Entrepreneurship capital types and economic growth: International evidence

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Abstract: This paper analyzes the effect of entrepreneurship capital types on economic growth. We use an augmented Cobb–Douglas production function, which introduces variables such as entrepreneurship capital into the analysis of growth as endogenous factor. We differentiate our work from the previous studies by using panel data analysis, with 43 countries in the period from 2002 to 2012, and different measures of entrepreneurship capital. Our estimations suggest that these measures have a positive effect on economic growth, specifically overall TEA and opportunity TEA. Distinguishing between groups of countries and periods of time, we find that overall TEA has a greater effect on economic growth in OECD countries and in the post-crisis period for all the countries in our sample. These results suggest new elements to both theoretical discussion and public policy focusing on entrepreneurship capital as an important factor to achieve economic growth.

Keywords: Entrepreneurship capital, Entrepreneurial activity, Economic growth, Cross-country analysis, Panel data.

1. Introduction

Entrepreneurship has been considered an important mechanism to achieve economic growth (Acs et al. 2012; Acs et al. 2008; Audretsch and Keilbach 2004a,b, 2008). Previous authors have provided evidence of the importance of entrepreneurship for growth, distinguishing between self-employment, business ownership and new business creation, among others (Blanchflower 2000; Carree and Thurik 2008; Carree et al. 2002). Such approaches have used elements of neo-classical economic growth and Schumpeterian theory to link entrepreneurship with economic growth.

First, Solow (1956) and Swan (1956) based their model of economic growth on the neo-classical production function, the key factors of which are capital and labor. Ever since, researchers have relied upon the model of the production function as a basis for explaining the determinants of economic growth. Lucas's (1988) and Romer's (1986) critique of the Solow approach did not follow the basic model of the neo-classical production function. Instead, they introduced variables such as human capital and externalities into this analysis to differentiate the types of labor. They found that more skilled labor generates positive externalities as well as more economic growth. Acs et al. (2011), Blanchflower (2000), Colino et al. (2014), Iyigun and Owen (1999) and Minniti and Lévesque (2010) used the neo-classical production function taking into account human capital as well as entrepreneurship (or self-employment) as special characteristics of individuals. Hence, entrepreneurship is

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assessed in an economic growth model to find its impact and complementarity. Second, according to Schumpeter (1934), entrepreneurs are agents capable of generating shocks in the economic cycle through innovation processes. This author develops a theory of economic development based on a creative destruction process generated by entrepreneurial activity. Using this theory, some authors have focused on the relationship between entrepreneurship and economic growth, taking into account the stages of development, finding that business ownership and the gross domestic product (GDP) per capita have a U-shaped form (Carree and Thurik 2008; Carree et al. 2002; Van Stel and Carree 2004). Based on these theories, other authors have proposed entrepreneurship as a conduit of knowledge that affects economic growth (Agarwal et al. 2007; Audretsch 2007; Audretsch and Keilbach 2008; Noseleit 2013).

Using these theories, Audretsch (2007) and Audretsch and Keilbach (2004a,b, 2005, 2008) included one set of forces that drives economic growth (Solow 2007). They developed the entrepreneurship capital concept, which includes the social factors in a production function. However, they were explicit regarding the limitations of entrepreneurship capital measured through firm demography, and suggested for future research that similar studies of other countries as well as studies based on additional indicators of entrepreneurship capital should be conducted. According to Audretsch et al. (2008), the new indicators should capture social and other latent factors in entrepreneurial activity over time and be comparable across countries. Thus, we propose in this paper overall total entrepreneurial activity (TEA), opportunity TEA and necessity TEA as new types of entrepreneurship capital. The Global Entrepreneurship Monitor (GEM) developed these variables, which allow the measurement of new business creation regarding the social context (Wennekers et al. 2005; Wong et al. 2005). According to Acs et al. (2008), on the one hand, these variables use uniform definitions and data collection across countries for international comparisons, and on the other hand, the variables measure the intention and capacity of a community to create firms in order to determine the relationship between entrepreneurship and national economic growth.[1] Using large cross-sections and time series of countries spanning a wide range of economic development allows researchers to gain an understanding of the possible differences in groups of countries and particular periods of time (Acs et al. 2008).

Therefore, the objective of this paper is to analyze the effect of entrepreneurship capital types on economic growth. We support our hypotheses in the conceptual framework that links entrepreneurship capital with economic growth using a neo-classical production function. Using a panel data model with information over the period 2002–2012 from the GEM and World Development Indicators (WDI), we provide empirical evidence of the impact of overall TEA, opportunity TEA and necessity TEA on economic growth, distinguishing between OECD and non-OECD countries and between pre- and post-crisis periods. Furthermore, following Acs et al. (2012), we overcome the endogeneity problem between entrepreneurial activity and economic growth by implementing some instrumental variables. We find that entrepreneurship capital, measured through overall TEA and opportunity TEA, has a positive and statistically significant impact on economic growth. We also find that the

[1] Although we focused on these three measures of entrepreneurship capital, we also considered a self-employment and an employers' measure. The problem with these two variables is the lack of information regarding countries and time.

effect of overall TEA on economic growth is higher in OECD countries and in the post-crisis period.

After this brief introduction, the study is structured as follows. In section 2, we discuss a conceptual framework that relates entrepreneurship capital with economic growth. In section 3, we present the data and model. In section 4, we discuss the results. Finally, in section 5, we conclude and highlight the future research line.

2. Conceptual framework: linking entrepreneurship capital with economic growth

One of the basic questions in economics concerns what drives economic growth. While the neo-classical theory has identified investment in physical capital and labor as the driving factors (Solow 1956; Swan 1956), the endogenous growth theory (Romer 1986) emphasizes the process of the accumulation of knowledge, and hence the creation of knowledge capital. Since Romer's paper, new variables have been included in the neo-classical model. Thus, the new class of endogenous growth model recognizes some aspects of social factors that are also important in generating economic growth.

