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The Determinants of Entrepreneurship at the Country Level: A Panel Data Approach

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Abstract:
The aim of this study is to analyze the impact of a variety of factors on the total entrepreneurial activity rate (TEA). A panel data approach of 26 developed countries was used to evaluate the simultaneous influence of the factors on TEA (2004–2011). Our findings show an inverse relationship between TEA and the initial capital effort; a direct relation between TEA, monetary freedom, investment freedom, financial market development and education; and a nonlinear concave relationship between TEA and the GDP per capita. The dynamic estimation approach shows a high speed of adjustment between the actual and desired rate of entrepreneurship. Overall, the main findings clarify which potential determinants have a real impact on entrepreneurial activity. Our contribution aims to help economic policymakers in developed countries to gain awareness of the main determinants of entrepreneurial activity at country level and thus to enable better decisions.

Keywords: total entrepreneurial activity (TEA), opportunity-driven entrepreneurship, necessity-driven entrepreneurship, determinants of entrepreneurship, panel data

JEL classification: L26, M13, C31

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1 Introduction

Despite the increased attention that entrepreneurship has deserved in recent years (Acs and Audretsch 2010), there is no general definition of entrepreneurship as a concept (Martin, Picazo, and Navarro 2010) due to its heterogeneity and multidisciplinary nature (Landström 2005). This complexity leads to an absence of academic consensus on the exact definition of entrepreneurship (Bennett 2006) although it does not adversely affect the accumulated knowledge on this subject (Davidsson 2009). The current academic divergence (Agca, Topal, and Kaya 2012), which dates back several decades according to Iversen, Jorgensen, and Malchow-Moller (2008), arises from difficulties in conceptualizing and defining theoretical models that could measure entrepreneurship. Because the phenomenon of entrepreneurship is complex, dynamic and diverse in meaning (Bruyat and Julien 2001) it is used in a number of areas like economics, management, psychology and behavioral sciences.

The awareness that entrepreneurship is essential for economic growth (Naudé 2010), considered to be 'the main vehicle of economic development' (Anokhin, Grichnik, and Hisrich 2008: 117) has made entrepreneurship a privileged topic in economic theory. In fact, it has been extensively studied by many economists, including Knight, Schumpeter, Kirzner, Baumol, Marshall, among many others, who have measured the effects that entrepreneurship can have on economic variables, such as employment, innovation and welfare gains (Acs, Desai, and Hessels 2008).

However, integrating the contribution of several areas when structuring entrepreneurship involves several levels of analysis at the country, organization, company or individual level (Luke, Verreynne, and Kearins 2007). If an entrepreneur is a person, they can be in the service of an organization and therefore be operating at the organizational level (Shane and Venkataraman 2000) and, at the same time, be part of the economic, social and institutional level (Veciana and Urbano 2008). It should be noted that the impact of entrepreneurship in the economy has prevailed at the level of company, industry or region over the comparative analysis between nations (Stel, Thurik, and Carree 2005), which were precisely our target, considering a set of developed countries. The fact that the comparative analysis between nations has been relegated to the background made the

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entrepreneurial phenomenon at the country level an attractive issue for the development of this study, particularly if we were to focus only on developed countries.

Rather than being a multidimensional measure of a country-level entrepreneurial environment and testing the rate and type of entrepreneurial activity (Stenholm, Acs, and Wuebker 2013), our study focuses on detecting the main determinants of entrepreneurial activities in a group of developed countries. Based on the multidisciplinary concept of entrepreneurship, it is not our intention to analyze previously tested variables, which may or may not confirm their influence on entrepreneurial activity, as various other studies have done (Acs et al. 2007; Aparicio, Urbano, and Audretsch 2016; Fernández-Serrano and Romero 2014; Harms and Groen 2016; Kollmann, Stöckmann, and Kensbock 2017). The focus of this exploratory study is to detect within a wide range of variables those that are statistically significant to explain entrepreneurial activity, and thus act as the starting point for further confirmatory research on new possible explanatory variables. Our aim is to fill this gap and to provide new evidence on the determinants of entrepreneurship, considering a vast number of institutional and sociocultural variables to check their relevance in developed countries.

On the other hand, the majority of studies in the relevant literature have considered cross-section or time-series data to study the entrepreneurial activity at a country level and it is only recently that a few studies have used panel data (Aparicio, Urbano, and Audretsch 2016; Albulescu and Tămăşilă 2016; Washington and Chapman 2014; Ferreira et al. 2017) or even structural equation modeling (Stenholm, Acs, and Wuebker 2013). The nonlinear relationship between the entrepreneurial rate and the stage of development is also explored to ascertain whether entrepreneurship is necessity or opportunity driven.

Another added value of our study is the dynamic approach we have taken to study entrepreneurial activity through a dynamic panel data model. Other studies have rarely measured the short-run and long-run effects of the determinants of entrepreneurship and measured the speed of adjustment between the actual and desired level, especially in developed countries.

These are the main contributions of this study and, under the cited multidisciplinary nature, we have chosen to study a wide range of determinants that could explain entrepreneurial activity. A panel data approach was used to identify these determinants as the most suitable to obtain robust and conclusive results in this case.

After the introduction, the rest of this paper is divided into four main sections: the literature review; methodology and empirical analysis; discussion, and conclusion. In the literature review, the concept of entrepreneurship is revisited and the difference between entrepreneurship by opportunity and necessity is explained. The methodology section describes the design of research, particularly those aspects related to sampling, data analysis, and model selection. The empirical results from the panel data analysis are presented in the same section so as to provide a coherent interpretation. Section 4 contains a detailed discussion of the empirical results in line with what the economic theory suggests. The last section concludes by summarizing the implications of the main findings.

2 Literature Review

In the economic world, the different levels of entrepreneurial activity of nations cannot be dissociated from the development stages of their economies (Freytag and Thurik 2007). According to Amorós and Bosma (2014, p.16), 'different types of entrepreneurship may all have important implications for socio-economic development'. As such, it is natural that factors that can influence the entrepreneurial activity of a developed country need not be the same in developing countries, and vice versa.

