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Entrepreneurship–growth nexus: does the size of the informal economy matter?

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ABSTRACT

This paper implements a multiple linear regression model on panel data of a sample of 64 countries over the period (2002–2015), in order to examine the influence of Entrepreneurship on the growth of output per worker. Our estimation strategy allows for providing a framework that accounts for some of the conflicting findings on the entrepreneurship–growth nexus. We account for the endogeneity of entrepreneurship by using a valid instrument, andfor the level of development and its interaction with entrepreneurship, we also account for the size of the informal economy as a moderating variable of the entrepreneurship–growth nexus. We find that the effect of entrepreneurship on growth is positive and significant, but the analysis fails to support that the relation varies by level of development and the size of the informal economy. Policy implications point to fostering entrepreneurship and designing policies that take into consideration the macroeconomic environment of the country.

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Entrepreneurship; total early-stage entrepreneurial activity (TEA); informal economy

1. Introduction

The literature on entrepreneurship–growth nexus is abundant; several studies recognized the positive role of Small- and Medium-Sized Enterprises (SMEs) or self-employment on economic growth and development, through increasing employment, innovation, and welfare (Wennekers and Thurik 1999; Ács and Naudé 2013). Others emphasized knowledge spillovers, increasing competition, and providing diversity among firms, that was proposed to have a positive impact on growth (Audretsch 2007; Hessels and Van Stel 2011). However, the diversity of methods, data, country-specific factors and proxies for entrepreneurship may have led to contradictory or inconclusive empirical findings. In particular, the country-specific differences such as the level of economic development (Van Stel, Carree, and Thurik 2005) require to be analyzed using the same methodology and specification. Hence, this research aims to employ a theoretical structure that explains and/or expands the different frameworks.

The theoretical as well as empirical contexts of this relationship examined in the literature reflect its multidimensional nature. These dimensions (individual, firm, country, sectoral, industrial factors, and regional levels) have been utilized by several

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studies, for example Noseleit (2013) and Van Stel and Carree (2004) focused on sectoral and industrial factors, while Ivanović-Djukić et al. (2018)_ENREF_4 and Wong, Ho, and Autio (2005) resorted to the presence of different types of entrepreneurship. On the other hand, Wennekers and Thurik (1999) analyzed different measurements of entrepreneurship in a theoretical framework linking entrepreneurship to economic growth.

This multidimensional nature of entrepreneurship would lead to different findings among countries at the national level. Several studies suggested that the impact of entrepreneurship on economic growth differs among countries depending on their level of economic development, as many have indicated a positive impact in developed countries (Dejardin 2000; Naudé 2008; Lepojevic, Djukic, and Mladenovic 2016). However, several studies indicated the positive influence of only those considered fast growing types of entrepreneurship in these countries rather than entrepreneurship in general (Wong, Ho, and Autio 2005; Valliere and Peterson 2009). While in developing countries, the relationship is more complex and is likely to have variety of results; some studies concluded that entrepreneurship has less of an impact on economic growth in developing countries than it does in developed ones (Van Stel, Carree, and Thurik 2005) or even has no significant impact (Sabella et al. 2014). However, there is also some evidence on a positive impact in these countries (Urbano and Aparicio 2016), which is higher and more significant in some cases (Bampoky et al. 2013). Moreover, prior empirical studies on cross-national comparison between countries with different levels of economic development faced challenges in confirming the theoretical hypotheses of the role of entrepreneurship in the growth process due to the lack of available comparable data. The investigation of entrepreneurship–growth nexus, especially for developing countries, is found to be under researched area of investigation and typically depends on small samples and short-term investigations (Naudé 2008).

The discrepancy in the empirical findings was attributed to different macroeconomic factors between countries (Acs 2006); As such, some studies pointed to the importance of considering the environment shaping the economy in which entrepreneurship occurs, and to the importance of improving the quality of this environment to support productive entrepreneurship (Acs 2006; Acs, Desai, and Hessels 2008). One of the characteristics of the economic environment, that may explain variations in the contribution of entrepreneurship in growth among countries, is the presence of the informal economy (Acs, Desai, and Klapper 2008; Ivanović-Djukić et al. 2018).

This study compliments the existing literature on growth and entrepreneurship by introducing the size of the informal economy to the entrepreneurship-augmented growth model. Informal economy has been widely viewed as a negative phenomenon; however, the findings of the empirical studies on the relationship between informal economy and economic growth are inconclusive. Some studies show the impact of informal economy on economic growth is positive (Adam and Ginsburgh 1985; Sakanko and Ewugi 2017), while others show a negative one (Loayza 1999; Eilat and Zinnes 2000), or differs among developed, transition, and developing countries (Gerxhani 2004; Schneider and Klinglmair 2004), which makes this relationship 'considerably ambiguous' (Schneider 2008), hence requires further investigation.

Moreover, there has been little attention given to the relationship between informal economy and entrepreneurship (Williams and Nadin 2010; Petrova 2016), which may be attributed to the negative view of the informal economy. However, in recent

decades, a growing research suggests that the informal economy may not be completely negative because it provides entrepreneurial qualities, treating the informal economy as an 'asset that needs to be harnessed' rather than an impediment to growth (Williams 2005; Williams and Round 2007). However, to the best of our knowledge, no empirical evidence relates informal economy to explain the variation in this relationship. In this regard, this study seeks to provide an empirical analysis in order to examine the impact of entrepreneurship on economic growth incorporating the influence of informal economy on this impact (the moderating role of informal economy on the relationship between entrepreneurship and economic growth).

This study contributes to the existing literature by using an endogenous growth model in which the effect of entrepreneurship on growth allows for these different (and seemingly conflicting views) magnitudes. Using a relatively long panel of countries from varying degrees of levels of development allows for capturing differences within and between countries. At the group level, one expects that the impact of entrepreneurship on output per worker may allow for the catching up hypothesis if the relationship is stronger on countries who are less developed. Our study also contributes to the existing literature by addressing the endogeneity of entrepreneurial activity rates by using skill perception as instrument. This instrument captures individual characteristics which are highly correlated with entrepreneurial activity rates and would satisfy the exclusion restrictions allowing for causal inference.

This study aims to answer the research questions through group comparison techniques by incorporating categorical variables and interaction terms in order to examine the impact of entrepreneurship on economic growth across countries with different levels of development. As for the moderating role of informal economy on this relationship, we also use an interaction term between the informal economy size and the rate of total entrepreneurial activity of the country. In order to do this, the methodology of this research employs two estimation strategies, an instrumental variables (IV) estimation approach that allows overcoming potential endogeneity issues and an ordinary least square (OLS) technique that works as a benchmark to analyze the robustness of the results.

This study proceeds as follows. The first section is Introduction, followed by a review of the literature on defining and linking entrepreneurship to economic growth as well as the broad relationship between entrepreneurship, economic growth, and informal economy. Section 3 explains our empirical model and the methodology used in this research, and describes the data and their sources. Section 4 presents and analyzes the results and discusses the findings of our study. Finally, Section 5 concludes and highlights future study insight.

