ICT incidence on the entrepreneurial activity at country level

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Abstract: This paper examines the explanatory factors of entrepreneurship with special emphasis on the information and communication technologies (ICT) development at country level. The ICT incidence on entrepreneurship is a recent field of research. A five period panel data analysis, 2007–2011, is estimated for 59 countries. By using the Global Entrepreneurship Monitor (GEM) total entrepreneurial activity indicator as the dependent variable, we observe a positive and significant influence of the ICT development on entrepreneurship. The main contribution of this paper is identifying an important area in need of more research in the entrepreneurship literature, linking ICT development to entrepreneurial activity. Recent estimations show that while mobile telephony is becoming more affordable worldwide, fixed broadband internet is not affordable for the majority of the world's inhabitants. Hence, a future extension of the model could be to examine the effect of mobile broadband tariffs on the entrepreneurial activity.

Keywords: entrepreneurship; information and communication technologies; ICT; bandwidth tariff; economic development; panel data.

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1 Introduction

New information and communication technologies (ICT) are strong promoters of productivity, economic growth and employment (Clarke, 2008; Fernández and Nieto, 2005; Pilat and Wolf, 2004; Yoguel et al., 2004; Chao, 2003; OECD, 2003; Bruque and Vargas, 2002; Amit and Zott, 2001; Brynjolfsson and Hitt, 2000; Lefebvre and Lefebvre, 1996). The specialised literature on ICT (Jorgenson and Stiroh, 1996; Jorgenson, 2001; Brynjolfsson and Hitt, 1995, 2000; Mansell et al., 2007; Cimoli et al., 2010; Novick et al., 2011) recognises that ICT investments have changed all the aspects of the productive dynamic of firms, regions and countries from different perspectives. These changes are achieved not only on the productive performance of the firms, but also on the creation of new economic sectors and employment.

The value of ICT extends far beyond direct economic benefits. ICT is a driving force in the acceleration of entrepreneurship and innovation, making it easier to identify and develop good ideas, and create and disseminate new products and services (INTEL, 2012).

The use of ICT drives entrepreneurship in virtually every market sector, from farming to computing and government services. Some of the ways in which ICT supports entrepreneurship and innovation include: Increases interconnectedness and collaboration; lowers the cost of entry for new entrepreneurs; enhances the ability of entrepreneurs to develop new business models, products, services, and processes; provides new tools to create, organise, store, and transmit information; and facilitates faster access to regional and international markets, among others.

Entrepreneurship is both a resource and a process of economic growth and development. For purposes of this paper, we consider entrepreneurship as a process that consists in the formation of new firms, the birth of new or nascent firms in a country.

Some recent literature argues that an increase in ICT use promotes the entrepreneurial activity (Viju, 2010; Leitao and Baptista, 2008). If ICT are considered determinants of the entrepreneurship capacity, we can expect that the digital divide among countries would cause different levels of entrepreneurship. In developed countries, internet access through mobile networks has increased quickly as a result of an expanding availability of intelligent mobile phones. Besides, almost every developed country has a high-speed broadband internet access with tariff reductions. In developing countries, mobile phones have also changed the way that people communicate, reaching by the end of 2008, 49.5% average penetration (this rate was nearly zero ten years ago) (ITU, 2009). However, broadband internet access is still rare in developing countries. To take full advantage of the potential of the internet, broadband internet access is indispensable (ITU, 2011). However, the high prices for broadband internet access are a main barrier. Galperín and Ruzzier (2010) argue that ICT access prices in Latin America are nearly three times higher than in developed countries, even when countries such as Uruguay, México and Chile have average tariffs similar to the OECD.

In developing countries, SME are a breeding ground for entrepreneurs (UNIDO, 2003). The use of mobile phones has helped many entrepreneurs reduce costs and improve business process. In many developing countries, farmers now use mobile phones to find best prices for their product (Kotelnicov, 2007). ICT, along with education/training and R&D, is one of the most important elements in building a platform for entrepreneurship. The critical challenge in the mix of entrepreneurship and ICT include the aspects such as lacking of ICT skills in most entrepreneurs.

A strong governmental commitment to ICT is one of several critical elements needed to help accelerate entrepreneurship (INTEL, 2012). Governments need to commit to innovation-related investments, including ICT, education/training, and R&D.

The objective of this paper is to determine the influence of ICT on the entrepreneurial activity. We are mainly interested in the determinants of entrepreneurship, rather than on the impact of entrepreneurship. This paper aims to develop a panel data analysis about the importance of ICT development as a determinant of entrepreneurship. The paper is organised as following: a special section about the ICT incidence on the entrepreneurial activity; a literature review focus on the explanatory factors of the entrepreneurial activity; the methodology used; the results obtained; and lastly, the final remarks.

2 ICT and entrepreneurial activity

The ICT incidence on entrepreneurship arises from the fact that an increase in ICT use leads to a higher entrepreneurial activity (Viju, 2010; Leitao and Baptista, 2008). This emerges from the idea that information is necessary to the entrepreneurial process because the richer information, the better opportunities that are recognised by the entrepreneur (Shane, 2003), and the better the opportunity recognition process, the better the business success (Ardichvili et al., 2003, Kotelnicov, 2007). Since ICT are information and coordination enablers, they are a source of entrepreneurship. Besides, the ICT development level influences the diversity in consumer demand leading to opportunities for entrepreneurship.

The fundamental economic role of computers becomes clearer if one thinks about organisations and markets as information processors (Galbraith, 1977; Simon, 1976; Hayek, 1945). Malone and Rockart (1991) explicitly reported that, based in their research on the effect of IT on the cost of information, information technology (IT) should lead to an overall shift from internal decisions within firms to the use of markets to coordinate economic activity. IT has the broad power to reduce the costs of coordination, communications, and information processing (Brynjolfsson and Hitt, 2000). Besides, more information about products and services becomes instantly available to customers, and as information goods (Shapiro and Varian, 1999) are transmitted over the internet.

