Entrepreneurship Contribution to the Three Pillars of Sustainable Development: What Does the Evidence Really Say?

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Summary. – Compared to the prior discussion of the emerging research on entrepreneurship and sustainable development, the purpose of this study is to investigate the ability of the entrepreneurial activity to simultaneously enhance economic growth, advance environmental objectives, and improve social conditions in developing countries. We mainly found that entrepreneurship in these countries positively contributes to the economic and social dimensions of sustainable development, while its contribution to the environmental dimension is negative. The results of causality test confirm the interactions among entrepreneurship and these three dimensions in both short and long-run. Limitations and future research directions, some managerial and policy implications for entrepreneurial action in sustainable development are also discussed.

Key words**:** Entrepreneurship; Pillars of sustainable development; Developing countries**.**

1. INTRODUCTION

Concerns about the planet's sustainability have emerged as an increasingly influential subject in business practice and academic settings, and more recently with the United Nations publication "The Future We Want" one of the outcomes of Rio+20 conference on sustainable development held in 2012 (Rahdari et al., 2016). Consciousness is increasing to highlight that a fundamental change in the way society produces energy and uses natural resources is needed if we make advances on pressing environmental concerns such as global climate change and ecosystem degradation (Hall et al., 2010). With this as context, the entrepreneurial action is increasingly recognized as an important vehicle to promise the future development of the whole society's preoccupations (Dean and McMullen, 2007; Patzelt and Shepherd, 2011).

The role of entrepreneurship, as a vehicle of economic and societal transformation, is not new in the economic literature. Several authors have already studied the link between resolving global problems and entrepreneurship (Shumpeter, 1934, 1942; Drucker, 1985; Matos and Hall, 2007). In this context, entrepreneurship has been cited as an important channel towards sustainable products and services, and new projects are underway as a panacea for many environmental and social concerns. For instance, Cohen and Winn (2007) proved that four types of market imperfections contributed to the environmental pollution and considered it as a source of significant entrepreneurial opportunities to establish the foundations for an emerging model of sustainable entrepreneurship by slowing the degradation and even gradually improving the earth's ecosystems. Similarly, York and Venkataraman (2010) proposed entrepreneurship as a solution rather than a cause of environmental degradation. They built a model that embraces the potential of entrepreneurship to supplement regulation, corporate social responsibility, and activism in resolving environmental problems. Recently, numerous prestigious journals in this area, like the Harvard Business Review, Journal of Business Venturing, and MIT Sloan Management Review, among others, have forwarded the idea that entrepreneurship could be a solution for numerous environmental and social preoccupations (e.g. Wheeler et al., 2005; Senge et al., 2007; Hall et al., 2010), but also in the documents of the international organizations e.g. UE Strategy, (2020), both, i.e. entrepreneurship and sustainability, being considered to guarantee the future development of the whole society.

Yet, despite the economic literature and research lines exploring the key role played by entrepreneurship in promoting a sustainable society, still major gaps in our knowledge of whether and how this process would actually hold in developing countries (Hall et al., 2010), while researchers from Global Entrepreneurship Monitor (GEM) reports that the rates of entrepreneurial activity in developing countries are more higher compared to those in developed ones (Vivarelli, 2013). In addition, since the Sustainable Development Goals (SDGs), appeared from the Rio+20 conference on sustainable development in 2012, are aimed at improving the economic, social and environmental conditions particularly in least developed countries, none of the entrepreneurial economic studies have explored the ability of entrepreneurship in achieving these goals in case of developing countries. Moreover, still there is a research gap in the literature on a holistic framework used to assess the contribution of the entrepreneurial activity in reaching the economic, environmental, and social goals of sustainable development –TBL or 3BL (triple-bottom-line) suggested by Elkington (1998) [1]– in an integrated framework, as emphasized by Hart and Milstein (2003).

Attending to the above-mentioned motivations, the purpose of this study is to address these gaps and give empirical evidence on the role of entrepreneurship in making developing countries more sustainable. It thus makes two fundamental contributions to the existing pool of knowledge. First, we examine the ability of the entrepreneurial activity to make developing countries more sustainable. Specifically, we examine the contribution of entrepreneurship on the economic, social and environmental dimensions of sustainable development to find out if entrepreneurship may creates economic growth, advances environmental objectives and improves social conditions in the developing countries. To the best of our knowledge, none of the existing studies have investigated the relationship between entrepreneurship and these three dimensions in an integrated framework, and in the context of developing countries. Second, our results, regarding to the linkages among entrepreneurship and the above-mentioned pillars of sustainable development, also contribute to the existing literature. To be more precise, they strongly support the environmental economics literature and the research in game theory by confirming that the challenges of sustainable development in developing countries correspond to a prisoners' dilemma problem whither the businesses/entrepreneurs are compelled to environmentally degrading behavior due to the divergence between individual rewards and collective sustainability goals.

[1] John Elkington coined this concept to express the diffusion of sustainable values in business activity performance

We begin our analysis with a review of the concept of sustainable development and discussing the connection between entrepreneurship and the three-pillars of sustainable development that are economy, society, and ecology. We then describe the study's research methodology and the used data. The empirical findings are then presented, followed by a discussion of their contributions to existing literature, managerial and policy implications for entrepreneurial actions in sustainable development, and limitations and future research directions. Study's main conclusions are given in the end.

2. LITERATURE REVIEW

A compact review of the literature on the concept of sustainable development, its main components and their interactions with the entrepreneurial activity are presented in this second section.

(a) *Sustainable development – a complex concept*

Historically, the concept of sustainable development was first appeared in a document entitled "Our Common Future", also known as the Brundtland Report, provided by the UN World Commission on Environment and Development (WCED) in 1987 (Lele, 1991). It define sustainable development as a development *which meets the needs of the present generation without compromising the ability of future generations to meet their* needs (WCED, 1987:43).

Indeed, sustainable development is recognized as a potential pathway to reorient development towards a more inclusive model, which aims to achieve a symbolic relationship among desirable economic, social, and environmental systems for both present and future generations (Folke et al., 2002; Cobbinah et al. 2011). This objective was born from the idea that the social, environmental and economic pillars of sustainable development are intimately interrelated and cannot be considered separately[2] (Strange and Bayley, 2008). We understand from this interrelationship that pure economic development needs to have some limits because the attainment of sustainable development needs the integration of not only its economic dimension, but also its environmental and social dimensions at all levels. If an economy focuses only in the economic sustainability dimension, then it would be a society whose gross domestic product gets higher, but also the one that destroys the environment or the one that disrespects their population's rights (Baker, 2006). Therefore, only by integrating social,

[2]Baker (2006) summarizes the interrelationship between environment, economy and society in the following points: environmental stresses and the economic development system are interrelated; environmental and economic problems are related to political and social factors; and these problems exist within a state, but also among states.

economic and environmental sustainability can positive synergies fostered, negative synergies be arrested and real development encouraged[3]. According to Serageldin et al. (1994), the basic premise that leads to this idea is that all human activity is a subsystem of the ecosystem. Indeed, the human population and the activity that it engenders are part of a larger whole that is the ecosystem in which they evolve. This ecosystem includes the physical environment and all living organisms that share and interact in and with this space. Human activity depends on the ecosystem and the ability of this ecosystem to maintain this activity. Some environmentalists will also push this reasoning further, because, in their view, human activity influences the ecosystem and, if human development is unchecked, there will be irreversible changes in the ecosystem that will endanger its ability to 'endure' human activity. According to this vision, sustainable development offers a development model that tries to reduce the impact of human activity on the ecosystem that it does not undergo significant and permanent changes.

However, with the current global challenges such as rapid urbanization, increasing poverty, climate change, and food insecurity a practical understanding of sustainable development is necessary and urgent especially in developing countries (World Economic and Social Survey, 2013). For that reason, leaders of 189 countries met in September 2000 at the United Nations in New York and agreed to achieve eight international development goals known as Millennium Development Goals (MDGs)[4] by the year 2015. Later, an agreement to launch a set of universal applicable Sustainable Development Goals (SDGs) appeared from the Rio+20 conference on sustainable development in 2012, which will build upon the MDGs and take centre stage at the post-2015 development agenda (Pintér et al., 2014). These goals (see Table A1 in the appendix) are aimed at transforming the current abominable conditions of education, health, employment, pollution, and poverty, among other problems, worldwide, particularly in developing countries (Rahdari et al., 2016). In response to these sustainability-related problems, researchers around the world are beginning to ask what role of

[3]Social, Economic and environmental sustainability form elements of a dynamic system. They cannot be pursued in isolation for sustainable development to flourish (Kwarteng et al., 2016). Social sustainability is the ability of our society to ensure the wellbeing of all its citizens. This well-being translates into the possibility for everyone, to access, whatever their standard of living, to basic needs: food, housing, health, equal access to work, security, education, human rights, culture and heritage, etc (see McKenzie, 2004; Dempsey, 2009). The economic sustainability is the ability to promote growth and economic efficiency through sustainable production and consumption patterns, i.e. a system of production that satisfies present consumption levels without compromising future needs (see Basiago, 1999). The environmental sustainability is the fact to preserve, improve and enhance the environment and natural resources in the long term, maintaining the great ecological balance by reducing risks and preventing environmental impacts (see World Bank, 1986 ; Basiago, 1999).

[4]The MDGs are the eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; combat HIV/AIDS, malaria and other diseases; ensure environmental sustainability; and develop a global partnership for development.

entrepreneurship and small business can play in achieving these goals (Parrish, 2010; Rahdari et al., 2016; Ben Youssef et al. 2017; Omri, 2017). Many of them agreed that entrepreneurship could contribute significantly to the world's economy, society as well as human kind through job creation, product innovation and exploitation of business opportunities. Indeed, both sustainable development and entrepreneurship are considered in the existing literature as solutions to ensure the future development of the entire society (Hall et al., 2010). Accordingly, we review, in the following subsection (b), the existing literature on the nexus among entrepreneurship and each component of sustainable development under three levels; (i) economic impact of entrepreneurship; (ii) social impact of entrepreneurship; and (ii) environmental impact of entrepreneurship.

(b) *Entrepreneurship and sustainable development*

The prior literature shows that entrepreneurship is increasingly being recognized as a significant channel for bringing about a transformation to sustainable products and services and the implementation of new projects addressing various social and environmental concerns. Thus, our objective here is to review the scant literature analyzing the interrelationship between entrepreneurship activity and the economic, social, and environmental pillars of sustainable development, focusing on empirical findings.

