York, US.

Anokhin, S., Schulze, W. (2009). "Entrepreneurship, innovation and corruption". *Journal of Business Venturing*, *24*(5), 465-476.

Arrow, K.J. (1962). "Economic welfare and the allocation of resources for invention". In National Bureau of Economic Research (Ed.), *The Rate and Direction of Inventive Activity: Economic and Social Factors* (pp. 609-626). Princeton University Press, Princeton, US.

Audretsch, D. B., Keilbach, M. (2004). "Entrepreneurship and regional growth: An evolutionary interpretation". *Journal of Evolutionary Economics*, *14*(5), 605-616.

Audretsch, D., Keilbach, M., Lehmann, E. (2006). *Entrepreneurship and economic growth*. Oxford University Press, New York, US.

Audretsch, D. B. Thurik, R. (2001). "What's new about the new economy? Sources of growth in the managed and entrepreneurial economies". *Industrial and Corporate Change*, *10*(1), 267-315.

Baptista, R., Karaöz, M., Mendonça, J. (2014). "The impact of human capital on the early success of necessity versus opportunity-based entrepreneurs". *Small Business Economics*, *42*(4), 831-847.

Baron, R. A., Ensley, M. D. (2006). "Opportunity recognition as the detection of meaningful patterns: Evidence from comparisons of novice and experienced entrepreneurs". *Management Science*, *52*(9), 1331-1344.

Bates, T. (1995). "Self-employment entry across industry groups". *Journal of Business Venturing*, *10*(2), 143-156.

Becker, G. S. (1993). *Human capital (3rd edition)*. University of Chicago Press, Chicago, the United States.

Block, J. H., Kohn, K., Miller, D., Ullrich, K. (2015). "Necessity entrepreneurship and competitive strategy". *Small Business Economics*, *44*(1), 37-57.

Block, J., Sandner, P. (2009). "Necessity and opportunity entrepreneurs and their duration in self-employment: Evidence from German micro data". *Journal of Industry, Competition and Trade*, *9*(2), 117-137.

Block, J. H., Wagner, M. (2007). "Opportunity recognition and exploitation by necessity and opportunity entrepreneurs: Empirical evidence from earnings equations". *Academy of Management Proceedings*, *2007*(1), 1-6.

Block, J. H., Wagner, M. (2010). "Necessity and opportunity entrepreneurs in Germany: Characteristics and earnings differentials". *Schmalenbach Business Review*, *62*(2), 154-174.

Bosma, N., Van Praag, M., Thurik, R., De Wit, G. (2004). "The value of human and social capital investments for the business performance of startups". *Small Business Economics*, *23*(3), 227-236.

Cassar, G. (2014). "Industry and start-up experience on entrepreneur forecast performance in new ventures". *Journal of Business Venturing*, *29*(1), 137-151.

Casson, M. (2003). *The entrepreneur: An economic theory*. Edward Edgar, Cheltenham, the UK.

Dakhli, M., De Clercq, D. (2004). "Human capital, social capital, and innovation: A multi-country study". *Entrepreneurship & Regional Development*, *16*(2), 107-128.

Davidsson, P., Honig, B. (2003). "The role of social and human capital among nascent entrepreneurs". *Journal of Business Venturing*, *18*(3), 301-331.

Drucker, P. F. (1985). *Innovation and entrepreneurship*. William Heinemann Ltd, London, UK.

Evans, D., Leighton, L. (1990). "Small business formation by unemployed and employed workers". *Small Business Economics*, *2*(4), 319-330.

Gartner, W. (1985). "A conceptual framework for describing the phenomenon of new venture creation". *Academy of Management Review*, *10*(4), 696-706.

Ghio, N., Guerini, M., Lehmann, E. E., Rossi-Lamastra, C. (2015). "The emergence of the knowledge spillover theory of entrepreneurship". *Small Business Economics*, *44*(*1*), 1-18.

Gimeno, J., Folta, T., Cooper, A., Woo, C. (1997). "Survival of the fittest? Entrepreneurial human capital and the persistence of underperforming firms". *Administrative Science Quarterly, 42*(4), 750-783.

