Entrepreneurship, Sectoral Outputs and Environmental Improvement : International Evidence

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Abstract

The relationship between entrepreneurship, output and environmental quality receives considerable attention from academics and policymakers, as society searches for solutions leading to environmental sustainability. Given this context, the current study contributes to this discussion by explaining how entrepreneurship and different sectoral outputs can help resolve the environmental problems of global socio-economic systems. So, we used data for 69 countries split across four homogeneous income-based panels: high-income, upper-middle-income, lower-middle-income, and low-income economies. Long-run elasticities suggest that (i) the rate of environmental damage due to the growth of sectoral outputs is much higher in the high-income sample; (ii) compared to output from other sectors, services makes the highest contribution to environmental degradation in high-income countries but its contribution in the other country samples is negative; indicating that a move to services economy would be beneficial for these countries; (iii) with the exception of the high-income sample, there is an inverted U-shaped relationship between output growth and environmental degradation across country samples and sectors; (iv) the contribution of entrepreneurial activity to environmental degradation is lower in high-income countries compared to other country samples; and (v) entrepreneurship 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. The findings are sensitive to different income groups and sectoral analyzes. In particular, these empirical findings aid sound economic policymaking for improving environmental quality and sustainable economic development.

JEL Codes : Q5, O4, D2, C5.
Keywords: Entrepreneurship; Sectoral outputs; Environment; Economic stages of development.

1. Introduction

Since the mid 1980s, environmental concerns have been considered in the design of economic policy. Natural capital is considered to be an indispensable production input, and also a determinant of societal wellbeing (Costantini and Monni, 2008). The incorporation of environmental topics in economic growth theories and empirics is beginning to receive extensive consideration in the literature, and the question of whether output growth leads to more environmental degradation has become central in discussions among both economists and environmentalists.[1]

Moreover, concern about whether the social–ecological processes which allow human wellbeing to be sustained suggests that sustainable development should be a broad social goal. The role of entrepreneurship in achieving such goal is emerging as a subject of some debate. It is considered as the most important channel toward production of sustainable products and services, and implementation of new projects to address many environmental and social concerns. Several studies, such as Schumpeter (1934: 1942), Drucker (1985), and Matos and Hall (2007), among others, examine the link between resolution of global problems and entrepreneurship. For example, Cohen and Winn (2007) show that four types of market imperfection contribute to environmental pollution; they are considered as sources of significant entrepreneurial opportunity to establish the foundations for an emerging model of sustainable entrepreneurship by slowing the degradation and even gradually improving ecosystems. Similarly, York and Venkataraman (2010) propose entrepreneurship as a solution to, rather than a cause of, environmental degradation. These authors form a model that embraces the potential of entrepreneurship to supplement regulation, corporate social

[1]Empirical debate over output growth and environmental quality began with the study by Grossman and Krueger (1991). The empirical association between them is described as the environmental Kuznets curve (EKC)[1]. The EKC describes a relationship where in the early stage of economic development environmental degradation increases with per capita income, and after a certain level of per capita income, environmental quality increases with a rise in per capita income (see Fig.1).

responsibility, and activism in resolving environmental problems. Shepherd and Pratzelt (2011) suggest that entrepreneurship can protect the ecosystem, improve environmental quality, reduce deforestation, and improve agricultural practices and freshwater supply. Since then, entrepreneurship could be a solution to numerous environmental and social problems (Wheeler et al., 2005; Senge et al., 2007; Hall et al., 2010)[2]. Starting from these considerations, we propose an EKC model which includes entrepreneurship as an aspect of sustainability.

This article makes two main contributions to the existing literature. First, we integrate entrepreneurship in the standard environmental Kuznets (EKC) model as an aspect of sustainability in order to examine the role of entrepreneurship activity on the environmental improvement. Specifically, we demonstrate that at early stages of economic development, entrepreneurial activity increases real incomes but damages the environment because at this stage, environmental quality is considered a luxury good. However, as countries achieve a certain level of economic development, the increased income from entrepreneurial activity contributes to the environmental improvement. Second, different sectoral outputs have been integrated in this model to identify the contribution of each sector on environmental quality, and to demonstrate that this contribution depends on the stages of economic development.

The rest of the article is organized as follows: section 2 provides a brief literature review; section 3 describes the empirical strategy; section 4 reports and discusses the empirical results; and section 5 concludes with some policy implications.

2. Theoretical framework and Hypotheses

2.1. Entrepreneurship and Environment

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[2] Several prestigious journals such as *Harvard Business Review*, *Journal of Business Venturing*, and *Entrepreneurship: Theory and Practice* published special issues covering this topic.

Currently, small businesses and entrepreneurship are economic fundamentals, and are responsible for breakthrough innovations which influence the growth of a free market economy and its general performance (Iyigun and Keskin, 2015). Originally, entrepreneurship was defined as establishing a business using individual capital and entrepreneurs and entrepreneurial activity have existed for a long time. However, Schumpeter introduced a new notion of entrepreneurship and of entrepreneurs as "innovators, who use a process of shattering the status quo of the existing products and services to set up new products, new services" (Sahin and Asunakutlu, 2014). In this perspective, entrepreneurship can be defined as the creation of new enterprising activities such as new ventures, strategic renewal, and innovation leading to better social and economic performance from companies (Habbershon et al., 2010).