(i) Economic impact of entrepreneurship: Entrepreneurship and economic growth

Macroeconomists have long known that modern national economic growth cannot fully be explained by growth in the usage of inputs such as capital and labor alone (Solow, 1957). Some of the endogenous growth theorists, such as Romer (1986) and Lucas (1988), among others, criticize the basic model of the neoclassical production function and argue that knowledge was an important production factor, along with the traditional factors of capital and labor. For this reason, some attention has been paid to the role of entrepreneurs in identifying and exploiting opportunities in the dynamic economy to produce growth (Holcombe, 1998). The change from a managed to an entrepreneurial economy heightened the significance of small entrepreneurs (Loveman and Sengenberger, 1991; Audretsch and Thurik, 2000).

Other theoretical models that illuminate the link between entrepreneurial activity and economic growth include those of Acs et al. (2009:2012), which built knowledge spillovers into the theory of entrepreneurship. They show that entrepreneurship facilitates knowledge spillovers, which conduct to enhance economic growth (Prieger et al., 2016). From this

perspective, Audretsch and Keilbach (2004) introduced entrepreneurship capital into a standard Cobb-Douglas production function and found that the startups of entrepreneurship lead to greater economic growth across 327 West German regions over the period 1989-1992.

In the same context, Urbano and Aparicio (2015) empirically examined the effect of three different types of entrepreneurship capital (overall total entrepreneurial activity (TEA), opportunity TEA, and necessity TEA) on economic growth using the neo-classical augmented Cobb–Douglas production function for 43 countries over 2002-2012 periods. In this setting, they analyzed the influence of overall TEA on economic growth by distinguishing between the groups of countries (OECD and non-OECD countries) and periods of time (pre- and post-crisis periods). On one hand, they assessed that entrepreneurship capital, measured by overall TEA and opportunity TEA could be key factors in achieving economic growth. On the other hand, regarding the groups of countries and the periods of times, they found that overall TEA has a higher effect on economic growth in OECD countries than in non-OECD countries, and in the post-crisis period in all countries than in the pre-crisis period. Furthermore, by using a database for 36 developed countries, Van Stel and Storey (2004) showed that entrepreneurship can be one of the driving forces of economic growth and that the rapid growth of new enterprises generates job creation in small and medium enterprises.

Recently, Prieger et al. (2016) confirmed that there is complex in the theoretical and empirical evidence on the relationship between entrepreneurship and growth in low- and middle-income countries. They estimated the impact of entrepreneurship on economic growth across developed and developing countries, in order to investigate the ‘‘growth penalty”[5]. They found that developing countries have more of their population running nascent small firms than in developed countries. Furthermore, they proved that a marginal increase in the entrepreneurship rate in developing countries has a positive effect on economic growth. On the contrary, in developed countries, there is no evident growth penalty. Moreover, Ferreira et al. (2016) examined the effects of entrepreneurship types, classified as Schumpeterian entrepreneurship (innovation-based)[6] and Kirznerian entrepreneurship (opportunity-based)[7],

[5]‘Growth penalty’ means that countries deviating from the equilibrium rate of entrepreneurship (the number of business owners exceeds the optimal rate) suffer a high growth penalty in terms of opportunity cost, measured in terms of foregone economic growth. In this manner, depending on whether a country’s actual rate of entrepreneurship is below or above its optimal rate, there exist technically both a positive and negative relationship between the rate of entrepreneurial activity and economic growth (Wong et al., 2005).

[6]Indicates that entrepreneurs product innovation, processing structural changes in the economy, bringing about the introduction of new competitors and contributing towards productivity, job creation and overall national competitiveness (Ferreira et al., 2016).

on economic growth across three different types of economy (factor-driven economy, efficiency-driven economy, innovation-driven economy), using an unbalanced panel composed of 43 countries over the period 2009-2013. They found that in terms of the overall model for GEM economies, neither Schumpeterian nor Kirznerian entrepreneurship returns any statistically significant effects on GDP growth. However, in efficiency-driven economies, there is evidence of a positive relationship between opportunity entrepreneurship and growth. Regarding the innovation-driven economies, neither type of entrepreneurship generates a significant impact on growth. Opportunity-related entrepreneurship can thus be identified as a fundamental mechanism in the transformation of new knowledge into economic growth (Audretsch et al., 2008). Wong et al. (2005), among others, found a similar deduction, indicating that the opportunity entrepreneurship rates reflect the creation of knowledge and technology, which could positively affect economic growth.

(ii) Social impact of entrepreneurship: Entrepreneurship and human development

Development economists have long believed that entrepreneurship matters for economic growth and development. Moreover, they have focused on the economic impacts of entrepreneurship (GDP, productivity, employment, etc.) and not so much on human development (Naudé, 2010: 2011). Therefore, although entrepreneurship is considered as a determinant factor of economic growth, it does not mean that it directly contributes to human development[8]. In economic literature, the impact of entrepreneurship on human development has been neglected (Gries and Naudé, 2011). The authors gave three fundamental explanations for this omission are that (i) a satisfactory framework thinking for thinking about entrepreneurship in development has not been properly used, (ii) the complex and multidimensional measurement of human development, and (iii) prior management and economic studies are mainly interested in subjects related the how, who and what equations, rather than on the impact of entrepreneurship. One of the objectives of this study is to fill this gap.

[7]The Kirznerian vision lessened the role of innovation as suggested by Scumpeter (1934 :1942) and emphasized the identification and exploration of new business opportunities as preeminent factors in entrepreneurship (Oner and Kunday, 2015). Thereby, opportunity entrepreneurship is considered as the result of individual decisions to create entrepreneurial initiatives based on knowledge (Reynlolds et al., 2005).

[8]United Nations Development Programme (1995) defines it as the process of improving human lives so that the individuals will be healthy, knowledgeable, and nourished as well as be able to participate in the community's life.

Among the existing studies on this topic, Gries and Naudé (2011) used an adequate framework of the Capability Approach (CA) pioneered by Amartya Sen and others. They contended that entrepreneurship spearheaded of stimulating human capabilities like the ability to work, to earn incomes, and wealth accumulation. Similarly, the United Nations Development Report (1998) pointed out that as the family becomes entrepreneurial and economically empowered, it begins to enjoy self-respect, a sense of belonging to the community and self-fulfillment. All these are dimensions of human development. Moreover, in analyzing the impact of entrepreneurship on education, Bell (1996) and Zumeta (1996) argued that since private enterprises know what degrees and specializations are needed by the production of the private sector, these enterprises finance universities to produce the required specializations. Ultimately, the graduates from those universities find jobs easily. In the same context, Itri et al. (2015) proved that entrepreneurship could help to solve the current health care crisis by creating products and services that improve health quality while reducing the costs. They also showed that, in the United States, entrepreneurship is the driving force to solve many of the complicated problems that physicians are currently facing, such as an increase proportion of patients with chronic diseases, childhood and adult obesity, and an aging population.

(iii) Environmental impact of entrepreneurship: Entrepreneurship and Environment

Environmental awareness and market dynamics are increasingly impacting the established businesses to improve their environmental performance. From an economic perspective, several types of research have explored the relationship between environmental quality and entrepreneurship. For instance, Cohen and Winn (2007) proved that four types of market imperfections (inefficient firms, externalities, flawed pricing mechanisms and information asymmetries) contributed to environmental degradation and that they also provide significant opportunities for the introduction of innovative technologies and business models in different sectors. They indicated that these opportunities establish the foundations for an emerging model of sustainable entrepreneurship, which allows founders to obtain entrepreneurial rents while simultaneously improving local and global social and environmental conditions. They have shown that sustainable entrepreneurship has the potential to slow down the degradation and even progressively enhance the earth's ecosystems. Similarly, Nkusi et al. (2013) claimed that emission certificates in developing countries have become a new opportunity for entrepreneurs and actors. This opportunity becomes an international trade commodity and opened a diversified market. The relationship

between entrepreneurship and environmental degradation is perceived as a zero-sum game where the nature is always a loser (Carson et al., 2003; Flannery, 2005). In the same line, Ben Youssef et al. (2017) found that, based on a study of the relationship between entrepreneurship and environmental sustainability for 17 African countries, both formal and informal entrepreneurship in Africa positively contribute to environmental pollution.

However, others like York and Venkataraman (2010), proposed entrepreneurship as a solution to, rather than a cause of, environmental degradation. They formed a model that embraces the potential of entrepreneurship to supplement regulation, corporate social responsibility, and activism in resolving environmental problems. Furthermore, according to Shepherd and Pratzelt (2011), entrepreneurial action can preserve the ecosystem, counteract climate change, reduce environmental degradation and deforestation, improve agricultural practices and freshwater supply, and maintain biodiversity. In addition, Stål et al. (2013) empirically examined the climate mitigation in agriculture production using an approached of a project run by the Swedish Board of Agriculture (SBA). This project aimed to determine and promote agricultural farming practices in order to reduce GHG emissions. They found that institutional entrepreneurship could be a possible solution to change within the Agri-field to reduce GHG emissions. More recently, using data for 69 countries split across four homogeneous income-based panels that are high-income, upper-middle-income, lower-middle-income, and low-income countries, Omri (2017) examined the contribution of entrepreneurship on environmental improvement. He found that its impact on environmental pollution is lower in high-income countries compared to other country samples, and this activity in high-income countries initially degrades the environment but then improves environmental quality after a certain level, that is, an inverted U-shaped relationship between entrepreneurship and environmental pollution.

3. DATA AND METHODOLOGY

(a) *Data*

The main goal of this study is to investigate the contribution of entrepreneurship on the three-pillars of sustainable development (economic growth, human development, and environmental quality) for 20 developing countries[9] over the period 2001-2012[10]. All the time series data below; with the exception of total entrepreneurship, was collected from the World

[9]Argentina, Brazil, China, Colombia, Egypt, India, Indonesia, Iran, Malaysia, Mexico, Morocco, Nigeria, Pakistan, Peru, Philippines, Romania, South Africa, Thailand, Tunisia and Turkey.
[10]Selection of the period of study and the number of countries depend upon the availability of data.