The extended use of ICT will help entrepreneurs create advantages, research, and participate for technology transfer, training, collaboration, and development of initiatives at global level (Viju, 2010). Besides, ICT are an important source of innovation, and consequently of entrepreneurship (Velde, 2004; Caceres and Aceytuno, 2008). ICT have not only emerged as a new economic sector, leading to new business opportunities, but they have also been extended to other economic sectors where innovation raises the creation of new firms.

Some studies argue that during the last two decades, the development of new technologies and consequently the emergence of new business models have shifted from large corporations to small and new ventures (Audretsch and Thurik, 2001; Thurow, 2003; Wennekers et al., 2005). Leitao and Baptista (2008) state under a neo-Schumpeterian approach, that the long term economic relationship among entrepreneurial activity, and investment in ICT drive creative destruction through the creation of further small and medium sized enterprises, thus revitalising the entrepreneurial innovative capacity of the host economies.

Broadband allows the development of new markets through the innovation of new network-based products and services, as well as the extension of the existing markets size (Czernich et al., 2009). As a result, broadband is often referred to as a general purpose technology (GPT) (Majumdar et al., 2009). A comparison of 2010 broadband prices shows that people in developing countries had to pay five times the price paid in developed countries. At the same time, between 2008 and 2010, fixed broadband prices in developing countries have decreased considerably, in both PPP and USD, and much more markedly than the other ICT services (ITU, 2011). Broadband services in Latin America are generally expensive and of poor quality when benchmarked against OCED countries, and Latin American countries are underperforming in broadband development after wealth, education and demographics factors are accounted for Galperín and Ruzzier (2010). Some studies from Brazil and Chile show that the presence of high internet access tariff is one of the main reasons of not using internet (Jordán, 2010).

3 Determinants of entrepreneurship: literature review

In the productive field, entrepreneurship is a process of building, developing and consolidation of new firms, dependent on the regions and industries under study (Arzeni, 1998). In the academic field the meaning is wider. Schumpeter (1934/2000) economic outcome-based concept that an entrepreneur creates value by carrying out new combinations causing discontinuity is embodied in many of the definitions offered within the last 50 years. Despite the number of published papers that might be considered related to the theory of entrepreneurship, no generally accepted theory of entrepreneurship has emerged (Bull and Willard, 1993).

Acs et al. (2007) define entrepreneurship as a conduit for spillovers of knowledge into the economy, enhancing productivity and growth. But entrepreneurial activity itself is also driven by spillovers, acting either through the transmission and availability of innovative ideas, or through the existence of an infra-structure which supports new entrepreneurial efforts. The analysis of the determinants of entrepreneurship represents valuable information for policy design.

Nowadays, researchers focus in the entrepreneur or Schumpeterian businessman because of his contribution to economic growth both in social terms, by generating employment and social welfare (Acs and Armington, 2006), and in economic terms, by creating and distributing wealth among salaries, interests and other gains (Grebel, 2007). Entrepreneurship is both a resource and a process of economic growth and development. For purposes of this paper, we consider entrepreneurship as a process that consists in the formation of new firms. It is not about recognising opportunities to create value in existent firms. Developing an entrepreneur economy requires some public institutions to encourage entrepreneurship, and the availability of financial, economic and legal resources. Therefore, the comprehension of the entrepreneurial activity is important to promote and support efficient firms' creation execution.

Determinants of entrepreneurship can be understood from the so called push (demand side of entrepreneurship) and pull (supply side of entrepreneurship) factor perspectives. Push factors represent opportunities to engage in entrepreneurial activity, and are influenced by factors related to technological development, government regulation, and the stage of economic development, for instance. The pull factors are

determined by characteristics of the population such as the income level, the degree of unemployment, institutional environment, among others.

The recent literature about the determinants of the entrepreneurial capacity at country level focuses in analysing the economic variables that influence the entrepreneurship level. This idea comes from Carree and Thurik (2003), OECD (2003) and Geroski and Jacquemin (1985). A country's economic development level plays an important role in understanding the entrepreneurial behaviour throughout time (Porter and Stern, 2002; Thurow, 2003; Audretsch and Thurik, 2001). The Global Entrepreneurship Monitor (GEM), GEM project provides empirical evidence for that statement by showing that developing economies since year 2001 face high prevalence rates of people involved in entrepreneurial activities. A country's higher development level can encourage and strengthen entrepreneurial activity (Acs et al., 2005).

The literature established an inverse relationship between *economic growth* and the entrepreneurial equilibrium rate up to certain level of entrepreneurship when the tendency changes (Carree et al., 2002; Audrestch et al., 2000). Carree et al. (2002) found a U-shaped relationship between the level of per capita income and the rate of self-employment (or business ownership) in 23 OECD countries. In a revisited version of the paper with new evidence, the authors obtained an 'L-shaped' model (Carree et al., 2007). Similarly, Wennekers et al. (2005) using GEM data showed three U-shaped approaches between entrepreneurship rates and the level of economic development, measured by income per capita. The relationship between entrepreneurial rate and economic growth was modelled by some authors (Crescente and Romero, 2009; Van Stel et al., 2006; Carree et al., 2002; Belso, 2004; Cuadrado-Roura et al., 2007).

The GEM reports establish that countries with low incomes have a high rate of entrepreneurial activity derived from the fact that a large part of the population has not been alternative sources of employment. This phenomenon is a major factor in Latin American entrepreneurship rates (Llisterri et al., 2006). Many studies analyse the relationship between entrepreneurship and *unemployment* (Cowling and Bygrave, 2003). Entrepreneurship has been suggested as a remedy against high unemployment and stagnant economic growth (European Commission, 2003; Carree and Thurik, 2003; Thurik et al., 2008).

