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Article

ICT Access and Entrepreneurship in the Open Innovation Dynamic Context: Evidence from OECD Countries

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Abstract: In recent decades, entrepreneurship has become increasingly important for innovation and economic growth. However, few studies demonstrate the role of information and communication technology systems (ICT) in promoting entrepreneurship, and even fewer studies show that ICT is a crucial resource for entrepreneurs. This study examines the direct influence of ICTs on entrepreneurial activity in OECD countries in the context of the open innovation dynamic. Based on an unbalanced dynamic longitudinal panel of data, we conclude that access to ICTs (mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions) positively influences Total early-stage Entrepreneurial Activity (TEA). However, the importance of ICTs for entrepreneurial activity is not equal, with mobile-cellular telephones having the strongest influence on the rate of new firm creation, followed by fixed-broadband, and internet access. This study contributes to the rationale of resource-based theory by demonstrating that ICTs are a valuable resource for boosting the capabilities for creating, collecting, processing, and interpreting information, which is vital for entrepreneurial activity. On the other hand, this study attempts to suppress an existing gap in the literature due to the still scarce studies demonstrating how macro-level ICTs affect the creation of new firms in countries. Finally, it contributed to empirically substantiating the relationship between open innovation dynamic and entrepreneurship, as very few studies do.

Keywords: open innovation dynamic; entrepreneurship; resource-based theory; information and communications technology (ICT); total early-stage entrepreneurial activity (TEA); entrepreneurial activity

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1. Introduction

The connection of innovation and entrepreneurship to Information and Communications Technology (ICT) is gradually being increasingly recognised as a catalyst and a facilitator of social and economic growth [1]. The increasing evolution of digital technologies means businesses must adapt to an increasingly global market [2], and policymakers have been considering ICTs for formulating their regional and national development objectives. However, the practical mechanisms for implementing policies that assist in adopting entrepreneurship and open innovation dynamics based on ICTs vary significantly from economy to economy [1,3].

In more uncertain and dynamic economic environments, innovation, as a rule, causes companies to be more creative, experimenting with the development of new processes, services, and products, thus giving rise to new business models that allow companies to expand and improve overall competitiveness [4].

In this context, ICTs have been pointed out as a key factor in developing innovation. In turn, innovation has been pointed out as being the basis of the economic development achieved by some economies since the last decade of the twentieth century. However, ICTs

alone do not guarantee greater socio-economic growth [5,6]. Thus, the use and availability of citizens' access to ICTs helps to understand how much an economy has used and taken advantage of the new knowledge made available by the knowledge society and what their impacts have been on economic growth [5,7–10].

From this perspective, entrepreneurship plays a relevant role in economies and society, with the need to foster it [11–13]. However, there are significant differences in entrepreneurial activity globally and across different types of economies, and these differences should be further studied [5]. Some studies point to the predictors for new ventures' success and growth [14,15]. However, little attention has been paid to the intersection of technological capabilities and innovations in new ventures, which are fundamental today [2]. More studies linking ICT development in different countries to entrepreneurial activity are still needed [16].

Thus, this study aims to analyse the potential influence of ICT on entrepreneurial activity in OECD countries in the context of the open innovation dynamic. ICT, including mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions, were considered for this study. Thus, the following research questions were formulated: (1) whether ICTs positively influence the rate of new firm creation in OECD countries, and (2) whether different ICTs have equal importance in stimulating entrepreneurial activity.

ICTs can help firms and economies improve their performance and achieve competitive advantages. However, both performance and competitive advantage typically depend on the internal resources that firms have access to and their ability to coordinate and combine the various resources [17–19]. The resource-based theory is relevant for addressing the implications of firms' resources [20]. The resource-based theory is appropriate for addressing the implications of firms' resources for organisational performance in economies [17,21]. The resource-based theory tells us that the possession of specific firm resources influences organisational performance. Therefore, resources are repeatedly considered the basis of wealth creation, allowing firms to develop competitive advantages by creating value for their customers [22–24]. In this way, access to ICTs is considered a necessary resource for business performance.