Putnam (1993) referred to social factors focusing on social capital, which consist of connections among individuals. Using this idea, some authors have linked social capital to entrepreneurship (Aldrich and Martinez 2003; Thornton and Flynne 2003). According to this literature, entrepreneurship should be encouraged where the investments in social capital are greater (Amin 2000; Simmie 2003; Smith 2003). Schumpeter (1934) also mentioned the idea of social capacity, establishing entrepreneurial behavior conceptually as a key factor in driving economic development. Entrepreneurial activity leads to the process of creative destruction (Schumpeter 1934) by causing constant disturbances to an economic system in equilibrium. These disturbances create opportunities for economic rent. In this way, Schumpeter's theory predicts that an increase in the number of entrepreneurs leads to an increase in economic growth. Hence, it is possible to link entrepreneurship with economic growth (Schumpeter 1934). Authors such as Minniti and Lévesque (2010) used this idea to incorporate entrepreneurship behavior into the Solow–Swan growth model. They developed a mathematical structure to demonstrate how entrepreneurship could impact on the steady state. Other authors, such as Audretsch and Keilbach (2004a,b, 2005, 2008), Bjornskov and Foss (2013) and Iyigun and Owen (1999), proved the effect of entrepreneurship on economic growth econometrically. They included entrepreneurship as a new input in the Solow–Swan model to find its relative importance in the growth process.

However, Audretsch (2007) and Audretsch and Keilbach (2004a,b, 2005) introduced the concept of entrepreneurship capital, which refers to the firm demography capable of creating value. This variable was assessed in the Cobb–Douglas production function, finding a positive effect on economic growth, but only at the regional level and using cross-sectional data. Reynolds et al. (2005) proposed a methodology of which the main indicator is overall total entrepreneurial activity (TEA). This methodology measures the stock of the adult population involved in the entrepreneurship process, and includes economic, social and cultural factors in its framework. In addition, this measure is uniform across countries, which is useful for international comparisons. Liñán and Fernandez-Serrano (2014), van Stel et al. (2005), Wennekers et al. (2005) and Wong et al. (2005), without using the entrepreneurship

capital concept, evaluated the effect of overall TEA on economic growth at the national level. However, they also limited their analysis to cross-sectional data. According to Audretsch and Keilbach (2004a,b), other types of entrepreneurship capital could explain economic performance, specifically measures that capture entrepreneurial activity in the social context. Overall TEA and other complementary measures, such as opportunity TEA and necessity TEA, used by van Stel et al. (2005) and Wong et al. (2005), among others, could follow Putnam's (1993) statement about social factors. According to Reynolds et al. (2005), overall entrepreneurship could cause effects on economic performance through the birth and expansion of firms that create jobs. Wong et al. (2005) stated the hypothesis that countries with higher levels of overall TEA will have faster growth rates. Their results showed that overall entrepreneurship is positively related to economic growth but not statistically significantly. According to Reynolds et al. (2000, 2001, 2002), overall TEA and economic growth are conjectured to be positively related. Hence, every person engaged in any behavior related to new business creation, no matter how modest, is relevant to the national level of activity (Reynolds et al. 2005). In this sense, we propose the following hypothesis:

H1: Overall TEA has a positive effect on economic growth.

As we mentioned before, it has been established that knowledge plays an important role in economic growth. For instance, Romer (1986) included a variable of knowledge in the neo-classical production function. Nevertheless, Acs et al. (2011) pointed out that knowledge may not be as automatic as has been assumed in the endogenous growth model. Therefore, other authors have used entrepreneurship as a conduit of knowledge (Agarwal et al. 2007; Audretsch 2007; Audretsch and Keilbach 2008; Noseleit 2013).

According to Reynolds et al. (2005), opportunity TEA can be considered as the net result of individual decisions to pursue entrepreneurial initiatives based on knowledge. Here, opportunity TEA can be associated with innovation. Some authors have come to recognize the capacities of potential entrepreneurial innovation and growth and their significant contribution to prosperity and economic welfare (Acs and Armington 2006; Audretsch 2007; Hajek et al., 2014; Levie and Autio 2008; Schramm 2006). According to Audretsch et al. (2008), entrepreneurs take knowledge-based opportunities and develop them into new products. This increases the amount of knowledge spillovers and has a positive impact on economic performance (Audretsch et al. 2008). These authors also argued that innovative entrepreneurs who invest in the development of new products and services based on new knowledge as a business opportunity can then take advantage with respect to other entrepreneurs. Therefore, opportunity entrepreneurship is an important mechanism in the transformation of new knowledge into economic performance (Audretsch et al. 2008). In this sense, Wong et al. (2005) pointed out that the opportunity TEA rates reflect the creation of knowledge and technology and could impact positively on economic growth (Acs et al. 2011; Noseleit 2013; Valliere and Peterson 2009). Thus, we propose the following hypothesis:

H2: Opportunity TEA has a positive effect on economic growth.

When Reynolds et al. (2005) developed the overall TEA measure in the GEM project, they also split it into two main parts, the first one being opportunity TEA, related to innovative entrepreneurship, as we already explained, and the second one being necessity TEA, which

results from market friction and is generally related to non-innovative firms. Campbell et al. (2010) proved that some regulations could cause friction in markets and force workers into survivalist entrepreneurship. Hence, new firm formation does not causally affect economic growth. In terms of public policy discussion, Shane (2009) advocated caution with respect to the entrepreneurship strategy, which could lead to firms with low job creation, generating little wealth. The individuals in this position tend to possess fewer endowments of human capital and entrepreneurial capability (Lucas 1978). As Wong et al. (2005) suggested, necessity TEA has either no significant relationship or a negative relationship with economic growth. The authors reported that those individuals motivated by necessity are driven to become entrepreneurs due to a lack of other employment opportunities. According to Audretsch et al. (2001), this type of entrepreneurship (capital) could reflect low creation value in the short-term economy growth. The individuals motivated by necessity tend to possess fewer endowments of human capital and entrepreneurial capability (Wong et al. 2005). Therefore, we propose the following hypothesis:

H3: Necessity TEA has a positive effect on economic growth, however the effect is smaller than that of opportunity TEA.