In fact, as (2003) note, the factors affecting the entrepreneurial activity are different between the developed and the developing countries. In developed countries there is a greater influence from factors such as historical rates of growth, education and innovation, while in developing countries the informal economy and institutions are more important. The question arises as to what kind of entrepreneurial activity is most beneficial for the economy. In fact, we need to distinguish two kinds of entrepreneurship, namely, that driven by necessity and that driven by opportunity. The first stems from the belief that creating an own business will give its promoter greater utility, because there is no better work option (Block et al. 2015). The second revolves around the identification of an opportunity arising from an innovative idea (Valdez et al. 2011). While in the case of entrepreneurship as a necessity, the generated value-added is residual and the economic activity is ephemeral, in the case of entrepreneurship driven by opportunity the association with technology generates a higher value-added in the economy, which last longer (Kautonen and Palmroos 2010). In general, entrepreneurial activity driven by necessity is a characteristic of developing countries (Acs 2006) where self-employment prevails as survival activity (Naudé 2010). In developed countries entrepreneurial activity is typically opportunity-driven and linked to innovation and technology (Wennekers et al. 2005).

Since the level of economic development of a country is an important factor in explaining entrepreneurial activity (Wennekers et al. 2005; Carree et al. 2007), it is important to understand the relationship between per capita income and entrepreneurship. According to Stel, Thurik, and Carree (2005), in developing countries the relationship between the total entrepreneurial activity (TEA) rate and GDP growth is negative, while in the relatively rich countries it is positive. In this context, Acs, Audretsch, and Evans (1994) and Wennekers and Thurik (1999) describe a convex relationship between entrepreneurship and GDP per capita. The negative relationship between the TEA rate and GDP per capita can be explained by the necessity nature of entrepreneurship (Reynolds et al. 2001), as opposed to entrepreneurship by opportunity, in which the TEA rate is positively related to GDP per capita.

Meanwhile, within the institutional theory of North (2005 and 1990), the degree of development of institutions also plays an important role in developing entrepreneurial activities. According to North (2005 and 1990), institutions establish a set of formal and informal rules that influence the behavior of economic agents, distinguishing institutions (formal rules) from organizations (informal rules). Metaphorically, it can be said that institutions act as the rulers (setting the political and legal rules, economic rules and contractual procedures) while organizations are the players (owners of ideas, beliefs, attitudes and personal values). According to Mcmillan and Woodruff (2002) informal institutions are expected, through governance, to have an important impact on entrepreneurial activity, but institutions with rigid formal rules might negatively influence entrepreneurial activity due to excessive regulation and bureaucracy (Gnyawali and Fogel 1994; Begley, Wee-Liang, and Schoch 2005).

With respect to the informal aspects of institutions, various indicators of competitiveness are given in the Global Competitiveness Report (World Economic Forum), and information on economic freedom can be found in the Index of Economic Freedom (The Heritage Foundation). With respect to the formal rules of institutions, the World Bank publication entitled Doing Business provides useful information on the aspects pertaining to technical and legal formalities, procedures and a whole set of rules for business creation.

According to institutional theory, a country's economic, cultural, political, and social institutions define the efficiency of production and transaction, which influence firms' strategies and operations (Peng 2003). It should be noted that institutions are particularly relevant in explaining differences in output per worker across countries (Cavalcanti and Novo 2005; Hall and Jones 1999). According to Cavalcanti and Novo (2005),improvements in institutions have a stronger effect on output per capita for developing countries (around 6.2%), than for developed countries (around 3.8%). Beyond that, the costs of engaging in entrepreneurship are higher in societies without strong market oriented institutions (North 1990).

At the institutional level, several studies including those by Bjørnskov and Foss (2008), Díaz-Casero et al. (2012), and Mcmullen, Bagby, and Palich (2008) found that indicators related to economic freedom (given by The Heritage Foundation) explain significantly entrepreneurship measured by the TEA. Moreover, in Spain Alvarez et al. (2011) confirm the relevance of institutional factors to explain entrepreneurial activity. In this institutional domain, too, Acs and Armington (2004), Wennekers et al. (2005) and Álvarez and Urbano (2011) suggest that human capital, political stability, innovation capacity or the tax burden are competitive factors that have significant impact on the entrepreneurial activity of a country.

In earlier studies, the factors explaining entrepreneurship were mainly economic in nature (Grilo and Thurik 2005). For instance, policies for increasing access to bank credit enhance entrepreneurial activity at a country level (Alvarez and Urbano 2011) as well as a wider range of financing instruments available in the market (Gnyawali and Fogel 1994; Van Gelderen, Thurik, and Bosma 2005). Under market logics, embedded agents are more likely to act and engage entrepreneurially (Thornton, Ocasio, and Lounsbury 2012), although market instability, particularly the inflation rate could constrain entrepreneurial intention (Porter and Schwab 2009). In this vein, as argued by Mcmullen, Bagby, and Palich (2008), monetary policy that restricts economic freedom is likely to be negatively associated with entrepreneurial activity as individuals choose less uncertain income-generating alternatives. From the economic domain, another institutional variable that could influence entrepreneurial activity is the investment environment. Yuen-Ping and Poh-Kam (2007) argue that regulatory business costs deter opportunity-driven entrepreneurship (21 of 26 countries in our sample belong to the 'opportunity-driven entrepreneurship stage' of GEM), whose absence facilitates investment and stimulates entrepreneurial activity (Gompers and Lerner 2001). However, using data from 39 countries, Van Stel, Storey, and Thurik (2007) find only the minimum capital requirement bears a statistically significant relationship to entrepreneurial activity.

While some institutional variables from economic domain have been dominant in explaining entrepreneurial activity at the country level, we should also consider other institutional variables related to sociocultural dimensions.

Some authors like Hofstede et al. (2004), Osman et al. (2011), and Wennekers et al. (2007) have suggested that non-economic factors associated with cultural dimensions are also important to explaining the entrepreneurship phenomenon. These include education, religion, language, ethnic factors, women participation in the labor

market, and others. In this context, Uhlaner and Thurik (2007) confirmed the significance of post-materialism in predicting TEA. Furthermore, entrepreneurship — which is understood to be a dynamic process of vision, change, and creation (Kuratko 2013) — can be influenced by other (non-pecuniary) variables that can contribute to the process described. In light of endogenous growth theory (Lucas 1988; Romer 1986), education and innovation could be two variables that explain the entrepreneurial phenomenon. In fact, as mentioned by Lee and Rogoff (1997, p.99), 'education helps entrepreneurs', insofar as, according to Robinson and Sexton (1994), higher levels of education lead to higher success rates for new start-ups and higher growth rates.