Several researchers and practitioners view entrepreneurship as a channel for sustainable development, and expect the innovative power of entrepreneurship to produce the next industrial revolution and a more sustainable future. In this view, entrepreneurship is seen more and more as a significant tool for promoting the change to sustainable products and processes (Hall et al., 2010). Cohen and Winn (2007) provide evidence that four categories of market imperfections[3] contribute to environmental pollution, and see this as providing opportunities for significant entrepreneurial activity, and a model of sustainable entrepreneurship based on slowing environmental degradation and progressively enhancing the earth's ecosystems. In addition, several environmentalists perceive the interconnection between business and the natural environment as a zero-sum game in which nature loses every time (Carson et al., 2003; Flannery, 2005). Similarly, Riti et al. (2015) investigate the causal relationship between entrepreneurship and the environment using a FMOLS approach

[3] Inefficient firms, externalities, flawed pricing mechanisms, and information asymmetries.

for Nigeria in 2000-2012. They find that entrepreneurship has a negative impact on the environment which makes sustainable development unattainable.

However, other studies such as York and Venkataraman (2010) see entrepreneurship as a solution to rather than a cause of environmental degradation. Their model includes the potential for entrepreneurship to complement regulation, corporate social responsibility, and activism in relation to resolving environmental problems. Furthermore, according to Shepherd and Pratzelt (2011) entrepreneurial activity can preserve the ecosystem, counteract climate change, reduce environmental degradation and deforestation, improve agricultural practices and freshwater supply, and maintain biodiversity. In this context, the experience of developed countries shows that when countries reach a high level of economic development, the relationship between entrepreneurship and environmental damage becomes negative and takes an inverted U-shape form. So, increased entrepreneurial activity does not always increase environmental degradation. In addition, we can see that several works analyze the impact of entrepreneurial activity on environment but tend to overlook how this impact changes at different stages of development. For that raison, Acs et al. (1994) indicate that the level of entrepreneurship across country and time-specific contexts is explained mostly by the stage of economic development. Accordingly, we formulate the following hypothesis:

Hypothesis 1. The impact of entrepreneurship on environmental quality differs across stages of economic development.

2.2. Output and Environment

Ecological modernization theory tries to clarify "how various institutions and social actors attempt to integrate environmental concerns into their everyday functioning, development, and relationships with others, including their relation with the natural world" (Mol et al., 2009). The theory builds upon a longstanding approach in environmental economics which recognizes that income growth contributes to environmental damage, but argues that further income growth can lead to a reduction in such problems (Grossman and Krueger, 1995). The environment is perceived as a luxury good, subject to public demand through the workings of an advanced market. During earlier stages or periods of economic development, environmental harms increase, but as development and affluence reach a certain point, the value the public places on the natural environment increases.

As already mentioned, the empirical association between growth and environmental degradation is described as EKC. Several studies such as Grossman and Krueger (1993), Ozturk and Acaravci (2010), Lau et al. (2014), and Omri et al. (2015) test the validity of the EKC hypothesis but provide mixed results. Some find an inverted U-shaped relationship between economic growth and environmental degradation (e.g., Lindmark, 2002; Ang, 2007), others find a linear relationship (e.g. Azomahou et al., 2006) or no relationship (e.g. Ang, 2008; Chebbi, 2009) between these elements. This literature suffers from an omitted variables bias problem due to use of a bivariate model (Farhani et al., 2014). Other studies include other determinants of environmental degradation such as human development (Costantini and Monni, 2008 and Gurluk, 2009), financial development (Shahbaz et al., 2013, Omri et al., 2015), and trade liberalization (Tiba and Omri, 2015). However, these multivariate analyses also provide contrasting conclusions on the validity of the EKC hypothesis. While Hacilogio (2009) for Turkey, and Mensah (2014) for six African countries confirm the existence of an inverted U-shaped relationship between output growth and environmental pollution, others (Giovanis, 2013 for United Kingdom; Wang et al., 2013 for 150 nations) find no such evidence.

From the above, it is clear that most of the existing works focus on the impact of aggregate output on the environment but little attention is paid to the sectoral level of outputs at different stages of economic development. For the ecological modernization theory, the impact of output on environmental degradation may increase for low- to middle-income countries but eventually declines for high-income countries. As high-income countries shift toward low carbon fuels, the output elasticity of emissions is likely to decline. The theory shows also that the output elasticity of emissions is affected by the level of technology efficiency. High levels of technology efficiency in high-income countries can help to reduce emissions. In this context, only few works such as Li and Lin (2015), Poumanyvong and Kaneko (2015) introduce industry sector in their analyses. These authors show that the impact of industrialization on environmental pollution is assumed to be positive but it is well known that at different stages of development, energy consumption takes different forms and involves different processes, causing the effects of industrialization on environmental degradation to vary. However, experience in developed countries shows that industrialization affects environmental degradation in different ways across different stages of development stages. In generally, in the middle phase of industrialization (pre-industrial and industrial economies), energy-intensive industries grow rapidly, and the effects of industrialization on environmental degradation are large and positive; however, in the later stages of industrialization (post-industrial economies), the effects become negative due to better energy efficiency and wide use of carbon-free energy types. We thus propose the following hypothesis:

Hypothesis 2. The impact of output on environmental quality differs across economic sectors and stages of economic development.