Although the literature has pointed out the importance of entrepreneurship for economic growth, many authors who have used cross-country analysis have made a distinction between high- and low-income countries, OECD and non-OECD countries, and developed and developing countries (Liñán and Fernandez-Serrano, 2014; Carree et al. 2002, 2007; Wennekers et al. 2005; Wong et al. 2005). For instance, Bruton et al. (2008) suggest that future research lines regarding entrepreneurship should focus on understand its effects on developing economies. Following this idea, Bruton et al. (2013) have provided evidence about the importance of entrepreneurship to reduce the poverty level in developing countries. According to Bruton et al. (2009), the effect of entrepreneurship on growth is due mainly to institutional differences. These authors have explored this issue in Latin American and Asian countries. The same idea is discussed by authors such as Acs and Amorós (2008), Stenholm et al. (2013) and Stephan and Uhlaner (2010) who differentiated between drivers of entrepreneurship and their effects on economic growth, considering the development stage and cultural factors of each country. In this regard, Contractor and Kundu (2004) conclude that the absence or circumvention of bureaucracy and corruption, as well as nurturing environment could foster entrepreneurship in developing countries such as India, China and Taiwan in order to obtain higher levels of economic development.

The debate about the relationship between entrepreneurship and economic performance regarding the distinction between groups of countries has presented different points of view. On the one hand, Carree et al. (2002, 2007) and van Stel et al. (2005) found a relationship between entrepreneurship and economic growth in a U-shaped form: entrepreneurship in countries with a high income level tend to be positive related to economic growth, while countries with a low income level have a negative relationship. They also concluded that low-income countries tend to have higher entrepreneurship rates based on necessity than high-income countries. Carree et al. (2002, 2007) used an OECD data set to assess the relationship; meanwhile, van Stel et al. (2005) analyzed the effect of entrepreneurship on economic growth using the GEM data set. Likewise, Wennekers et al. (2005) used a GEM data set to analyze the U-shaped and L-shaped relations for opportunity and necessity nascent

entrepreneurship, separately. They found that in those low-income countries, relatively many nascent entrepreneurs engage in entrepreneurial activity out of necessity. Comparing the two types of data, it is possible to associate high income with OECD countries and low income with non-OECD countries (Carree et al. 2007; Wennekers et al. 2005). Although these authors identified the absence of an effect of entrepreneurship on economic growth in developing countries, it does mean that entrepreneurship should be discouraged; necessity TEA plus opportunity TEA, for instance, both contribute to lowering unemployment (van Stel et al. 2005). Autio (2008) established a gap regarding whether and how entrepreneurship either contributes or does not contribute to economic growth in developing countries. According to Dejardin (2000), the more innovative entrepreneurs exist in an economy, the faster it will grow. Naudé (2010, 2011) argued that if the demand for entrepreneurship is higher in developing countries, as is normally expected, entrepreneurship could also affect positively the economic growth in these countries. Sanyang and Huang (2010) followed the previous idea, discussing the importance of programs that support the entrepreneurial initiatives in developing economies. Specifically, they studied how EMPRETEC, an entrepreneurship program implemented in some developing countries, encourages entrepreneurial activity in order to enhance the economic development. Some results are perceived from indicators such as more educated and skilled people, employment creation, product diversification and economic growth. Valliere and Peterson (2009) and Wong et al. (2005) assessed empirically the relationship between entrepreneurship and economic growth, considering the hypothesis in which overall TEA has a higher impact on economic growth in high-income countries than in those with a low income. The statement of Dejardin (2000), Valliere and Peterson (2009) and Wong et al. (2005) was established in order to understand the composition of entrepreneurial activities in each country. According to Dejardin (2000) and Wong et al. (2005), countries with higher overall TEA rates will experience better growth performance. Regarding the association of high income with OECD countries and low income with non-OECD countries, we propose the following hypothesis:

H4: Overall TEA has a greater impact on the economic growth of OECD countries than that of non-OECD countries.

Carree et al. (2002, 2007) suggested another distinction related to the time dimension. According to them, through time series it is possible to model the equilibrium adjustment mechanism. This implies understanding the relationship between entrepreneurship and economic performance in each part of the growth cycle (adjustment, boom and crisis). With respect to the recent crisis events, the "World Economic Forum's Annual Meeting of the New Champions 2009" (UN 2009) pointed out that the decline in global growth started in 2007, highlighting a new crisis period, especially in those countries with a high income level, and resulted in a contraction in emerging economies.

The recent literature has suggested entrepreneurship as a key element to overcome the world crisis. Some authors have proposed that entrepreneurship based on innovation tends to survive and grow in an economic crisis and enhances the economic performance through employment (Kraus et al. 2012). Cace et al. (2011) suggested that crisis effects generate institutional change, which is reflected in social entrepreneurship behavior as a mediator of welfare. Other institutional changes have been perceived, such as incentives to engage in business creation. In this sense, Năstase and Kajanus (2009) suggested that economic crises

offer policy makers an opportunity to address structural weaknesses and accelerate change, establishing the foundation for stronger and more durable growth. According to these authors, entrepreneurship can weather the current global economic crisis better than current businesses, and thus increase the economic growth. Based on this study, Onofrei and Lupu (2012) suggested that the fostering of entrepreneurial activity in a crisis period also generates new managerial methodologies, useful to both new and established firms, which contribute to the better performance of firms as well as the economy. As a result, more employment could be obtained through job creation or self-employment. In this sense, Copeland and James (2014) studied a policy framework to guide the European decision until 2020, which includes entrepreneurship policies. According to these authors, entrepreneurial activity based on job creation instead of own-account workers is what improves economic performance. Indeed, Cumming and Li (2013) pointed out the importance of funding through venture capital, such as a complementary policy to entrepreneurship in a crisis period, which could imply more entrepreneurs creating jobs and improving the economic growth. Román et al. (2013) investigated the transition from unemployment to self-employment in the European region in the crisis period. They concluded that self-employed people can be considered a heterogeneous group, among which only those self-employed people who contribute to job creation are important to overcoming the crisis and therefore increasing economic growth, otherwise more self-employment will not necessarily achieve economic growth in the long run. According to Thurik et al. (2008), self-employment based on entrepreneurial ideas is stronger in regard to economic growth than self-employment generated by refugee effects. Taking this into consideration, Năstase and Kajanus (2009) suggested that the new policies derived from an economic crisis generate better entrepreneurship rates than those derived in periods out of crisis. Thus, we propose the following hypothesis:

H5: Overall TEA has a positive effect on economic growth, however the effect is higher in a post-crisis period.