3 Methodology and Empirical Analysis

The focus of this exploratory and descriptive study is to act as the starting point for further research on these domains. Indeed, Rubin and Babbie (2010) note that 'exploratory and descriptive studies, for example, do not test hypotheses', and our research seeks to define objectives rather than to establish and confirm specific hypotheses. The aim of this study is to understand the influence of a variety of factors (economic and non-economic) on the TEA as given in the Global Entrepreneurship Monitor (GEM), for a group of developed countries.

3.1 Sample, Data and Variable Definition

At the country level, the GEM's annual reports provide relevant indicators on the entrepreneurial activity from which the TEA rate emerges. The TEA rate is the percentage of population able to develop a professional activity that is actively involved in setting up a business, whether in business start-ups (nascent entrepreneurs) or 42 months after the birth of a business unit (owner-managers of new companies) (2012). For the country level analysis we prefer the TEA from GEM's annual reports rather than evidence of country level differences developed by Busenitz, Gomez, and Spencer (2000).[1]Of a total set of 53 countries (excluding Taiwan) from GEM's report in 2011, the empirical analysis uses a sample of 26 developed countries[2] and the time horizon spans from 2004 to 2011. We chose to focus our analysis on developed countries to test specifically in this group of countries which determinants might be statistically significant to explain TEA. This purpose is justified because variables affecting entrepreneurial activity differ for the developed and the developing countries (Reynolds, Bygrave, and Autio 2003).

To control for the financial crisis effects of 2008 we use a dummy variable that takes the value of one from 2008 to 2011 and zero otherwise. To test the stability of the model we distinguish two periods, the pre-crisis period (2004–2007) and the post-crisis period (2008–2011).

Since the time series data are not uniform for all countries an unbalanced panel data procedure is used that enhance a total of 157 observations, after removing the missing values. Table 1 provides the country information used in the sample and the corresponding time span in each case.

Table 1: Countries in the sample and the data time span.

South Africa (2004 to 2006 and 2008 to 2011)	France (2004 to 2011)
Germany (2004 to 2006 and 2008 to 2011)	Greece (2004 to 2011)
Argentina (2004 to 2011)	Netherlands (2004 to 2011)
Australia (2004, 2005, 2006, 2010 and 2011)	Hungary (2004 to 2011)
Belgium (2004 to 2011)	Ireland (2004 to 2008 and 2010,2011)
Brazil (2004 to 2011)	Iceland (2004 to 2010)
Canada (2004, 2005 and 2006)	Italy (2004 to 2010)
Croatia (2004 to 2011)	Japan (2004 to 2011)
Denmark (2004 to 2011)	New Zealand (2004 to 2005)
Slovenia (2004 to 2011)	Norway (2004 to 2011)
Spain (2004 to 2011)	United Kingdom (2004 to 2011)
United States of America (2004 to 2011)	Singapore (2004, 2005, 2006 and 2011)
Finland (2004 to 2011)	Sweden (2004 to 2007 and 2010,2011)

Source: Countries were selected by the availability of data retrieved from Global Entrepreneurship Monitor (Kelley et al. 2012), Global Competitiveness Report (Schwab 2011), Doing Business – The World Bank (2011), Economic Freedom – The Heritage Foundation (Miller and Holmes 2010), International Monetary Fund (2011), World Bank (2011) and International Human Development Indicators (Klugman 2011).

The countries considered in the sample can be characterized and classified according to their level of development. Taking 2011 as reference year (the last year of data collection), according to the World Bank (2011) definition, the countries considered are classified as:

- low income, when their Gross National Income per capita (GNI) is equal to or less than USD 1,026;
- medium-low income when their GNI pc is above USD 1,026 and does not exceed USD 4,036;
- medium-high income when their GNI pc is above USD 4,036 and does not exceed USD 12,476;
- high-income when their GNI pc is above USD 12,476.

Although the listed countries have different levels of development, according to the World Bank classification (2011) South Africa, Argentina and Brazil are classified as medium-high income countries, while the other 23 countries are considered as high-income. According to the World Bank (2011), the medium-high income and high-income countries are formally considered developed.

Data were collected for a vast number of explanatory variables to check their importance in an attempt to explain the entrepreneurial activity rate across countries. The variables initially considered are explained in A and they have the following characteristics:

i. competitiveness taken from the Global Competitiveness Report (Schwab 2011),

ii. formal economic factors given by Doing Business – The World Bank (2011),

iii. informal economic variables from the Index of Economic Freedom – The Heritage Foundation (Miller and Holmes 2010),

iv. macroeconomic and financial variables taken from the International Monetary Fund (2011) and the World Bank (2011), and

v. social and cultural factors given by the International Human Development Indicators (Klugman 2011).

To optimize the chosen model, we used a stepwise selection method (Hocking 1976) to perform a backward estimation starting with the whole set of explanatory variables (A) and sequentially eliminating the variables with no statistical significance, after performing an F-test on the joint significance of the population parameters. By doing so, we arrived at a parsimonious model that includes the five most relevant explanatory variables explained in Table 2.

Table 2: Explanatory variables included in the model.

Nature	Variable	Description	Scale	Source
Economic - formal factors	*Paid-in minimum capital*	The paid-in minimum capital requirement is the amount that the entrepreneur needs to deposit in a bank before registration and up to 3 months following incorporation and it is recorded as a percentage of the economy's income per capita. It is an observable variable that belongs to the factor 'starting a business'.	Rate The higher the value, the greater the capital effort in opening a new business.	*Doing Business – The* World Bank (2011)
Economic - informal factors	*Monetary Freedom*	Represents the absence of market distortions caused by the inflation rate and price controls. The score for the monetary freedom component depends on two factors: The weighted average of inflation rate for the most recent three years; Price controls.	Index (0–100) The higher the value, the lower the pressure on the currency (inflation) and lower the price controls.	*Index of Economic Freedom – The Heritage Foundation* (*Miller and Holmes 2010*)
	Investment Freedom	Represents the absence of investment restrictions.	Index (0–100) The higher the value, the lower the investment restrictions.	