3. Empirical strategy

3.1. Data and Models

The article estimates the relationships between entrepreneurship, GDP, and different sectoral outputs, and environmental quality by controlling for per capita energy use, per capita trade openness, per capita financial development, and human development. We measure environmental pollution using CO_2 emissions. Real agriculture value added per capita (Y_A), real industry value added per capita (Y_I), and real services value added per capita (Y_S) respectively measure sectoral outputs from the agriculture, industry and services sectors. The indicator of environmental degradation (E) is measured in metric tons per capita. The indicator of entrepreneurship activity (EP) is defined as the total number of new registered businesses as a percentage of the working-age population (Thai and Turkina, 2013; Dau and Cazurra, 2014). The indicator of foreign trade (T) is defined as export plus import divided by population, i.e. total per capita trade volume. The indicator of financial development (FD) is defined as private sector credit plus domestic credit provided by the banking sector divided by the population. Energy consumption (EC) in kg of oil equivalent per capita is used to measure energy consumption. The indicator of human development is measured by the modified human development index (Gürlük, 2009). Based on data availability, 69 countries were selected for the empirical estimation over the period 2001-2011[4]. Table 1 presents a detailed description of the variables used.

Using the World Bank classification[5], we can split our sample of 69 countries into four homogeneous groups: high-income countries (22 countries), upper-middle-income countries (14 countries), lower-middle-income countries (23 countries), and low-income countries (10 countries)[6]. In our analyses, we used the following samples (table 2): sample 1 includes only high-income countries, sample 2 includes both high and upper-middle-income countries, sample 3 includes both upper-middle-income and lower-middle-income countries, and sample 4 includes both lower-middle-income and low-income countries.

Table 1
Definition of the variables used in the analysis.

Variable	Definition	Data Source
Per capita CO_2 emissions (E)	CO_2 emissions are the release of carbon into the atmosphere. This indicator is used as a measure of	Word Development Indicators

[4] Country selection and the period of study were based on the availability of data.
[5] http://data.worldbank.org/about/country-classifications.
[6] Lists of countries included in each panel are provided in Appendix.

	environmental degradation. Data is in metric tons per capita.	
Entrepreneurship (EP)	Measured as the total number of new registered businesses as a percentage of the working-age population.	Global Entrepreneurship Monitor (GEM)
GDP (Y)	Measured by per capita US$ (2005).	Word Development Indicators
Agricultural output (Y_A)	Measured by per capita agricultural value added.	Calculated using data from Word Development Indicators
Industrial output (Y_I)	Measured by per capita industry value added.	Calculated using data from World Bank
Services output (Y_S)	Measured by per capita services value added.	Calculated using data from Word Development Indicators
Foreign trade (T)	Defined as export plus import divided by population i.e. total trade volume per capita.	Calculated using data from Word Development Indicators
Financial development (FD)	Defined as private sector credit plus domestic credit provided by banking sector divided by population i.e. financial development per capita.	Calculated using data from World Bank
Energy consumption (EC)	Measured as kg of oil equivalent per capita.	Word Bank
Human development (MHDI)	Measured using the modified human development index (MHDI) which measures the average achievements in a country in two basic dimensions of human development (education and life expectancy).	Calculated using data from World Bank

Table2
Samples presentation.

Countries	Sample 1	Sample 2	Sample 3	Sample 4
High-Income	HI	HI		
Upper-Middle-Income		UMI	UMI	
Lower-Middle-Income			LMI	LMI
Low-Income				LI
Total	22 countries	36 countries	37 countries	33 countries

In line with the literature, we formulate the following model:

$$E_{it} = \alpha_0 + \alpha_1 Y_{it} + \alpha_2 EP_{it} + \alpha_3 T_{it} + \alpha_4 FD_{it} + \alpha_5 HDI_{it} + \alpha_6 EC_{it} + \varepsilon_{it} \quad (1)$$