2. Literature review and hypothesis development

2.1. Growth theory

Neoclassical studies of economic growth depend on the traditional growth theory by Solow (1956), which highlighted the contribution of labor and physical capital in explaining economic growth as the main factors in the production function. Later on, many have emphasized the important role of human capital in the process of economic growth (Mincer 1981; Barro 1992; Mankiw, Romer, and Weil 1992). Mankiw, Romer, and

Weil (1992) developed an augmented Solow growth model that includes the human capital as an additional factor of production, which they argued is a better model for explaining international growth variation. More recently, some strands of the literature, beginning with the work of Romer (1986), suggested an endogenous growth theory considering additional factors of production. Neoclassical growth models assume technological progress is an exogenous factor of growth that was kept out of the model, leaving different technology levels between countries unexplained and uncounted for.[1] However, Romer (1986) has illustrated the importance of knowledge capital as a factor of production in addition to the traditional factors of capital and labor, and the failure of the predictions of the neoclassical model to match the empirical evidence of the long run accelerating growth rates implied by the endogenous growth.

There have been also some attempts to incorporate entrepreneurship in endogenous growth models. Schmitz (1989) linked entrepreneurship to economic growth within an endogenous growth model, which predicts that more entrepreneurial activity will lead to higher economic growth due to greater existing knowledge, arguing that entrepreneurs not necessarily have to be innovators and that they have a key role in promoting growth through transferring and spreading knowledge developed by innovators.

Recent studies (Audretsch and Keilbach 2004a, 2004c, 2005; Audretsch 2007) linked entrepreneurship to regional economic growth have introduced the concept of entrepreneurship capital. This refers to 'the capacity for economic agents to generate new firms' (Audretsch 2007), as an additional factor of production through its contribution in knowledge spillovers as well as in increasing competition and diversity. Moreover, they have emphasized the positive role of entrepreneurship in growth and that regions with higher rates of entrepreneurship will have higher growth rates.

These studies, among others (Audretsch and Keilbach 2004b, 2008; Acs et al. 2012; Noseleit 2013), have argued that knowledge may not affect growth directly as it is assumed in Romer's (1986) endogenous view, therefore, they considered entrepreneurship as a conduit of knowledge that serves as a mechanism that facilitates knowledge spillovers and thus generates additional growth. They assumed that knowledge is a necessary, but not sufficient engine of growth (González-Pernía and Peña-Legazkue 2015). However, most of these studies focus only on the regional economic growth. Nonetheless, some studies (Braunerhjelm et al. 2010; Acs et al. 2012) indicated the important role of entrepreneurship in stimulating growth at a national level; however their research is limited to samples of only developed countries, which requires wider national comparison.

Therefore, in line with those who indicated the role of entrepreneurship as an additional factor of production at the regional level (Audretsch and Keilbach 2004a, 2004b, 2005, 2008; Audretsch 2007), this study aims to employ an endogenous growth model that includes entrepreneurship; however, at a national level with countries of different levels of economic development. Moreover, according to their findings as well as the predictions of Schmitz (1989), more entrepreneurship leads to higher rates of growth, it might be expected that countries within lower levels of economic development would have higher impact of entrepreneurship on economic growth as they have higher rates of entrepreneurial activity than it is in more developed countries.

2.2. Growth and entrepreneurship

Urbano, Aparicio, and Audretsch (2019) provide a recent and excellent review of the literature on the link between entrepreneurship and economic growth. The study points to various frameworks used to examine this relationship. Several studies followed the neoclassical growth model (Audretsch and Keilbach 2004c; Minniti and Lévesque 2010). Others proved that the more recent endogenous growth models could account for entrepreneurship as an additional factor of production (Hessels and Van Stel 2011; Noseleit 2013). Moreover, more recent articles, following institutional approach in understanding this relationship, use institutional economic theory that takes into account the institutional environment in which entrepreneurship occurs, suggesting that institutional factors are fundamental cause of economic growth and productivity through fostering productive entrepreneurship (Bjørnskov and Foss 2016; Bosma, Sanders, and Stam 2018; Urbano et al. 2019). Some scholars (Wennekers and Thurik 1999; Sternberg and Wennekers 2005; Wong, Ho, and Autio 2005) have used the Schumpeterian view of entrepreneurship, as an innovation process, and linked it to the hypothesis that entrepreneurship is related to economic development, not only to economic growth (Urbano, Aparicio, and Audretsch 2019).

More recently, a growing number of studies argue that entrepreneurship effect on growth varies by development level. Among these studies, many have highlighted, theoretically and empirically, the significant and positive impact in developed countries (Dejardin 2000; Acs and Varga 2005; Naudé 2008; Lepojevic, Djukic, and Mladenovic 2016). In addition, within less developed countries, there are also some studies that pointed to the theoretical underpinnings of a positive effect of entrepreneurship on growth; among those are job creation, increasing business experience, the dynamic nature of enterprises (McMillan and Woodruff 2002), and the role of SMEs in increasing competition (Carlin et al. 2001). However, some recent empirical studies provide evidence on the existence of a negative or non-significant relationship in less developed countries. Van Stel, Carree, and Thurik (2005) examined the influence of entrepreneurial activity, measured by TEA rates, on economic growth and found that it has a positive effect in developed countries but a negative effect in the case of developing countries. They argued that this negative effect is related to insufficient number of large firms and lower human capital levels of entrepreneurs in less developed countries. Stam and Van Stel (2011) found no significant effect of entrepreneurship on growth in poor countries, and a significant positive effect in transition and rich countries. In addition, in a study conducted in Palestine, Sabella et al. (2014) provided another evidence of a non-significant relationship between entrepreneurship (measured by start-up rates) and economic growth in developing countries. This discussion leads to the second hypothesis,

Hypothesis 1: There is no relationship between entrepreneurship and growth

Moreover, some scholars have made distinction between several types of entrepreneurship such as opportunity entrepreneurial activity (OEA), reflecting entrepreneurs seeking advantages of opportunities, necessity entrepreneurial activity (NEA), reflecting those who choose entrepreneurship out of necessity and lack of other alternatives, and high-expectation entrepreneurial activity (HEA) that reflects firms that are expecting to grow fast. Both Lepojevic, Djukic, and Mladenovic (2016) and Valliere and Peterson (2009)

also found an insignificant impact of all types in developing countries, however, in developed countries, the former found a significant and positive impact of all three types, while the latter found this significant impact of only HEA. This is consistent with the finding that this type makes the greatest impact on growth in developed countries (Autio 2005) and the highest contribution in net job creation compared to other new firms and entrepreneurship in general (Henrekson and Johansson 2010). Moreover, Wong, Ho, and Autio (2005) found that only HEA has a significantly positive impact on economic growth through its contribution in enhancing knowledge development and access to innovation, regardless the level of development, while other types have no impact in either level.