Competitiveness	*Financial Market Development*	Reflects the funding efficiency level for the economy and the capital market stage.	Likert scale (1–7) The higher the value, the greater the degree of financial market development.	*Global Competitiveness Report – World Economic Forum (Schwab 2011)*
Social and cultural	*Education Index100*	Represents the average level of education of adults and the expected level of education for children.	Index (0–100)* The higher the value, the higher the level of literacy in a country.	*International Human Development Indicators (Klugman 2011)*

* To harmonize the scale of the indexes, the Education Index has been multiplied by 100.
Source: Compiled by the authors based on the relevant sources.
Monetary $\text{Freedom}_i = 100 - \alpha \sqrt{\text{Weighted Avg. Inflation}_i} - \text{PC penalty}_i$

Keeping the aforementioned definition of variables in mind, and in line with economic theory it is expected that TEA would be negatively related to 'Paid-in minimum capital' and positively related to the other variables. That is, high initial capital requirements can be an obstacle to encouraging entrepreneurial activities, but higher monetary freedom, lower investment restrictions, more efficient financial markets and higher education levels all positively affect the development of business activities.

3.2 Descriptive Statistics

Table 3 reports some elementary descriptive statistics on the variables used in the estimation approach. Looking at the data, we can highlight some relevant aspects. On the basis of the data, the values of TEA vary between 1.5 (minimum value for Japan in 2004) and 20.8 (maximum value for Argentina in 2011) and the mean value is around 7%.

Table 3: Descriptive statistics of variables.

	TEA	***Paid-in minimum capital***	***Monetary freedom***	***Financial market development***	***Education index100***	***Investment freedom***
Mean	7.04098	17.3712	80.8707	4.86467	86.9264	70.721
Median	6	10.15	81.2	4.95103	87.85	70
Minimum	1.5	0	60.6	3.12758	64.5	40
Maximum	20.8	125.7	94.3	6.40034	100	95
Std. Dev.	3.39887	23.8393	5.8073	0.767612	8.44183	14.652
C.V.	0.482727	1.37235	0.0718097	0.157793	0.0971147	0.20719
Skewness	1.26138	2.04082	−0.760266	−0.435385	−0.815274	−0.21625
Ex, kurtosis	1.60731	4.86439	1.39871	−0.701524	0.277828	−1.1517
5% Perc,	3.12	0	71.445	3.43972	69.245	50
95% Perc,	14.36	65.705	88.9	5.91246	99.07	90
IQ range	4	23.25	7.05	1.12043	9.3	20
Missing obs,	25	0	0	26	26	0

Source: Compiled by the authors.

The variable 'Paid-in minimum capital' is a rate that represents the initial capital required to start-up a business in relation to income per capita. For the countries considered, the values of this variable range from a minimum of 0 points (typical of countries like Australia, Brazil, Canada, France, Ireland, Japan, New Zealand, Singapore, South Africa, United Kingdom or the United States, where there are no initial capital requirements for starting a new business activity, to a maximum of 125.7 points in Greece in 2004. The mean value is around 17.3%. The higher the value the greater the capital effort required to commence a new business activity.

'Monetary Freedom' is an index ranging from 0 points to 100 points and reflects the degree of monetary freedom in a country or degree of distortions on monetary flows. For the countries considered, the values range from a minimum of 60.6 points (Argentina in 2007) to a maximum of 94.3 points (Japan in 2008). The

higher the value of this variable the lower the restrictions on financial flows, due to less regulation of capital flows and less uncertainty involved in developing business activities.

The variable 'Financial Market Development' is an index ranging from 1 to 7 points that describes the level of funding efficiency of the economy and the stage of development of the capital market. For the countries considered the values of this variable range from a minimum of 3.13 points (Greece in 2011) to a maximum of 6.40 points (United Kingdom in 2005) and the mean value is around 4.8. The higher the value of the index the higher the degree of development of the financial market.

The 'Education Index' ranges from 0 to 100 points and shows the average level of education of adults and the expected level of education for children. This index ranges from 64.5 points (Brazil in 2005) to a maximum of 100 points (New Zealand in 2010 and 2011) with a mean value of about 86.2. The higher the value of the index the higher the country's literacy level, which determines the qualification of human capital.

The 'Investment Freedom' index ranges from 0 to 100 points and reflects the ease of investment in a country with fewer barriers and restrictions. This index ranges from a minimum of 40 points (Argentina in 2004) to a maximum of 95 points (Ireland in 2006). The higher the value of the index the lower the restrictions and barriers to the investment plans.

According to the coefficient of variation statistic, the highest dispersion of values (higher heterogeneity among countries) is found in the 'Paid-in minimum capital' variable, followed by TEA and the 'Investment Freedom' index.

Table 4 reports the correlation coefficient matrix among the explanatory variables to detect possible problems of multicollinearity.

Table 4: Correlation matrix of independent variables.

Paid-in minimum capital	*Monetary freedom*	*8th Pillar: financial market development*	*Education index100*	*Investment freedom*
1.0000				
−0.0901	1.0000			
−0.1310	0.2980*	1.0000		
−0.0757	0.0861	0.0677	1.0000	
0.0805	0.3727*	0.4242*	0.0714	1.0000

Source: Compiled by the authors.
Note: the star indicates the statistical significance of the correlation at the 5% level.

It can be seen that all correlation coefficients are low in magnitude and only three are statistically significant; according to Evans (1996), they are weak and moderate correlations. The weak correlation between the explanatory variables is due to the nature of the panel data and the chosen estimation method. Fixed effects models are designed to study the causes of changes within a unit [or entity] taking into account unit specific characteristics which are invariant in time. Furthermore, according to Hsiao (2014), panel data has the advantage of increasing the degrees of freedom and lessening the problem of multicollinearity. In addition, we decided to estimate the pooled version of the model to get the variance inflation factor (VIF) as an indicator of multicollinearity (see B).