Gruber, M., MacMillan, I. C., Thompson, J. D. (2012). "From minds to markets: How human capital endowments shape market opportunity identification of technology start-ups". *Journal of Management*, *38*(5), 1421-1449.

Heckman, J. J. (1976). "The common structure of statistical models of truncation, sample selection and limited dependent variables and a simple estimator for such models". *Annals of Economic and Social Measurement*, *5*(4), 475-492.

Heckman, J. J. (1979). "Sample selection bias as a specification error". *Econometrica, 47*(1), 153-161.

Hessels, J., Van Gelderen, M., Thurik, R. (2008). "Entrepreneurial aspirations, motivations, and their drivers". *Small Business Economics*, *31*(3), 323-339.

Hinz, T., Jungbauer-Ganz, M. (1999). "Starting a business after unemployment: characteristics and chances of success (empirical evidence from a regional German labour market)". *Entrepreneurship & Regional Development*, *11*(4), 317-333.

Honig, B. (1996). "Education and self-employment in Jamaica". *Comparative Education Review*, *40*(2), 177-193.

Koellinger, P. (2008). "Why are some entrepreneurs more innovative than others?" *Small Business Economics*, *31*(4), 21-37.

Koellinger, P., Minniti, M. (2009). "Unemployment benefits crowd out nascent entrepreneurial activity". *Economics Letters*, *103*(2), 96-98.

Koellinger, P., Minniti, M., Schade, C. (2007). ""I think I can, I think I can": Overconfidence and entrepreneurial behavior". *Journal of Economic Psychology*, *28*(4), 502-527.

Koellinger, P., Mell, J., Pohl, I., Roessler, C., Treffers, T. (2015). "Self-employed but looking: A labor market experiment". *Economica, 82*(325), 137-161.

Lazear, E. P. (2005). "Entrepreneurship". *Journal of Labor Economics*, *23*(4), 649-680.

Markman, D. D., Baron, R. A. (2003), "Person-entrepreneurship fit: Why some people are more successful as entrepreneurs than others". *Human Resource Management Review*, *13*(2), 281-301.

Martin, B., McNally, J. J., Kay, M. (2013). "Examining the formation of human capital in entrepreneurship: A meta-analysis of entrepreneurship education outcomes". *Journal of Business Venturing*, *28*(2), 211-224.

Marvel, M. R., Lumpkin, G. T. (2007). "Technology entrepreneurs' human capital and its effects on innovation radicalness". *Entrepreneurship Theory and Practice*, *31*(6), 807-828.

McMullen, J. S., Bagby, D. R., Palich, L. E. (2008). "Economic freedom and the motivation to engage in entrepreneurial action". *Entrepreneurship Theory and Practice*, *32*(5), 875-896.

Parker, S. C. (2009). *The economics of entrepreneurship*. Cambridge University Press, Cambridge, the UK.

Peña, I. (2002). "Intellectual capital and business start-up success". *Journal of Intellectual Capital*, *3*(2), 180-198.

Polanyi, M. (1967). *The tacit dimension*. Routledge and Kegan, London, UK.

Poschke, M. (2013). "Who becomes an entrepreneur? Labor market prospects and occupational choice". *Journal of Economic Dynamics and Control*, *37*(3), 693-710.

Puhani, P. A. (2000). "The Heckman correction for sample selection and its critique". *Journal of Economic Surveys*, *14*(1), 53-68.

Pyysiäinen, J., Anderson, A., McElwee, G., Vesala, K. (2006). "Developing the entrepreneurial skills of farmers: Some myths explored". *International Journal of Entrepreneurial Behaviour & Research*, *12*(1), 21-39.

Reynolds, P. D., Bygrave, W. D., Autio, E., Hay, M., Kauffman, M., All, F. (2002). *Global Entrepreneurship Monitor 2002: Executive Report*. Babson College and London Business School, Babson Park/London.

Reynolds, P., Bosma, N., Autio, E., Hunt, S., De Bono, N., Servais, I., Chin, N. (2005). "Global Entrepreneurship Monitor: Data collection design and implementation 1998-2003". *Small Business Economics*, *24*(3), 205-231.