The results of this study suggest that high levels of ICT (mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions) positively affect business creation in OECD countries, although the importance of each of these ICTs is not similar.

Thus, this study is original because studies addressing entrepreneurship and ICTs from a resource-based theory perspective are scarce, thus bringing new contributions to the literature [2]. On the other hand, there is a gap in the literature on the impact of ICTs on country entrepreneurship [16]. Few studies have attempted to analyse the direct impact of ICTs at the macro level on new firm creation [25]. As ICT access and coverage vary across countries [26], entrepreneurs' access, through ICTs, to consumer, competitor, and market information, as well as business opportunities in different locations may have important implications for the rate of new firm creation. This study takes a multi-level analytical approach, as we do not analyse the data for an individual country, since according to Parida and Örtqvist [4], there is a low variation in the institutional conditions. This study can assist entrepreneurs and policymakers in making decisions about investments in ICTs and the infrastructure needed for their successful performance (Siqueira & Bruton 2010 [17]) to make the necessary resources available for entrepreneurial activity.

Moreover, this study bridges the gap of insufficient studies that cross-reference technological capabilities with innovations in new ventures (Mohsen et al. 2021 [2]). This study also explains the influences of ICTs on innovation in new ventures, helping entrepreneurs foster productive entrepreneurship as suggested by [27]. Finally, this paper demonstrates the empirical relationship between the open innovation dynamic and entrepreneurship.

2. Review of the Literature

2.1. Entrepreneurship and Resource-Based Theory

Entrepreneurs and resources play a key role in global economies [2]. The entrepreneurs drive value creation through a correct combination and optimisation of resources. In this context, the relationship between entrepreneurship and resource-based theory has been recognised by academics [28]. This relationship has gradually developed new insights [24], and the resource-based theory can explain the success of entrepreneurial activity [29]. According to the resource-based theory, ICT is identified as a valuable and crucial source of heterogeneous resources, which help companies to gain a competitive advantage in terms of information and improve their efficiency and business performance [25,30,31]. Specifically, in this study, three ICTs are considered through their accessibility and use, enabling them to increase business success.

In this follow-up, implementing an entrepreneurial institution and vision are fundamental in defining which resources contribute to achieving a sustainable competitive advantage [32]. Thus, internal resources are more relevant in formulating a competitive advantage strategy than external factors [20,33]. On the other hand, internal resources must be retained and developed within the organisations, that is, they cannot be obtained or even bought from the markets. [34,35]. There are six types of internal resources: (1) organisational resources (corporate culture, quality control systems, and relationships); (2) physical resources; (3) financial resources; (4) human resources; (5) intangible resources (e.g., goodwill, brand recognition, and reputation); and (6) technological capabilities (e.g., ICTs) [35,36].

Resources can also be intangible (e.g., employment of qualified personnel and internal knowledge of technology) or tangible (e.g., physical assets and financial capital) [17]. The shared use of tangible and intangible resources plays a vital role in firms' performances and the economies where they are located [37]. At least two resources are considered important for high-tech entrepreneurial firms: (1) the level of education of the entrepreneur, and (2) the investments in technology [38,39]. Entrepreneurial education complements technological resources, that is, to increase the firm's performance, human capital can help leverage the effects of technological resources [17,40].

Following the logic of the resource-based theory, a widespread access to ICT can provide entrepreneurs with access to new markets and new business ideas since a better knowledge and understanding of consumers, competitors, and markets is a critical and crucial resource for increasing responsiveness to markets and is a determinant of better business performance [25,41]. Thus, the great quantity of information qualified by access to ICTs is a valuable resource for entrepreneurs. Thus, the great quantity of information qualified by access to ICTs is a valuable resource for entrepreneurs, since this information is used as determinants for entrepreneurs to achieve competitive advantages [42].