3.3 Model Selection and Estimation Approach

As explained above, we use unbalanced panel data to estimate the model that explains TEA across 26 countries, over the period 2004 to 2011. We assume a *lin-lin* and *log-lin* model specification to check the robustness of the results. In the *log-lin* model the estimated coefficients represent the semi-elasticities showing the percentage change in the dependent variable due to an absolute change in the explanatory variables. The base model takes the following form:

$$TEA_{it} = a_i + b_1 Paid\_in\ minimum\ capital_{it} + b_2 Monetary\ Freedom_{it} + b_3 Financial\ Market_{it} + b_4 Education_{it} + b_5 Investment\ Freedom_{it} + \mu_{it} \quad (1)$$

Three methods can be used to estimate models with panel data. The simple OLS approach on the pooled model, which assumes no-country and time specific effects. However, this method of estimation is more appropriate to a set of homogeneous countries which is not our case since our sample includes countries with different structures and levels of development, although the majority of them are high-income countries. An alternative estimation approach that captures country specific heterogeneity is the fixed effects (FE) model that captures

the country specific heterogeneity in the *intercept* (a_i differs from country to country) as shown in eq. (1). This model can be estimated by the LSDV (Least Squares Dummy Variables) method, assuming country specific dummy variables, or by the time-demeaned estimation approach[3] (Wooldridge 2003). In the FE method an explicit hypothesis must be made that fixed effects are not correlated[4] with the explanatory variables and under this condition FE estimates are consistent. The third estimation method applied to panel data is the Random Effects (RE) approach, which holds that a country´s heterogeneity is not observable and is captured in the error term.[5] The estimation method used is GLS (generalized least squares) applied to the partial demeaned model (see Wooldridge 2003). Using this method the hypothesis that the unobserved error term is not correlated with the explanatory variables[6] is crucial to obtain unbiased and consistent estimates.

To decide which estimation method to perform (OLS, LSDV or GLS), three statistical tests are normally performed. The F-test[7] testing the pooled model versus the FE model, the Breush-Pagan LM test[8] testing the pooled model versus the RE model and the Hausman test[9] testing the RE model versus the FE model. Table 5 reports the results from the panel diagnostic tests on the *lin-lin* model and, as shown, the FE model is the most appropriate specification to adopt.

Table 5: Selection of the appropriate estimator.

Panel diagnostic test	*P-value*	Hypothesis	Conclusion
F (25,126) = 16.8703	8.36649e–033	H_0: 'Pooled' (OLS) H_A: Fixed Effects (LSDV)	Rejection of Pooled Model in favor of the Fixed Effects Model
Breusch-Pagan LM = 106.674	5.24852e–025	H_0: 'Pooled' (OLS) H_A: Random Effects (GLS)	Rejection of Pooled Model in favor of the Random Effects Model
Hausman H = 33.9515	2.43455e–006	H_0: Random Effects (GLS) H_A: Fixed Effects (LSDV)	Rejection of Random Effects Model in favor of the Fixed Effects Model

Source: Compiled by the authors.

3.4 Estimation Results and Interpretation

Taking the financial crisis of 2008 into account, it is important to test whether this event causes structural instability in the estimated models. We can address this idea by performing the Chow test of structural change, by splitting the sample into the pre-crisis period 2004–2007 and the post–crisis period 2008–2011. The results of the Chow test are reported in Table 6. They show that in all models no structural change is confirmed at the 1% level except for model 4 where this hypothesis is valid at the 10% level.

Table 6: Results of Chow's test.

Models	F-statistic	*P*-value	Conclusion (significance level = 5 %)
Model 1	F(6, 145) = 1.26152	0.2788	(pre-crisis period = post-crisis period)
Model 2	F(6, 145) = 1.06702	0.3851	(pre-crisis period = post-crisis period)
Model 3	F(8, 141) = 1.39838	0.2022	(pre-crisis period = post-crisis period)
Model 4	F(3, 177) = 2.17592	0.0925	(pre-crisis period = post-crisis period)
Model 5	F(7, 137) = 1.15347	0.3337	(pre-crisis period = post-crisis period)

Source: Compiled by the authors.

Table 7 reports the estimation results of the TEA eq. (1). Models 1 and 2 (columns 2 and 3, respectively) show the results of the *lin-lin* and *log-lin* models, assuming fixed effects characteristics. Model 3 (column 4) introduces the per capita income variable and its squared value to test the nonlinear relationship between TEA and per capita income to ascertain whether entrepreneurship is driven by necessity or by opportunity. The same hypothesis is tested by a simple relationship between TEA and per capita income, shown in column 5 (Model 4). Finally, a dynamic model specification with a lagged dependent variable is estimated in column 6 (Model 5) using the generalized method of moments (GMM) estimation approach; we performed a two-step estimation approach with asymptotic standard errors.

Table 7: Estimation results of the TEA equation (dependent variable TEA).

Control variables and constant:	Model 1 LSDV (lin-lin)	Model 2 LSDV (log-lin)	Model 3 LSDV (lin-lin)	Model 4 LSDV (lin-lin)	Model 5 GMM (log-lin)
Constant	−49.746 (***) *P-value* 0.0001	−4.906 (***) *P-value* 0.0095	−46.039 (***) *P-value* 0.00032	−10.771 (***) *P-value*0.00001	0.010 *P-value* 0.32924
Paid-in minimum capital	−0.030 (***) *P-value* 0.0003	−0.005(***) *P-value*1.16e–05	−0.021 (***) *P-value*0.00701		−0.003 (***) *P-value* 0.00001
Monetary Freedom	0.072 (*) *P-value* 0.0631	0.013 (**) *P-value* 0.0226	0.065 (*) *P-value* 0.07447		0.014 (***) *P-value* 0.00136
8th Pillar: Financial Market Development	1.325 (***) *P-value* 0.0002	0.170 (***) *P-value* 0.0011	0.963 (***) *P-value* 0.00370		0.084 (***) *P-value* 0.00034
Education Index100	0.482 (***) *P-value* 0.0005	0.052 (**) *P-value* 0.01000	0.212 *P-value* 0.1428		−0.002 *P-value* 0.93005
Investment Freedom	0.051 (**) *P-value* 0.0286	0.008 (**) *P-value* 0.0254	0.064 (***) *P-value* 0.00313		0.003 (*) *P-value* 0.08036
GDPppp per capita	—-	—-	0.001 (***) *P-value* 0.00001	0.0009 (***) *P-value* 0.00001	—-
GDPppp per capita^2	—-	—-	−1.292e-08 (***) *P-value* 0.00001	−1.060e-08 (***) *P-value* 0.00001	—-
Ln TEA(−1)	—-	—-	—-	—	0.213 (***) *P-value* 0.00001
Statistical robustness:					
R^2	0.863	0.832	0.889	0.863	—-
LSDV F-Stat	F(30. 126) = 26.396 *P-value* = 5.12e–41	F(30. 126) = 20.799 *P-value* = 1.05e–35	F(32. 124) = 31.16086 *P-value* = 3.24e–45	F(27. 155) = 36.40116 *P-value* = 8,96e–54	—-
Test for AR(2) errors	—-	—-	—-	—	z = −1.67728 [0.0935]
Sargan over-identification test	—-	—-	—-	—	Chi-square(20) = 19.4033 [0.4958]
Wald (joint) test					Chi-square(6) = 1686.52 [0.0000]

Source: Compiled by the authors.
Note: ***, **, * indicate that coefficients are statistically significance at 1%, 5% and 10% level, respectively.