3. Data and methods

As we noted earlier, this paper analyzes the effect of entrepreneurship capital types on economic growth using an unbalanced panel of data for the period 2002–2012. These types are operationalized through the overall TEA rates, the best-known indicator of the GEM, opportunity TEA and necessity TEA.

The dependent variable is the gross domestic product (GDP) constant at 2005 $US, which is one of the best-known indicators of economic growth. The source of data to measure this is the World Development Indicator (WDI) of the World Bank. This variable as well as the independent variables (except TEA, opportunity TEA and necessity TEA) were transformed through the population aged 15–64 years, following Nicolini (2011).

The data on independent variables, specifically those that are traditionally included in a production function, such as gross capital formation (GKF), government consumption and savings, were obtained from the WDI. The variable GKF as well as government consumption and savings are measured in constant values at 2005 $US. Meanwhile, TEA, opportunity TEA and necessity TEA were obtained from the GEM project. The TEA variable defines entrepreneurs as adults who are in the process of setting up a business that they will at least

partly own and/or who currently own and manage an operating young business (up to 3.5 years old). The opportunity and necessity TEA rates differentiate between entrepreneurs who are motivated to pursue perceived business opportunities and those who are driven to become entrepreneurs as a last resort, when other options for economic activity are absent or unsatisfactory.

Table 1 presents a list of dependent and independent variables used in this study, including their sources. Our final sample consists of an unbalanced panel with data on 289 observations and 43 countries: 25 OECD countries and 18 non-OECD countries[2] (see annex 1 for a list of countries).

Insert Table 1 about here

We use a standard measure of economic performance, labor productivity, i.e., a country's economic output relative to its population aged 15–64 years. Dividing the output by the input of the population aged 15–64 corrects for the size of a country, hence increasing the pertinence of this measure. We link this measure of national economic growth to the traditional factors of capital, government consumption and savings (Bleaney and Nishiyama, 2002), along with our factor of entrepreneurship capital, by using a Cobb–Douglas production function. Dividing each variable by the population aged 15–64 (except E, which is divided by the adult population), and using the natural logarithm to estimate it, we obtain the following equation:

$$\ln y_{it} = \varphi \ln \mathrm{ec}_{it} + \beta \ln x_{it} + ln\alpha_i + \mu_{it} \quad (1)$$

where:
i is the country and *t* is time.
ln y_{it}: natural logarithm of the GDP per population aged 15–64.
ln x_{it}: natural logarithm of a vector of control variables (GKF, government consumption and savings) per population aged 15–64.
ln ec_{it}: natural logarithm of the entrepreneurship capital types.
Ln α_i: natural logarithm of the dummy variable for each country (fixed-effects constant).
μ_{it}: error term.

In this paper, given the availability of data from 2002 to 2012 (43 countries), we estimated random- and fixed-effects models and we used the Hausman specification test in order to verify the choice of the fixed- or random-effects model. The test suggested the use of the fixed-effects specification for the overall TEA, opportunity TEA and necessity TEA models ($X^2(3) = 44.94$, Prob > $X^2 = 0.00$; $X^2(3) = 44.90$, Prob > $X^2 = 0.00$; $X^2(3) = 45.14$, Prob > $X^2 = 0.00$, respectively), which rejects the null hypothesis that the difference in coefficients is not systematic. Moreover, since heteroskedasticity is detected, we estimate linear regressions with robust variance estimates, which are based on a variable list of equation-level scores

[2] We used the classification of the OECD: http://www.oecd.org/about/membersandpartners/list-oecd-member-countries.htm

and a covariance matrix. Given that it is likely that the level of economic growth in period *t* is associated with the level of economic growth in period *t-1*, a test is applied to assess the serial correlation in the idiosyncratic errors of a linear panel-data model. We find that autocorrelation problems exist (F(1,36) = 129.81, Prob > F = 0.00). To control for the possible endogeneity of entrepreneurship and the simultaneous relationship between economic growth and entrepreneurship capital, a two-stage least squares estimation is suggested as appropriate method (Acs et al., 2012). To this purpose as well as autocorrelation problem, we introduce one lagged period of our dependent variable as instrument to explain each entrepreneurship capital type (Audretsch and Keilbach, 2008), and two additional instruments such as those younger than 15 or older than 64 that are dependent of to the working-age population (Age) and the square of this latest variable (Age^2). Some studies such as Acs et al. (2012) and Storey (2003) suggest that demographic variables have shown that individuals in these age cohorts are most likely to undertake entrepreneurial activities, implicating possible valid instruments. To assess their validity, each of the two-stage least squares estimations reports the test of underidentification (Kleibergen-Paap's statistic) and overidentification (Hansen's J statistic). The Kleibergen-Paap's statistic establish in the null hypothesis that the equation is underidentified. A rejection of the null indicates that the matrix is full column rank (i.e., the model is identified). The Hansen's J statistic for valid instruments is also reported. The joint null hypothesis is that the instruments are valid instruments, i.e., uncorrelated with the error term, and the reported value is the p-value stating the probability that the test statistic is zero, which would imply acceptance of the null hypothesis. The partial instrumental variables R^2 is also reported and describes how much of the squared residuals in the first-stage regression is explained by the instrumental variables. This test together with the partial p-value—i.e., the probability that the joint F value for the instrumental variables is zero—describes how good the instrumental variables are at explaining entrepreneurship.