Reviewing the literature on the entrepreneurship–growth nexus within different levels of economic development, we find some limitations that may explain the different results, especially in the case of developing economies that seems to be unconvincing due to this variety of findings. One of these limitations is that most of these studies depends on one point of time or on short-term investigations, that is less than 5 years, while many have argued that entrepreneurship is a long-term process that requires long-term basis planning (Sternberg and Wennekers 2005; Carree and Thurik 2010; Savrul 2017). Using data for a 42-year period in a study on a sample of 20 OECD countries, Erken, Donselaar, and Thurik (2018) indicated the long-term positive role of entrepreneurship on productivity, using four different models explaining the total factor productivity (TFP) that were established and accepted in the economic growth literature. In addition, they found that entrepreneurship still has a strong positive impact on TFP in a combined model including all variables from these four models together (Erken, Donselaar, and Thurik 2018). Moreover, the results of some empirical studies that rely on long-term periods, due to more data availability, are different from those previously done, but seem to reflect similar implications among each other. Some of these studies indicated that total entrepreneurial activity has a positive and significant impact in all stages of development, which is found to be higher in more developed economies (Urbano and Aparicio 2016; Ivanović-Djukić et al. 2018; Stoica, Roman, and Rusu 2020). However, distinguishing between two types of entrepreneurship, Stoica, Roman, and Rusu (2020) found opportunity entrepreneurship to have a greater and significant positive impact in developing countries compared to developed ones, while necessity entrepreneurship found to have a significantly negative impact in more developed countries, and an insignificant one in developing countries. However, they only focus on a sample of 22 European countries, which requires wider national comparison. In addition, Aparicio, Urbano, and Audretsch (2016) found a similar impact of opportunity entrepreneurship using a sample of 43 developed and Latin-American developing countries; they explain their findings by institutional factors that encourage this type of entrepreneurship in developing countries more than it does in more developed countries. Urbano et al. (2019) also find a simultaneous causality between institutional environment and entrepreneurial activity that affects economic growth. They indicated a positive impact of opportunity entrepreneurship on economic growth in a sample of 14 developing countries taking into account some institutional factors that are important in explaining the entrepreneurial activity and entrepreneurial behavior and therefore fostering economic growth. Under this institutional approach, Aparicio, Audretsch, and Urbano (2020) find a positive and significant influence of social progress orientation, measured by 'civic activism, voluntary spirit, and the inclusion of minorities', on innovative and opportunity-driven entrepreneurship, and on economic

growth in turn. Moreover, using data of 53 countries of different levels of economic development, Bampoky et al. (2013) found a positive impact of entrepreneurship for the entire sample, which gets higher and more significant in less developed countries. We observe a common finding between these studies, depending on long-term periods, which indicates that a positive impact of entrepreneurship on economic growth is found in all stages of economic development. Hence, using a sample of 64 countries covering 14 years (2002–2015), we expect to find this positive impact in all stages of economic development, however, further investigation would help to understand the behavior and the contribution of this positive impact in each stage.

Hypothesis 2: The relationship between growth and entrepreneurship is independent of the level of development.

This does not mean that all previous studies depend on short-term periods, their different results might be due to other issues such as using unsuitable measures. Sabella et al. (2014), for example, have used a long-term period in their investigation, however, the non-significant relationship may be due to the use of start-up rates as a measure for entrepreneurship, which might not be a sufficient measure and does not capture all entrepreneurial activities, since a large percentage of start-ups may not survive (Valliere and Peterson 2009). Moreover, this rate depends on official data capturing only registered firms and neglecting informal enterprises (Sabella et al. 2014). However, our study uses TEA which captures formal and informal nascent and young enterprises reflecting more entrepreneurial activity (Acs, Desai, and Klapper 2008). Moreover, investigating the impact of self-employment on economic growth in developing countries, Pietrobelli, Rabellotti, and Aquilina (2004) and Yamada (1996) found a negative impact. As for developed countries, several studies found positive (Carree et al. 2007; Braunerhjelm et al. 2010; Acs et al. 2012) and negative (Carree and Thurik 1999; Blanchflower 2000; Salgado-Banda 2007) relationships, which indicate that this debate is unsettled. Moreover, self-employment includes self-employed entrepreneurs in addition to other self-employed who might not have entrepreneurial characteristics (Levine and Rubinstein 2018), and different countries might have different levels of these two types of self-employed people, which may have led to the diverse findings.

Another limitation found is that previous empirical work may suffer from inappropriate methodologies that fail to account for unobserved heterogeneity among different countries (Naudé 2011). In addition, some studies are subjected to the problem of omitted variable biases due to the lack of consensus on what should be considered as a standard specification and neglecting other relevant factors that basically explain national growth variations (Bjørnskov and Foss 2016). While, some methods suffer from causality issues, as they do not take into consideration the recursive impact of economic growth on entrepreneurship, we address this issue by appropriately using the IV technique, which we discuss subsequently.

2.3. Informal economy

The findings of negative or non-significant effect of entrepreneurship on economic growth in developing countries are in conflict with the claim that the more entrepreneurial activity rates in a country, the more economic growth it will have (Dejardin 2000);

since developing countries are found to have much higher rates of entrepreneurial activity than it is in developed countries (Acs, Desai, and Hessels 2008). Wong, Ho, and Autio (2005) explain this by the existence of higher rates of technological innovative knowledge based entrepreneurs in more developed nations. Others related the findings to the variations in institutional and macroeconomic environments across nations (Acs, Desai, and Hessels 2008; Ivanović-Djukić et al. 2018).

In this research, we examine the influence of the presence of different informal economy sizes in countries with different levels of economic development, as one of the factors capturing the nature of the macroeconomic environments within a country. As such, this study provides an empirical investigation, distinguishing between three stages of economic development: factor-driven stage, efficiency-driven stage, and innovation-driven stage, following Global Entrepreneurship Monitor (GEM) classification of the selected countries during the period of the study.[2]

The difficulty of defining and measuring the informal economy led to the use of several definitions and various estimation methods in previous studies according to the context and purpose of that study (Schneider and Buehn 2018). However, this study will follow the definition of an IMF working paper by Medina and Schneider (2018), they presented estimates of the size of informal economy, as percentage of GDP, for 158 countries over 25 years using Multiple Indicators Multiple Causes approach (MIMIC).

The literature linking informal economy and economic growth is diverse and not definitive, thus more research needs to be done in this area (Heintz 2012) as these studies have not reached any conclusive results. Loayza's (1999) empirical study in Latin American economies found a negative relationship between the informal economy size and economic growth, and related this to the quality of government institutions and policies that would influence the informal economy size in an opposite way to its influence on economic growth. A study by Fichtenbaum (1989) also finds a negative relationship, indicating that a significant proportion of the productivity slowdown in the 1970s and 1980s in the United States is due to the rapid growth of the informal economy during this period.

However, some studies may support the view of a positive impact of the informal economy on economic growth, through providing '*a dynamic and entrepreneurial spirit which can lead to more competition, higher efficiency, and strong boundaries and limits for government activities*' (Schneider 2008). Others find a positive relationship through a significant positive impact of the informal economy on consumer expenditures (Bhattacharyya 1999), or on the growth rates of GDP per capita as the case in Colombia (Schneider 2007). Goel, Saunoris, and Schneider (2019) suggest that the negative or positive impact of informal economy on economic growth can be determined according to what extent there are synergies between the formal and informal sectors, which stimulates growth and productivity. Baklouti and Boujelbene (2020) relate the relationship between the informal economy and economic growth to the institutional quality of the country, and that if the size of informal economy increased in countries with high institutional quality, it would not reduce the economic growth of this country.

Hypothesis 3: The size of the informal economy has no effect on output growth

Gerxhani (2004) provided a literature survey which compares countries by the level of development and observed that informal economy in developed countries offers contributions to income and growth which would make it accumulated with the formal one;

while informal economy in less developed countries is characterized with low income and yields little accumulation and growth capacity.

Viewing the informal economy from entrepreneurial perspective, Maloney (2004) developed a view of the informal economy as an '*unregulated micro-entrepreneurial sector*' that is an integral part of the economy. In line with this view, Williams (2007) describes informal economy as an 'enterprise hidden culture' that encourages the creation of new enterprises and development. Informal businesses may also be considered as a 'kind of productive entrepreneurship' (Smallbone and Welter 2001). Moreover, Williams (2005) considers the informal economy as a potential '*driver of economic development*', representing a starting point for entrepreneurs to launch their enterprises, who transfer of their work into the formal sector when given the right incentives. However, Fredström, Peltonen, and Wincent (2020) find a negative relationship between informal economy size and entrepreneurship, suggesting that the informal economy size is not sufficient to determine entrepreneurship productivity and that the governance quality and institutional characteristics of a country should be taken into account before determining the real effect of informal economy on entrepreneurship outcomes.