A careful reading of Table 7 suggests that the estimation results are satisfactory in terms of the goodness of fit (more that 80% of the explanation in TEA is due to the explanatory variables) and in terms of the statistical significance of the population parameters. The estimations show an inverse relationship between TEA and the 'Paid-in minimum capital' variable and a direct relationship between TEA and the other variables, as expected.

Interpreting the marginal impacts of the covariates we can say that each percentage point (p.p.) increase in the 'Paid-in minimum capital' rate is responsible for 0.03 p.p decrease in TEA in Model 1, everything else remains constant. This impact is 0.5% in Model 2 (semi-elasticity) and 0.021 p.p. in Model 3 when the per capita income variable is included. As expected, this allows us to assert that the higher the (minimum) capital effort is required to start a new business activity the lower the TEA is in this sample of countries.

By analogy, with respect to 'Monetary Freedom' index (ranging from 0 to 100 points) the evidence shows that a unit increase in this index is associated with 0.072 p.p. increase in the TEA rate in Model 1, 1.3% increase

in Model 2 and 0.065 p.p. increase in Model 3, respectively. As anticipated, greater monetary stability favors the creation of new business activities.

The 'Financial Market Development' variable (ranging from 1 to 7 points) has also a positive impact on the TEA rate. It is estimated that one point increase in this scale is responsible for a 1.325 p.p. increase in TEA rate in Model 1, 17% increase in Model 2 and 0.963 p.p. increase in Model 3, everything else being constant. This evidence is in line with the claim that countries with more advanced financial markets offer better conditions for the development of entrepreneurial activities.

With respect to the 'Education Index' (ranging from 0 to 100) the evidence suggests that 1 unit increase in this index is associated with 0.482 p.p. increase in the TEA rate (Model 1) and it is responsible for 5.2% increase in TEA, in Model 2. The education variable has no statistical significance in Model 3, when the per capita income is included in the TEA equation. As expected, more qualified human capital helps to promote entrepreneurial activities in this sample of countries.

The 'Investment Freedom' variable (ranging from 0 to 100) reveals that one unit increase in this index is associated with 0.051 p.p. increase in TEA in Model 1, it is responsible for 0.8% increase in TEA in Model 2 and 0.064 p.p. increase in model 3, respectively. As expected, the results suggest that the removal of investment barriers stimulates the creation of new businesses.

Model 3 is an augmented specification of the TEA equation that includes the per capita income variable and its squared value in order to test the nonlinear (quadratic) relationship between TEA and the income factor. Our empirical evidence suggests that both parameters are statistically significant at the highest 1% level, thereby supporting the idea of an inverse U-shape (concave) relationship. This means that as per capita income increases the TEA rate also increases, up to a threshold point (turning point) after which the relationship becomes negative. Therefore, as countries improve their income level, this induces higher entrepreneurial activity up to a point where further economic development does not imply higher business activity. This is in accordance with the steady-state hypothesis applied to the business activity, meaning that the more advanced countries are close to their long-run equilibrium rate, which makes it harder to further develop activities related to new businesses, due to the existing higher stock of entrepreneurship. Taking the partial derivative of TEA with respect to per capita income and its squared value we are able to determine the threshold point[10] which is equivalent to USD 38,699.6. The same concave relationship is confirmed when the simple relation between the TEA and per-capita income (and its squared value) is considered, as shown in Model 4. A further justification of this concave relationship is given in the next section.

Finally, the last column of Table 7 reports the estimation results of the dynamic specification of the TEA equation (Model 5) with the lagged dependent variable. The dynamic panel data model estimation uses the Generalized Method of Moments (GMM) technique, as suggested by Arellano and Bond (1991). The model is estimated by using variables in first differences and lagged variables or lagged differences as instruments to control for the endogeneity of the lagged dependent variable. The results are quite satisfactory and through the Durbin-Wu-Hausman test all regressors are exogenous. All the short-run semi-elasticities of the covariates are statistically significant (except that for education) and carry their expected signs. In this method, we should also emphasize that all statistically significant coefficients confirmed the results of fixed effects models. The coefficient of the lagged dependent variable is also statistically significant, which validates the hypothesis of the stock adjustment mechanism.[11] The speed of adjustment runs at 78.7%,[12] showing a relatively high speed of closing the gap between the actual TEA rate and the desired level.

The estimation of the dynamic panel model determines the long-run effects of the covariates by dividing the short-run effects by the coefficient of the speed of adjustment. Interpreting the long-run marginal impacts of the covariates in Model 5, we can conclude that each percentage point (p.p.) increase in the 'Paid-in minimum capital' rate is responsible for a 0.381% decrease in the TEA rate,[13] everything else remaining constant. By analogy, every unit increase in the 'Monetary Freedom' index is responsible for a 1.779% increase in the TEA rate.[14] The long-run impact of the 'Financial Market Development' on the TEA rate is the highest one and equivalent to 10.673%,[15] while the 'Investment Freedom' factor is responsible for a 0.381% increase[16] in the entrepreneurial activity rate.

4 Discussion

In line with the institutional theory of North (2005 and 1990), we have used a sample of 26 developed countries and data for the period 2004–2011 to explain the entrepreneurial activity in these countries. Several explanatory variables (institutional and sociocultural) were used in the empirical analysis to explain entrepreneurship, but the most dominant ones were found to be those associated with financial conditions such as the minimum initial capital required to start-up a business, the degree of monetary and investment freedom and the degree of

development of financial markets. Besides the importance of financial factors it has been shown that the educational level of the economies is also an enhancing factor for developing new business activities. The relevance of the impact of institutional factors to explain the entrepreneurial activity within this set of developed countries should be noted. All the relationships found between TEA, institutional explanatory variables, and the education index are individually discussed according to their impact. The quadratic relationship found between the TEA and the GDP per capita (in PPP terms) is also discussed, and it reveals an inverse U- shape (concavity).