4. Results and discussion

Table 2 reports the means, standard deviations, maximum, minimum value and correlation coefficients of the variables used in this study. As table 2 shows, the GDP was significantly correlated with the gross capital formation, government consumption and instruments (Bleaney and Nishiyama, 2002). Also, as may be seen, the correlation between GDP and overall TEA is very high, since the entrepreneurship capital diminishes as income grows (Carree et al., 2002, 2007). The same applies to the levels of opportunity TEA and necessity TEA. Given the correlations among the independent variables, we tested for the problem of multicollinearity, which might affect the significance of the main parameters in the regressions, through variance inflation factor (VIF) computations. The VIF values were low (lower than 5.03).

Insert Table 2 about here

Table 3 shows the results of the regressions with robust variance estimates. Following Carree and Thurik (2008) and Carree et al. (2002, 2007), we include in some models time fixed effects to account for business cycle. Thus, in model 1 apart from the control variables, we consider all the countries in the sample, a time fixed effects and the first type of entrepreneurship capital (overall TEA), model 2 we also include time fixed effects and we assesses the second type of entrepreneurship capital (opportunity TEA), model 3 estimates the third type of entrepreneurship capital (necessity TEA), model 4 includes only OECD countries and overall TEA, model 5 includes only non-OECD countries and overall TEA (both of them with time fixed effects) and model 6 considers the overall TEA only in pre-crisis, while model 7 assesses overall TEA in post-crisis.[3] All the models are highly significant ($p < 0.001$), which mean that the explanatory variables jointly explain the variance of economic growth.

Insert Table 3 about here

The first model considers the first variable of entrepreneurship capital that we defined previously and the traditional variables used in a production function (capital, government consumption and savings). The results show that overall TEA has a positive and significant influence ($p < 0.01$) on economic growth. The second model considers the second variable of entrepreneurship capital. The results show that opportunity TEA has a positive and significant influence ($p < 0.05$) on economic growth. With respect to the third model, which considers necessity TEA, the results show that this variable is significant ($p < 0.01$), but the instruments are not valid to explain necessity entrepreneurship (valid instruments $p < 0.01$), and therefore we cannot conclude its impact on economic growth. The fourth model considers the first variable of entrepreneurship capital only in OECD countries. The results show that overall TEA has a positive and significant influence ($p < 0.01$) on economic growth. The fifth model considers overall TEA only in non-OECD countries. Although the results show that overall TEA has a positive and significant influence ($p < 0.1$) on economic growth, the instrumental variables' test indicate that the instruments are not valid (valid instruments $p < 0.05$), and therefore we cannot conclude anything about entrepreneurship capital and economic growth in developing countries. The sixth model considers the first variable of entrepreneurship capital only before crisis period. The results show that overall TEA has a positive and significant influence ($p < 0.01$) on economic growth. The seventh model considers the first variable of entrepreneurship capital after crisis period. The results show that the overall TEA has a positive and significant influence ($p < 0.05$) on economic growth. In this model we have to mention that we cannot reject the null hypothesis of valid instruments at 5% of significance. Assuming this level, we can make inference about the estimation results.

Concerning the testing of the hypotheses, hypothesis 1 suggests that entrepreneurship capital has a positive effect on economic growth. We found a positive impact of entrepreneurship

[3] Based on Phelps (2010), we classified the pre-crisis periods as 2002–2006 and the post-crisis period as 2009–2012.

capital, such as the overall TEA, on economic growth in our sample ($\varphi = 0.278$, $p < 0.01$). Hence, we follow the statement presented by Audretsch (2007) and Audretsch and Keilbach (2004a,b, 2005), which defines a positive relationship between the new input (entrepreneurship capital) and the economic growth, and include this variable in a Cobb–Douglas production function. However, we use a different variable in order to understand entrepreneurship capital, such as a homogenous measure in all countries, which is consistent with the theory. This result could indicate that entrepreneurial activity is an important factor to achieve economic growth in all the countries contained in our sample. In fact, for each country in our sample, if the TEA increases by 1% through time, the GDP per population aged 15–64 increases by 0.278%, *ceteris paribus*. With respect to Wong et al.'s (2005) findings, our study is differentiated by statistical significance. While Wong et al. did not conclude in terms of overall TEA, we support the importance of this input to the economic growth process. These results contribute to the discussion established by Wennekers and Thurik (1999) that links entrepreneurship with economic growth, assessed through the Solow–Swan model as Audretsch (2007) suggested. Using this approach, Minniti and Lévesque (2010) concluded that entrepreneurial activity is the action of alert individuals who are willing to incur costs in exchange for expected profits, which is an important process in economic growth.

Hypothesis 2 proposes that opportunity TEA has a positive effect on economic growth. We find that this entrepreneurship capital is positively related to economic growth ($\varphi = 0.327$, $p < 0.05$). As we mentioned earlier, opportunity TEA defines a different characteristic in each country in terms of the innovation process. According to Wong et al. (2005), entrepreneurial activity influenced by opportunities tends to impact positively on economic growth. However, they did not find statistically significant evidence. In contrast, our results suggest that for each country in our sample, if opportunity TEA increases by 1% through time, the GDP per population aged 15–64 increases by 0.327%, *ceteris paribus*. This is consistent with Audretsch and Keilbach's (2004a, 2008) and Audretsch et al.'s (2008) results, according to which the entrepreneurship capital associated with innovation has a positive impact on economic growth. Furthermore, we point out that the effect of opportunity TEA on economic growth does not significantly differ among these countries. This idea, supported by Valliere and Peterson (2009), suggests that those countries that encourage entrepreneurial activity based on innovation could obtain improved outcomes in terms of economic performance. Therefore, we could suggest that entrepreneurship has a relevant role in promoting economic growth, on which social endowment is a factor that has a relevant influence. In addition, according to Braunerhjelm et al. (2010) and Mueller (2007), entrepreneurial activity based on innovation is one missing link in converting knowledge into economically relevant knowledge; therefore, spillovers could be obtained to increase the economic growth.