Development Indicator database published by the World Bank. The time series data of total entrepreneurship were collected from the Global Entrepreneurship Monitor (GEM) data. Our data includes the following variables:

- *Entrepreneurship:* measured by the total number of newly registered businesses as a percentage of the working-age population (Thai and Turkina, 2013; Dau and Cazurra, 2014). The ratio for measuring entrepreneurship can be represented as follows:

$$Entrepreneurship = \frac{Number\ of\ New\ Registers\ \&\ Unregistered\ Business}{Working\ Age\ Population}$$

- *Economic growth:* measured by per capita GDP in constant 2005 US$.
- *Environmental quality:* measured by per capita CO_2 emissions in metric tons.
- *Human development:* The level of human development is measured by the Human development Index (Gürlük, 2009). The HDI measures the average achievements in a country in three basic dimensions of human development:
  - *(i)* *Life expectancy index:* measures the relative achievement of a country of a newly born infant would live from an average number of years;
  - *(ii)* *Education index:* is composed of two-thirds of a percentage rate of adult's literacy among all adults and one-third of school enrolment of (primary, secondary, and tertiary), this ratio represented the higher gross enrolment ratio:

$$Education\ = \frac{2}{3} Adultlitercyindex + \frac{1}{3} Grossenrolment$$

    Due to the constrained availability of adult literacy in this study, we used the gross enrolment index. Therefore, education will be calculated as follows:

    Education = School enrollment (primary) + School enrollment (Secondary) + School enrollment (Tertiary)

  - *(iii)* *GDP index:* The GDP index is calculated using per capita GDP in constant US$, which represent the income.

For each of those dimensions, an index value is computed on a scale of 0–1 where "0" corresponds to the minimum, and "1" to the maximum value assigned to the corresponding indicator. Individual index for a given country is computed by the following general formula:

Dimension index (DI) = $\frac{currentvalue - Minimumvalue}{Maximumvalue - Minimumvalue}$, $DI = f$(GDP, Education, Life expectancy)

The HDI for each country will be calculated as the simple arithmetic average of the three indexes (Sagar and Najam, 1998; UNDP, 2008). The HDI formula depends on three indexes presented above:

$$HDI = \frac{1}{3} GDP + \frac{1}{3} Education + \frac{1}{3} Life\ expectancy$$

Several studies modified conventional HDI by subtracting the GDP share from the formula. Thus, the MHDI does not include the income factor to eliminate the multicollinearity problem in the regression analysis. A similar approach was tested by Costantini and Monni (2008) to explore the relationship between sustainable development and economic growth.

MHDI will be presented as follows: $MHDI = \frac{1}{2} education + \frac{1}{2} life\ expectancy$

Details on the description of the used variables and their sources are presented in Table 1.

Table 1.
Variables description and data sources.

Variable name	**Description**	**Source**
Entrepreneurship	Total number of newly registered and unregistered businesses as a percentage of the working-age population	Global Entrepreneurship Monitor (GEM data)[a]
Economic growth	GDP per capita (constant 2005 US$)	World Bank (WDI)[b]
Environmental quality	CO2 emissions per capita (in metric tons)	World Bank (WDI)
Human development	HDI the average achievements in a country in three basic dimensions of human development (GDP, education, and life expectancy).	World Bank (WDI)

Sources: [a] http://www.gemconsortium.org/data; [b] http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

(b) *Methodology*

In order to tackle this issue, we propose an empirical methodology in 3 steps. First, we analyze the cross-sectional dependence and check the stationarity of the series. Second, we estimate the long-run relationships among the variables using FMOLS and DOLS techniques. Finally, we estimate a panel VECM to demonstrate the interconnection between entrepreneurship and the three-pillars of sustainable development.

(i) Panel Unit Root and Cross-sectional Dependence Tests

De Hoyos and Sarafidis (2006) noted that the presence of cross-sectional dependence in cross country panels may be due to undiscovered common shocks that turn into the part of error terms. For this reason, if cross-sectional dependence is present in the data, but not considered, it leads to inconsistent standard errors of the estimated parameters (Driscoll and Kraay, 1998). We test the cross sectional dependence by applying semi-parametric test developed by Friedman, (1937) and one parametric test developed by Pesaran, (2007). The test statistics of these two tests are as follow:

Freidman's statistics compute

$$R = \frac{2}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{r}_{ij} \tag{1}$$

Where $\hat{r}$ is the spearman's rank correlation coefficient

$r_{ij} = r_{ji} = \dfrac{\sum_{t=1}^{T} \left(r_{it} - (T+1/2)\right)\left(r_{jt} - (T+1/2)\right)}{\sum_{t=1}^{T} \left(r_{it} - (T+1/2)\right)^2}$ of the residuals.

Pesaran's statistics compute:

$$CD = \sqrt{\frac{2T}{N(N-1)}} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{ij} \right) \tag{2}$$

Where $\hat{\rho}_{ij}$ is the estimate of

$$\rho_{ij} = \rho_{ji} = \frac{\sum_{t=1}^{T} \varepsilon_{it} \varepsilon_{jt}}{\left(\sum_{t=1}^{T} \varepsilon_{it}^2 \right)^{1/2} \left(\sum_{t=1}^{T} \varepsilon_{jt}^2 \right)^{1/2}} \tag{3}$$

The null hypothesis to be tested is: $\rho_{ij} = \rho_{ji} = corr(\varepsilon_{it}, \varepsilon_{jt}) = 0$ for i ≠ j and the alternative hypothesis to be tested is $\rho_{ij} = \rho_{ji} \neq 0$ for some i ≠ j.

The cross-sectional dependence test a key step before applying panel unit root tests. The first problem in the panel unit root test is whether or not the cross-sections forming the panel are independent of one other. For the panel with cross-sectional dependence, the first-generation unit root tests tend to over-reject the null hypothesis. The stationary of the series has been analyzed with one of the second-generation unit root test which is the cross-sectionally augmented IPS (CIPS) unit root test. This test considers both heterogeneity and cross-sectional dependence across panels and is also a popular second-generation panel unit root test. This unit root test is applied to investigate the order of integration in the series. This is a prerequisite for panel cointegration models. If the variables considered are I (1), then it can be concluded that the variables tested are stationary in first difference, suggesting that this group of variables may be cointegrated in the long-run.

Among the most recently used test is the CIPS test of Pesaran (2007). The CIPS test is the modified IPS test based on the average of individual Augmented Dickey-Fuller (CADF) test specified as follows:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} CADF_i \tag{4}$$

The distribution of the CIPS statistic is found to be non-standard even for large N. This test, which makes it possible for cross-sectional dependence to be caused by a single unobservable common factor, is valid for both unbalanced and balanced panels in which cross-sections and time dimensions are of the same order of magnitude.

(ii) *Panel Cointegration Tests*

After confirming that the series is stationary using Fridman (1937), Pesarn (2004) CD test and CIPS of Pesaran (2007) unit root test on underlying panels, the series is ready for panel cointegration analysis. The present analysis suggests Pedroni is cointegration test (1999, 2004), in order to examine whether there is a long-run relationship between the variables. To test for the cointegration relationship in the heterogeneous panel, Pedroni (1999, 2004) proposed seven different statistics, which are classified into four within dimension statistics and three between dimension statistics (see table 3 in the appendix). Thus, Pedroni proposed two types of panel cointegration tests: a within-dimension approach based on panel cointegration tests, and between-dimension approaches called group mean panel cointegration statistics.

(iii) *Panel Cointegration Estimates*

Although OLS estimators of the cointegrated vectors are super-convergent, their distribution is asymptotically biased and depends on nuisance parameters associated with the presence of a serial correlation in the data (Kao and Chiang, 2001; Pedroni, 2001a, 2001b). Many types of problems existing in the time series analysis may also arise for the panel data analysis and tend to be more marked even in the presence of heterogeneity (Kao and Chiang, 2001). To carry out tests on the cointegrated vectors, it is consequently necessary to use methods of effective estimation. Various techniques, such as FMOLS estimator was initially suggested by Phillips and Hansen (1990) and DOLS estimator of Saikkonen (1991) and Stock and Watson (1993). In the case of panel data, Kao and Chiang (2001) proved that these two techniques led to normally distributed estimators. They also proved that both OLS and

FMOLS show a small sample bias and that the DOLS estimator appears to outperform both estimators. Similar results are obtained by Phillips and Moon (1999) and Pedroni (2001a) for FMOLS estimator.[11]

The FMOLS panel estimator for the coefficient β is defined as:

$$\hat{\beta} = N^{-1}\sum_{i=1}^{N}\left(\sum_{t=1}^{T}(y_{it}-\bar{y})^2\right)^{-1}\left(\sum_{t=1}^{T}(y_{it}-\bar{y})\right)z_{it}^{*} - T\hat{\eta}_i \quad (5)$$

Where $z_{it}^{*} = (z_{it}-\bar{z}) - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}\Delta y_{it}$, $\hat{\eta}_i \equiv \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^{0} - \frac{\hat{L}_{21i}}{\hat{L}_{22i}}(\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^{0})$ and $\hat{L}_i$ is a lower triangular decomposition of $\hat{\Omega}_i$. The associated t-statistics gives:

$$t_{\hat{\beta}^*} = N^{-1/2}\sum_{i=1}^{N} t_{\hat{\beta}^*,i} \text{ Where } t_{\hat{\beta}^*,i} = \left(\hat{\beta}_i^{*} - \beta_0\right)\left[\hat{\Omega}_{11i}^{-1}\sum_{t=1}^{T}(y_{it}-\bar{y})^2\right]^{1/2} \quad (6)$$

The panel DOLS estimator for the coefficient β is defined as:

$$\hat{\beta^{**}} = \frac{1}{N}\sum_{i=1}^{N}\left[\left(\sum_{t=1}^{T}(Z_{i,t}Z_{i,t})\right)^{-1}\left(\sum_{t=1}^{T}Z_{i,t}\,w_{i,t}\right)\right] \quad (7)$$

Where

$Z_{i,t} = [X_{i,t} - \mathrm{x}_i, \Delta X_{i,t-K_i}, \ldots, \Delta X_{i,t+K_i}]$ is the vector of regressors, and $\mathrm{w}_{\mathrm{i,t}}\tilde{} = w_{i,t} - \overrightarrow{w_i}$

(iv) *Panel Causality Test*

Following the work of Engle and Granger, (1987); we specify the VECM panel model to examine Granger causality relationship between ENT, per capita GDP (Y), human development (MHDI) and CO_2 (C) emissions. After estimating Eqs. (5) and (6) and identifying the long-run relationships, an error correction model can be developed as follows:

$$(1\text{-L})\begin{bmatrix} ENT_t \\ GDP_t \\ MHDI_t \\ CO_{2\ t} \end{bmatrix} = \begin{bmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \\ \phi_4 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} a_{11i}a_{12i}a_{13i}a_{14i} \\ b_{21i}b_{22i}b_{23i}b_{24i} \\ c_{31i}c_{32i}c_{33i}c_{34i} \\ d_{41i}d_{42i}d_{43i}d_{44i} \end{bmatrix}\begin{bmatrix} ENT_{t-i} \\ GDP_{t-i} \\ MHDI_{t-i} \\ CO_{2\ t-i} \end{bmatrix}$$

$$+ \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \xi_4 \end{bmatrix}[\mathrm{ECT}_{t-1}] + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{bmatrix} \quad (7)$$

[11]FMOLS is a non-parametric approach to dealing with corrections for serial correlation, serial correlation, while OLS and DOLS are a parametric approach, which DOLS estimators include lagged first-differenced term are explicitly estimated as well as consider a simple two variable panel regression model.