This review on the impact of the informal economy on economic growth and entrepreneurship leaves us with the impression that the evidence is varied and circumstantial. In addition, since there are limitations on data availability on estimations of the size of informal economy, due to the difficulty in measuring it, there is lack of empirical studies on informal economy (Elgin and Oztunali 2014). Moreover, the positive view of the informal economy, within entrepreneurial perspective, does not consider the level of economic development among countries, in addition, the entrepreneurial activity in the informal economy could be productive and create values, or it could be ineffective to economic growth, as it is in the formal one (Bureau and Fendt 2011). Thus this view might not hold for all development levels. Furthermore, the predictions of the positive view are built according to only theoretical basis as well as more qualitative frameworks that rely on questionnaires and interviews collected data, which requires more advanced empirical investigation to test this hypothesis. Therefore, this paper provides an empirical contribution to this literature intending to examine the actual influence of the size of informal economy on the role of entrepreneurship in driving economic growth, through its moderating impact on entrepreneurship and distinguishing between three groups of countries (factor, efficiency, and innovation-driven).

Hypothesis 4: The size of the informal economy has no bearing on the entrepreneurship-growth relationship.

3. Data and sample descriptive statistics

The sample combines macroeconomic and entrepreneurship data on 64 countries that participated in the Global Entrepreneurship Monitor (GEM), over the period (2002–2015). Those countries are classified according to their levels of economic development.[3] We choose our variables depending on the theoretical and empirical approaches of the previous related studies. Our final dataset consists of an unbalanced panel data with 478 observations and 64 countries. A list of variables included in the study appears in Table 1, the list was chosen based on the literature and theoretical framework.

Aiming to control for the possible endogeneity of entrepreneurship, we include an instrumental variable that influence activity rates: self-efficacy according to theory and empirical literature. Wennberg, Pathak, and Autio (2013) find self-efficacy to have an important role in understanding the entrepreneurial behavior. It also helps in capturing '*the entrepreneurial mindsets of each country's inhabitants*' (Reynolds et al. 2005). Moreover, this perceptual variable has significant correlation with entrepreneurship (Arenius and Minniti 2005). Self-efficacy has a positive correlation with entrepreneurial entry and encourages productive entrepreneurship that leads to more economic growth (Wennberg, Pathak, and Autio 2013; Aparicio, Urbano, and Audretsch 2016). It is often argued that growth rates are unlikely to be related to perceptual variables, as economic theory postulates several models of growth (Gould and Ruffin 1993; Bleaney and Nishiyama 2002), but none of which includes this variable, hence, the exclusion restriction holds.

Table 2 summarizes the descriptive statistics for the entire sample with the 478 observations over the period of analysis, reporting the means, standard deviations, maximum, and minimum value of the variables used in this study, in addition to the correlation coefficients between them. We note that all variables included have significant variability, which indicates that our sample covers a wide range of countries with several variations explaining the different influences on economic growth between countries with different levels of economic development. In particular, R&D has high variability reflecting different numbers of employees engaged in research and development field among countries of different levels of development, which ranges between about 17 employees/million people in less developed countries and about 8000 employees/million in more developed countries. However, variability of this variable is expected among different levels of economic development and is a common pattern found in other studies such as González-Pernía and Peña-Legazkue (2015). The average level of entrepreneurial activity is 9.281 with rates varying between 1.5 and 38.6, which also confirms significant variations among the different observations included in our sample.

Analyzing the correlation matrix, we observe that all independent variables are significantly correlated with the dependent variable. Moreover, although correlations among

Table 1. Description of the variables.

Variables	Description	Source
Dependent variable		
GDP/L	Gross domestic product divided by total employment. Data for GDP are in constant 2010 U.S. dollars	WB
Independent variables		
TEA	The percentage of 18–64 aged population who either are owners of a new business (less than 3.5 years old) or are involved in setting up a new business	GEM
GKF/L	Gross capital formation divided by total employment. Data for GKF are in constant 2010 U.S. dollars	WB
HCI	Human capital index depending on average schooling years and return to education	PWT
R&D	The number of researchers working in Research and Development (per million people)	WB
Moderator variable		
LOD	Development dummy, 0 for factor driven, 1 for efficiency driven and 2 for innovation driven	GEM
IES	The size of informal economy as a percentage of GDP	IMF
Instrumental variables		
Self-efficacy	The percentage of 18–64 aged population who are confident of having the required skills and capabilities to start a new business	APS

WB, World Bank; GEM, Global Entrepreneurship Monitor (annual reports); PWT, Penn World Tables (version 9.1); IMF, International Monetary Fund; APS, Adult Population Surveys by GEM.

Table 2. Descriptive statistics and correlation matrix.

Variables	Obs.	Mean	SD	Min.	Max.	
Log (GDP/L)	478	10.694	.880	7.489	12.356	
TEA	478	9.281	5.909	1.500	38.600	
Log (GKF/L)	478	9.214	.873	6.055	10.811	
HCI	478	3.035	.456	1.737	3.742	
R&D	478	2758.244	2020.449	17.376	8006.673	
IES	478	20.039	9.242	6.660	55.060	
	1	2	3	4	5	6
1. Log (GDP/L)	1.000					
2. TEA	−0.584*	1.000				
3. Log (GKF/L)	0.965*	−0.578*	1.000			
4. HCI	0.676*	−0.409*	0.669*	1.000		
5. R&D	0.750*	−0.478*	0.757*	0.671*	1.000	
6. IES	−0.649*	0.359*	−0.698*	−0.630*	−0.634*	1.000

*$p < 0.001$.

independent variables are significant, the magnitudes of the correlations between our main variable of interest, TEA, and the other independent variables are less than 0.6, which mitigates the risk of multicollinearity existence. Moreover, we computed the values of the variance inflation factor (VIF) for each of our independent variables in order to check for multicollinearity. The results indicated no serious multicollinearity issues influencing our estimates since the highest VIF value was 3.47 for Log (GKF/L), while other values are less than 3 with 1.53 for our main variable of interest (TEA). The negative correlation between the level of entrepreneurial activity and the output growth per worker could be explained by different economic development levels and that less developed countries have higher rates of entrepreneurial activity (Acs, Desai, and Hessels 2008; Aparicio, Urbano, and Audretsch 2016; Boudreaux 2019). This can be seen from Figure 1, which shows simple correlations between the level of entrepreneurial activity and the output growth per worker for each level of economic development. However, this simple correlation does not predict the exact way entrepreneurial activity contributes and cause change to the output growth, hence, well-defined statistical model is employed in this paper in order to better capture this relationship.

4. The empirical model

This research examines the impact of entrepreneurship on economic growth, and how would this impact differ by the level of economic development. Additionally, we investigate two interaction terms: the first being level of development with entrepreneurship and moderating role of the size of the informal economy with entrepreneurship. These are used along with entrepreneurship, human capital, knowledge capital, in addition to the capital per worker.