Entrepreneurial activity is not only a consequence of a push effect of (the threat of) unemployment but may also be the result of a pull effect produced by a thriving economy full of opportunities (Parker, 2004; Thurik et al., 2008). The occupational choice approach suggests that increased unemployment will lead to an increase in start-up activity because the opportunity costs of starting a firm have decreased. This effect has been referred to as the 'refugee' effect. However, unemployed people tend to possess lower endowments of human and social capital and entrepreneurial talent which may lead to early exit. High unemployment may also imply lower levels of personal wealth reducing the likelihood of becoming self-employed or the survival in the initial stages of business ownership (Van Stel et al., 2007).

Many authors have analysed the way *innovation* emerges and the entrepreneurial or business opportunities linked to them (Cáceres, 2005; Shane, 2003; Schumpeter, 1934/2000; Malerba and Orsenigo, 1996). The entrepreneurial process requires some form of innovation. Innovation is considered the main source of business opportunities. An important knowledge condition that affects the rate of new firm formation in an industry is the nature of the innovation process (Shane, 2003). According to Schumpeter

(1934/2000), business opportunities are more likely to emerge in developing innovations sectors. The successful application of an innovation in one sector will enhance business opportunities in other related sectors.

Acs and Audretsch (1989) examined the net entry of small firms into 247 manufacturing industries in the USA and found a higher rate of entry in those industries where the firms' innovation rate was higher. Wong et al. (2005), using the GEM total entrepreneurial activity (TEA) indicator, argue that the technological innovation level and the creation of new firms in a country are independents events.

Bowen and Clerq (2005) examine the role of *institutional factors* guiding the nature, rather than the level, of entrepreneurial activity. They make a distinction between specific resources embedded in the institutional environment (financial capital and human capital); and the rules governing the undertaking of economic activities within the environment (regulatory protection, regulatory complexity and the level of corruption). It is the regional milieu of agents and institutions of an economy, a region or a society that is conducive to the creation of new firms (Audrescht et al., 2008).

Djankov et al. (2002) study *the presence of administrative burdens, or entry regulations*. The regulatory dimension of the institutional factor consists in laws, regulations and public policies that support new businesses and reduce the risk of losses. Entrepreneurial activities exhibit variations since entry regulations of new firms vary from country to country. For example, a Slovenian entrepreneur in 2006 spent 60 days to complete nine required business start-up procedures to form a firm. Empirical evidence suggests that entrepreneurs could decline their intention to create a firm if they have to follow many rules and procedures, contact different institutions, and obtain licenses (Dana, 1990; Grilo and Thurik, 2005; Young and Welch, 1993; Begley, 2005).

Although there are many studies that consider the new technology as one of the forces that stimulate the growth of new firms (Knight et al., 1987), only a few analyse the role of *ICT* (Ospina, 2011; Viju, 2010; Leitao and Baptista, 2008; Giaoutzi and Vescoukis, 2006). Giaoutzi and Vescoukis (2006) demonstrate differential demands and needs of ICT for entrepreneurial action.

This paper has a closed resemblance with Ospina (2011) who develops an econometric model of panel data for 49 countries around the world in the period 2001–2007. The author finds a significantly positive influence of *ICT* on the density of new firms. The study uses the density of new firms from The World Bank Group Entrepreneurship Survey as the dependent variable[1]. Since different sources of data on entrepreneurship have led to contradictory or inconclusive empirical findings for research (Acs et al., 2008), we want to check the robustness of the model by using GEM data. GEM data captures informality of entrepreneurship, particularly in developing countries. Many developing countries host substantial informal sectors, so entrepreneurs are able to operate entirely within the informal economy. Informality arises from the fact that firm formation does not necessarily mean firm registration. GEM data considers a large set of entrepreneurial activities, from businesses that operate in the formal sector but opt for a different legal status than a limited liability corporations (LLC), to businesses that can be part of the informal economy, to entrepreneurial initiatives that are at the very early stage and hence can potentially become businesses operating in the formal sector but do not yet actually do so.

Besides, Ospina (2011) does not control by internet access tariffs. Countries that do well in terms of ICT affordability are those with low tariffs. A way to measure ICT affordability is taking into account both the prices of ICT services and the income levels

to reflect the financial ability to pay on the demand side (The World Bank, 2009; Galperín and Ruzzier, 2010).

4 Methodology

From a panel data corresponding to the period 2007–2011 and a sample of 59 countries we study the incidence of ICT on entrepreneurial activity. Using a five-period model responds to the availability of data. The time restriction comes from the ICT development index (IDI) which is a novel indicator (published since 2007) and the TEA indicator, available for a set of countries.

We use the period 2007–2011 because the International Telecommunications Union (ITU) changed the index methodology in 2007. Until 2007, the ITU has published the information and communication technologies-opportunity index (ICT-OI). Hence, IDI is available from 2007. Besides, TEA data is available up to an average of 50 countries in the period.

The dependent variable is the TEA, the number of adults (18–64 years old) per 100 involved in a nascent firm or young firm or both (if doing both, still counted as one active person). Nascent entrepreneurs are individuals who are starting a new business and baby entrepreneurs are individuals who are owners and managers of a young firm (source: GEM).

The Independent variable of interest is the IDI that is computed by the International Telecommunication Union in more than 150 countries worldwide. Its main objective is to provide policy makers with a useful tool to benchmark and assess their information society developments and to monitor progress that has been made globally to close the digital divide. The top ranking economies are primarily high-income countries from the developed world, whereas the least developed countries rank towards the bottom of the index. Despite impressive growth in the uptake of mobile telephony in many countries, the magnitude of the digital divide remains almost unchanged. However, the divide is slightly closing between countries with very high and those with low ICT levels (ITU, 2009).