Where (1-L) is the difference operator. Besides, from the long-run cointegrating relationship, $ECT_{t-1}$was derived from the lagged error correction term. The significance of t-statistic of the lagged error correction term shows the long-run causation. Furthermore, to test Granger causality, it is also desirable to check whether the two sources of causation are jointly significant. This can be done by testing the joint hypothesis of the short and long-run causality. The joint causality test indicates whether the variables bear the burden of the short-run adjustment to re-establish the long-run equilibrium. The direction of the short-run causality provides the existence of a significant relationship in first difference of the variables. To test the direction of the short-run causality between the variables, we used the joint χ^2statistics for lagged independent variables of the first difference.

4. EMPIRICAL ANALYSIS

The results of the descriptive statistics and correlation matrix are presented in Table 2 and 3, respectively. On average, the highest levels of entrepreneurship and per capita GDP are found for Philippines (0, 22) and Argentina (15975, 41), while the lowest averages of entrepreneurship (0, 03) and per capita GDP (699, 97) are for Pakistan. Additionally, the highest average level of human development is for Peru (0, 79), followed by Mexico (0, 78), however, the lowest is for the Philippines (0, 03). Then, the highest average level of CO2 emissions per capita is for South Africa (8, 86), while the lowest average is for Nigeria (0, 63). In term of volatility, Indonesia is the highest volatile country (defined by the standard deviation) in terms of entrepreneurship (0,05), followed by Colombia and Peru (0,04). Also, the highest volatile country in terms of per capita GDP is Argentina (24026, 74). It is also noted that China and Tunisia are the highest volatile country in terms of human development (0, 27). Finally, we can see that Iran is the highest volatile country in terms of CO2 emissions (0, 82). In addition, the correlation coefficients suggest that the reported regression models will not be seriously distorted by multicollinearity. It is clear that entrepreneurship has the highest correlation with economic growth and CO_2 emissions, but the lowest correlation with human development, indicating that entrepreneurship plays an important role in economic growth and environmental degradation. In addition, economic growth has the highest correlation with human development and CO_2 emissions, which indicates that the increase of economic growth increases, at the same time, human development, and environmental degradation. Finally, CO_2 emission has the highest correlation with human development.

As the first step, we applied the Friedman (1937) and Pesaran (2004) tests to examine the cross-sectional dependence in our data. The results, which are reported in Table 4, reject

the null cross-sectional independence for all the considered variables. Prior to the formal econometric modeling, we need to employ the Pesaran (2007) panel unit root test in order to understand the integration properties of our data. The results reported in Table 4 indicate that all the series being considered are non-stationary at their level forms. However, at first difference, all the series of the variables are integrated, indicating that the selected series is integrated at order I.

Table 2.
Descriptive statistics.

Country		Means 'ENT'	Std.dev 'ENT'	Means 'Y'	Std.dev 'Y'	Means 'MHDI'	Std.dev 'MHDI'	Means 'C'	Std.dev 'C'	World bank country classification by income
1.	Argentina	0,09	0,03	15975,41	24026,74	0,57	0,25	4,19	0,48	Upper- middle
2.	Brazil	0,12	0,02	5138,04	517,04	0,19	0,15	1,94	0,13	Upper -middle
3.	China	0,12	0,02	2144,35	729,30	0,49	0,27	4,7	1,27	Upper -middle
4.	Colombia	0,14	0,04	3613,17	405,88	0,21	0,18	1,46	0,11	Upper -middle
5.	Egypt	0,09	0,01	1358,09	160,09	0,07	0,03	2,37	0,30	Lower -middle
6.	India	0,07	0,02	834,48	185,01	0,17	0,20	1,40	0,22	Lower -middle
7.	Indonesia	0,19	0,05	1378,67	204,71	0,16	0,19	1,64	0,20	Lower- middle
8.	Iran	0,09	0,02	2884,98	364,84	0,27	0,25	7,10	0,82	Upper- middle
9.	Malaysia	0,06	0,01	5779,75	638,21	0,21	0,21	6,95	0,802	Upper- middle
10.	Mexico	0,05	0,03	7943,65	368,03	0,78	0,2	3,83	0,12	Upper -middle
11.	Morocco	0,15	0,02	2091,94	261,85	0,72	0,25	1,51	0,14	Lower -middle
12.	Nigeria	0,13	0,04	831,42	169,18	0,43	0,1	0,63	0,10	Lower- middle
13.	Pakistan	0,03	0,00	699,97	64,00	0,0	0,05	0,87	0,07	Lower -middle
14.	Peru	0,12	0,04	3033,11	552,91	0,79	0,14	1,44	0,37	Upper- middle
15.	Philippines	0,22	0,00	1264,5	141,12	0,03	0,02	0,85	0,04	Lower- middle
16.	Romania	0,03	0,01	5000,82	866,97	0,42	0,16	4,31	0,35	Upper- middle
17.	South Africa	0,04	0,01	5353,5	441,89	0,15	0,12	8,86	0,69	Upper -middle
18.	Thailand	0,15	0,03	2809,25	360,05	0,36	0,23	3,95	0,40	Upper- middle

19.	Tunisia	0,10	0,03	3411,88	396,73	0,60	0,27	2,33	0,11	Lower- middle
20.	Turkey	0,08	0,01	7219,89	925,24	0,34	0,22	3,72	0,42	Upper- middle

Notes: Std. Dev.: indicates standard deviation, ENT, Y, MHDI, and CO_2 indicate entrepreneurship, GDP per capita, Modified Human Development Index, and per capita CO_2 emissions, respectively.

Table 3

Pearson correlations.

	ENT	Y	C	MHDI
ENT	1.000			
Y	0.491**	1.000		
C	0.544	0.685*	1.000	
MHDI	0.094	0.375	0.644**	1.000

Notes: ENT, Y, MHDI, and CO_2 indicate entrepreneurship, GDP per capita, Modified Human Development Index, and per capita CO_2 emissions, respectively. * and ** represent the statistical significance at the 1% and 5% levels, respectively.

Table 4

Cross-sectional dependence and panel unit root tests.

Test Statistics	Friedman	Pesaran (2004) CD-test	Pesaran (2007) CIPS test	
			Level	Δ
lnENT	172.751* (0.000)	2.079** (0.025)	-0.931 (0.902)	-4.080*(0.000)
lnY	1013.026* (0.000)	114.253* (0.000)	-1.042 (0.704)	-4.877*(0.000)
lnMHDI	983.250* (0.000)	11.925* (0.000)	-0.769 (1.000)	-6.231*(0.000)
lnC	121.423* (0.000)	21.015* (0.000)	-1.599 (0.633)	-5.306*(0.000)

Notes: Under the null hypothesis of cross-sectional independence, the Pesaran CD statistics is distributed as a two-tailed normal standard. Δ denotes the first differences. A constant is included in the Pesaran CIPS test and the rejection of the null hypothesis indicates stationarity in at least one country. Values in parentheses denote the probability values. * and ** represent the statistical significance at the 1% and 5% levels, respectively.

The unique order of integration of the variables helps us to apply the panel cointegration approach in order to examine the long-run relationship between the variables. The results of Pedroni's (1999, 2004) panel cointegration tests are reported in Table 5. Pedroni used four within-dimension (panel) test statistics and three between-dimension (group) statistics to check whether the selected panel data are cointegrated. The within dimension statistics contain the estimated values of the test statistics based on estimates that pooled the autoregressive coefficient across different cross-sections for the unit root test on the estimated residuals. On the other hand, the between-dimensions report the estimated values of the test statistics based on the estimators that average individually estimated coefficients for each cross-section. The results of the within-dimensions tests and the between-dimensions tests suggest that there is strong evidence to reject the null hypothesis of no cointegration in each panel. Therefore, entrepreneurship, economic growth, human development, and CO_2 emissions are cointegrated in the selected developing countries. Once

the cointegration between these variables is confirmed, the long-run coefficients are estimated in the next step.

Table 6 provides the long-run coefficients estimated by applying the FMOLS and DOLS techniques for entrepreneurship, economic growth, human development, and CO_2 emissions, respectively. The estimated coefficients from the long-run cointegration relationship can be interpreted as a long-run elasticity.

Table5
Pedroni Cointegration Results.

	Within-dimension (four statistics)				*Between-dimension (three statistics)*		
	Panel v-statistic	Panel rho-statistic	Panel PP-statistic	Panel ADF-statistic	Group rho-statistic	Group PP-statistic	Group ADF-statistic
Statistic	-6.172	4.641	-16.911*	-7.759*	5.876*	-20.891*	-10.652*
Prob.	1.000	1.000	0.000	0.000	0.000	0.000	0.000

Notes: The null hypothesis of Pedroni test examines the absence of cointegration. The lags (automatic) election is based on SIC with a max lag of 5. * represents the statistical significance at the 1% level (P-values are put in parentheses).

Table 6
FMOLS and DOLS results.

Panel	*ENT*	*Y*	*MHDI*	*C*
ENT =f(Y, MHDI, C)				
FMOLS	-	3.175** (0.034)	0.072*** (0.082)	-1.740*** (0.077)
DOLS	-	2.630***(0.053)	0.152** (0.031)	-1.407***(0.079)
Y = f(ENT, MHDI, C)				
FMOLS	0.171***(0.067)	-	0.075* (0.000)	-0.173 (0.125)
DOLS	0.157** (0.045)	-	0.093* (0.000)	-0.103 (0.419)
MHDI = f(ENT, Y, C)				
FMOLS	0.133 (0.764)	6.247* (0.000)	-	-1.449** (0.035)
DOLS	0.826* (0.000)	0.237***(0.058)	-	-1.912***(0.076)
C = f(ENT, Y, MHDI)				
FMOLS	0.404** (0.032)	0.803* (0.000)	-0.104 (0.606)	-
DOLS	0.236** (0.010)	0.377* (0.000)	-0.043 (0.320)	-

Notes: P-values are put in parentheses. *, ** and *** represent the statistical significance at the 1%, 5% and 10% levels, respectively.