2.2. Open Innovation Dynamic in Entrepreneurship

Open innovation has provided a new paradigm for businesses and economies [13,43]. Open innovation can be defined as using "intentional knowledge inputs and outputs" to accelerate internal innovation, allowing a firm to expand in markets for the external use of innovation [44]. Thus, open innovation is one of the approaches to innovation management that is, according to West and Gallagher [45], "systematically encouraging and exploring a wide range of internal and external sources for innovation opportunities, consciously integrating that exploration with firm capabilities and resources, and broadly exploiting those opportunities through multiple channels". In recent years, globalisation and rapid technological advances have led to the increasing dynamics of open innovations, leading to a new paradox of open innovation called the open innovation dynamic [46].

Open innovation consists of two dimensions: (1) open innovation input; (2) open innovation output [1]. Open inbound innovation consists of establishing relationships with external individuals or organisations to access their scientific and technical expertise. This can enable the improvement of internal innovation performance. Open input inno-

vation is further considered to be a practice of leveraging the discoveries of others, i.e., it suggests that a company cannot consider only its R&D [43,47,48]. Concerning outbound open innovation, it can be defined as a practice of establishing relationships with other external organisations to commercially exploit their technological knowledge [1,49]. Thus, the outgoing open innovation should look for the market (externally) organisations that contemplate business models that are more appropriate for the commercialisation of a particular technology [49–51].

Currently, the relationship between open innovation and entrepreneurship must be explored, taking into account the digital economy [52,53]. In this digital context, interactions between different actors are fast and global, creating ideal conditions for entrepreneurship [54]. Thus, technological innovations are considered essential sources of new value creation, leading organisations to maximise profits. The motives of open innovation, namely those of open inbound innovation, contemplate the acquisition of new knowledge as well as increasing customer satisfaction [55,56].

It is necessary to study the benefit and proper development of open innovation activities from an external perspective, considering the elements that best use information [57]. Therefore, it is convenient to anticipate which capabilities benefit the information flow, both at the internal environment level (e.g., communication processes and culture) and the external environment level (e.g., information technology used and external collaboration) [58,59]. The ICT adoption by organisations is considered a key factor in the value creation process [57,60], and the ICTs can lower the costs of the open innovation dynamic and the complexity of innovation. Thus, an open innovation dynamic could eliminate the harmful consequences of inadequate knowledge [61]. If open innovation is implemented effectively, its momentum can drive new business creation activity and cause companies to have significant growth from small businesses to world leaders. In this way, open innovation not only changes companies and the business structure but can lead to economic growth [61,62].

Nowadays, technological tools process, store information, and allow the communication and exchange of information in different ways, contributing to the inclusion of innovation activities at various external and internal levels. ICTs enable the frequent cooperation of the actors involved in actions that work together, regardless of how complex they are, as the innovation process [59,63,64]. On the other hand, ICTs are considered key elements by organisations for transforming and assimilating knowledge and information into competitive advantages, which come from the innovation process [57].

2.3. ICT Access and Entrepreneurship

Access to ICTs facilitates the creation of new enterprises and boosts their development and growth [65]. Thus, entrepreneurs can benefit from access to ICTs for several reasons: (1) the development of ICTs increases and facilitates the ability of entrepreneurs to create, collect, process, and interpret information [66]; (2) it boosts an environment conducive to new ideas and new business opportunities namely, in online markets, encouraging the creation of new businesses [65]; (3) it increases entrepreneurs' motivation through the social influence on ICT-facilitated interactions of an entrepreneur with other entrepreneurs, making entrepreneurs more aware of the benefits of ICT use and endowing them with greater market intelligence capable of more assertive and quicker responses [67–69]; (4) it enhances the effective communication and information exchange, enabling entrepreneurs to coordinate multiple consumers in entrepreneurial activities, reducing uncertainty and increasing the possibility of greater entrepreneurial success [69].