The IDI incorporates different aspects and lessons learned, from earlier indices. In particular, the development of the IDI has been guided by previous ITU composite indices, such as the digital access index (DAI), the digital opportunity index (DOI) and the ICT opportunity index (ICTOI).

The selected indicators correspond to three subcomponents of the index (or sub-indices):

- ICT infrastructure and access (including fixed and mobile telephony)
- ICT use (primarily by individuals, but also households, businesses, others as data become available in the future) and the intensity of use
- ICT skills (or capacity necessary to use ICTs effectively).

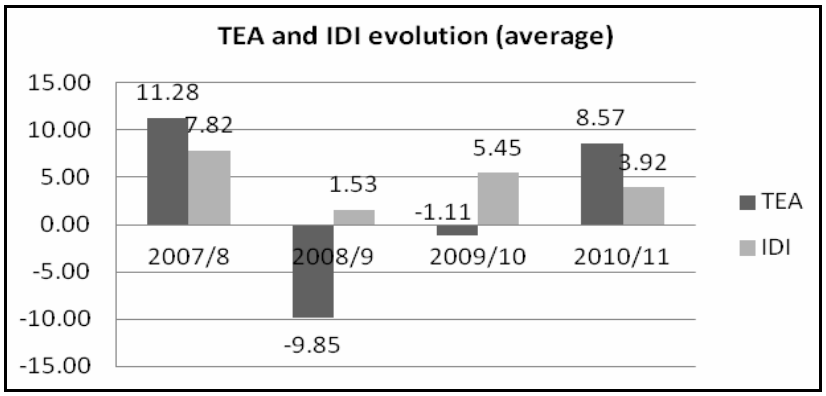
We can observe (Figure 1) the relationship between TEA and IDI in a scatter diagram.

Figure 1 Relationship between TEA and IDI (see online version for colours)

Source: The author based on STATA

On average, the countries improved their IDI scores over the period although with different variation[2]. This result is to be expected, as ICT access and use is globally increasing. On average, IDI goes from 4.86 in 2007 to 5.83 in 2011. Figure 2 highlights the evolution of the TEA and the ICT development over the period under study. The TEA shows a negative variation in the second and third period, while IDI always increased, although with different variations.

Figure 2 Evolution of TEA and IDI (averages)



Source: The author

5 Model specification

We use a fixed effects model with standard errors adjusted to explore the relationship between the TEA and the predictors: IDI and bandwidth access tariffs. We assume that something within the individual country may impact or bias the TEA. In this kind of model, where t is small and N large the decision about fixed effects or random effects generates differences in the parameters estimations. In these cases, we must use information efficiently to estimate the part of the relationship behaviour contained in variables that substantially differ from one individual to another.

In reference to this individual effect, panel data models have been developed in two directions. Fixed effects models, characterised by the correlation between regressors and the specific effect, and random effects models, without correlation. According to the Hausman test, this paper estimates the model with a fixed effects model.[3] In theory, the selection of the model depends on the recognition of structural differences among countries in the sample. In the fixed effects model[4], the individual-specific effect is a random variable that is allowed to be correlated with the explanatory variables.

The model is specified as follows:

$$\begin{aligned} TEA_{i,t} = {} & \beta_1 IDI_{i,t} + \beta_2 Tariff_{i,t} + \beta_3 GDPpc_{i,t} \\ & + \beta_4 GDPpc^2{}_{i,t} + \beta_5 Unemployment_{i,t} + \beta_6 Trademarks_{i,t} \\ & + \beta_7 DaysBuss_{i,t} + a_i + e_{i,t} \end{aligned}$$

where

- i: country.
- t: year (2007, 2008, 2009, 2010, 2011).
- a_i: denote the individual effects (country effects).
- $e_{i,t}$: is the error term.
- *TEA*: total entrepreneurial activity (entrepreneurship rate). Number of adults (18–64 years old) per 100 involved in a nascent firm or young firm or both (if doing both, still counted as one active person) (source: GEM).
- *IDI*: IDI represents the ICT development index. It is a composite index. The index captures the level of advancement of ICT (source: ITU).

Hypothesis: The higher the IDI of a country, the higher the TEA will be.

- *Tariff*: fixed broadband internet access tariff (dollar per month) (source: Trading Economics).

  The fixed broadband internet access tariff is included since an important element in monitoring ICT developments is to examine the cost of ICT services. High tariffs are often a major barrier to ICT uptake, in particular among poor people. Bandwidth tariffs have an indirect impact on entrepreneurship, by affecting ICT use and the innovation rates. Therefore, they must be included in the model. If we omit the variable, we would incur in a model specification problem. Otherwise, the significance of the ICT use variable could be biased.

FBIAT is the lowest sampled cost per 100 kilobits a second per month and is calculated from low and high speed monthly service charges. Monthly charges do not include installation fees or modem rentals.

- *GDPpc*: per cápita gross domestic product. It 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, in current dollars (source: The World Bank).

  We add the gross domestic product to control for economic development differences among countries.

- *GNIpc2*: is the square of the per capita gross national income.

- *Unemployment*: rate of unemployment as percentage of total labour force (source: The World Bank). Unemployment refers to the share of the labour force that is without work but available for and seeking employment. The unemployment rate is a push factor. We expect, ceteris paribus, that a higher unemployment rate is associated to higher firm formation rates.

- *Trademarks*: trademark applications filed are applications to register a trademark with a national and regional Intellectual Property (IP) Office. A trademark is a distinctive sign which identifies certain goods or services as those produced or provided by a specific person or enterprise [source: The World Intellectual Property Organization (WIPO)]. By using this variable, we pretend to measure the impact of innovation on the entrepreneurial activity.