In the first equation, and for the FMOLS estimator, the coefficients are 3.175, 0.072, and -1.740 for per capita GDP, human development, and per capita CO_2 emissions, respectively. We found that per capita GDP has a positive and a statistically significant effect on entrepreneurship at 5% level. The magnitude of 3.175 implies that a 1% increase in economic growth increases entrepreneurship by around 3.18%. This result confirms the finding of Galindo and Méndez-Picazo (2013), which argued that higher levels of economic activity creates new business opportunities and increases entrepreneurs' interest in taking advantage of these opportunities by providing products with a higher degree of competitiveness in the

markets. On the other hand, many studies show that the increase in economic growth increases the wage income, which, in turn, leads people to be more reluctant to opt for self-employment (Lucas, 1978; Iyigun and Owen, 1998). On his side, Shapero (1982) adds that entrepreneurship is less likely when people are satisfied with the status quo or life in general. In addition, we find that the effect of human development on entrepreneurship is positive and statistically significant at 10% level. The magnitude of 0.072 implies that a 1% increase in human development increases entrepreneurship by around 0.07%. This result is in line with the finding of Niklas et al. (2015), which found that the participation of individuals in entrepreneurship education programs and training in high school such as "JACP"[12] program will increase their likelihood to engage in entrepreneurship and starting a new firm in the long run as well as it increases their entrepreneurial incomes. Gielnik et al. (2012), Rietveld et al. (2015) also found that healthiest business owners run their businesses with higher exceptions because they are more likely to have the skills, knowledge, and experience to run a business, and are less likely to fear of failure, and their better mental capacity can increase their ability to capture promising opportunities in their environment. It was also found that CO_2 emissions have a negative and statistically significant effect on entrepreneurship at 10% level. The magnitude of -1.740 implies that a 1% increase of per capita CO2 emissions decreases entrepreneurship by around 1.7%. This result contradicts the findings of Cohen and Winn (2007), Dean and McMullen (2007), York and Venkataraman (2010), which viewed the environmental issues as sources of entrepreneurial opportunity and introduce a new breed of entrepreneurship, and also viewed as examples of market failure in which environmental degradation constitutes opportunities for the introduction of innovative technologies and business models in different sectors. They indicated that these entrepreneurial opportunities establish the foundations for an emerging model of sustainable entrepreneurship, which allows founders to obtain entrepreneurial rents while simultaneously improving local and global social and environmental conditions.

However, the coefficients from panel DOLS estimator are 2.630, 0.152, -1.407 for per capita GDP, human development and per capita CO_2 emissions, respectively. We can see that the effect of GDP on entrepreneurship is positive and statistically significant at 10% level. The magnitude of 2.630 indicates that a 1% increase in per capita GDP increases entrepreneurship by around 2.6%. In addition, it was also found that the effect of human development on entrepreneurship is positive and statistically significant at 5% level. The

[12] The Jacob Program is a practical program aim to train and develop entrepreneurial skills of high school students using the approach of "learning by doing." (Niklas et al., 2015).

magnitude of 0.152 implies that a 1% increase in human development increases entrepreneurship by 0.15%. Finally, we found that CO_2 emissions have a negative and statistically significant effect on entrepreneurship at 10% level. The magnitude of -1.407 implies that a 1% increase of per capita CO_2 emissions decreases entrepreneurship by around 1.4%.

In the second equation, and for the FMOLS estimator, the coefficients are 0.171, 0.075, -0.173 for entrepreneurship, human development, and per capita CO_2 emissions, respectively. It can be seen that entrepreneurship has a positive and statistically significant effect on per capita GDP at 10% level. The magnitude of 0.171 indicates that a 1% increase in entrepreneurship increases economic growth by around 0.17%. This result is in line with the findings of Audretsch and Keilbach (2004) and Prieger et al., (2016), which claimed that entrepreneurship contributes to output and growth by serving as a conduit for knowledge spillovers, increasing competition, and injecting diversity (Audretsch and Keilbach, 2004). They also found that a marginal increase in the rate of entrepreneurship has a positive effect on economic growth in developing countries. They suggested that without venture capital, highly innovative entrepreneurs - those who would add the most to national growth - would be more likely to fail (Prieger et al., 2016). Furthermore, human development is found to have a positive and statistically significant at 1% level on economic growth. The magnitude of 0.075 indicates that a 1% increase in human development increases economic growth by around 0.08%. This result confirms the finding of Ranis et al. (2000), which indicated that higher levels of human development affect the economy via enhancing people's capabilities and consequently their productivity and creativity. They also added that the education and health of a population are among the key determinants of the growth of output and exports, i.e. as people become better educated, nourished and healthier, they contribute more to economic growth through improving technology, attracting more foreign capital, higher labor productivity, and higher exports. On the other hand, the CO_2 emissions variable was found to have a negative and statistically insignificant impact on economic growth. For the DOLS estimator, the coefficients are 0.157, 0.093 and -0.103 for entrepreneurship, human development, and CO_2 emissions, respectively. It was also found that entrepreneurship has a positive and statistically significant effect on per capita GDP at 5% level. The magnitude of 0.157 indicates that a 1% increase in entrepreneurship activity increases economic growth by around 0.16%. In addition, it was found that the effect of human development on economic growth is positive and statistically significant at 1% level. The magnitude of 0.093 implies

that a 1% increase in human development increases economic growth by around 0.09%. On the other hand, the CO_2 emissions variable was found to have a negative and statistically insignificant impact on economic growth.

In the third equation and for the FMOLS estimator, the coefficients are 0.133, 6.247, -1.449 for entrepreneurship, GDP, and CO2 emissions, respectively. Entrepreneurship has a positive and statistically insignificant impact on human development. Furthermore, it was found that the effect of economic growth on human development is positive and statistically significant at 1% level. The magnitude of 6.247 implies that a 1% increase in economic growth increases human development by around 6.25%. This result confirms the finding of Ranis et al. (2000), which claimed that economic growth contributes to human development through household and government activity; civil society such as community organizations and other non-governmental organizations (NGOs). Households' propensity to spend their income on elements which contribute most directly to the promotion of human development, e.g., education and health, food, varies depending on the level and distribution of income across households, as well as on who controls the allocation of expenditure within households. Turning to the government, economic growth contributes to human development through public expenditures on health and education. Finally, NGOs or other civil society activity is typically heavily oriented towards human development objectives (e.g., projects generating income for the poor and spending on schools, nutrition and health). Moreover, it was found that the effect of CO_2 emissions on human development is negative and statistically significant at 5% level. The magnitude of -1.449 indicates that a 1% increase in per capita CO_2 emissions decreases human development by 1.45%. Within this context, Speldewinde et al. (2009) argued that environmental degradation can potentially leads to mental health problems like depressive illness and psychological ill-health of the rural population, caused by drought, loss of productivity and lowering of soil value. Similarly, According to the World Health Organization (2009), air pollution has been also seen as a major environmental risk to health and is estimated to cause approximately two million premature deaths worldwide per year. A reduction of air pollution is expected to reduce the global burden of disease from respiratory infections, heart disease, and lung cancer.

However, the coefficients from the DOLS estimators are 0.826, 0.237, and -1.912 for entrepreneurship, per capita GDP, and per capita CO_2 emissions, respectively. It can be seen that entrepreneurship has a positive and statistically significant effect on human development at 1% level. The magnitude of 0.826 implies that a 1% increase in entrepreneurship increases

human development by around 0.83%. This result confirms the finding of Naudé and Gries, (2011) in which they found that entrepreneurship contributes to the expansion of human capabilities, such as work capacity, income generation, and wealth accumulation. Innovation and entrepreneurship in health care can also support to solve the current health care crisis by creating products and services that enhance quality and comfort while reducing costs (Itri et al., 2015). In addition, it was found that economic growth has a positive and statistically significant impact on human development at 10% level. The magnitude of 0.237 implies that a 1% increase in economic growth increases human development by around 0.24%. Finally, the effect of CO_2 emissions on human development is negative and statistically significant at 10% level. The magnitude of -1.912 implies that a 1% increase in per capita CO_2 emissions decreases human development by1.91%.

In the fourth equation and for the FMOLS estimator, the coefficients are 0.404, 0.803, -0.104 for entrepreneurship, GDP, and human development, respectively. In fact, entrepreneurship was found to have a positive and statistically significant effect on CO2 emissions at 5% level. The magnitude of 0.404 implies that a 1% increase in entrepreneurship activity increases per capita CO2 emissions by around 0.40%, meaning that, in the short run, entrepreneurship in developing countries contributes negatively to environmental degradation. This result is consistent with the finding of Ben Youssef et al. (2017) in case of African countries. The authors explain this result by the significant size of informal sector in Africa and suggest that improving institutions quality, promoting innovation and encouraging entrepreneurs to use environmental-friendly technologies should improve the environmental quality in these countries. Moreover, it was found that economic growth has a positive and statistically significant impact on CO_2 emissions at 1% level. The magnitude of 0.803 indicates that a 1% increase in economic growth increases CO_2 emissions by around 0.80%. This result indicates that the production level might lead to a higher level of pollution emissions. This result confirms the finding found by Acaravci and Ozturk (2010), Lee and Oh (2015). In addition, human development has a negative and statistically insignificant impact on CO_2 emissions. Nevertheless, for the DOLS estimators, the coefficients are 0.236, 0.377, -0.043 for entrepreneurship, GDP, and human development, respectively. It was also found that entrepreneurship has a positive and statistically significant effect on CO_2 emissions at 5% level. The magnitude of 0.236 implies that a 1% increase in entrepreneurship activity increases per capita CO_2 emissions by around 0.24%. Furthermore, it was found that economic growth has a positive and statistically significant impact on CO_2 emissions at 1%

level. The magnitude of 0.377 indicates that a 1% increase in economic growth increases CO_2 emissions by around 0.38%. Finally, human development was found to have a negative and statistically insignificant impact on CO_2 emissions.

Table 7 presents the results of the long- and short-run VECM Granger causality tests between entrepreneurship and the three-pillars of sustainable development. To simplify these findings, we summarize the results of this table in Figure1. This figure corroborates the four-way linkages (unidirectional causality or bidirectional causality) in the short and long-run between entrepreneurship (ENT), economic growth (Y), human development (MHDI) and CO2 emissions (C).