Hypothesis 3 proposes that necessity TEA has a lower effect on economic growth than opportunity TEA. Here, entrepreneurship capital analyzed in relation to necessity TEA has a significant influence on economic growth ($\varphi = 0.079$, $p > 0.01$). However, as we mentioned before, the Hansen's J statistic rejects the null hypothesis, implicating that the estimation result is not reliable. This result could mean that demographical factors are not accurate to explain the relationship between necessity TEA and economic growth. Also it is possible to assume that the election of an entrepreneurial career could be a solution in the short run, but not in the long run, especially in the creation of aggregate value in the economy. In this sense,

our results are consistent with Wong et al. (2005), who did not find any significance relationship between necessity TEA and economic growth. A possible explanation could be based on the U-shaped form discovered by Carree et al. (2002, 2007), van Stel et al. (2005) and Wennekers et al. (2005), among others, who found that some developing countries have a negative relationship between entrepreneurship and economic growth, while other developing countries have a flatter relationship between these two variables. Valliere and Peterson (2009) found similar results, arguing that a high prevalence of necessity entrepreneurs exists in developing countries, which could not represent significant added value to economic growth. These authors suggested that necessity TEA could contribute to reducing the unemployment rate, but not to increasing the total output (Valliere and Peterson 2009). Furthermore, this could imply that those non-OECD countries tend to have more necessity than opportunity entrepreneurship, as Wennekers et al. (2005) suggested. This result led to further analysis regarding the distinction between groups of countries and the testing of whether or not non-OECD countries are less influenced by entrepreneurship, assuming that these countries have a higher necessity entrepreneurship rate.

In this sense, hypothesis 4 suggests that entrepreneurship capital has a greater impact on the economic growth of OECD than non-OECD countries. Although in both groups of countries the effect of entrepreneurship capital is positive, we found that the impact of entrepreneurship capital, such as overall TEA, on OECD economic growth is higher than that in OECD countries (model 4: $\varphi = 0.250$, $p < 0.01$ vs. model 5: $\varphi = 0.089$, $p < 0.1$). Here, it is important to notice that Hansen's J statistic is not rejected at 2.5% of significance in non-OECD countries. Greater value implies not valid instruments, and therefore the analysis cannot be performed. Under this assumption, we are in the line of the study by Wennekers et al. (2005), who showed that there appears to be a U-shaped relationship between the level of economic development and the rate of entrepreneurship. The study by van Stel et al. (2005) showed that entrepreneurial activity has a positive effect on economic growth in highly developed countries but a negative effect in developing countries. Although Wennekers et al. (2005) found that those countries with a low income level tend to have more necessity entrepreneurship, and hence a U-shaped form exist, our results in also suggest that for each country in the OECD group, if the overall TEA increases by 1% through time, the GDP per population aged 15–64 increases by 0.250%, *ceteris paribus*; meanwhile, in non-OECD countries, the change is only 0.089%. These results follow the statement of Dejardin (2000), which argued that high levels of the entrepreneurship rate are associated with high rates of growth. These results could be explained by entrepreneurship capital that creates jobs and adds value, which is expected to be higher in developed countries, as Naudé (2010, 2011) suggested.

To equilibrate the difference between developing and developed economies, non-OECD countries should focus on increasing the human capital, upgrading the technology availability and promoting enterprise development (Acs and Szerb, 2007). It is important to start enterprise development policies early because the main drivers are perceptual variables that are difficult to change in the short run. Moreover, non-OECD countries need an adequate prevalence of large multinational companies that provide external effects, for example, through spin-offs that encourage researchers to create new business and subcontracting to small firms that pull new ventures to the markets, which could improve the productivity and reduce the uncertainty (Wennekers et al. 2005). In addition, these countries should try to

exploit scale economies by fostering both internal and foreign direct investment, by promoting the development of infrastructure and management education (Wennekers et al. 2005). In this sense, a higher degree of entrepreneurship capital could guarantee enhanced economic performance and faster rates of economic growth, especially in those countries (low-income) with a high level of the unemployment rate, and hence entrepreneurship could result as an important mechanism to reduce it. Furthermore, these results suggest that at the microeconomic level, the choices, activities and functions of entrepreneurs may stimulate also the economic growth in non-OECD, regardless of whether individuals are motivated by opportunity or by necessity. What matters is the aggregated effect of entrepreneurship capital on economic growth. As the present analysis is conducted at the aggregative macroeconomic level, we are able to distinguish between these different roles of the entrepreneurs, highlighting the importance that should take this factor in non-OECD countries. As in OECD countries, the policy makers must take into account that the process implies long-term strategies required to high potential entrepreneurship, which should increase in these countries (Wong et al. 2005). According to them, this entrepreneurship takes a long time to obtain results in terms of employment and growth, even more so considering that these countries' poverty rate is higher due to the structural problems (Bruton et al., 2013).

Hypothesis 5 suggests that entrepreneurship capital has a positive effect on economic growth, but the effect is higher after crisis period. Although in both periods the effect of entrepreneurship capital is positive, we found that the impact of entrepreneurship capital, such as overall TEA, on economic growth is higher in the post-crisis than in the pre-crisis period (model 7: $\varphi = 0.120$, $p < 0.05$ vs. model 6: $\varphi = 0.099$, $p < 0.01$). Similar to the previous hypothesis, it is important to assume 9% of significance to avoid the rejection of valid instruments' null hypothesis. The results could reflect the policy framework studied by Copeland and James (2014), who claimed that entrepreneurship policy must be addressed to job creation and productivity growth. This could imply that the change in growth is faster in the post-crisis period. According to Román et al. (2013), the entrepreneurship capital endowment in the post-crisis period could imply both the transition of unemployment to self-employment and the creation of jobs; therefore, entrepreneurship could be an important mechanism to overcome economic growth in the post-crisis period. Moreover, according to Bjørnskov and Foss (2013), entrepreneurship is most effective in terms of raising productivity under resource allocation encouraged by the public sector, which tends to change in post-crisis periods. In this sense, they suggested that states can successfully raise the effectiveness of entrepreneurship in terms of increasing the overall productivity, basically through investments in public "infrastructure services," which improve processes, products and organizations (Bjørnskov and Foss 2013). In this sense, Năstase and Kajanus (2009) suggested programs that involve business incubators, clusters of innovative SMEs and science and technology parks, in which development agencies play an important role in facilitating appropriate access to financing for SMEs at the local and regional level. This institutional change and a larger amount of private funds could encourage the demand for entrepreneurs in post-crisis periods. Braunerhjelm and Henrekson (2013) claimed that entrepreneurship could be useful to the learning, adoption and adaptation of particular policies from the specific countries and to solving the difficulties involved in pre-crisis and crisis periods. Possible effects of entrepreneurship on growth after the crisis period could be changes in production methods, which involve the role of absorbing surplus labor, providing innovative intermediate inputs to final-good-producing firms, permitting greater