In this study, the access to ICTs is represented by mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions. We use these ICTs as determinants of entrepreneurial activity for several reasons. First, the growth of mobile-cellular telephones, the internet, and fixed-broadband subscriptions is stagnating due to their increasingly widespread access, but the conditions and ease of access are not equal in all countries. That is, in all countries, the efficient access to these ICTs should be a primary condition. On the other hand, internet access is a fundamental resource for

mobile technology, integral to the information society [16]. The use of mobile phones and the internet has catapulted the diffusion of ICTs [70], and as such, has increased the quality and quantity of the information available for innovations, enhancing the crucial role of entrepreneurship [71,72]. The access to broadband internet has also boosted the business environment, accelerating entrepreneurship through the lower costs of starting a new business and facilitating the creation of networks between entrepreneurs, customers, suppliers, and competitors [65,73,74]. The effective and efficient communication and information exchange among the various participants in entrepreneurial activity is facilitated by access to ICTs, reducing the risk and uncertainties inherent in the entrepreneurial process and increasing the chances of business success [69]. In this context, the following hypotheses were formulated:

Hypothesis 1 (H1). *High levels of Mobile-cellular phone subscriptions positively influence Total Early-stage Entrepreneurial Activity (TEA) in OECD countries.*

Hypothesis 2 (H2). *OECD countries with higher internet access rates have higher TEA rates.*

Hypothesis 3 (H3). *High levels of fixed-broadband subscriptions positively influence TEA in OECD countries.*

These hypotheses can be schematised in the following theoretical model (Figure 1).

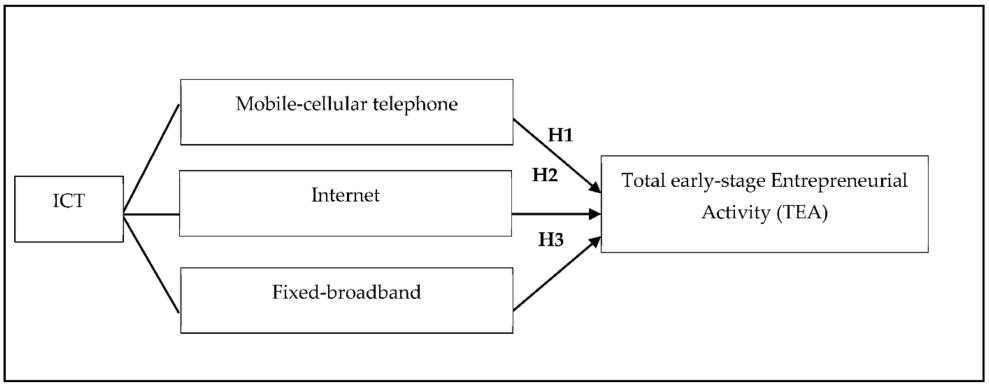

Figure 1. Theoretical model.

3. Data and Methodology

This paper aims to examine the direct influence of ICTs on entrepreneurial activity in OECD countries in the context of open innovation dynamics. The study uses a qualitative methodology through the Generalised Method of Moments (GMM). This methodology is the most pertinent to carrying out this study since it validates theories and relationships between variables through large samples of collected data [75]. In this way, this methodology allows for the generalisation of the results, possibly replicating them with other samples [76,77]. Similar to Nogueira et al. [78], the steps of the process for preparing this paper were as follows: (1) A gap was found in the literature; (2) literature review and hypothesis development; (3) data collection; (4) hypothesis testing; (5) data analysis and interpretation.

3.1. Sample

This study contemplates a sample of 37 OECD countries and a period from 2000 to 2019. The choice of OECD countries for the sample was made because this group of countries have internally differentiated access to ICTs. Considering the objective and the structural framework, the dependent variable of this study is TEA which was collected by the National Expert Survey of the GEM [79]. TEA as a variable explained by ICT was used by Afawubo and Noglo [80], Alderete [16], Hassen [81], Tang and Konde [82], and

Colovic and Lamotte [83]. The independent variables are the ICT measures: mobile-cellular telephone subscriptions per 100 inhabitants, a percentage of individuals using the internet, and fixed-broadband subscriptions per 100 inhabitants. These variables were collected by the World Bank [84]. These indicators used as explanatory variables of entrepreneurship were also used by Alderete [85], Irene [86], Yan and Guan [87], and Jafari-Sadeghi et al. [88]. The acronyms of the dependent and independent variables are shown in Table 1.

Table 1. Dependent and independent variables.