For the short-run causality test, Figure 1 shows that there is a unidirectional causality running from entrepreneurship to per capita GDP. This result is consistent with the finding of Li et al. (2009), Prieger et al., (2016), which found that by increasing productivity in a market and creating innovative ideas and economic opportunities entrepreneurship increases per capita GDP. In addition, it was found that there is a bidirectional causal relationship between entrepreneurship and CO_2 emissions. Similarly, there exists bidirectional causality between economic growth and CO_2 emissions, indicating that environmental degradation has a causal impact on economic growth, and a persistent decline of environmental quality may exert a negative externality to the economy by affecting human health, and thereby may reduce productivity in the long-run (Lee and Oh, 2015). In addition, bidirectional causality between human development and CO_2 emissions has also been identified, indicating that on the other hand, education can decrease CO_2 emissions by creating awareness among the people, while reduces emissions and leads to sustainable development. On the other hand, environmental degradation may cause different diseases because of human activities. For the relationship between economic growth and human development, there is a unidirectional causality running from economic growth to human development. By contrast, there exist a neutrality relationship between human development and entrepreneurship. For the long-run relationships, Figure 1 also show the interrelationship between entrepreneurship and the economic, social and environmental dimensions of sustainable development, i.e. there is (i) a bidirectional causality between economic growth and environmental degradation, between entrepreneurship and environmental degradation, and between economic growth and entrepreneurship; and (ii) a unidirectional causality running from human development to entrepreneurship, economic growth, and CO_2 emissions.

Table 7

The Panel VECM Granger Causality Results.

Dependent Variables	Short-run Source of Causation (Independent variables)				Long-run
	ΔENT	ΔY	ΔMHDI	ΔC	ECT
ΔENT	-	0.428 (0.652)	0.329 (0.720)	0.123** (0.038)	-0.022** (0.014)
ΔY	35.967* (0.000)	-	0.479 (0.6194)	3.334** (0.037)	-0.471* (0.000)
ΔMHDI	0.459 (0.631)	2.702*** (0.0912)	-	5.211* (0.000)	-0.095 (0.280)
ΔC	4.249** (0.017)	4.081*** (0.059)	0.322** (0.034)	-	-0.177* (0.005)

Notes: Short-run causality is determined by the statistical significance of the partial F-statistics associated with the right hand side variables. Long-run causality is revealed by the statistical significance of the respective error correction terms using a t-test. P-values are listed in parentheses. *, ** and *** represent the statistical significance at the 1%, 5% and 10% levels, respectively.

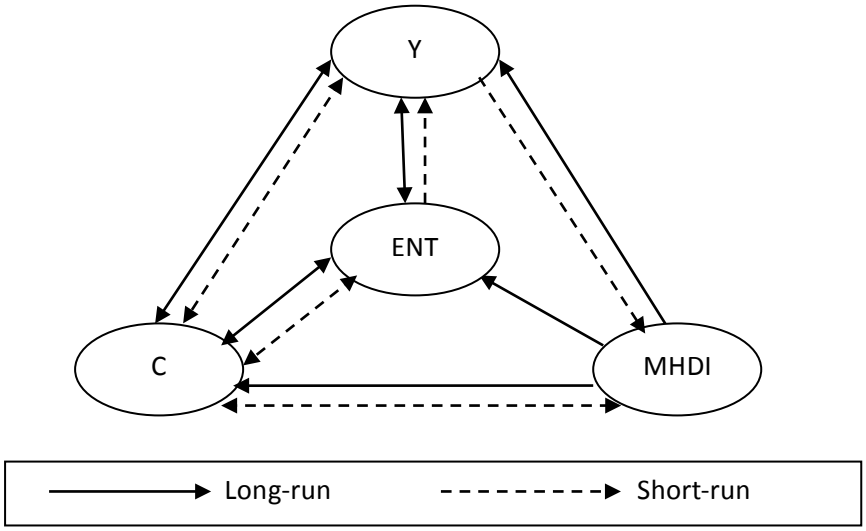

Figure 1. Entrepreneurship and the three-pillars of sustainable development.

5. DISCUSSION

Overall, the results of our study provide strong support for the argument that the entrepreneurial activity interrelated with the three-pillars of sustainable development (economy, society, and ecology). Our findings contribute to the entrepreneurial economic literature by providing an empirical approach, which demonstrate not only the contribution of entrepreneurship on these three pillars, but also confirms the assumption that these last ones

are interconnected. This approach, not only contributes to the existing literature, but also conducts to policy and managerial implications and gives some future research directions.

(a) Research contributions

Despite the debates surrounding sustainable development, it has emerged as a concept increasingly influential both in academic and managerial circles. Within this context, entrepreneurial activity has been cited as a significant channel for sustainable products and processes, and new ventures are being held up as a panacea for many social and environmental concerns. This idea was advanced by some influential practitioner journals such as Entrepreneurship: Theory and Practice, Harvard Business Review, Journal of Business Venturing, the MIT Sloan Management Review, among others, but also in the documents of the international organizations e.g. UE Strategy, (2020), both, i.e. entrepreneurship and sustainability, being considered to guarantee the future development of the whole society. Researchers from other disciplines such as economics, finance, law, among others, have also been interested on this topic, making it multidisciplinary research problem.

Yet, despite this growing attention on this topic, most of the business-sustainability related literature has been focused on how competitive advantage can be affected by sustainable development, how businesses can reduce their environmental impacts and how innovation enhance sustainable development. Fewer studies have thus tackled the issue of sustainable development from an entrepreneurship perspective, particularly in leading practitioner journals (Hall et al, 2010). From the four entrepreneurship journals listed in'Top50' business journals used by the Financial Times[13]– Entrepreneurship: Theory and Practice, Harvard Business Review, Journal of Business Venturing, and MIT Sloan Management Review –, to the best of our knowledge, only seven published articles on entrepreneurship-sustainable development nexus (Hall and Vredenburg, 2003; Cohen and Winn, 2007; Dean and McMullen, 2007; Parrish and Foxon, 2009; Hall et al., 2010; Pacheco et al., 2010; and Parrish, 2010). In addition, since the SDGs, appeared from the Rio+20 conference on sustainable development in 2012, are aimed at improving the economic, social, and environmental conditions particularly in the least developed countries, none of the entrepreneurial economic studies have explored the ability of entrepreneurship in achieving these goals in case of developing countries. Starting from these considerations, our humble

[13]Financial Times Top 50 Journals Used in Business School Research Rankings ; Link :https://library.mcmaster.ca/find/ft-research-rank-journals.

contributions in this study is to demonstrate the interconnection among the three-dimensions of sustainable development and to examine the ability of the entrepreneurial activity to make developing countries more sustainable. Specifically, we examine the contribution of entrepreneurship on these dimensions (economy, society, and ecology) to find out if entrepreneurship may create economic growth while advancing environmental objectives and improving social conditions in the developing countries. To the best of our knowledge, none of the existing studies have investigated the relationship between entrepreneurship and these three-pillars in an integrated framework, and in the context of developing countries. Moreover, our results about the linkages among entrepreneurship and the above-mentioned pillars of sustainable development also contribute to the existing literature. More precisely, they strongly support the environmental economics literature and the research in game theory by confirming that the challenges of sustainable development in developing countries correspond to a prisoners' dilemma problem whether the businesses/entrepreneurs are compelled to environmentally degrading behavior due to the divergence between individual rewards and collective sustainability goals.

(b) Managerial and policy implications

This study supports the idea of the previous studies in which entrepreneurship cannot simultaneously enhances economic growth, advances environmental and social objectives without some required conditions, especially in developing countries. Our empirical findings show that entrepreneurial activity in developing countries negatively contributes to environmental sustainability, which, in turn, exerts negative impacts on both human development and economic growth. Accordingly, some important implications for managers and policy makers regarding the sustainability process are given below.

From a managerial viewpoint, entrepreneurs in developing countries should focus on businesses ideas that balance the economic, social, and environmental effects of their activities by engaging their businesses strategically in sustainable practices in the search for efficiency and competitiveness in the three areas of sustainability (Egri and Herman, 2000; Perrini et al., 2007). These businesses should be encouraged to provide their products and services through an environmentally friendly process or with the help of clean technologies. The adoption of these technologies in the production line can enhance the firm's image, offer to it a competitive advantage in the market –economic success through the application of innovative environmental and social practices –, and escape the entrepreneur from the prisoners' dilemma problem. Cohen and Winn (2007: p.30) also suggested "the real gains will

only be made by harnessing the innovative potential of entrepreneurs who will develop the innovative business solutions to deal with the environmental challenges". Entrepreneurs may beneficiate from industry alliances or partnerships and from networks with economic development, environmental or other civil organizations. These partnerships and ties helped the entrepreneurs to identify and exploit sustainable development opportunities (Aldrich and Fiol, 1994).

Furthermore, from a policy viewpoint, supporting "opportunity entrepreneurship" is a possible solution to escape the sustainability challenges. Entrepreneurs are fully conscious of the potential market opportunities that might exist for "environmentally friendly" products and services. So, the creation of a new generation of entrepreneurs, helped by modern technologies, could identify and exploit these "niche" opportunities. In certain situations, businesses may be subject to influential laws and regulations that encourage them to apply more sustainable and efficient methods of production. Therefore, "opportunity entrepreneurs" will thus try to achieve more their market share– something not possible without changing laws and regulations. Moreover, the economic literature advocates innovation as a vital catalyst to change toward sustainability (Lozano et al., 2013; Silvester, 2015; Ben Youssef et al. 2017). For that reason, policy makers in developing countries should strengthen the innovation capacity of enterprises through more investment in training and education programs, patent protection, strengthening cooperation between industries and research centres, and stimulating applied research studies for innovative products and services.

(c) Limitations and future research directions

In addition to the insights and implications provided by this research study, it poses some important limitations that should be pointed out: First, the way that we have measured the triple-bottom-line indicators. Regarding the SDGs, different indicators related to the economic, social, and environmental objectives such as poverty, food security, health, wellbeing, quality of education, climate change, among others, could be analyzed in the future research studies. Second, our study only examines the direct effects of entrepreneurship on the pillars of sustainable development. However, the process toward a sustainable entrepreneurship is complex and it might take place through several steps. For this reason, some of the previous studies (e.g. Hall et al., 2010) suggest that entrepreneurship cannot simultaneously achieve the sustainability goals without implementing some required conditions. Thus, future studies can extend this research by employing mediating or

moderating models in order to examine the conditions through which entrepreneurship could achieve these objectives. They can also examine the roles of innovation, business alliances and partnerships, civil organization and networks in advancing entrepreneurship-sustainability nexus.

6. CONCLUDING REMARKS

The role of entrepreneurship in attaining the sustainability goals is emerging as an important subject of some debates in the recent few years. Most of the international organizations, policy makers and economists considered it as a solution to promise the future development of the whole society. Despite this significant importance, the links between them are unclear. In this study, we tried to clarify these links by examining the ability of entrepreneurship to simultaneous attains the economic, social, and environmental objectives for twenty developing countries over the period 2001-2012.