- *Starting a business*: The number of days for starting a business, from The World Bank's Doing Business Reports, pretends to measure the time spent by starting a business. This indicator is one of the doing business ranking that investigates the regulations enhance business activity and those that constrain it. It covers the number of days necessary to starting a business in a country. It can be compared across 183 economies and over time (source: The World Bank Doing Business Reports). A high number of days mean the regulatory environment is less conducive to the starting and operation of a local firm. A few number of days on starting a business means the regulatory environment is more conducive to the starting and operation of a local firm. We expect that the less the number of administrative procedures, the less the cost of starting a business; the higher the entrepreneurial activity.

We do not include explicitly the human capital or level of education since this is one of the components of the development index.

Apart from the characteristics captured by the variables included, there are some differences caused by an economic, social and political diversity among countries that are not included explicitly. They can be estimated by including a dummy variable specific to each country, so that the error term decomposed in a traditional error term and a specific error term. A national' capacity for entrepreneurship is argued to be the key factor in successful national economies (Lawton et al., 2005). The national culture is considered an explanatory factor of entrepreneurial orientation of countries (George and Zahra, 2002; Hayton et al., 2002).

In Table 1, we show the descriptive statistics of the variables included in the model. See Table 2 for details on correlation matrix for these variables.

Table 1 Descriptive statistics

Variable	*Meaning*	*Obs*	*Mean*	*95% Conf.*	*Interval*
TEA	Total entrepreneurial activity	206	9.552282	8.711973	10.39259
IDI	ICT development index	288	5.371354	1.62	8.56
Tariff	Fixed broadband access tariff	253	28.03884	26.50787	29.5698
Unemployment	Level of unemployment	253	8.252763	7.572882	8.932644
Trademarks	Residents trademarks	238	30,267.52	24,451.85	36,083.19
daybusiness	Number of days for starting a business	241	24.90456	21.489	28.32013
gdppcdollar	Gross domestic product	289	22,546.08	20,261.99	24,830.16

Source: The author

Table 2 Correlation matrix

	tea	idi	tariff	trademarks	gdppc	daysbusiness	unemployment
tea	1.0000						
idi	-0.6011*	1.0000					
tariff	0.1715	0.1425	1.0000				
trademarks	-0.0177	-0.0249	-0.1660	1.0000			
gdppcdolar	-0.4271*	0.7814*	0.3497*	0.0218	1.0000		
daysbusiness	0.4168*	-0.4239*	-0.0274	0.0601	-0.3720*	1.0000	
unemployment	0.0901	-0.2671*	-0.0850	-0.1288	-0.3542*	-0.0421	1.0000

Note: *Significance level at 5%.

Source: The author

6 Results

The estimated model includes all the variables previously mentioned, with special interest on the IDI. The results show the TEA of a country rises with ICT development, the level of innovation and the number of days for starting a business.

It can be proved that the model is robust in the IDI variable. The higher the IDI, the greater the TEA is. Thus, ICT have the potential to drive entrepreneurship. ICT are not only a driving force for economic growth, but also they can promote the formation of new firms. However, the costs of ICT services, measured by the fixed broadband internet access tariff, are not found significant for the entrepreneurial activity.

The variable innovation, proxied by trademarks, shows a positive and significant relationship with the entrepreneurial activity. This result is similar to Keilbach et al. (2009). Recently, the GEM project based on the Global Competitiveness Report pointed out that certain framework conditions relate more fully to innovation-driven[5] economies that are specific to innovation and new venture creation (Bosma and Levie, 2010).

Similar to some literature (Acs et al., 2008), there is a significant and positive relationship between TEA and the administrative barriers to start a business (measured by days for starting a business). Since the dependent variable measures the entrepreneurial activity that is not necessarily a registered or formal activity, a country with many barriers and regulations for starting a business can have an increase in its entrepreneurial activity. The implication is that barriers to entry are greater for corporate entrepreneurship than for young businesses that have not incorporated or for nascent entrepreneurs in the process of starting a business. Besides, Djankov et al. (2002) find that high costs of entry exist in most countries, and that countries with more corruption have larger unofficial economies.

Besides, we control for economic development through GDP per cápita. We observe no significant relationship between the level of development of a country and the entrepreneurship rate. Although this paper states the possibility of a not linear specification between entrepreneurship and GNI per capita, by including the square of the per cápita gross domestic product, we cannot deduce a clear relationship between the variables.

In respect to unemployment, the positive and significant relationship with entrepreneurship follows the occupational choice approach that suggests that increased unemployment will lead to an increase in start-up activity.

The fixed effects model does not identify the regressors' coefficients when they do not change along the time. FE removes the effect of those time-invariant characteristics from the predictor variables so we can assess the predictors' net effect. We can deduce that ICT are growing so fast worldwide that there impact on TEA is significant even if the time-period is short. For some conventional predictors of the entrepreneurial activity, such as unemployment, the situation is different. Their values are more static in time.