Variables	Acronyms	Definition	Papers That Used the Variables
Dependent			
Total early-stage Entrepreneurial Activity	TEA	Percentage of population aged 18–64 who are either nascent entrepreneurs or owner-manager of a new business	Afawubo and Noglo [80], Alderete [16], Hassen [81], Tang and Konde [82], Colovic and Lamotte [83]
Independent			
Mobile-cellular telephone subscriptions per 100 inhabitants	MOBILE	During the past three months, cell phone subscriptions were used per 100 inhabitants.	Alderete [85], Irene [86], Yan and Guan [87], and Jafari-Sadeghi, Garcia-Perez, Candelo and Couturier [88]
Percentage of Individuals using the internet	INTERNET	During the past three months, the percentage of individuals using the internet.	
Fixed-broadband subscriptions per 100 inhabitants	FIXEDBROAD	Fixed-broadband subscriptions (fixed subscriptions to high-speed access to the public internet) per 100 inhabitants.	

The data panel that makes up the sample contains 400 observations, with the number of observations related to data availability. GEM does not collect data annually for all countries and restricts the number of entrepreneurship measures collected.

3.2. Methods

First, a statistical analysis of dependent and independent variables was performed. Then, correlation analysis was performed between the dependent and independent variables to assess the multicollinearity between variables [89]. Finally, a model was estimated by the Generalised Method of Moments (GMM) estimation method, with a fixed cross-section and cross-section weight instruments.

The GMM method is widely used for large samples and time series dynamic panel data. This method proves consistent and asymptotically normal in large samples, and does not require the specification of the distribution of error terms [89,90]. Considering the sample characteristics used in this study, GMM is the most efficient method, correcting the common heteroscedasticity and autocorrelation problems. On the other hand, it enables controlling for unobserved specific effects at the country level and non-stationary variables.

Considering the structural framework, the model of this study can be defined by Equation (1):

$$Y_{it} = ß_1 Y_{it-1} + ß_2 Z_{it} + \mu_{it} + e_{it} \quad (1)$$

in which, Y_{it} is the TEA as a measure of entrepreneurial activity; Y_{it-1} is the lagged TEA variable for the country i in the period $t-1$; Z denotes the independent variables related to the ICT measures; μ are the unobserved effects at the country level; and e is the error term. As Y_{it-1} is correlated with μ_{it}, heteroscedasticity problems result due to unobserved effects at the country level. Heteroscedasticity problems are overcome by introducing the first differences of the variables, resulting in Equation (2):

$$Y_{it} - Y_{it-1} = ß_1(Y_{it-1} - Y_{it-2}) + ß_2(Z_{it} - Z_{it-1}) + (e_{it} - e_{it-1}) \quad (2)$$

We could still have an autocorrelation problem of Y_{it-1} e e_{it} with the independent variables Z. This is overcome by using instrumental variables, assuming that the time-varying errors have zero means, there is no correlation between the error terms, and there is no correlation between the lagged independent variables and the future error terms. Thus, the three independent variables measuring ICT were used as instrumental variables.

4. Results

Table 2 shows the descriptive statistics of the variables (dependent and independent). The mean value of the dependent variable TEA is 8.99%. The minimum value of this variable is 1.50% registered in Japan in 2004, and the maximum value is 36.70% in Chile in 2019.

Table 2. Statistical analysis.

	Tea	Mobile	Internet	Fixedbroad
Mean	8.99	104.61	66.30	21.57
Median	7.60	108.60	72.16	23.96
Maximum	36.70	172.12	99.01	46.33
Minimum	1.50	14.23	5.08	0.01
Std. Dev.	5.02	27.97	22.77	12.83
Obs (n)	400	400	400	400

Source: own elaboration.

Regarding the independent variables related to ICTs, the average percentage of internet users (INTERNET) is 66.30%, with the maximum rate being 99.01% recorded in Iceland in 2018 and 2019, and the minimum rate of 5.08 % registered in Mexico in 2000. The average value of mobile-cellular telephone subscriptions per 100 inhabitants (MOBILE) is 104.61, i.e., the maximum value was 172.12 in Finland in 2012 and the minimum value of 14.23 in Mexico in 2000. Finally, the average value of fixed-broadband subscriptions per 100 inhabitants (FIXEDBROAD) is 21.57, with a maximum value of 46.33 registered in Switzerland in 2018 and a minimum value of 0.01 in Latvia in 2000. Variations in the values presented by the statistics of the independent variables predict that these variables will have different impacts on the countries' economic growth, so it was confirmed that there are no lagged effects.