Our estimation strategy is to first use OLS as a benchmark model. However, our identification strategy requires that we implement a two-stage least squares (2SLS) estimation, taking into account the endogeneity of entrepreneurship for a possible causal relation when measuring the effect of entrepreneurship on economic growth, which assumes economic growth might have a recursive effect on entrepreneurship. Many scholars (Audretsch and Keilbach 2004b; Van Stel, Carree, and Thurik 2005; Acs et al. 2012; González-Pernía and Peña-Legazkue 2015) have considered the aforementioned

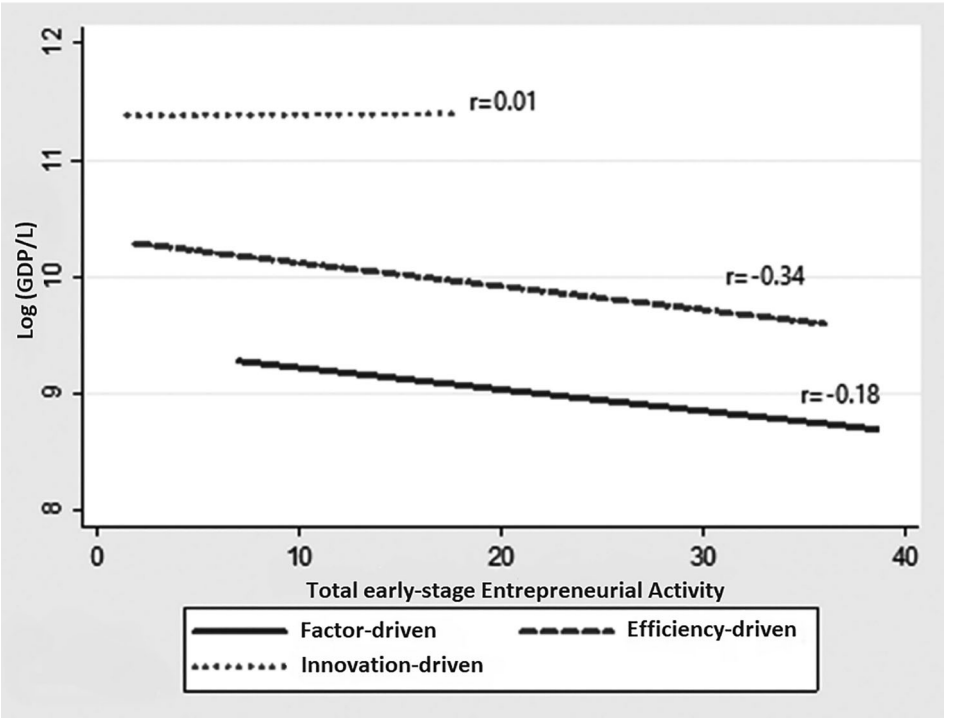

Figure 1. The relationship between entrepreneurial activity and output per worker for each level of economic development.

approach; however, this study is based on panel data, consisting of both time-series and cross-sectional data sets. Panel data techniques provides more variability and more efficient and reliable estimations of the effects, compared to models of only cross-sectional or time-series data, and it allows for addressing unobserved individual heterogeneity using either random or fixed effects procedures (Park 2011). In this regard, we employ a fixed effects specification through including country fixed effects that allow for the unobserved heterogeneity across countries.[4]

We estimate variants of the endogenous growth model, as follows:

$$y_{it} = k_{it}^{\alpha} H_{it}^{\theta} R_{it}^{\gamma} E_{it}^{\delta} \mathrm{IES}_{it}^{\mu} (\mathrm{IES} * \mathrm{E})_{it}^{\tau} \tag{1}$$

where y is the output per worker, H is the human capital index, R is the knowledge input, and E is the rate of entrepreneurial activity and IES is the informal economy size. Moreover, in order to solve for possible endogeneity problem of entrepreneurship and the simultaneous relationship with economic growth, we perform an instrumental variable approach. In this approach, entrepreneurship is instrumented by a variable that reflects individual entrepreneurial perceptions that influence the creation and stimulation of entrepreneurial activity, which we discussed in the previous section.

Our analysis (estimation by OLS and 2SLS) begins by utilizing the full sample of countries, and then we take into account three groups of countries according to their stage of economic development: factor-driven, efficiency-driven, or innovation-driven stage in order to compare the influence of entrepreneurship between

different stages through a categorical distinction between these stages. We also use an interaction term between the level of economic development and entrepreneurship in order to investigate the influence of the level of economic development on the entrepreneurship–growth nexus.

Several studies have emphasized the importance of using interaction terms, whether in economic fields or other sciences, as it is essential in understanding the theoretical development about the conditions that may affect known relationships, in terms of strength and direction (Aguinis and Gottfredson 2010; Andersson, Cuervo-Cazurra, and Nielsen 2014). This approach provides better understanding of group differences allowing for both intercept and slope to differ between these groups, and is a much better technique than estimating separate models for each group, which may contain loss of statistical power and therefore misleading results (Williams 2015).

5. Results and discussion

The identification strategy of the empirical model requires that the model be estimated using instruments for entrepreneurship. As such, we estimate the model using two specifications: the 2SLS estimator and the pooled OLS estimator with time fixed effects to be used as a benchmark. In this section, we present several specifications and discuss the results of the estimated regressions. The regressions use data of 64 countries that participated in GEM during the period (2002–2014) in order to assess the effect of entrepreneurial activity on economic growth. Both estimation techniques are applied on the entire sample of countries and on the three groups of countries according to their levels of economic development. Finally, our estimations also examine the moderating role of the informal economy size on the entrepreneurship–growth nexus.

Regression results are presented in Tables 3 and 4. Table 3 shows the OLS estimation results, while Table 4 shows the 2SLS estimation results. These regressions use TEA to measure entrepreneurship, and the log of output per worker, to measure economic growth. Both methods include the same model specifications, by which we assess the effect of entrepreneurship on economic growth through a growth model that includes entrepreneurship and knowledge as determinants, in addition to the traditional production factors. Model 1 shows the effect of entrepreneurial activity on economic growth for the entire sample of 64 countries including entrepreneurship (TEA) in addition to the other production factors: log physical capital per worker (log (GKF/L)), human capital index (HCI), and the knowledge indicator (R&D). Model 2 highlights the differences of the effect of entrepreneurial activity between the different groups of countries according to their levels of economic development, by adding a factor variable (level of development (LOD)) which has three categories: Factor-driven stage, Efficiency-driven stage, and Innovation-driven stage. This allows for differences in intercepts between these groups. Allowing for slope differences between groups of countries, Model 3 presents the results for using an interaction term between entrepreneurial activity and the level of development (TEA*LOD) in order to show whether the entrepreneurship–growth nexus varies by level of development. The last model presents the results of the moderating role of the informal economy size on the relationship between entrepreneurship and economic growth, using the interaction term between entrepreneurial activity and the informal economy size (TEA*IES).

Table 3. Least squares estimates of the fixed effects panel model (dependent variable is output per worker).