Starting with the inverse relationship found between the TEA rate and 'Paid-in minimum capital' variable allows us to conclude that the initial capital for starting up a new business is a barrier to the emergence of new companies. The described inverse relationship was also found in other studies like (Van Stel, Storey, and Thurik 2007), thus supporting the idea that the higher the capital effort to start up a new business the lower the predisposition for entrepreneurship.

Another financial factor related to 'Monetary Freedom' is found to have a positive impact on the entrepreneurial activity rate in this group of countries. Higher monetary freedom is achieved through higher price stability, lower inflationary pressure and less government price regulation. These are crucial conditions to reduce the risk and uncertainty in the markets encouraging new entrepreneurial activities. This is in line with the conclusions discussed by Porter and Schwab (2009) who see inflation as a threat to entrepreneurial activity. The positive impact of Monetary Freedom on TEA has also been found by Mcmullen, Bagby, and Palich (2008) who used a sample of 37 countries and the GEM 2002 data, within the concept of entrepreneurship driven by necessity. As Mcmullen, Bagby, and Palich (2008) pointed out, monetary policy that restricts economic freedom is likely to be negatively associated with entrepreneurial activity because individuals choose less uncertain income-generating alternatives.

In our empirical analysis 'Financial Market Development' was found to have a direct relationship with the TEA rate, too. From this relationship we can conclude that the higher the stage of development of a country's financial market, the greater the tendency for entrepreneurship. This finding reflects the importance of a wider range of financing instruments to the economy and corroborates the results of Gnyawali and Fogel (1994) and Van Gelderen, Thurik, and Bosma (2005), showing the positive influence that better access to credit has in promoting new businesses.

Our evidence also shows that 'Investment Freedom' is another important factor with a positive effect on the TEA rate, indicating that the absence of investment barriers is beneficial for enhancing entrepreneurial activity in a country. This conclusion is consistent with other studies that state that the abolition of investment barriers fosters an increase in the technological level (Wacziarg 2001), improves the access to capital markets, especially risk capital, facilitates investment and stimulates entrepreneurial activity (Gompers and Lerner 2001).

Despite the important role of financial factors for enhancing higher entrepreneurial activity, a social indicator related to Educational standards of the economy is shown to positively influence the initiative to develop business activities. In fact, given this evidence, it is pertinent to mention two main aspects of human capital (regarding education) in the light of the new theories of endogenous growth: (i) the assumption that human capital is a productive factor and, therefore essential to economic growth (Becker 1962; Lucas 1988) and (ii) the critical role of human capital for innovation (Nelson and Phelps 1966). This latter premise allows us to realize the importance of people's qualification for innovation and, by extension, as shown by the results obtained, for entrepreneurial activity at the country level. The prevailing idea here corroborated by some scholars (Davidsson and Honig 2003) is that education leverages a country's entrepreneurial activity.

Finally, the quadratic relationship found between the TEA and the GDP per capita (in PPP terms) reveals an inverse U-shape (concave) relationship which is consistent with the idea of entrepreneurship driven by opportunity and associated with innovation. A possible explanation of this result lies in the fact that our sample involves medium and high income countries with a high accumulated stock of business activities.

To sum up, since the roots of entrepreneurship are mostly related to the market conditions (financial and investment) and to education, as well as the aforementioned inverse U-shape relationship between TEA and GDP, we can conclude that the nature of entrepreneurship in developed countries is driven by opportunity.

Authors like Acs and Szerb (2010) have suggested a cubic relationship between entrepreneurship and the country's development level. Based on the classification of Schwab, Porter, and Sachs (2002) from the Global Competitiveness Report, the authors distinguish three levels of development: (i) the factor-driven stage, where low-cost labor and access to natural resources are the dominant sources of competitive advantages; (ii) the investment-driven stage (known also as the efficiency-driven stage), where the efficiency in producing standard products and services becomes the dominant source of competitive advantage, and (iii) the innovation-driven stage, where the ability to produce innovative products and services at the global technology frontier becomes the dominant source of competitiveness. According to the GEM (2011) data, the majority of countries in our sample belong to the final stage of development (innovation-driven stage), and of a total of 26 countries only five (Argentina, Brazil, Africa South, Hungary and Croatia) belong to the second stage of development (efficiency-driven stage). Figure 1 illustrates the nonlinearity between entrepreneurship and the stage of economic devel-

opment which justifies our empirical findings of a concave shape. According to this, as countries develop, the accumulation of entrepreneurial activities increases up to a turning point (the threshold point found in our empirical analysis corresponds to USD 38 699.6/per capita income), after which entrepreneurship reduces in intensity or starts declining. The explanation of this tendency can lie in the marginal diminishing returns to scale property and the close approximation to the steady-state level of entrepreneurial activities.

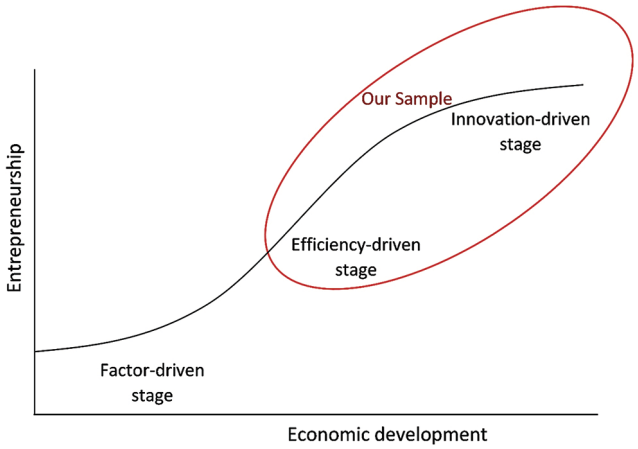

Figure 1: Entrepreneurship and development stages.
Source: Adapted from Acs and Szerb (2010: 5)

5 Conclusions

Among a variety of institutional and sociocultural variables it is found that the initial capital effort (measured by Paid-in minimum capital), money market liberalization (through the Monetary Freedom index), restrictions on investment (through the Investment Freedom index), and a country´s educational level are the predominant factors explaining the entrepreneurial activity rate in a set of 26, mostly advanced, countries. This evidence leads to the conclusion that entrepreneurial activity is mostly driven by favorable financial market conditions that encourage the start-up of new business activities with strong links to innovation and technological processes. This latter evidence is reinforced by the fact that human capital qualifications (through the educational level) are essential for promoting entrepreneurial activities. This is in line with the original ideas of the classical theory (Alfred Marshall and Jean-Baptiste Say) stating that capital is the main source of creating wealth and the new theory of endogenous growth (Barro 1990; Romer 1990) stating that human capital (through innovation) is the engine of economic growth.