specialization in manufacturing and raising productivity and employment in both the modern and the traditional sector (Gries and Naudé 2010; Stephens and Partridge 2011).

Summing up, the results show a positive effect of overall TEA, opportunity TEA (statistically significant) and necessity TEA (not valid instruments) on economic growth in a heterogeneous sample (high- and low-income countries). Hence, what matters is that a country has a relatively high absolute number of at least one type of entrepreneurship capital. Regarding the homogenous sample, we found that entrepreneurship capital is more positively related to OECD countries than non-OECD countries, which could imply that entrepreneurship should be more encouraged in developing countries to obtain similar results as developed ones. This is consistent with the results comparing the pre-crisis and post-crisis periods. Here the change in economic growth after a crisis could be explained in part by entrepreneurship policies that encourage the creation of jobs through self-employment. In terms of public policy, our results point out the importance of entrepreneurship capital to economic growth, especially characterized by the innovation process. In addition, our results highlight, as the extant literature, the importance of focusing on appropriate strategies to encourage entrepreneurial activity, otherwise the effect of entrepreneurship on growth will be null in terms of economic growth, as Shane (2009) suggested.

5. Conclusions

In this paper, longitudinal panel data (for the period 2002–2012) were used to investigate empirically the effect of entrepreneurship capital types on economic growth. Using a conceptual framework to link entrepreneurship capital with economic growth (Audretsch 2007; Audretsch and Keilbach 2004a,b, 2005), we analyzed the influence of overall TEA, opportunity TEA and necessity TEA on economic growth. We also considered the effect of overall TEA on economic growth in OECD and non-OECD countries and pre- and post-crisis periods. We overcame the endogeneity issues through instrumental variables, useful to understand the effect of entrepreneurship capital on economic growth.

The main findings are the following. First, there is evidence of a positive relationship between overall TEA and economic growth. A high level of entrepreneurship capital, measured as overall entrepreneurial activity, is related to high rates of economic growth. Second, we found a positive relationship between opportunity TEA and economic growth. Similar to overall TEA, entrepreneurship capital analyzed according to entrepreneurial activity based on opportunities encourages economic growth, although the impact is lower than that of overall TEA and higher than that of necessity TEA (which is not statistically significant). These results suggest that the entrepreneurship capital types, especially overall and opportunity TEA, could be key factors in achieving economic growth. In addition, it is important that policy makers redefine the strategies to encourage entrepreneurship in each country. In terms of long-run growth, strategies related to entrepreneurship motivated by the exploration and evaluation of opportunities are important. Otherwise, entrepreneurial activity motivated by necessity could solve short-run problems, but have no effect on long-run economic growth.

Regarding the groups of countries (OECD and non-OECD), we also found that entrepreneurship capital is more related to economic growth in OECD countries than in non-OECD countries, similar to findings of the extant literature. This could imply that entrepreneurship capital endowment fosters faster developed economies. This result was consistent when we ran a regression considering the pre- and post-crisis periods. We found that the effect of entrepreneurship capital is higher on economic growth in the post-crisis period in all countries than in the pre-crisis period. These results could be useful in terms of public policy that encourages entrepreneurship behavior, especially entrepreneurship behavior that is capable of creating jobs and improving the national productivity.

Finally, according to Valliere and Peterson (2009), the prevalence and economic role of different types of entrepreneurs may vary among specific countries. Part of this variance is due to national conditions and part of it is due to socio-cultural influences. Different types of entrepreneurial activity are therefore likely to play varying roles in the economic growth among emerging and developed countries. Furthermore, according to Copeland and James (2014), a crisis period could cause possible changes in the institutional structure, not only related to the public policy of entrepreneurship, but also possibly associated with the self-motivation of individuals who pursue their own benefit and social welfare. Taking this into account, we identified a possible limitation in our model, which include some demographical variables as instruments in order to differentiate this effect given the heterogeneity of countries in the sample. In some cases (models 5 and 7) were necessary assume a specific significance level to carry out the analysis. The future research lines could consider some variables to control the environmental characteristics. For instance, Urbano and Alvarez (2014) pointed out the importance of institutional factors to understanding the configuration of entrepreneurial activity among countries that have different economic growth rates. Under this approach, it could be possible relax the assumptions presented in this paper and perform a more precise comparative analysis.

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Annex

Insert Annex 1 about here

Tables

Table 1. Description of variables

	Variable	Definition	Source[a]
Dependent variable	Gross Domestic Product (GDP)	GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in constant 2005 U.S. dollars.	WDI 2002-2012
Entrepreneurship capital types	Overall Entrepreneurial activity (TEA)	Total early-stage entrepreneurial activity. Percentage of adults aged 18–64 setting up a business or owning–managing a young firm (up to 3.5 years old), including self-employment.	GEM APS 2002-2012
	Opportunity TEA	Opportunity TEA is the percentage of adults aged 18–64 setting up a business or owning–managing a young firm (up to 3.5 years old), including self-	GEM APS 2002-2012

		employment who are motivated to pursue perceived business opportunities.	
	Necessity TEA	Necessity TEA is the percentage of adults aged 18–64 setting up a business or owning–managing a young firm (up to 3.5 years old), including self-employment who are involved in entrepreneurship because they have no better option for work.	GEM APS 2002-2012
Control variables	Gross capital formation (GKF)	Gross capital formation (formerly gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Data are in constant 2005 U.S. dollars.	WDI 2002-2012
	Government consumption	General government final consumption expenditure which includes all government current expenditures for purchases of goods and services. Data are in constant 2005 U.S. dollars.	WDI 2002-2012
	Savings	Gross domestic savings are calculated as GDP less final consumption expenditure (total consumption).	WDI 2002-2012
	Population ages 15-64	Total population between the ages 15 to 64 is the number of people who could potentially be economically active.	WDI 2002-2012
Instrumental variables	Age	People younger than 15 or older than 64 that are dependent of to the working-age population. Proportion of dependents per 100 working-age population	WDI 2002-2012
	Age^2	Square of people younger than 15 or older than 64 that are dependent of to the working-age population	WDI 2002-2012