	Model (1)	Model (2)	Model (3)	Model (4)
TEA	0.00227*	0.00228*	0.00736***	−0.00123
log capital/worker (GKF/L)	0.289***	0.231***	0.232***	0.200***
Human capital index (HCI)	0.241***	0.232***	0.250***	0.215***
Research and development (R&D)	0.0000310***	0.0000287***	0.0000304***	0.0000257***
Efficiency driven		0.244***	0.323***	0.257***
Innovation driven		0.286***	0.405***	0.290***
Entrepreneurship-development interaction (TEA*LOD)			−0.005**	
Informal economy size (IES)				−0.008***
Entrepreneurship-size interaction (TEA*IES)				0.000112
_cons	7.192***	7.515***	7.363***	8.018***
N	478	478	478	478
F	156.8	161.2	142.6	126.2
R^2 – within	0.605	0.703	0.710	0.713
R^2 – overall	0.883	0.875	0.873	0.854
R^2 – between	0.923	0.915	0.908	0.898
Cross section weak dependence (*p*-value)	0.003	0.036	0.064	0.007
Autocorrelation (*p*-value)	0.000	0.000	0.000	0.000
Heteroskedasticity (*p*-value)	0	0	0	0

Level of statistical significance: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

As shown in Table 3, testing for cross-section weak dependence, Ditzen (2018) implies this is not a serious problem in our data. Wooldridge's (2002) test of first-order autocorrelation rejects the null of no first-order serial correlation. On the other hand, the modified Wald test of heteroskedasticity (Baum 2001) also rejects the homoscedasticity hypothesis. Thus our estimates in the two stage least squares corrects for autocorrelation and heteroskedasticity by using robust standard errors as shown in Table 4.

The 2SLS estimates are provided in Table 4, and first stage estimates are in Table 5. We first address the first stage estimates in Model 4, the human capital index is significant

Table 4. 2SLS estimation results with fixed effects: second-stage coefficients (robust standard errors).

	Model (1) Log output/ worker	Model (2) Log output/ worker	Model (3) Log output/ worker	Model (4) Log output/ worker
TEA	0.0150*	0.0163***	0.0176***	0.0153**
log capital/worker (GKF/L)	0.285**	0.227***	0.227***	0.221**
Human capital index (HCI)	0.144	0.126	0.131	0.144
Research and development (R&D)	0.0000332**	0.0000296**	0.0000300***	0.0000297**
Efficiency driven		0.240**	0.262**	0.282**
Innovation driven		0.332***	0.364***	0.385**
Entrepreneurship–development interaction (TEA*LOD)			−0.001	−0.002
Informal economy size (IES)				−0.002
Entrepreneurship-size interaction (TEA*IES)				0.0000721
Development –size interaction (LOD*IES)				
Self-efficacy				
_cons	7.397***	7.717***	7.674***	7.740***
N	478	478	478	478
F	12.22	19.98	20.01	25.30
R^2 – within	0.628	0.729	0.731	0.732
R^2 – overall	0.851	0.857	0.855	0.853
R^2 – between	0.905	0.906	0.903	0.899
Wooldridge (*p*-value)	0.000	0.008	0.005	0.012

Level of statistical significance: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

and positive, and so are the level of development and self-efficacy. In addition, the development–size interaction is negative and significant, implying that the informal economy size dampens the positive effect of level of development on TEA. The second stage results (Models 1–4) show that the elasticities of the production factors in the models are positive and significant as expected. The estimates for physical capital per worker (GKF/L) are within the usual range and are close to those reported by Mankiw, Romer, and Weil (1992) and other related studies. However, considering differences of TEA impact (using TEA*LOD) in the third model, we can see that the results for HCI are not significant in the second stage, but very significant in the first stage, this may indicate the importance of human capital factor in differentiating the influence of entrepreneurship among different countries. The estimates for R&D are also positive and significant as expected in the endogenous growth theory by Romer (1986); however, their effect is very small although significant.[5]

The effect of entrepreneurship on growth is positive and significant for most models leading to the rejection of hypothesis 1; this is consistent with several previous studies that have confirmed this positive relationship (Wennekers and Thurik 1999; Audretsch 2007; Hessels and Van Stel 2011; Acs et al. 2012; Urbano and Aparicio 2016; Ivanović-Djukić et al. 2018). This also supports the hypothesis that entrepreneurship is a factor that stimulates economic growth and productivity (Audretsch and Keilbach 2004b, 2004c, 2005, 2008), confirming the ability of endogenous growth models to account for entrepreneurship (Wennekers and Thurik 1999). However, the magnitudes of TEA coefficient in Model 1 differ between the two estimations. On the one hand, the OLS estimation shows that a 10% change in entrepreneurial activity (TEA) rates is associated with only about 0.02% change in economic growth, expressed by output per worker, this is significant with $p < 0.05$. On the other hand, in the 2SLS estimation, Model 1 shows a higher and more significant ($p < 0.001$) effect of entrepreneurial activity that indicates a 10% change in TEA is associated with about 0.16–0.18% change in the output per worker.

Regarding the differences among groups of countries: factor-driven, efficiency-driven, and innovation-driven countries, the results of adding LOD in Model 2 in Tables 3 and 4 provide the evidence of significant differences across the three groups, showing that at a

Table 5. First stage estimates of the TEA equation.

	Model (1)	Model (2)	Model (3)	Model (4)
log output per worker	0.883	1.059	1.059	−1.577
Human capital index	6.773***	6.762***	6.762***	6.000***
Research and development	−0.0000942	0.0000277	0.0000277	−0.000301
Self-efficacy	0.111***	0.113***	0.113***	0.103***
Efficiency driven		−0.530	−0.530	7.160**
Innovation driven		−4.270	−4.270	7.377*
Informal economy size				−0.0456
Development level –size interaction				−0.271***
_cons	−24.02*	−23.59*	−23.59*	2.982
N	478	478	478	478
F	8.505	9.793	9.793	14.86
R^2 – within	0.140	0.154	0.154	0.225
R^2 – overall	0.0381	0.00469	0.00469	0.0928
R^2 – between	0.0516	0.0000526	0.0000526	0.0956

Level of statistical significance: *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

given rate of TEA, the log output per worker is higher for innovation-driven and efficiency-driven stages relative to the factor-driven stage. We notice that the base outcome of the three levels of development is the factor-driven stage, and the results for the other categories of LOD are both positive and significant, which indicates that they have higher levels of output per worker. In other words, we observe that the efficiency driven countries are about 24% higher relative to factor driven. Countries within the innovation-driven stage fluctuate according to model specification; nonetheless, they are positive and significant. The results from Model 2 are presented in Figure 2[6], from which we can see a notable shift of output per worker levels between factor-driven and efficiency-driven stages. This can be explained by the shift of the efficiency-driven stages into more productive and competitive economies that are also associated with huge transfer into wage employment from high rates of self-employment in factor-driven stages (Acs, Desai, and Hessels 2008), as self-employment is found to be negatively related to economic growth in some samples (Blanchflower 2000; Salgado-Banda 2007). In addition, this stage move from depending on small firms to large ones, which allows it to catch up faster to the levels of output in more developed stages. For the results from Model 2 in both OLS and 2SLS estimations, we can see that TEA coefficient is still positive and significant, which indicates the importance of entrepreneurship in stimulating economic growth in all levels of development.

Turning to Model 3, including the interaction term TAE*LOD (hypothesis 3) allows for slope differences between the three groups of countries in order to examine the behavior of the effect of entrepreneurship on output per worker within each group, which is presented in Figure 3. The coefficient for TEA*LOD in OLS estimation is found to be negative and significant. This means that the direction of the positive relationship becomes slower in more developed countries, even though they have higher output levels. This means that a sharp increase of entrepreneurship rates in countries within the factor-driven stage is associated with higher increase of economic growth than it is in countries of higher levels of economic development. That is, the response of economic growth to a change in entrepreneurship rates decreases in more developed countries and depending on the relative sizes of coefficients on TEA and the interaction term, the effect of TEA on growth turns negative in innovation driven countries. This variance of the positive effect of entrepreneurship might be due to several differences between countries within different levels of development, such as different country policies, regulations, macroeconomic environment, institutional environment that surrounds the entrepreneurial activity within the country. All of these factors contribute to fostering or hindering the positive impact of entrepreneurship according to their role in facilitating a productive entrepreneurial environment that leads to higher levels of economic growth.