Table 3 Estimation outputs

Fixed-effects (within) regression				Number of obs	=	128
Group variable: i				Number of groups	=	43
R-sq: within = 0.2131				Obs per group: min	=	1
between = 0.0007				avg	=	3.0
overall = 0.0002				max	=	5
				F(6,42)	=	8.32
corr(u_i, Xb) = -0.6836				Prob > F	=	0.000
(Std. Err. adjusted for 43 clusters in i)						
		Robust				
TEA	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
IDI	**1.044155**	**.4471828**	**2.33**	**0.024**	**.1417032**	**1.946606**
tariff	.0027021	.0283931	0.10	0.925	-.0545974	.0600017
unemployment	.0296804	.1134484	0.26	0.795	-.1992678	.2586286
gdppcdolar	7.90e-07	.000044	0.02	0.986	-.0000881	.0000897
gdppcdolar2	1.15e-10	4.34e-10	0.26	0.793	-7.61e-10	9.90e-10
trademarks	**.0000715**	**.0000255**	**2.81**	**0.008**	**.0000201**	**.0001229**
daysbusiness	**.0767161**	**.0363773**	**2.11**	**0.041**	**.0033037**	**.1501284**
_cons	-2.52366	3.210877	-0.79	0.436	-9.003471	3.956151
sigma_u	6.2580587					
sigma_e	1.4000756					
rho	.95233355	(fraction of variance due to u_i)				

Source: The author using STATA 11

7 Final remarks

This paper examines the explanatory factors of entrepreneurship with special emphasis on the ICT development at country level. It provides some insights about the ICT development incidence on entrepreneurship investigating to what extent differences in ICT development contribute to explain differences in entrepreneurial activity across countries. To achieve this goal, we estimate a fixed effects panel data with 59 countries for the period 2007–2011.

We observe a positive and significant influence of the ICT development on entrepreneurship. This means that a country with a high ICT development would achieve a greater entrepreneurial activity. The richer information, the better opportunities that are recognised by the entrepreneurs and the better the opportunity recognition process is.

The results obtained stress that entrepreneurs do not take their decisions to build a new firm in an isolated manner. Otherwise, they respond to environmental factors, such as the business environment and the innovation environment, to achieve a better position in the global market. The ICT development is perceived as a new explanatory factor of the entrepreneurship activity.

By using a panel data model has the advantage of eliminating the omitted variable bias problem of modelling. We suggest extending the sample to obtain more precise estimates due to efficiency gain brought by more data.

The main contribution of this paper is identifying an important area in need of more research in the entrepreneurship literature, linking ICT development to entrepreneurial activity. For example, micro loans used to purchase cell phones has led to immense entrepreneurial activity in many developing countries. Recent estimations show that while mobile telephony is becoming more affordable worldwide, fixed broadband internet is not affordable for the majority of the world's inhabitants. A future extension of the model could be to examine the effect of mobile broadband tariffs on the entrepreneurial activity.

Entrepreneurship is still an issue in the policy agency, policy research priorities go from measuring entrepreneurship to fostering the entrepreneurial activity through appropriate policies. Many policies focus on the role of environmental conditions. In this paper, we suggest the important role play by ICT to promote entrepreneurship.

References

Acs, Z. and Armington, C. (2006) *Entrepreneurship, Geography and American Economic Growth*, Cambridge University Press, Cambridge.

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

Acs, Z., Desai, S. and Klapper, L. (2008) 'What does 'entrepreneurship' data really show?', *Small Business Economics*, Vol. 31, No. 3, pp.265–281.

Acs, Z., O'Gorman, C., Szerb, L. and Terjesen, S. (2007) 'Could the Irish miracle be repeated in Hungary', *Small Business Economics*, Vol. 28, Nos. 2–3, pp.123–142.

Acs, Z.J. and Audretsch, D.B. (1989) 'Small-firm entry in U.S. manufacturing', *Economica*, Vol. 56, No. 222, pp.255–265.

Amit, R. and Zott, C. (2001) 'Value creation in e-business', *Strategic Management Journal*, Vol. 22, Nos. 6–7, pp.493–520.

Ardichvili, A., Cardozo, R. and Ray, S. (2003) 'A theory of entrepreneurial opportunity identification and development', *Journal of Business Venturing*, Vol. 18, No. 1, pp.105–123.

Audretsch, D. and Thurik, R. (2001) 'What is New about the New Economy? Sources of growth in the managed and entrepreneurial economy', *Industrial and Corporate Change*, Vol. 10, No. 1, pp.267–315.

Belso, J. (2004) 'Tasa óptima de empresarialidad y desarrollo económico', *Evidencias para el caso español, Estudios de economía*, Vol. 2, No. 31, pp.207–225.

Bosma, N. and Levie, J. (2010) *Global Entrepreneurship Monitor, 2009 Global Report*, Babson College, Wellesley.

Bruque, S. and Vargas, A (2002) 'Influence of the internet use on firm performance. An application to the pharmaceutical distribution industry in Spain', *European Conference on Information Systems (ECIS)*, Poland.

Brynjolfsson, E. and Hitt, L. (1995) 'Information technology as a factor of production: the role of differences among firms', *Economics of Innovation and New Technology*, Vol. 3, Nos. 3–4, EEUU.

Brynjolfsson, E. and Hitt, L.M. (2000) 'Beyond computation: information technology, organizational transformation and business performance', *Journal of Economic Perspectives*, Vol. 14, No. 4, pp.23–48.

Bull, I. and Willard, G.E. (1993) 'Towards a theory of entrepreneurship', *Journal of Business Venturing*, Vol. 8, No. 3, pp.183–195.

Cáceres, F.R. (2005) *Oportunidades para crear empresas*, Expandora Sur, Sevilla.

Carree, M., Van Stel, A, Thurik, R. and Wennekers, S. (2007) 'The relationship between economic development and business ownership revisited', *Entrepreneurship and Regional Development*, Vol. 19, No. 3, pp.281–91.

Carree, M., Van Stel, A., Thurik, R. and Wennekers, S. (2002) 'Economic development and business ownership: an analysis using data of 23 OECD countries in the period 1976–1996', *Small Business Economics*, Vol. 19, No. 3, pp.271–290.

Carree, M.A. and Thurik, A.R. (2003) 'The impact of entrepreneurship on economic growth', in Audretsch, D.B. and Acs Z.J. (2003): *Handbook of Entrepreneurship Research*, pp.437–471, Kluwer Academic Publishers, Boston/Dordrecht.