To test the validity of the EKC hypothesis, we specify and estimate the following multiple regression equations:

$$E_{it} = \alpha_0 + \alpha_1 Y_{it} + \alpha_2 Y^2{}_{it} + \alpha_3 EP_{it} + \alpha_4 T_{it} + \alpha_5 FD_{it} + \alpha_6 HDI_{it} + \alpha_7 EC_{it} + \varepsilon_{it} \quad (2)$$

$$E_{it} = \alpha_0 + \alpha_1 EP_{it} + \alpha_2 EP^2{}_{it} + \alpha_3 Y_{it} + \alpha_4 T_{it} + \alpha_5 FD_{it} + \alpha_6 HDI_{it} + \alpha_7 EC_{it} + \varepsilon_{it} \quad (3)$$

where i, t, and ε are the country, the time period, and the error term respectively. In Eq.2 (EKC), the parameters α_1, ….., α_7 are the respective CO_2 emissions long-run elasticities with respect to income, squared income, entrepreneurship, trade, financial development, human development and energy consumption. Based on the EKC hypothesis, the expected signs of $\partial Y / \partial E > 0$ and $\partial Y^2 / \partial E < 0$ lead to an inverted U-shaped relationship between emissions and income growth. In this study, the EKC hypothesis is extended further by replacing real GDP per capita by sectoral output in order to validate it across sectors. The logic behind this relationship is that at early stages of economic development, sectoral output induces pollution ($\partial Y_A / \partial E > 0, \partial Y_I / \partial E > 0, \partial Y_S / \partial E > 0$); however, as income rises the incidence of further environmental damage decreases ($\partial Y_A^2 / \partial E < 0, \partial Y_I^2 / \partial E < 0, \partial Y_S^2 / \partial E < 0$), due to higher environmental consciousness and use of modern technology which generates less pollution.

In Eq.3 (MEKC), we replace the square of GDP (Y^2) by the square of entrepreneurship (EP^2) in order to examine the quadratic relationship between entrepreneurship and environmental degradation. The logic underlying this relationship is that at early stages of economic development, entrepreneurial activity increases real incomes but damages the environment because at this stage, environmental quality is considered a luxury good. However, as countries achieve a certain level of economic development, the increased income from entrepreneurial activity encourages a higher societal demand for a clean environment, and induces efforts to reduce environmental damage by increasing the number of environmentally friendly projects and introducing clean production to improve environmental quality.

2.2. Estimation procedures

In estimating the final versions of Equations (2) and (3) related respectively to the EKC and MEKC models, we use recently developed panel econometric techniques. They improve the statistical reliability of our tests by integrating cross-country heterogeneity and cross-country dependence. For heterogeneous countries, assuming cross-sectional independence across panels could as Banerjee et al. (2004) and others suggest, distort the results.

To estimate our two models as a panel cointegration model, we consider a three-step empirical methodology. First, we analyze the cross-sectional dependence and check the stationarity of the series. Second, we perform a cointegration test to examine the long-run dynamics of cross-sectional dependence across countries. Third, we estimate the long-run relationships among the variables using fully modified ordinary least square (FMOLS) techniques.

2.3.1. Cross-sectional dependence and panel unit root tests

The sample data were examined first using the Pesaran (2004) test for cross-sectional dependence (CD) to determine the presence of (CD) or cross sectional independence. This is an important step before applying panel unit root tests. The conventional unit root tests can provide weak findings due to low power if they are applied to series with CD. Therefore, we applied the cross-sectionally augmented panel unit root test (CIPS), one of the unit root tests from the second-generation developed by Pesaran (2007), which assumes that a series is CD. 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 at their first difference, suggesting that this group of variables may be cointegrated in the long-run. The next subsection provides a detailed discussion of the panel cointegration test.

2.2.2. Panel cointegration tests

After confirming that the series is stationary by applying the Pesaran (2004) CD test and Pesaran (2007) CIPS unit root tests to the underlying models, we can perform panel cointegration analysis. The literature suggests a number of panel cointegration tests e.g. the Pedroni (1999, 2004) panel cointegration test, and the Kao (1999) panel cointegration test . In our study we want also to check for a long-run equilibrium relationship among the variables, using the Pedroni (1999, 2004) panel cointegration test. Pedroni suggests seven different statistics to test for cointegration relationships in heterogeneous panels. These tests are corrected for bias introduced by potentially endogenous regressors, and are classified into within dimension and between dimensions statistics. The first sets are described as panel cointegration statistics, and the second are termed mean panel cointegration statistics.

2.2.3. Panel long-run estimation

After all the variables are cointegrated, the next step is to estimate the associated long-run cointegration parameters. Fixed effects, random effects and general method of moment methods can lead to inconsistent and misleading coefficients when applied to cointegrated panel data. Among the existing panel data cointegration techniques, we use Pedroni (1999) Fully Modified Ordinary Least Squares (FMOLS) estimator which deals with possible heteroskedasticity and autocorrelation of the residuals, takes into account the presence of nuisance parameters, is asymptotically unbiased and, more importantly, deals with potential endogeneity of regressors. Tables 5 and 6 present the results of the long-run estimations using the FMOLS method.

4. Results and discussion

The results in table 3 are for the Pesaran cross-sectional dependence test which is applied to all variables. The null of cross-sectional independence is rejected for each selected variable. Formal econometric modeling requires an understating of the integrating properties of the data. Thus, we apply Pesaran (2007) panel unit root test. Its results are reported in Table 3 and indicate that all series under consideration are non-stationary at their level form. However, at first difference level, the all series of variables are integrated. It implies that the selected series are integrated at I(1) in each panel.