[a] WDI. World Development Indicators (WDI) by World Bank. http://databank.worldbank.org/data/home.aspx; GEM. Global Entrepreneurship Monitor (GEM). http://www.gemconsortium.org/

Table 2. Descriptive statistics and correlation matrix

	Variables	Obs.	Mean	Std. Dev.	Min	Max	1	2
1	Ln GDP	289	10.159	1.012	7.124	11.540	1	
2	Ln TEA	289	1.981	0.574	0.336	3.693	-0.478*	1
3	Ln Opportunity TEA	289	1.663	0.562	-0.211	3.387	-0.298*	0.953*
4	Ln Necessity TEA	289	0.258	0.964	-2.365	2.494	-0.726*	0.772*
5	Ln GKF	284	8.668	0.975	5.165	10.283	0.973*	-0.483*
6	Ln Government consumption	289	-13.702	1.699	-18.229	-9.108	0.309*	-0.140
7	Ln Savings	284	8.695	1.021	4.903	10.802	0.897*	-0.407*
8	Age	289	50.139	6.896	35.532	88.493	-0.125	0.254*

9	Age^2	289	2561.337	809.098	1262.541	7831.001	-0.190*	0.284*

		3	**4**	**5**	**6**	**7**	**8**	**9**
3	Ln Opportunity TEA	1						
4	Ln Necessity TEA	0.586*	1					
5	Ln GKF	-0.319*	-0.714*	1				
6	Ln Government consumption	-0.063	-0.352*	0.353*	1			
7	Ln Savings	-0.238*	-0.659*	0.910*	0.304*	1		
8	Age	0.246*	0.129*	-0.269*	0.013	-0.296*	1	
9	Age^2	0.266*	0.174*	-0.331*	-0.025	-0.340*	0.985*	1

* $p < 0.01$.

Table 3. Regression analysis explaining economic growth

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Ln GDP	**Ln GDP**	**Ln GDP**	**Ln GDP**	**Ln GDP**	**Ln GDP**	**Ln GDP**
	All countries	**All countries**	**All countries**	**OECD countries**	**non-OECD countries**	**All countries before crisis**	**All countries after crisis**
Entrepreneurship capital types							
Ln TEA	0.278***			0.250***	0.089*	0.099***	0.120**
	(0.098)			(0.071)	(0.054)	(0.027)	(0.055)
Ln Opportunity TEA		0.327**					
		(0.131)					
Ln Necessity TEA			0.079***				
			(0.027)				
Control variables							
Ln GKF	0.168***	0.141**	0.196***	0.061	0.338***	0.222***	0.252***
	(0.061)	(0.068)	(0.049)	(0.044)	(0.046)	(0.033)	(0.048)
Ln Government consumption	0.176	0.327*	0.106	0.085	0.362***	0.336***	0.261**
	(0.151)	(0.183)	(0.071)	(0.174)	(0.080)	(0.110)	(0.128)
Ln Savings	0.062	0.039	0.101***	0.055	0.024	0.053**	0.042
	(0.045)	(0.055)	(0.024)	(0.058)	(0.034)	(0.027)	(0.040)
Time fixed effects	Yes	Yes	No	Yes	Yes	No	No
Partial instrumental variables R^2	0.045	0.033	0.073	0.083	0.099	0.182	0.096
Partial p-value	0.043	0.100	0.003	0.015	0.218	0.002	0.022
Underidentification test (p-value)	0.051	0.079	0.007	0.011	0.19	0.016	0.024
Valid instruments (p-value)	0.140	0.438	0.000	0.815	0.025	0.498	0.090
Observations	236	236	236	168	68	67	119

*** p < 0.01; ** p < 0.05; * p < 0.10.

Note: Heteroskedasticity corrected standard errors are shown in parentheses. Estimates for time fixed effects dummies are not presented but can be supplied upon request.

Annex 1. List of countries

	Country	No. of years	OECD countries	Non-OECD countries
1	Australia	7	X	
2	Belgium	11	X	
3	Bosnia and Herzegovina	5		X
4	Brazil	11		X
5	Chile	8	X	
6	China	4		X
7	Colombia	7		X
8	Croatia	11		X
9	Denmark	11	X	
10	Finland	11	X	
11	France	11	X	
12	Germany	5	X	
13	Greece	10	X	
14	Guatemala	3		X
15	Hungary	7	X	
16	Iceland	9	X	
17	Ireland	3	X	
18	Italy	9	X	
19	Japan	9	X	
20	Korea	5	X	
21	Latvia	6		X
22	Malaysia	4		X
23	Mexico	3	X	
24	Netherlands	11	X	
25	Nigeria	2		X
26	Norway	11	X	
27	Pakistan	3		X
28	Panama	2		X
29	Peru	7		X
30	Poland	2	X	
31	Portugal	3	X	
32	Romania	6		X
33	Russian Federation	7		X
34	Singapore	2		X
35	Slovenia	9	X	
36	South Africa	5		X
37	Spain	11	X	
38	Sweden	3	X	
39	Switzerland	4	X	
40	Thailand	2		X
41	United Kingdom	11	X	
42	United States	11	X	
43	Uruguay	7		X
	Total	289	25	18