Indeed, since the vast majority of the sample considered in this study (21 of 26 countries) represent advanced countries belonging to the Innovation-Driven Stage of development, our evidence confirms that favorable financial and investment conditions, as well as the knowledge economy, are the driving forces that encourage the development of entrepreneurial activities motivated by innovation (opportunity-driven entrepreneurship) and not by necessity. The inverse U-shape relationship found between the entrepreneurial activity and income per capita reinforces this conclusion, by indicating that as countries become wealthier so business activities increase, but not infinitely. A certain point will be reached (the steady-state level) where further economic development will not necessarily imply higher entrepreneurial activity and this would be explained by the diminishing returns to scale property and the higher business stock level. This is consistent with the idea that the higher/lower the distance from the steady-state the higher/lower the economic development, where entrepreneurship plays an important role.

Through the Chow test, we can also conclude that the world financial crisis of 2008 and the economic crisis in the years until 2011 did not have a significant effect on changing the entrepreneurial activity in this group of countries.

Finally, the dynamic estimation approach shows that the stock-adjustment mechanism is suitable to study the short-run and long-run effects of the main sources of entrepreneurship. The speed of adjustment between the actual and desired level of entrepreneurship is quite fast (78.7%), a tendency that characterizes the advanced countries. The dynamic approach confirms the important role that financial conditions have in explaining the business activity rate, but it fails to capture the important role of education in this process. This suggests that higher levels of human capital should be used, mostly in relation to innovation (and R&D), in order to explain its dynamic impact on entrepreneurial activity.

The findings of this study could be improved by including a wider sample of developed countries and using more recent data set that make the distinction between developed and developing countries feasible, in terms of different determinants that affect the TEA rate.

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Appendix

A Possible explanatory variables

Variables included in the study

Nature of the variable	Variable name	Source
Competitiveness variables	Institutions Infrastructure Macroeconomic environment Health and primary education Higher education and training Goods market efficiency Labor market efficiency Financial market development Technological readiness Market size Business sophistication Innovation	*Global Competitiveness Report – World Economic Forum (Schwab 2011)*
Economic – formal factors	Starting a Business Dealing with Construction Permits Getting Electricity Registering Property Getting Credit Protecting Investors Paying Taxes Trading Across Borders Enforcing Contracts Resolving Insolvency Property Rights	*Doing Business – The* World Bank (2011)
Economic – informal variables	Freedom from Corruption Fiscal Freedom Government Spending Business Freedom Monetary Freedom Investment Freedom Financial Freedom Trade Freedom Labor freedom	*Index of Economic Freedom – The Heritage Foundation* (*Miller and Holmes 2010*)
	Voice and Accountability Political Stability and Absence of Violence Government Effectiveness Regulatory Quality Rule of Law Control of Corruption	*World Governance Indicators (2011)*

Other financial and economic variables	Investment (% GDP) GDP per capita in USD Unemployment Rate Foreign direct Investment in USD National Savings (% GDP) Tax Revenue (% GDP) Credit to the private sector (% GDP) Education index	*International Monetary Fund (2011)* *The* World Bank (2011)
Sociocultural variables	Human development index Income Gini index	*International Human Development Indicators (Klugman 2011)*

Source: Compiled by the authors.

B Variance inflation factors

Detection of multicollinearity

Variables	VIF	1/VIF
Paid-in minimum capital	*1.060*	*0.943*
Monetary freedom	*1.209*	*0.827*
8th Pillar: financial market development	*1.290*	*0.775*
Education index100	*1.015*	*0.985*
Investment freedom	*1.368*	*0.731*

Source: Compiled by the authors.

Notes

1 Data collected from students in the United States, Sweden, Norway, Spain, Italy, and Germany.
2 Some developed countries were removed from the sample because data was unavailable and Taiwan was removed because it is not officially a country but a state of the Republic of China.
3 The two approaches are identical.
4 That is cov(α_i,X_{it}) = 0 where X_{it} is any explanatory variable.
5 If we assume that $\alpha_i = a + v_i$ in eq. (1) the RE model will have an error term $w_{it} = v_i + u_{it}$ where v_i is the unobserved country specific effect.
6 That is cov(v_i,X_{it}) = 0
7 The F-statistic is given by: $F_{sat} = \left(\frac{\frac{R^2_{fe} - R^2_{pool}}{N-1}}{\frac{1-R^2_{fe}}{NT-N-k}} \right) \sim F_{(N-1,NT-N-K)}$
8 The Breush-Pagan test is a LM test given by: $LM = \frac{NT}{2(T-1)} \left[\frac{\sum_{i=1}^{N} (\sum_{t=1}^{T} \hat{w}_{it})^2}{\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{w}_{it}^2} - 1 \right]^2 \sim x_1^2$
9 The Hausman statistic is given by:$H = \left(\hat{b}_{fe} - \hat{b}_{re}\right)' \left[Var\left(\hat{b}_{fe}\right) - Var\left(\hat{b}_{re}\right) \right]^{-1} \left(\hat{b}_{fe} - \hat{b}_{re}\right) \sim \chi_k^2$
10 Partial derivative: $\frac{\partial TEA_{it}}{\partial PIBppppc_{it}} = +0.001 - 2 \times 0.00000001292 \times PIBppppc_{it} = 0$
$PIBppppc_{it} = 38699,6USD$
11 The stock adjustment mechanism is defined as ($\ln TEA_{it}$-$\ln TEA_{it-1}$) = δ ($\ln TEA^*_{it}$-$\ln TEA_{it-1}$) where δshows the speed of adjustment (0≤ δ≤ 1), that is, how fast the actual variation of the TEA rate adjusts to its optimal level TEA*. The short-run model with variables in levels can be presented as $\ln TEA_{it} = \delta a_i + \delta\alpha X_{it} + (1-\delta)\ln Q_{it-1,}$ where X_{it} is a vector of the explanatory variables Gujarati (2003). *Basic econometrics*, McGraw Hill.
12 1 – δ = α ‹ = › 1 – δ = 0.213‹ = › δ = 0.787
13 –0.003 / 0.787 = –0.00381
14 0.014 / 0.787 = 0.01779
15 0.084 / 0.787 = 0.10673
16 0.003 / 0.787 = 0.00381

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