Since at the first difference the variables are stationary for both panel EKC and panel MEKC, Pedroni's (1999, 2004) cointegration test is employed to examine the long-run equilibrium relationship between the variables. The results of the Pedroni (1999, 2004) panel cointegration tests are reported in table 4. Pedroni uses four within dimension (panel) test statistics, and three between dimension (group) statistics to check whether the selected panel data are cointegrated. Within dimension statistics contain the estimated values of the test statistics based on estimators pooling the autoregressive coefficient across different cross-sections for the unit root test on the estimated residuals. Between dimension statistics report the estimated values of the test statistics based on estimators that average individually estimated coefficients for each cross-section.

Table 3
Results of the panel unit root and cross-sectional dependence tests.

Variables	Pesaran CD test		CIPS test			
			Level		Δ	
	CD-test	p-value	T-stat	p-value	T-stat	p-value
Sample 1 (HI): High-income countries						
LnE	10.124*	(0.000)	-1.197	(1.000)	-2.220*	(0.000)
LnY	12.085*	(0.000)	-1.205	(1.000)	-3.542*	(0.000)
LnY_A	10.250*	(0.009)	-2.558	(0.998)	-2.119*	(0.003)
LnY_I	11.529*	(0.000)	-2.184	(0.999)	-1.905*	(0.000)
LnY_S	9.524*	(0.000)	1.893	(1.000)	-3.273*	(0.000)
Ln EP	10.552*	(0.000)	-2.052	(1.000)	-2.087**	(0.022)
LnT	14.921*	(0.000)	-1.013	(1.000)	-3.845*	(0.000)
LnFD	12.021*	(0.000)	1.464	(1.000)	-2.404*	(0.000)
MHDI	8.6103**	(0.017)	-2.231	(1.000)	-2.430**	(0.011)
LnEC	10.826*	(0.000)	2.118	(1.000)	-1.333*	(0.000)
Sample 2 (HI & UMI): High-income countries and Upper-middle-income						
LnE	5.122**	(0.023)	-0.997	(0.817)	-4.457*	(0.000)
LnY	10.129*	(0.000)	-2.655	(1.000)	-5.009*	(0.000)
LnY_A	7.147*	(0.000)	-1.923	(0.998)	-1.957*	(0.000)
LnY_I	4.509**	(0.014)	-0.804	(0.789)	-3.109*	(0.000)
LnY_S	6.338*	(0.000)	-2.078	(1.000)	-7.114*	(0.000)
Ln EP	7.087*	(0.000)	-1.425	(0.998)	-5.727*	(0.000)
LnT	10.842*	(0.000)	-1.579	(1.000)	-2.910*	(0.000)
LnFD	15.530*	(0.000)	-1.930	(1.000)	-4.325*	(0.000)
MHDI	3.391**	(0.046)	-1.089	(0.999)	-3.185*	(0.000)
LnEC	10.826*	(0.008)	-3.108	(1.000)	-5.263*	(0.000)
Sample 3 (UMI & LMI): Upper-middle-income and Lower-middle-income						
LnE	11.392*	(0.000)	-2.533	(0.999)	-4.492*	(0.000)
LnY	9.711*	(0.000)	-2.203	(1.000)	-3.631*	(0.000)
LnY_A	6.112*	(0.000)	-2.412	(1.000)	-3.221*	(0.000)

LnY_I	8.298*	(0.000)	-1.883	(0.958)	-2.705*	(0.000)
LnY_S	4.651*	(0.002)	-2.118	(1.000)	-2.150*	(0.000)
Ln EP	4.475*	(0.003)	-1.699	(1.000)	-2.625*	(0.000)
LnT	10.179*	(0.000)	-2.560	(1.000)	-3.002*	(0.000)
LnFD	12.615*	(0.000)	-1.704	(1.000)	-3.529*	(0.000)
MHDI	6.297*	(0.000)	-2.593	(1.000)	-2.057*	(0.000)
LnEC	2.574*	(0.000)	-1.856	(0.889)	-2.119*	(0.000)
Sample 4 (LMI & LI): Lower-middle-income and Low-income						
LnE	10.390*	(0.000)	-2.233	(0.765)	-3.397*	(0.000)
LnY	6.711*	(0.000)	-1.703	(1.000)	-2.930*	(0.000)
LnY_A	6.252*	(0.000)	-1.712	(1.000)	-2.920*	(0.000)
LnY_I	9.348*	(0.000)	-2.083	(0.958)	-3.005*	(0.000)
LnY_S	5.601*	(0.000)	-2.108	(0.941)	-3.050*	(0.000)
Ln EP	7.475*	(0.000)	-1.719	(1.000)	-2.921*	(0.000)
LnT	7.179*	(0.000)	-1.720	(1.000)	-2.902*	(0.000)
LnFD	11.61*	(0.000)	-1.754	(1.000)	-3.322*	(0.000)
MHDI	7.181*	(0.000)	-2.192	(0.880)	3.365 *	(0.000)
LnEC	6.895*	(0.000)	-2.179	(0.900)	-2.877 *	(0.000)

Notes: All panel unit root tests were performed with restricted intercept and trend for all the variables. * and ** are statistical significance at the 1% and 5% levels, respectively.