Table 3 shows the correlation matrix between the dependent and independent variables. As there is no high correction between the variables (less than 0.50), we conclude that the model that will be estimated will not have multicollinearity problems.

Table 3. Correlation Matrix.

	1	2	3	4
1. TEA	1.0000			
2. MOBILE	0.3640	1.0000		
3. INTERNET	0.4768	0.4753	1.0000	
4. FIXEDBROAD	0.4153	0.4285	0.4945	1.0000

Source: own elaboration.

The results of the GMM estimation of the model are shown in Table 4. As described above, we used the Arellano–Bond estimator, introducing a one-year delay in the dependent variable TEA (TEA(−1)). The AR(1) p-value is 0.000,,and as such, we reject the null hypothesis that there is no autocorrelation of the error terms for a significance level of p = 0.000. According to Mileva [91], the AR(2) test is more important because it allows for detecting the levels of autocorrelation, and as such, validating the quality of the GMM

estimator. As the *p*-value of AR(2) is greater than 0.10, there is no second-order autocorrelation [92]. Finally, we also present in Table 3 the *p*-value of the Hansen Test, which, being higher than 0.10, shows that the model is well specified and that there is no evidence to reject the quality of the instrumental variables used in the model [93].

Table 4. Results of GMM Estimation. Dependent Variable: TEA.

Variables	Coefficient	Standard Errors
TEA (−1)	0.8960	(0.0562) **
MOBILE	0.0903	(0.0040) **
INTERNET	0.0363	(0.0053) *
FIXEDBROAD	0.0550	(0.0047) *
AR (1)	0.8126	
p-value (AR1)	0.0000	
AR (2)	0.2659	
p-value (AR2)	0.7987	
p-value (Hansen Test)	0.8678	
Obs.	400	
Cross Sections Included	34	
Period Included	17	

Note: * $p < 0.000$; ** $p < 0.05$. All models are estimated by the GMM method using the Arellano–Bond estimator. All models include fixed effects. Source: own elaboration.

All variables are statistically significant. In sum, higher levels of mobile-cellular telephone subscriptions positively influence (β = 0.0903) TEA in OECD countries, confirming H1. Higher rates of individuals using the internet positively impact (β = 0.0363) on TEA, confirming H2. Finally, high levels of fixed-broadband subscriptions positively influence (β = 0.0550) TEA in OECD countries, confirming H3. We further conclude from the coefficients that the indicators of access to ICTs do not all have the same importance for creating new firms, with the mobile-cellular phone being the ICT that most positively influences TEA and the Internet being the ICT that has the least influence on TEA.

5. Discussion and Implications

5.1. Discussion of Results

The open innovation dynamic is pointed out as being one of the most relevant practices for organisations to be increasingly competitive in an increasingly global market [94]. The open innovation dynamic depends on entrepreneurship to improve innovation performance [55]. In the present study, it was evident that high levels of ICT (mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions) positively affected the creation of new firms in OECD countries, confirming the first research question. However, according to the second research question of this study, do mobile-cellular telephone subscriptions, individuals using the internet, and fixed-broadband subscriptions contribute in similar proportions to entrepreneurship? From the results obtained, if we were to order the results in descending order, we conclude that of the ICTs considered, mobile-cellular telephone subscriptions have the most significant influence on the creation rate of new enterprises, followed by fixed-broadband subscriptions, and finally, individuals using the internet. These results can be explained on the one hand by the fact that the growth rate of internet subscriptions is decreasing due to the market becoming saturated, that is, internet access is more and more widespread (Alderete) [85].

On the other hand, the technological evolution of mobile-cellular phones and their use for different purposes makes the rate of use increase more and more. The logic is that today we can do everything through a mobile phone [70]. However, this reflection needs to be deepened and complemented with other studies.