Robinson, P. B., Sexton, E. A. (1994). "The effect of education and experience on self-employment success". *Journal of Business Venturing*, *9*(2), 141-156.

Romero, I., Martínez-Román, J. A. (2012). "Self-employment and innovation. Exploring the determinants of innovative behavior in small businesses". *Research Policy*, *41*(1), 178-189.

Schaltegger, S., Wagner, M. (2011). "Sustainable entrepreneurship and sustainability innovation: Categories and interactions". *Business Strategy and the Environment*, *20*(4), 222-237.

Schjoedt, L., Shaver, K. G. (2007). "Deciding on an entrepreneurial career: A test of the pull and push hypotheses using the panel study of entrepreneurial dynamics data". *Entrepreneurship Theory and Practice*, *31*(5), 733-752.

Schmitz, J. A. (1989). "Imitation, entrepreneurship, and long-run growth". *Journal of Political Economy, 97*(3), 721-739.

Schultz, T. (1959). "Investment in man: An economist's view". *Social Service Review*. *33*(2), 69-75.

Schumpeter, J. A. (1934). *The theory of economic development*, Harvard University Press, Cambridge, US.

Thurik, A. R., Carree, M. A., Van Stel, A., Audretsch, D. B. (2008). "Does self-employment reduce unemployment?" *Journal of Business Venturing*, *23*(6), 673-686.

Ucbasaran, D., Westhead, P., Wright, M. (2011). "Why serial entrepreneurs don't learn from failure". *Harvard Business Review*, *89*(4), 26-36.

Unger, J. M., Rauch, A., Frese, M., Rosenbusch, N. (2011). "Human capital and entrepreneurial success: A meta-analytical review". *Journal of Business Venturing*, *26*(3), 341-358.

Utterback, J. M. (1978). "Management of technology". in Hax, A. (Ed.), *Studies in operation management* (pp. 137-160). North Holland Pub., Amsterdam, the Netherlands.

Van de Ven, W. P., Van Praag, B. M. (1981). "The demand for deductibles in private health insurance: A probit model with sample selection". *Journal of Econometrics*, *17*(2), 229-252.

Van Stel, A., Storey, D. J., Thurik, A. R. (2007). "The effect of business regulations on nascent and young business entrepreneurship". *Small Business Economics*, *28*(2), 171-186.

Williams, N., Williams, C. C. (2011). "Beyond necessity versus opportunity entrepreneurship: Some lessons from English deprived urban neighbourhoods". *International Entrepreneurship and Management Journal*, *10*(1), 23-40.

Zhao, F. (2005). "Exploring the synergy between entrepreneurship and innovation". *International Journal of Entrepreneurial Behaviour & Research*, *11*(1), 25-41.Wong, P. K., Ho, Y. P., Autio, E. (2005). "Entrepreneurship, innovation and economic growth: Evidence from GEM data". *Small Business Economics*, *24*(3), 335-350.

Zhao, H., Seibert, S. E., Lumpkin, G. T. (2010). "The relationship of personality to entrepreneurial intentions and performance: A meta-analytic review". *Journal of Management*, *36*(2), 381-404.

Appendix 1: List of countries in the GEM data

Algeria, Angola, Argentina, Australia, Austria, Bangladesh, Barbados, Belgium, Bolivia, Bosnia & Herzegovina, Brazil, Canada, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Denmark, Dominican Republic, Ecuador, Egypt, Finland, France, Germany, Ghana, Greece, Guatemala, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kazakhstan, Korea (South), Latvia, Lebanon, Lithuania, Macedonia, Malaysia, Mexico, Montenegro, Morocco, Netherlands, New Zealand, Norway, Pakistan, Palestine, Panama, Peru, Philippines, Poland, Portugal, Puerto Rico, Romania, Russia, Saudi Arabia, Serbia, Singapore, Slovak Republic, Slovenia, South Africa, Spain, Sweden, Switzerland, Syria, Taiwan, Thailand, Tonga Islands, Trinidad & Tobago, Tunisia, Turkey, Uganda, United Arab Emirates, United Kingdom, United States of America, Uruguay, Vanuatu, Venezuela, Yemen, Zambia.