The results of the within dimension tests and the between dimension tests provide strong evidence that the null hypothesis of no cointegration in each panel should be rejected. Having confirmed the cointegration between these variables, in the next step we estimate the long-run coefficients. The test-statistics for all seven tests show that the null hypothesis of no cointegration can be rejected. Therefore, in our sample period, all the variables we consider have long-run associations. This leads to the conclusion that the variables considered are cointegrated for the four samples, and share a two long run equilibrium relationship with all the variables in eqs. (2) and (3). After confirming the cointegration among variables is confirmed, the long-run coefficients are estimated.

Table4

Pedroni (1999, 2004) panel cointegration statistics and results.

Sample 1 (HI): High-income countries

	Panel EKC									Panel MEKC	
	Model 1		Model 2		Model 3		Model 4				
Within-dimension	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	Within-dimension	T-statistics	Prob.
Panel v-stat	0.308	(0.451)	-7.411*	(0.000)	-2.096*	(0.000)	0.726	(0.126)	Panel v-stat	-1.989*	(0.000)
Panel rho-stat	1.903	(0.739)	-3.259*	(0.000)	-7.311*	(0.000)	-1.909**	(0.011)	Panel rho-stat	-4.258*	(0.000)
Panel ADF-stat	-2.236*	(0.000)	-1.326*	(0.014)	-3.420*	(0.000)	-7.440*	(0.000)	Panel ADF-stat	-7.311*	(0.000)
Panel PP-stat	-8.337*	(0.000)	-2.668**	(0.007)	-1.997*	(0.000)	-3.613*	(0.003)	Panel PP-stat	-4.742*	(0.000)
Between-dimension									Between-dimension		
Group rho-stat	0.156	(0.781)	0.425	(0.299)	-4.944*	(0.000)	-8.101*	(0.000)	Group rho-stat	0.177	(0.551)
Group ADF-stat	-11.125*	(0.000)	-4.857*	(0.000)	-3.169*	(0.000)	-9.339*	(0.000)	Group ADF-stat	-9.658*	(0.000)
Group PP-stat	-5.441*	(0.000)	-1.192**	(0.031)	-2.332*	(0.000)	-2.709*	(0.005)	Group PP-stat	-3.311*	(0.000)

Sample 2 (HI & UMI): High-income countries and Upper-middle-income

	Panel EKC									Panel MEKC	
	Model 1		Model 2		Model 3		Model 4				
Within-dimension	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	Within-dimension	T-statistics	Prob.
Panel v-stat	-3.211*	(0.000)	-2.368**	(0.029)	0.190	(0.611)	-1.169**	(0.023)	Panel v-stat	-4.230*	(0.000)
Panel rho-stat	-5.471*	(0.000)	-3.709*	(0.000)	0.311	(0.398)	-3.114*	(0.000)	Panel rho-stat	-5.198*	(0.000)
Panel ADF-stat	-1.913*	(0.000)	-2.122*	(0.000)	-4.007*	(0.000)	-9.196*	(0.000)	Panel ADF-stat	-7.347*	(0.000)
Panel PP-stat	-3.502*	(0.000)	-4.726**	(0.015)	-2.019*	(0.000)	-4.020*	(0.000)	Panel PP-stat	-8.678*	(0.000)
Between-dimension											
Group rho-stat	0.817	(0.109)	-5.425*	(0.000)	0.976	(0.151)	-1.976**	(0.042)	Group rho-stat	-1.991**	(0.019)
Group ADF-stat	-6.338*	(0.000)	-3.269*	(0.000)	-2.729*	(0.000)	-2.397*	(0.000)	Group ADF-stat	-7.613*	(0.000)
Group PP-stat	-2.163*	(0.007)	-4.328*	(0.000)	-3.012*	(0.000)	-3.770*	(0.000)	Group PP-stat	-3.186*	(0.004)

Sample 3 (UMI & LMI): Upper-middle-income and Lower-middle-income

	Panel EKC									Panel MEKC	
	Model 1		Model 2		Model 3		Model 4				
Within-dimension	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	Within-dimension	T-statistics	Prob.
Panel v-stat	-4.322*	(0.000)	-1.764**	(0.033)	-4.116*	(0.002)	-3.088*	(0.000)	Panel v-stat	0.394	(0.374)
Panel rho-stat	-1.610*	(0.000)	-6.709*	(0.000)	-4.450*	(0.000)	-2.727*	(0.000)	Panel rho-stat	-1.582**	(0.011)
Panel ADF-stat	-2.934*	(0.000)	-3.122*	(0.000)	-2.328**	(0.014)	-1.926*	(0.005)	Panel ADF-stat	-2.475*	(0.000)
Panel PP-stat	-2.533**	(0.011)	-1.726***	(0.062)	-3.390*	(0.000)	-4.106*	(0.000)	Panel PP-stat	-2.951*	(0.000)
Between-dimension									Between-dimension		