In the last two decades, mobile phones and the internet have accelerated the diffusion of ICTs [70]. According to Alderete [85], mobile phones have become increasingly accessible in economies in general. ICTs play a fundamental role in increasing the quantity and quality of innovations, thus stimulating entrepreneurship as well as socio-economic growth. On the other hand, ICTs have facilitated trade at regional, national, and global levels. In this way, companies have increasingly integrated ICTs, changing their organisational dynamics, business models, and strategies [71,72]. In this way, ICTs simplify international communications, financial transactions, and the sharing of knowledge and information, which can accelerate the growth of entrepreneurship, lowering the initial investment costs of entrepreneurs. ICTs also contribute to other sectors of the economy, such as e-banking, e-trading, e-business, and e-commerce [70]. On the other hand, high levels of ICTs also foster R&D and strengthen labour efficiency and skills, that is, ICTs indirectly affect economic growth [73,74].

Broadband internet has become fundamental with regard to the business environment [16]. However, in the world at large, according to Alderete [85], fixed broadband internet is not available in terms of access to the vast majority of the world's inhabitants. The rate of fixed broadband internet usage has not changed over the last few years and is becoming more and more expensive in relation to the monthly income of households. This phenomenon is more visible in developing countries [16,85]. The question is, if nowadays more companies are providing these services, and the services are increasingly developed, should they not be getting cheaper? Cheaper and more widespread access could stimulate entrepreneurship rates, further increasing the current figures.

On the other hand, currently, mobile broadband internet has not come to replace fixed broadband internet. Thus, mobile broadband internet does not jeopardise investment in fixed broadband internet [16]. In the long term, the differentiation between fixed and mobile technologies will depend on the quality and capacity of the services. It will also depend on the availability of service offerings that require intensive use of mobile broadband [95]. In developed countries, mobile broadband internet complements fixed broadband internet. These things considered, it can be stated that ICT is a technology that allows the development and acceleration of entrepreneurship and contributes to explaining the differences in entrepreneurial activity among the different OECD countries [16].

5.2. Implications for Theory

Our study fills the gap in the literature concerning the necessity for more studies that analyse the intersection of technological capabilities with innovations in new ventures [2]. It further bridges the gap concerning the necessity for more studies that link the development of ICTs in different countries to entrepreneurial activity [16].

This study brings new contributions as it uses resource-based theory as a lens for interpretation and contextualises it with OECD countries. Therefore, it helps develop and extends the resource-based theory application since ICTs are considered resources. Studies that use resource-based theory to study entrepreneurial activity in different economies are scarce. Based on the resource-based theory, the impact of ICTs on entrepreneurial activity in several OECD countries was studied. On the other hand, this study complements previous studies' results, which demonstrate a positive link between entrepreneurship and ICTs [16,85,96].

We also contribute empirical evidence for the valuation of the open innovation dynamic in new businesses, particularly for the importance of investing heavily in ICTs. Investment in ICTs propels the creation of new firms and promotes the development of entrepreneurial activity [97]. Therefore, this paper contributes to the current debate about the digitalisation era [98–100], providing insights into how ICTs can affect business strategies.

5.3. Practical Implications

The results of this study can be considered by national and international investors and can play a facilitating role in regional, national, or local development. Thus, the

present results have highlighted some practical issues that should be given attention, as they may allow for enhancing the adoption, more broadly, of open innovation dynamic and ICTs in entrepreneurship [1]. The innovation provided by entrepreneurial activity has been the subject of much attention by various actors, and its importance is transversal, not limited only to some economies [2,13]. As this study has shown, the importance of innovation is cross-cutting.

Investment in ICTs can enable firms to develop innovations that give them a competitive advantage over their competitors [2,17]. Thus, investment in ICTs can play a key role in the process of transforming capabilities into competencies. In this fashion, it is possible to improve innovation and entrepreneurship, increasing the region's economic growth where the companies are located [101–103]. The present study's results can also help entrepreneurs design a digital strategy by constructing their own knowledge. This knowledge can be built through favourable policies and the interaction between professional associations, regulators, and government organisations to identify changes in industry and society [2,43].