Our empirical analysis, based on FMOLS, DOLS and VECM techniques, offers important findings with regard to the sustainable development process. First, we found that entrepreneurship in developing countries positively affects the economic and social dimensions of sustainable development, while its effect on the environmental dimension is negative. This confirmed that the challenges of sustainable development in developing countries correspond to a prisoners' dilemma problem whither the businesses/entrepreneurs are compelled to environmentally degrading behavior due to the divergence between individual rewards and collective sustainability goals. Second, our findings confirm the interactions among entrepreneurship and the pillars of sustainable development in both short and long-run.

Appendix

Table A1. The 17 SDGs (UN, 2015).

Goals	Description
Goal 1	End poverty in all its forms everywhere.
Goal 2	End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
Goal 3	Ensure healthy lives and promote well-being for all at all ages.
Goal 4	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Goal 5	Achieve gender equality and empower all women and girls.
Goal 6	Ensure availability and sustainable management of water and sanitation for all.
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy for all.
Goal 8	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.
Goal 9	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Goal 10	Reduce inequality within and among countries.
Goal 11	Make cities and human settlements inclusive, safe, resilient and sustainable.

Goal 12	Ensure sustainable consumption and production patterns.
Goal 13	Take urgent action to combat climate change and its impacts.
Goal 14	Conserve and sustainably use the oceans, seas and marine resources for sustainable development.
Goal 15	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse landdegradation and halt biodiversity loss.
Goal 16	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.
Goal 17	Strengthen the means of implementation and revitalize the global partnership for sustainable development.

References

Acaravci, A., Ozturk, I. (2010), "On the Relationship between Energy Consumption, CO2 Emissions and Economic Growth in Europe", Energy, 35, pp. 5412-5420.

Acs, Z. J., Braunerhjelm, P., Audretsch, D. B., Carlsson, B, (2009), "The knowledge spillover theory of entrepreneurship."Small Business Economics, 32, pp. 15–30.

Acs, Z.J., Sanders, M. (2012), "Knowledge Spillover Entrepreneurship in an Endogenous Growth Model", Social Science Research Network SSRN, SSRN (Available at SSRN).

Aldrich, H.E., Fiol, C.M. (1994), "Fools rush in the institutional context of industry creation", AcadManag Rev, 19, pp. 645–670.

Audretsch, D. B. and R. Thurik (2000), "Capitalism and Democracy in the 21st Century: From the Managed to the Entrepreneurial Economy", Journal of Evolutionary Economics, 10, pp. 17–34.

Audretsch, D.B., Keilbach, M. (2004), "Entrepreneurship Capital and Economic Performance," Regional Studies, 38, pp. 949–959.

Audretsch, D. B., Bonte, W., Keilbach, M. (2008), "Entrepreneurship capital and its impact on knowledge diffusion and economic performance", Journal of Business Venturing, 23, pp. 687–698.

Baker, S. (2006), "Sustainable Development", Routledge, London.

Basiago, A. (1999). "Economic, social, and environmental sustainability in development theory and urban planning practice", The Environmentalist, 19, 145–6.

Bell, M.W., Khor H.E. and Kochhar, K. (1993), "China at the Threshold of a Market Economy", IMF Occasional Paper 107, IMF, Washington, September.

Ben Youssef, A., Boubaker.S., Omri, A. (2017). "Entrepreneurship and sustainability: The need for innovative and institutional solutions", Technological Forecasting and Social Change.

Carson, R., Lear, L., Wilson, E.O. (2003), Silent Spring, 40th ed, Houghton Mifflin Company, Boston.

Chick, A. (2009), “Green Entrepreneurship: A Sustainable Development Challenge”. In Mellor, R., Coulton, G., Chick, A., Bifulco, A., Mellor, N. and Fisher, A. (Eds.), Entrepreneurship for Everyone: A Student Textbook (139-150). London: SAGE Publications.

Cobbinah, P. B., Black, R., Thwaites, R. (2011), “Reflections on six decades of the concept of development: Evaluation and future research”, Journal of Sustainable Development in Africa, 13, , pp. 134–149.

Cohen, B., Winn, M.I, (2007), “Market imperfections, opportunities and sustainable entrepreneurship”, Journal of Business Venturing, 22, pp. 29-49.

Costantini, V., Monni., S. (2008), “Environment, human development and economic growth”, Ecological Economics. 64, pp. 867 – 880.

Dau, L.A., Cazurra, A.C. (2014), “To formalize or not to formalize: Entrepreneurship and pro-market institutions”, Journal of Business Venturing, 29, pp.668–686.

De Hoyos, R., Sarafidis, V. (2006), “Testing for Cross-Sectional Dependence in Panel-Data Models”, STATA Journal, 6, pp. 482–496.

Dean, T., McMullen, J. (2007), "Toward a theory of sustainable entrepreneurship: reducing environmental degradation through entrepreneurial action", Journal of Business Venturing, 22, pp. 50–76.

Dempsey, S. E. (2009)."NGOs, Communicative Labor, and the Work of Grassroots Representation", Communication and Critical/Cultural Studies, 6, pp. 328–45.

Driscoll, J., and A. C. Kraay. (1998), "Consistent covariance matrix estimation with spatially dependent data", Review of Economics and Statistics, 80, pp. 549–560.

Drucker, P F. (1985), "Innovation and Entrepreneurship: Practice and Principles". New York, USA: HarperBusiness.

Egri, C., Herman, S. (2000), "Leadership in the North American Environmental Sector: Values, Leadership Styles, and Context of Environmental Leaders and Their Organizations", Academy of Management Journal, 43, pp. 571–604.

Elert, N., Andersson, F., Wennberg, K. (2015), "The impact of entrepreneurship education in high school on long-term entrepreneurial performance", Journal of Economic Behavior and Organization Volume 111, pp. 209-223.

Elkington, J. (1998), “Partnerships from cannibals with forks: The triple bottom line of 21st-century business”, Environmental Quality Management, 8, pp. 37–51.

Elkington, J. (1999), “Triple bottom line reporting: Looking for a balance”, Australian CPA, (March), pp. 19–21.

Elkington, J. (2004), “Enter the triple bottom line. In: Henriques, A., Richardson, J. (Eds.), The Triple Bottom Line: Does It All Add up?” Earthscan, London, pp. 1– 16.

Engle, R.F., Granger, C.W.J. (1987), “Co-integration and Error Correction: Representation, Estimation, and Testing”, Econometrica, 55, pp.251–276.

Ferreira, J.J., Fayolle, A., Fernandes,C., Raposo, M. (2016), “Effects of Schumpeterian and Kirznerian entrepreneurship on economic growth: panel data evidence”, Entrepreneurship and Regional Development, http://dx.doi.org/10.1080/08985626.2016.1255431.

Flannery, T. (2005), The Weather Makers, Grove Press, New York, NY.

Folke, C., Carpenter, S., Elmqvist, T., Gunderson, L., Holling, C. S., Walker, B. (2002), “Resilience and sustainable development: Building adaptive capacity in a world of transformations”. A Journal of the Human Environment, 31, pp. 437–440.

Friedman, M. (1937), “The use of ranks to avoid the assumption of normality implicit in the analysis of variance”, Journal of the American Statistical Association, 32, pp. 675–701.

Galindo, M.A., Méndez-Picazo, M.T., (2013), “Entrepreneurship, economic growth, and innovation: Are feedback effects at work?” Journal of Business Research, 67, pp. 825–829.

Gielnik, M.M., Zacher, H., Frese, M. (2012), “Focus on opportunities as a mediator of the relationship between business owners' age and venture growth”, J. Bus. Ventur, 27, pp. 127–142.

Gürlük, S. (2009), “Economic growth, industrial pollution and human development in the Mediterranean Region”, Ecological Economics, 68, pp. 2327–2335.

Hall, J., Vredenburg, H. (2003). “The challenges of innovating for sustainable development”. Sloan Management Review, 45, pp. 61–69.

Hall, J.K., Daneke, G.A. and Lenox M.J. (2010), “Sustainable Development and Entrepreneurship: Past Contributions and Future Directions”, Journal of Business Venturing, 25, pp. 439-448.

Hart, S.L., Milstein, M.B. (2003), “Creating sustainable value”,Acad. Manag. Exec, 17, pp. 56–67.

Holcombe, Randall G. (1998), "Entrepreneurship and Economic Growth", Quarterly Journal of Austrian Economics, 2, pp. 45–62.

Hubbard, G. (2006), "Sustainable organisation performance: Towards a practical measurement system", Monash Business Review, 2, pp. 1-19.

Itri, A.N., Ballard, D.H., Kantartzis, S., Sullivan, J.C., Weisman, J.A., Durand, D.J., Ali, S.,Kansagra, A.P. (2015), "Entrepreneurship in the Academic Radiology Environment", 22, pp. 14-24.

Iyigun, M.F., Owen, A.L. (1998). "Risk, entrepreneurship, and human-capital accumulation". AEA Papers and Proceedings 88, pp. 454–457.

Kao, C., Chiang, M.-H. (2001), "On the Estimation and Inference of a Cointegrated Regression in Panel Data, in: Baltagi B. (ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels", Advances in Econometrics, 15, pp. 161–178.

Kwarteng, A., Dadzie, S.A., Famiyeh, S. (2016), "Sustainability and competitive advantage from a developing economy", Journal of Global Responsibility, 7, pp. 110-125, DOI 10.1108/JGR-02-2016-0003.

Lee, S., Oh., D. (2015), “Economic Growth and the Environment in China: Empirical Evidence Using Prefecture Level Data”, China Economic Review, 36, pp. 73–85.

Lele, S. M. (1991), “Sustainabledevelopment: A criticalreview”, World Development, 19, pp. 607-621.

Loveman G, Sengenberger, W. (1991), “The re-emergence of small-scale production: an international perspective”, Small Business Economics, 3. 1-38.

Lozano, R., Lozano, F.J., Mulder, K.F., Huisingh, D., Waas, T. (2013), “Advancing higher education for sustainable development: international insights and critical reflections”, Journal of Cleaner Production, 48, pp. 3-9.

Lucas Jr., R.E. (1978). “On the size distribution of business firms”. Bell Journal of Economics 9, PP. 508–523.

Lucas, R. E. (1988), “On the Mechanics of Economic Development.” Journal of Monetary Economics, 22, pp. 3-39.