Group rho-stat	-3.261*	(0.000)	-4.425*	(0.000)	-2.558*	(0.005)	-2.976*	(0.000)	Group rho-stat	0.912	(0.196)
Group ADF-stat	-1.899**	(0.019)	-2.269*	(0.000)	-4.364*	(0.000)	-3.552*	(0.000)	Group ADF-stat	-4.339*	(0.000)
Group PP-stat	-3.036*	(0.000)	-2.328*	(0.000)	-3.671*	(0.000)	-2.268*	(0.004)	Group PP-stat	-5.016*	(0.000)

Sample 4 (LMI & LI): Lower-middle-income and Low-income

	Panel EKC									Panel MEKC	
	Model 1		Model 2		Model 3		Model 4				
Within-dimension	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	T-statistics	Prob.	Within-dimension	T-statistics	Prob.
Panel v-stat	-4.009*	(0.000)	-4.083*	(0.000)	0.245	(0.489)	-5.001*	(0.000)	Panel v-stat	-0.912***	(0.053)
Panel rho-stat	-1.999*	(0.000)	-2.197**	(0.027)	-2.171**	(0.017)	-2.325*	(0.000)	Panel rho-stat	-2.193**	(0.011)
Panel ADF-stat	-3.416*	(0.000)	-4.379*	(0.000)	-3.130*	(0.000)	-5.291*	(0.000)	Panel ADF-stat	-3.148*	(0.000)
Panel PP-stat	-2.313*	(0.000)	-1.313***	(0.052)	-1.572**	(0.020)	-3.123*	(0.000)	Panel PP-stat	-2.081*	(0.000)
Between-dimension									Between-dimension		
Group rho-stat	-3.880*	(0.000)	-6.320*	(0.000)	0.379	(0.326)	-4.267*	(0.000)	Group rho-stat	-1.408*	(0.000)
Group ADF-stat	-2.239*	(0.000)	-1.829*	(0.007)	-4.279*	(0.000)	-2.627*	(0.000)	Group ADF-stat	-3.322*	(0.000)
Group PP-stat	-2.674*	(0.000)	-2.499*	(0.000)	-4.189*	(0.000)	-2.394*	(0.000)	Group PP-stat	-2.910*	(0.000)

The null hypothesis of Pedroni's test examines the absence of cointegration. Lag selection (automatic) is based on SIC with a max lag of 5. *, ** and *** represent the statistical significance at the 1%, 5% and 10% levels, respectively.

Tables 5 and 6 present the results of the respective panel FMOLS estimates for EKC and MEKC. All the variables except the MHDI variable are expressed in natural logarithms. The estimated coefficients of the long-run cointegration relationship can be interpreted as long-run elasticities. Tables 5 and 6 show that environmental degradation is a positive function of output growth, financial development, and energy consumption. This finding is in line with most previous studies (see Omri, 2013; Apergis and Payne, 2014). It can generally be observed that the rate of environmental degradation due to GDP or sectoral outputs is much higher in case of low-income economies with inadequate, unsophisticated, and primitive production technologies, poor environmental regulation, etc. However, a first look at the results in tables 5 and 6 reveal an interesting pattern for the relationship between output growth and environmental degradation. While GDP has a positive and statistically significant impact on environmental degradation across the different four samples considered, long-run elasticity of GDP is much higher in sample 2 (upper-middle-income and high-income countries -0.199) and sample 1 (high-income countries -0.158), compared to sample 4 (lower-middle-income and low-income countries -0.087). What is the reason for these unexpected but robust results? Can it be argued that compared to high-income and upper-middle-income countries, those countries with the lowest incomes have achieved far more environmentally efficient economic growth? These questions require more research. The general economic rationale indicates that higher income countries generally rely more on services and industry sectors to enhance their economic growth, these sectors use more energy either directly or indirectly, which results in more emissions. So, since high-income countries are responsible for most of the world's environmental pollution, the level of their environmental conservation efforts is evidently insufficient. Given their prosperity and economic size, they should channel more resources and logistics to reduce CO_2 emissions arising from energy use, most of which comes from fossil fuels. It is important for these countries to use cleaner and more efficient fossil fuel sources such as natural gas and higher-grade coal. It is important for them to increase use of renewable energy sources such as hydro, solar, geothermal, and wind. These countries should devote serious effort to technology advances to achieve a balance between economic growth and environmental conservation which is a public good. Such efforts would control and reduce environmental pollution without harming economic growth and development. Moreover, levels of energy use differ between those countries with the highest income and those with lowest income. The high-income countries consume the lion's share of the world's energy resources. Moreover, levels of energy use differ between those countries with the highest income and those with lowest income. The high-income countries consume the lion's share of the world's energy resources. In addition to the impact of output, we find that energy consumption has a positive and significant impact on environmental degradation in all four samples, indicating that environmental degradation is elastic with respect to energy consumption, and a 1% increase in energy consumption increases environmental degradation within the range 0.194% for the high-income (HI) sample and 0.098% for the lower-middle-income and low-income (LMI & LI) samples. This finding is in line with Omri and Kahouli (2014). Moreover, financial development exhibits a generally positive impact on environmental degradation in all but the high-income sample; however, this is statistically significant only for middle-income (UMI & LMI) samples. Its impact is negative and significant for the high-income sample (-0.027), indicating that, in high income countries, financial development can lead to technological innovation which contributes significantly to reducing environmental damage (King and Levine, 1993). Also, technological innovation promotes environmentally friendly production by easing the access to financial resources (Tamazian et al., 2009), and helping investors to use new and advanced technology for more environmentally friendly production (Shahbaz et al., 2013). Human development has a negative and statistically significant impact on environmental degradation for all except the low-income countries. This result is in line with Costantini and Monni (2008). Finally, trade openness has a negative impact on environmental degradation in most of the countries considered; however, it is statistically significant only in the case of high-income, lower-middle-income and low-income countries. In addition, the impact is higher in the case of the lower-middle-income and low-income samples compared to the high-income sample. This is because foreign trade requires the trading countries, particularly low-income countries, to undertake rigorous and standardized environmental actions in their manufacturing processes in order to export to high-income countries.