The result from model 3 differs from the findings of Van Stel, Carree, and Thurik (2005), that entrepreneurship has negative (if any) effect on growth within low-income countries and a strong and significant positive one in high-income ones. However, their study was based on a cross-section of 36 countries for a single year (2002). Our findings from the two stage least squares with robust standard errors indicate the positive impact of entrepreneurship does not vary by level of development (unable to reject the third hypothesis) as the interaction term is insignificant given that the level of development does affect output growth differently. In addition,

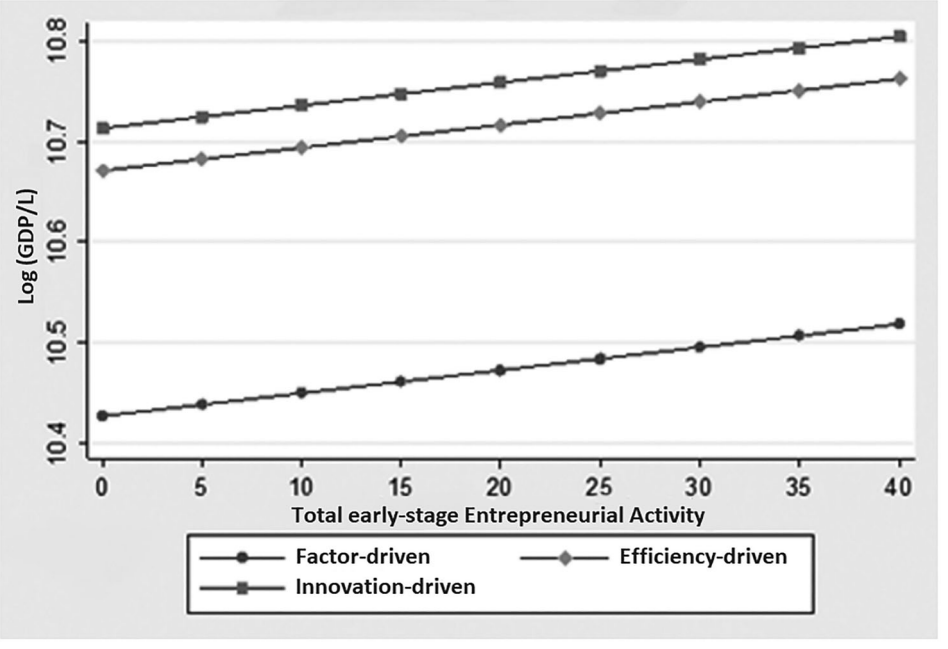

Figure 2. Results for the effect of entrepreneurial activity by levels of development.

there are several findings that only the high growth potential entrepreneurship (HEA) has truly significant impact in developed countries (Autio 2005; Valliere and Peterson 2009). Therefore, defining entrepreneurship as a new business creation and the use of

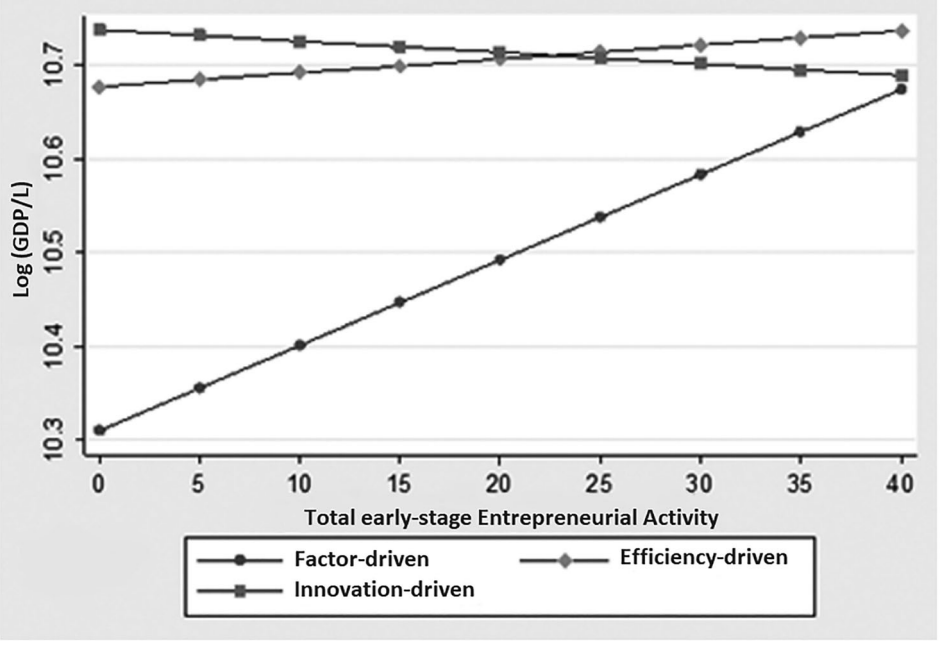

Figure 3. Differences of slopes of the effect of entrepreneurial activity between levels of development.

entrepreneurship as total (TEA) as our independent variable may have led to the negative result in these countries, considering the findings that the HEA presents a very small proportion of total entrepreneurship as new firm creation (Autio 2005; Storey 2014). Moreover, we are not aiming to reduce the importance of innovation in these countries, Wong, Ho, and Autio (2005) have distinguished between innovation and new business creation as separate types of entrepreneurships; they confirmed that a very small share of total entrepreneurs are engaged in technological innovation. However, as the entrepreneurship–growth nexus is still under research in developing countries (Naudé 2008), the positive result in these countries gives new insights of the possible impact of several types of entrepreneurship in these countries, which might not be the same as in developed ones.

The inclusion of the interaction term (TEA*LOD) leads to the decline of the model's fit, suggests that model (2) is more adequate in explaining the relation between TEA and output growth. Some scholars have discussed the idea of an optimal level of entrepreneurship (Audretsch et al. 2002; Bampoky et al. 2013). Bampoky et al. (2013) found that, assuming specific optimal rate of entrepreneurial activity for each country, a deviation (an increase or a decrease) from this optimal level would negatively influence economic growth. They also suggested that this optimal level of entrepreneurship differs between developed and less developed countries, and that it is lower in more developed ones, which indicates that less developed countries need to have higher entrepreneurial rates to reach their optimal levels. The lack of significance in the entrepreneurship–level of development interaction does not lend support to this hypothesis. This result is also similar to the catching up hypothesis where lower level of development countries grow at a faster rate to catch up with the more developed ones as illustrated in Bampoky et al. (2013).

Moving to Model 4 (hypothesis 4) shows the results for the moderating role of the informal economy size on the relationship between entrepreneurship and economic growth. The small and insignificant coefficients of the interaction term TEA*IES, in both OLS and 2SLS estimations, imply that IES does not have any significant role in moderating this relationship, which means we were unable to reject hypothesis 4. Moreover, this result would not differ between the three groups of countries according to their levels of development, which have the same insignificant impact.[7] Further, the negative coefficient of IES shown in Table 4, which is significant in the OLS estimation with $p < 0.01$, implying a negative direct impact of the informal economy size on economic growth, which supports the findings in several previous studies (Fichtenbaum 1989; Loayza 1999). The findings from model 4 contradict the hypothesis that the informal economy may have a positive impact on economic growth through providing entrepreneurial qualities and encouraging productive entrepreneurial activity and thus being a driver of growth and development, which was introduced in some previous literature (Smallbone and Welter 2001; Williams 2005; Williams and Round 2007). Moreover, this insignificant result might be due to taking into account only the level of development as a classification for countries. This would be consistent with those who suggest that this relationship can be better determined when considering other characteristics of different countries such as the governance and institutional quality (Baklouti and Boujelbene 2020; Fredström, Peltonen, and Wincent 2020), which was beyond the scope of this study.