Mackenzie., A .F. D. (2004), “Re-imagining the land, North Sutherland”, Scotland Journal of Rural Studies, 20, pp. 273–87.

Mark-Herbert, C., Rotter, J. Pakseresht, A. (2010), "A Triple Bottom Line to Ensure Corporate Responsibility", In Berg, P. (Eds.), Timeless Cityland: An Interdisciplinary Approach to Building the Sustainable Human Habitat (1-7). Uppsala: Sveriges Lantbruks Universitet.

Matos, S., Hall, J. (2007), "Integrating sustainable development in the extended value chain: the case of life cycle assessment in the oil and gas and agricultural biotechnology industries", Journal of Operations Management, 25, pp. 1083-1102.

Naudé, W. (2010), "Entrepreneurship, developing countries, and development economics: new approaches and insights". Small Business Economics, 34, pp.1-12. DOI: http://dx.doi. org/10.1007/s11187-009-9198-2.

Naudè,W.A.(2011), "Entrepreneurship is not a Binding Constraint on Growth and Development in the Poorest Countries", World Development, 39 , pp. 33-44.

Naudé, W., Gries, T. (2011), "Entrepreneurship and human development: A capability approach", Journal of Public Economics, 95, pp. 216–224.

Nkusi, I.J., Habtezghi , S.,Dolles,H. (2013), "Entrepreneurship and the carbon market: opportunities and challenges for South African entrepreneurs".

Omri, A. (2017). “Entrepreneurship, sectoral outputs and environmental improvement: International evidence”, Technological Forecasting and Social Change.

Öner, M. A., Kunday, Ö. (2016), “A study on Schumpeterian and Kirznerian entrepreneurship in Turkey: 2006–2013”, Technological Forecasting and Social Change, 102, pp. 62–71.

Pacheco, D.F., Dean, T.J., Payne, D.S. (2010), “Escaping the green prison: Entrepreneurship and the creation of opportunities for sustainable development”, Journal of Business Venturing, 25 , pp. 464–480.

Parrish, B., Foxon, T. (2009), “Sustainability entrepreneurship and equitable transitions to a low-carbon economy”, Greener Management International, 55, pp. 47–62.

Parrish, P.D. (2010), “Sustainability-driven entrepreneurship: principles of organization design”, Journal of Business Venturing, 25, pp. 510-523.

Patzelt, H., Shepherd, D. A. (2011), “Recognizing opportunities for sustainable development”, Entrepreneurship: Theory and Practitioners, 35, pp. 631– 652.

Pedroni, P. (1999), “Critical Values for Cointegration Tests in Heterogeneous Panels with Multiple Regressors”, Oxford Bulletin of Economics and Statistics, 61, pp. 653–670.

Pedroni a, P. (2001a) “Fully Modified OLS for HeterogenousCointegrated Panels, in: Baltagi B. (ed.), Nonstationary Panels, Panel Cointegration, and Dynamic Panels.” Advances in Econometrics, 15, pp. 93–130.

Pedroni, P. (2001b), “Purchasing Power Parity Tests in Cointegrated Panels.”, Review of Economics and Statistics, 83, 727–731.

Pedroni, P. (2004), “Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests With an Application to the PPP Hypothesis.” Econometric Theory, 20, pp.597–625.

Perrini, F., A. Russo, A. Tencati (2007), “CSR Strategies of SMEs and Large Firms. Evidence from Italy”, Journal of Business Ethics, 74, pp. 285–300.

Pesaran, M. (2004), “General Diagnostic Tests for Cross Section Dependence in Panels,” Working Paper, University of Cambridge, June.

Pesaran, M.H. (2007) “A simple panel unit root test in the presence of cross-section dependence”, Journal of Applied Econometrics, 22, pp. 265-312.

Phillips, P., Hansen, B. (1990), “Statistical Inference in Instrumental Variables Regression with I(1) Processes”, Review of Economic Studies, 57, pp. 99–125.

Phillips, P., Moon, H. (1999), “Linear Regression Limit Theory for Nonstationary Panel Data”, Econometrica.67, pp. 1057–1112.

Pinter, L., Almassy, D., Antonio, E., Hatakeyama, S., Niestroy, I., Olsen, S., Pulawska, G. (2014), “Sustainable Development Goals and Indicators for a Small Planet: Part I: Methodology and Goal Framework”. Asia-Europe Foundation (ASEF), Singapore.

Prieger, J.E., Bampoky, C., Blanco, L., Liu, A. (2016), “Economic Growth and the Optimal Level of Entrepreneurship”, World Development, 82, pp. 95-109.

Rahdari, A., Sepasi, S., Moradi, M. (2016), “Achieving sustainability through Schumpeterian social entrepreneurship: The role of social enterprises”. Journal of Cleaner Production, 137, pp. 347–360.

Ranis, G., Stewart, F., Ramirez, A. (2000), “Economic Growth and Human Development”, World Development, 28 , pp. 197-219.

Reynolds, P. D., Bosma, N. S., Autio, E. (2005), ”Global Entrepreneurship Monitor: Data Collection Design and Implementation 1998–2003”, Small Business Economics, 24, pp. 205–231.

Rietveld, C.A., Van Kippersluis, H., Thurik, A.R. (2015), "Self-employment and health: barriers or benefits?", Health Econ, 24, pp. 1302–1313.

Romer, P. M. (1986), "Increasing Returns and Long-Run Growth.", Journal of Political Economy, 94, pp. 1002-37.

Sagar, A. D., Najam, A. (1998), "The human development index: A critical review", Ecological Economics, 25, pp. 249–264.

Saikkonen, P., (1991), "Asymptotically efficient estimation of cointegration regressions", Econom Theory.7, pp. 1–21.

Shapero, A. (1982). "Social Dimensions of Entrepreneurship". In: Kent, C., Sexton, D., Vesper, K. (Eds.), The Encyclopedia of Entrepreneurship. Prentice-Hall, Englewood Cliffs, pp. 72–90.

Schumpeter, J. A. (1934), "The Theory of Economic Development: An Inquiry Into Profits, Capital, Credit, Interest, and the Business Cycle". New Brunswick, NJ: Transaction Books.

Schumpeter, J. A. (1942), "Capitalism, Socialism, and Democracy, 3rd edn". New York: Harper and Row.

Senge, P., Lichtenstein, B., Kaeufer, K., Bradbury, H., Carroll, J. (2007), "Collaborating for systemic change", MIT Sloan Management Review, 48 , pp. 44–53.

Serageldin., I. (1995), "The human face of the urban environment". In Serageldin I et al. (eds.). Proceedings of the Second Annual World Bank Conference on Environmentally Sustainable Development: the Human Face of the Urban Environment, Washington, DC, 1994, World Bank: Washington, DC; 16–20.

Shepherd, D.A., Patzelt, H. (2011), "The New Field of Sustainable Entrepreneurship: Studying Entrepreneurial Action Linking "What Is to Be Sustained" With 'What Is to Be Developed'. Entrepreneurship", Theory and Practice, 35, pp. 137–163.

Silvester, S., Beella, S., van Timmeren, A., Bauer, P., Quist, J., van Dijk, S. (2013), "Exploring design scenarios for large-scale implementation of the electric vehicles; the Amsterdam airport Schiphol Case". Journal of Cleaner Production, 48, pp. 211-219.

Slaper, T., Hall, T. (2011), "The Triple Bottom Line: What Is It and How Does It Work?", INDIANA BUSINESS REVIEW, 86, pp. 4-8.

Solow, Robert M. (1957), "Technical Change and the Aggregate Production Function", Review of Economics and Statistics, 39, pp. 312-320.

Speldewinde, P.C., Cook, A., Davies, P., Weinstein, P. (2009), "A relationship between environmental degradation and mental health in rural Western Australia", Health and Place, 15, pp. 880–887.

Stål, H.I., Bonnedahl, K.J., Eriksson,J. (2013), "The challenge of introducing low-carbon industrial practices: Institutional entrepreneurship in the agri-food sector", European Management Journal.

Stock, J.H., Watson, M.W. (1993), "A simple estimator of cointegrating vectors in higher order integrated systems", Econom, 61, pp. 783–820.

Strange, T., Bayley, A. (2008), "Sustainable Development. Linking Economy, Society, Environment", Organisation for Economic Co-operation and Development (OECD): Paris, France.

Thai, M.T.T., Turkina, E. (2013), "Macro-level determinants of formal entrepreneurship versus informal entrepreneurship", Journal of Business Venturing, 29, pp. 490–510.

UNDP (1995), "The United Nation Development Report", UNDP.

UNDP , (1998), "The United Nation Development Report", UNDP.

UNDP, (2008), "Human development report 2007/2008: Fighting climate change: human solidarity in a divided world". New York: Palgrave.

Urbano, D., Aparicio, S. (2015), "Entrepreneurship capital types and economic growth: International evidence", Technological Forecasting and Social Change.

Van Stel, A., Storey D. (2004), "Link between Firm Birth and Job Creation: Is There a Upas Tree effect?" Regional Studies, 38, pp.893-909, November.

Vivarelli, M. (2013), "Is entrepreneurship necessarily good? Microeconomic evidence from developed and developing countries", Industrial and Corporate Change, 22, pp. 1453–1495.

WCED (World Commission on Environment and Development), (1987), "Our Common Future", Oxford University Press, Oxford.

Wheeler, D., McKague, K., Thomson, J., Davies, R., Medalye, M., Prada, M. (2005), "Creating sustainable local enterprise networks", MIT Sloan Management Review, 47, pp. 33–40.

Wiedmann, T., Lenzen, M. (2009) "Unravelling the impacts of supply chains – a new triple-bottom-line accounting approach and software tool", Environmental Management Accounting for Cleaner Production, pp. 65–90, Springer, Netherlands.

Wong, P.K., Ho, Y.P., Autio, E. (2005), "Entrepreneurship, innovation and economic growth: Evidence from GEM data", Small Business Economics, 24, pp. 335–350.

World Bank 1986 .Ž .Environmental Aspects of Bank Work.The World Bank Operations Manual Statements, OMS 2.36. Washington, DC: World Bank.

World Economic and Social Survey (2013), "Sustainable Development Challenges", Department of Economic and Social Affairs. United Nations, New York.

York, J.G., Venkataraman, S. (2010), "The entrepreneur–environment nexus: Uncertainty, innovation, and allocation", Journal of Business Venturing, 25, pp.449–463.

Zumeta, W. (1996), "Meeting the Demand for Higher Education Without Breaking the Bank: A Framework for the Design of State Higher Education Policies for an Era of Increasing Demand", The Journal of Higher Education, 6, pp. 367-425 .