Chao, A.D. (2003) 'El efecto de las tecnologías digitales en la competitividad de la empresa española', *Revista Estudios de Economía Aplicada*, Vol. 21, No. 3, Issue 1, pp.521–534.

Cimoli, M., Hofman, A. and Mulder, N. (2010) *Introduction and synthesis. In Innovation and Economic Development. The impact of information and communication Technologies in Latin America*, Comisión Económica Para América Latina y el Caribe (CEPAL) Naciones Unidas, Edwar Elgar Publishing, Inglaterra.

Clarke, G. (2008) 'Has the internet increased exports for firms from low and middle-income countries?', *Information Economics and Policy*, Vol. 20, No. 1, pp.16–37.

Cowling, M. and Bygrave, W. (2003) 'Entrepreneurship and unemployment. Relationships between unemployment and entrepreneurship in 37 nations participating in the global entrepreneurship monitor (GEM) 2002', *Frontiers of Entrepreneurship Research*, pp.544–555.

Cuadrado-Roura, J.R., García-Tabuenca, A. and Crespo, J. (2007) *Entrepreneurship, Creative Industries and Regional Dynamics in Spain*, 47º Congreso ERSA, 29 Agosto, París.

Czernich, N., Falck, O., Kretschmer, T. and Woessmann, L. (2009) *Broadband Infrastructure and Economic Growth*, CESIFO Working Paper No. 2861 [online] http://www.SSRN.com.

Djankov, S., La Porta, R., de-Silanes, F. and Shleifer, L.A. (2002) 'The regulation of entry', *Quarterly Journal of Economics*, Vol. 117, No. 1, pp.1–35.

European Commission (2003) *Green Paper Entrepreneurship in Europe*, European Commission, Brussels.

Galperín, H. and Ruzzier, C. (2010) 'Las tarifas de banda ancha: benchmarking and analysis', Chapter V in Jordán, V., Galperín, H. and Peres, W. (Eds.): *Acelerando la revolución digital: banda ancha para América Latina y el Caribe*, Naciones Unidas, Santiago de Chile.

George, G. and Zhara, S.A. (2002) 'Culture and its consequences for entrepreneurship', *Entrepreneurship: Theory and Practice*, Vol. 26, No. 4, pp.5–7.

Giaoutzi, M. and Vescoukis, V. (2006) 'The role of ICTs in building entrepreneurial capacity in the regions of the future', *Int. J. of Entrepreneurship and Innovation Management*, Vol. 6, No. 3, pp.191–204.

Grebel, T. (2007) 'Neo-Schumpeterian perspectives in entrepreneurship research', in H. Hanusch and A. Pyks (Eds.): *Elgar Comparison to Neo-Schumpeterian Economics*, pp.147–158, Edgar Elgar, Cheltenham, UK.

Hayton, J.C., George, G. and Zahra, S.A. (2002) *Global Entrepreneurship Monitor. Informe Ejecutivo 2004*, Extremadura. Trujillo (Cáceres) Fundación Xavier de Salas.

ITU (2009) *Measuring the Information Society. The ICT Development Index*, International Telecommunication Union, Geneva, Switzerland.

ITU (2011) *Measuring the Information Society*, International Telecommunication Union, Geneva, Switzerland.

Jordán, V. (2010) 'Banda ancha: la nueva brecha digital', Chapter 3 from Jordán, V., Galperin, H. and Peres, W. (Eds.): *Acelerando la revolución digital: banda ancha para América Latina y el Caribe*, Naciones Unidas, Santiago de Chile.

Jorgenson, D. (2001) 'Information technology and the U.S. economy', *American Economic Review*, Vol. 91, No. 1, American Economic Association, EEUU.

Jorgenson, D. and Stiroh, K. (1996) 'Information technology and growth', *The American Economic Review*, Vol. 89, No. 2, *Papers and Proceedings of the One Hundred Eleventh Annual Meeting of the American Economic Association*, Mayo 1999.

Keilbach, M., Tamvada, J.P. and Audretsch, D. (2009) *Sustaining Entrepreneurship and Economic Growth: Lessons in Policy and Industry Innovations from Germany and India*, Springer, International Studies in Entrepreneurship, USA.

Kotelnikov, V. (2007) 'Small and medium enterprises and ICT', *Asia Pacific Development Research Programme*, United Nations Development Programme, UNDP-APDIP, Thailand.

Lawton, H., Glasson, J. and Chadwick, A. (2005) 'The geography of talent: entrepreneurship and local economic development in Oxfordshire', *Entrepreneurship & Regional Development*, Vol. 17, No. 6, pp.449–478.

Lefebvre, E. and Lefebvre, L. (1996) *Information and Telecommunication Technologies. The Impact of THEIR adoption on Small and Medium-sized Enterprises*, International Development Research Centre, Canadá.

Leitao, J. and Baptista, R. (2008) 'Inward FDI and ICT: are they a joint technological driver of entrepreneurship?', in Iandoli, L. (Ed.): *Technology Driven Entrepreneurship: How Technology Shapes the Way Entrepreneurs Start and Run Their Business*, 5th Inter-RENT Online Publication, European Council for Small Business and Entrepreneurship (ECSB), Turku, Finland.

Llisterri, J.J., Kantis, H., Angelelli, P. and Tejerina, L. (2006) *Is Youth Entrepreneurship a Necessity or an Opportunity? A First Exploration of Household and New Enterprise Surveys in Latin America*, Sustainable Development Department Technical Papers Series, Inter-American Development Bank, Washington, DC.