In order to test the significance of the combined contribution of both IES and the interaction TEA*IES to our growth model, we evaluate the difference between models 3 and 4 using the *F*-test of nested models. The results showed that there was a significant difference between the two models with $p < 0.001$, indicating that the combined effect of these two variables is different from zero and that at least one of them has an effect on growth. Moreover, we have implemented a Wald test on the interaction TEA*IES in order to test whether restricting this variable to zero would harm the fit of the model or not. The result showed there was no evidence that its effect differs from zero, confirming the notion that it had no significant contribution to the model, and that the informal economy size has no significant role in moderating the entrepreneurship–growth nexus.

We notice, in both Tables 3 and 4, that TEA coefficients remain significant and in the same range, using different model specifications, which provides an evidence of structural validity of our estimations in both regression techniques we used. This stability of TEA coefficients also emphasizes a robust support that entrepreneurship is one important factor enhancing growth.

Turning the attention to the fit of the models, for the OLS estimation results in Table 3, R^2 values in all models show a well-defined estimation, and good model fits that explains more than roughly 88% of the total variance in the growth output per worker. In 2SLS estimations, R^2 values also show reasonably good model fits that get better in the models including LOD, which indicates the differences among the groups that is explained in the estimation. In addition, from the within and between R^2 values in each model, we can see that this estimation was able to explain about 63–73% of growth variations within countries, and about 89–91% of growth variations between countries. Higher 'between' values indicates the ability of this model to account for national growth variations among different countries, which is one of the main goals of this study. Further, the 2SLS estimation has similar results and very close to those from the OLS on the most part, with the same signs, showing the same direction of effects, however, 2SLS captures larger and more significant magnitudes of TEA estimates. This difference indicates that some endogeneity existed, and assumes that the instrumental variable approach was able to account for this possible endogeneity of entrepreneurship. In order to confirm this, we have checked for the presence of endogeneity problem through a Wooldridge test (Wooldridge 2010) on the four models in the 2SLS estimation, which indicated the endogeneity of TEA is highly significant level.[8] Hence, we are more likely to trust the predicted values from the 2SLS estimation than those from OLS, which clearly suffer from downward bias.

6. Conclusion and recommendations

This study was motivated by the conflicting views on the relationship between entrepreneurship and growth. The literature points to either positive or negative relation, depending on the type of data used and study setting. In addition to that, very few studies incorporated the informal economy size into this intersection of relationships. Our research design incorporated the level of development as a mechanism by which we can introduce cohesion to the seemingly conflicting views; it also incorporated the

size of the informal economy, which was typically dealt with in isolation. The estimation methodology also adds another advantage to establish causal inference between entrepreneurship and growth.

On the one hand, entrepreneurship has been widely considered a strong driver of economic growth in theory, empirical distinctions between developed and developing countries have brought mixed results. However, the findings of our study indicate that entrepreneurship matters to economic growth, but this relation is not moderated by the level of development. This implies that policies aimed at boosting the effect of entrepreneurship on growth are similar in all levels of development. This research clearly illustrates (Figure 2) that the effect of entrepreneurship on growth of output per worker is still positive for all three levels of development when the relationship is strictly linear. Adding the interaction term does not change the magnitude of the effect of this relationship, and it is clearly not significant (Figure 3 and OLS results give a different result). On the other hand, we find no significant influence of the informal economy size on output per worker. In addition, in both cases (OLS and 2SLS estimations), the moderating role is insignificant.

The previous evidence shows variety of results, especially in developing countries, in which entrepreneurship–growth nexus mostly assumed to be negative or insignificant. However, using national level GEM data, this study adds to the extant empirical cross-national literature on entrepreneurship by providing wider comparison on the long run. Distinguishing between three groups of countries according to their level of economic development in the second model showed significant differences between these groups. However, consistent with studies which have conducted long-run investigations (Urbano and Aparicio 2016; Ivanović-Djukić et al. 2018; Stoica, Roman, and Rusu 2020), we found that total entrepreneurial activity (considering linear relationship) has a positive and significant impact on economic growth and in all stages of development. In addition, the insignificance of the interaction term is not consistent with the findings of Bampoky et al. (2013), who explained this negative impact by reaching an optimal level of entrepreneurship, which might imply that our sample of developed countries have fulfilled or exceeded their optimal levels.

While we acknowledge the need to formulate policies that meet countries' macroeconomic environment, our findings indicate that this relation requires more investigation and analysis. The insignificant interaction term has shown sensitivity to assumptions about the error structure of the data (Tables 3 and 4). The study has some limitations regarding the data availability; first, the time span we use (2002–2015) is restricted due to late beginning of GEM project and the used index for the informal economy size, which was measured only until 2015. Second, although we were able to capture a large number of observations, TEA rates included a number of missing values, as some countries are found to have only one or two observations according to their participation in GEM. In addition, our analysis focuses on total entrepreneurial activity in general. Hence, it would be worthwhile to conduct future studies on the impact of several types of entrepreneurship given the attention to long-run investigations, which might bring different findings to complete the analysis. Consequently, this contributes to directing policy makers to provide appropriate incentives and remove obstacles to those considered productive entrepreneurial

activities, thus contributing to their survival and sustainability and therefore enhancing national economic growth through the focus on increasing the quality rather than the just the quantity of entrepreneurship.

These findings also provide other important implications for future research; further investigation should help to understand what factors might influence the success or failure of entrepreneurial activities in each stage of economic development.

Based on these conclusions, practitioners should devise policies that foster entrepreneurship to increase growth. Moreover building empirical analyses on well-framed theoretical approaches and well-defined measures of entrepreneurship would have great impact on future results in the study of entrepreneurship, giving an attention to the importance of endogenous growth models in reforming the role of entrepreneurship in economic growth.

Notes

1. See Gould and Ruffin (1993) and Plosser (1992) for more details.
2. For more information, please see https://www.gemconsortium.org/.
3. GEM adopted this classification from the World Economic forum (WEF), to which we refer for the classifications of countries for the years before 2008, since GEM started to use this classification in 2008.
4. We have implemented a Hausman test in order to compare between fixed and random effect specifications, and the null that random effect model is preferred was rejected at 1%. Moreover, a Wald test for adding time-fixed effects indicated that we do not need to include them in our model, since we failed to reject the null that the coefficients for all year dummies are jointly equal to zero.
5. This might be caused by the high variability of this factor for our sample of countries, which was discussed in Section 3.
6. The reported graphs in Figures 2 and 3 are from the OLS estimation only, since the graphs from 2SLS are very similar and show the same behavior of the examined relationship.
7. The results still insignificant and behaves equally considering each level of economic development separately.
8. The results are shown in Table 4. This is a heteroskedastic robust version of the Durbin–Wu–Hausman test (Durbin 1954; Hausman 1978; Wu, 1974), which is reported when using robust VCE in the estimation.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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