Internet access and the use of multifunctional mobile phones can influence the rate of new business creation, as verified in this study. However, for entrepreneurs and society in general to effectively exploit the opportunities provided by this technology, access to broadband internet is fundamental [16]. In some regions, it is necessary to reinforce internet coverage.

5.4. Political Implications

Many policy actions related to innovation and entrepreneurship have not had the expected practical outcomes at the policy level. However, implementing ICTs can increase transparency and effectiveness, and decrease potential corruption [1]. Thus, policymakers in OECD countries should develop and create an optimal institutional environment to facilitate the creation of new firms from innovation [104,105]. Such an environment must be characterised by investment in emerging and innovative technologies (e.g., 5G technology). This will enable entrepreneurs to develop more innovative products and services, thereby increasing the rates of new ventures [13].

Governments must still put the added value of new technologies into practice by transitioning to a digital public administration. To this end, policymakers must make their services increasingly available to citizens. This will provide citizens and entrepreneurs with access to new information at the governmental level, new forms of contracts, bidding, lower transaction costs through mobile apps, and ease the bureaucracies inherent in the entrepreneurial process that are a barrier to startups [16]. On the other hand, policymakers can also implement a more technology-oriented policy to allow entrepreneurs access to a free space. In this new space, it should be possible to experiment, theorise, and receive qualified training in the latest digital technologies [2,106].

Finally, policymakers need to allow new competitors to enter the telecommunications market to increase fixed and mobile broadband infrastructure and reduce prices. To this end, reducing barriers to entry for new firms in the telecommunications sector is key [16].

5.5. Limitations and Future Lines of Research

According to the ICT Development Index, there are three dimensions to assess ICT use, ICT access, and ICT skills. In this study, we only used the ICT access dimension, that is, the level of infrastructure and access to ICTs, assessing their direct influence on entrepreneurial activity. In future studies, we may analyse the impact of the other two dimensions on entrepreneurial activity, which reflect the intensity and capacity of ICTs. TEA data is collected by GEM, which does not collect data annually for all economies. Moreover, GEM data is based on interviews rather than objective data.

On the other hand, ICT data is collected by the World Bank and is objective and quantitative, and this mix of data alongside the data gaps in some years and countries may bias the sample. The evaluation of the influence of ICT on entrepreneurial activity was carried out only through TEA. The impact of ICT on entrepreneurship can be analysed by

categories, such as entrepreneurship by needs or opportunity, and the results can be further enriched. Although mobile-cellular telephone, internet access, and fixed-broadband are the most widely used measures to assess access to ICTs at the national level, other indicators such as mobile broadband internet may also be included.

Future studies may also compare the influence of ICTs in different economic blocs, such as the European Union, North American Free Trade Agreement (NAFTA), Southern Common Market (Mercosur), and Association of Southeast Asian Nations (ASEAN) and Asia-Pacific Economic Cooperation (APEC).

6. Conclusions

This study demonstrates that access to ICTs can influence the rate of new firm creation, and as such, accelerate innovation in an open innovation dynamic context. These results can be explained by the fact that ICTs reduce market friction, fight corruption, increase productivity, decrease production costs, increase skilled labour, save time, encourage the creation of new firms, and improve the development and growth of installed firms [70]. However, ICT access indicators (mobile-cellular phone, internet access, and fixed-broadband) do not have an equal influence on the entrepreneurial activity of countries, which can be explained by the fact that ICT access is not equal in all OECD countries, a consequence of the disparate levels of economic growth and development.

The gaps in the literature on this topic suggest that more studies are needed at the macro level that cross-reference ICTs with innovations in new ventures at the national level [2]. Currently, there are few empirical studies on how ICTs directly influence entrepreneurship [16]. Finally, studies that address entrepreneurship and ICTs from a resource-based theory perspective are scarce, but they are required to bring new contributions to the literature. Furthermore, the direct influence of ICTs on entrepreneurship in OECD countries was empirically assessed from a resource-based theory perspective, making this study original. Theoretical, practical, and governmental recommendations that can stimulate entrepreneurship and innovation in countries using ICTs were also left open for further research.

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