Majumdar, S., Carare, O. and Chang, H. (2009) 'Broadband adoption and firm productivity: evaluating the benefits of general purpose technology', *Industrial and Corporate Change*, Vol. 19, No. 3, pp.1–34.

Malerba, F. and Orsenigo, L. (1996) 'Schumpeterian patterns of innovation are technology-specific', *Research Policy*, Vol. 25, No. 3, pp.451–478.

Mansell, R., Avgerou, C., Quah, D. and Silverstone, R. (2007) *The Oxford Handbook of Information and communication Technologies*, Oxford University Press, Oxford, Inglaterra.

Novick, M., Rotondo, S. and Yoguel, G. (2011) 'Cambio estructural, conductas tecnológicas y empleo. El tránsito hacia un estudio más complejo de las TIC en la Argentina', in Novick, M and Retondo, S. (Eds.): *Chapter 1 In El desafío de las TIC en Argentina. Crear capacidades para la generación de empleo*, United Nations, Santiago de Chile.

OECD (2003) *ICT and Economic Growth. Evidence from OECD Countries, Industries and Firms*, OECD, France.

Parker, S.C. (2004) *The Economics of Self-employment and Entrepreneurship*, Cambridge University Press, Cambridge.

Pilat, D. and Wolfl, A. (2004) 'ICT production and ICT use: what role in aggregate productivity growth?', in *The Economic Impact of ICT-Measurement, Evidence, and Implications*, pp.85–104, OECD, Paris.

Porter, M. and Stern, S. (2002) 'Innovation: location matters', *MIT Sloan Management Review*, Vol. 42, No. 4, pp.28–36.

Schumpeter, J. (1939) *Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process*, Vol. 2, McGraw-Hill, New York.

Schumpeter, J.A. (1934/2000) 'Entrepreneurship as innovation', in R. Swedberg (Ed.): *Entrepreneurship: The Social Science View*, pp.51–75, Oxford University Press. Oxford.

Shane, S. (2003) *A General Theory of Entrepreneurship*, Edward Elgar Publishing, Massachusetts.

The World Bank (2009) *Information and Communication for Development: Extending Reach and Increasing Impact*, The World Bank, Washington DC.

Thurik, A.R., Carree, M.A., Van Stel, A.J. and Audretsch, D.B. (2008) 'Does self-employment reduce unemployment?', *Journal of Business Venturing*, Vol. 23, No. 6, pp.673–686.

Thurow, L. (2003) *Fortune Favours the Bold: What We Must Do to Build a New and Lasting Global Prosperity*, Harper Collins, New York.

Van Stel, A., Storey, D. and Thurik, R. (2006) *The Effect of Business Regulations on Nascent and Actual Entrepreneurship*, Discussion Papers on Entrepreneurship, Growth and Public Policy, edited by Group Entrepreneurship, Growth, and Public Policy, Max Planch Institute of Economics, Jena, Germany.

Van Stel, A., Carree, M. and Thurik, R. (2007) 'The effect of entrepreneurial activity on national economic growth', *Small Business Economics*, Vol. 24, No. 3, pp.311–321.

Velde, T.R. (2004) 'Schumpeter's theory of economic development revisited', in E. Brown and Ulijn, Jan (Eds.): *Chapter 5 in Innovation, Entrepreneurship and Culture: The Interaction between Technology, Progress and Economic Growth*, pp.103–130, Edward Edward, Terrence.

Viju, M. (2010) 'Women entrepreneurship in Middle East: understanding barriers and use of ICT for entrepreneurship development', *International Entrepreneurship and Management Journal*, Vol. 6, No. 2, pp.163–181.

Wennekers, S., van Wennekers, A., Thurik, R. and Reynolds, P. (2005) 'Nascent entrepreneurship and the level of economic development', *Small Business Economics*, Vol. 24, No. 3, pp.293–309.

Wong, P., Ho, Y. and Autio, E. (2005) 'Entrepreneurship, innovation and economic growth: evidence from GEM data', *Small Business Economics*, Vol. 24, No. 3, pp.335–350.

Yoguel, G., Novick, M., Milesi, D., Roitter, S. and Borello, J. (2004) *Información y conocimiento: la difusión de las tecnologías de información y comunicación en la industria manufacturera Argentina*, Revista CEPAL, No. 82.

Notes

1 See Acs et al. (2008) for a comparison between the two databases designed to measure entrepreneurship: The Global Entrepreneurship Monitor (GEM) and The World Bank Group Entrepreneurship Survey (WBGES) dataset.

2 The countries included are the USA, Russia, Romania, Greece, Netherlands, Belgium, France, Spain, Hungary, Italy, Romany, UK, Denmark, Norway, Japan, India, Ireland, Iceland, Finland, Latvia, Yugoslavia, Slovenia, Argentine, Brazil, Colombia, Chile, Croatia, Dominique Republic, Peru, Uruguay, Turkey, México, Australia, Austria, Bolivia, Canada, Check Republic, Ecuador, Egypt, Germany, Hong Kong, Indonesia, Iran, Jamaica, South Korea, Macedonia, Malaysia, New Zealand, Philippines, Portugal, Singapore, South Africa, Sweden, Switzerland, Thailand, Arabs Emirates, Venezuela, Poland, and Costa Rica.

3 The Hausman test rejects the null hypothesis about the existence of not-systematic differences in the estimated coefficient from both models, with a *p*-value of 0.00.

4 We reject the hypothesis that there are time-specific effects which affect all countries in the same way. Besides, a joint test show that all years coefficients are jointly equal to zero.

5 GEM groups the participating economies into three levels: factor-driven, efficiency-driven, and innovation-driven. These are based on the World Economic Forum's (WEF) Global Competitiveness Report II, which identifies three phases of economic development based on GDP per capita and the share of exports comprising primary goods.