Table 5

Panel FMOLS Long-run Elasticity Estimates for EKC.

Independent variables	Dependent variable : Environmental degradation (E)							
	Model 1		Model 2		Model 3		Model 4	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
Sample 1 (HI): High-income countries								
LnY	0.158*	(0.003)	-	-	-	-	-	-
LnY^2	-0.077	(0.120)	-	-	-	-	-	-
Ln Y_A	-	-	0.125**	(0.019)	-	-	-	-
LnY_A^2	-	-	-0.082	(0.134)	-	-	-	-
Ln Y_I	-	-	-	-	0.147***	(0.067)	-	-
LnY_I^2	-	-	-	-	-0.054	(0.198)	-	-
Ln Y_S	-	-	-	-	-	-	0.164*	(0.000)
LnY_S^2	-	-	-	-	-	-	-0.066	(0.152)
LnEP	0.065*	(0.007)	0.049**	(0.010)	0.075**	(0.019)	0.061***	(0.056)
LnT	-0.094**	(0.035)	-0.079***	(0.088)	-0.103**	(0.024)	-0.098***	(0.095)
LnFD	-0.027**	(0.035)	0.116*	(0.005)	0.131*	(0.003)	0.114**	(0.022)
MHDI	-0.127***	(0.058)	-0.075***	(0.091)	-0.121***	(0.089)	-0.109**	(0.037)
LnEC	0.194*	(0.004)	0.141**	(0.042)	0.191*	(0.000)	0.199**	(0.014)
Constant	0.230**	(0.012)	0.184*	(0.000)	0.255***	(0.056)	0.179*	(0.000)
Sample 2 (HI & UMI): High-income countries and Upper-middle-income								
LnY	0.199**	(0.015)	-	-	-	-	-	-
LnY^2	-0.111**	(0.017)	-	-	-	-	-	-
Ln Y_A	-	-	0.102***	(0.092)	-	-	-	-
LnY_A^2	-	-	-0.100**v	(0.077)	-	-	-	-
Ln Y_I	-	-	-	-	0.112**	(0.014)	-	-
LnY_I^2	-	-	-	-	0.054	(0.206)	-	-
Ln Y_S	-	-	-	-	-	-	0.131	(0.104)
LnY_S^2	-	-	-	-	-	-	-0.066	(0.152)
LnEP	0.097*	(0.000)	0.103*	(0.000)	0.077***	(0.094)	0.111**	(0.018)
LnT	-0.044	(0.105)	-0.102	(0.152)	0.112	(0.103)	-0.046	(0.190)
LnFD	0.099	(0.114)	0.102**	(0.012)	0.092***	(0.061)	0.097*	(0.000)
MHDI	-0.097**	(0.034)	-0.056**	(0.011)	-0.105*	(0.004)	-0.098***	(0.074)
LnEC	0.151*	(0.000)	0.110***	(0.071)	0.201*	(0.000)	0.184***	(0.052)
Constant	0.196*	(0.001)	0.225*	(0.008)	0.172***	(0.081)	0.189***	(0.066)
Sample 3 (UMI & LMI): Upper-middle-income and Lower-middle-income								
LnY	.0141***	(0.049)	-	-	-	-	-	-
LnY^2	-0.099**	(0.012)	-	-	-	-	-	-
Ln Y_A	-	-	0.071	(0.130)				
LnY_A^2	-	-	-0.064***	(0.094)	-	-	-	-

Ln Y_I	-	-	-	-	0.104**	(0.018)		
LnY_I^2	-	-	-	-	-0.095*	(0.000)	-	-
Ln Y_S	-	-	-	-	-	-	-0.097**	(0.013)
LnY_S^2	-	-	-	-	-	-	-0.023	(0.164)
LnEP	0.129*	(0.000)	0.135**	(0.027)	0.128*	(0.000)	0.134**	(0.040)
LnT	-0.109	(0.114)	-0.091	(0.124)	0.054	(0.178)	0.101	(0.113)
LnFD	0.106**	(0.033)	0.077**	(0.033)	-0.081	(0.124)	0.089**	(0.040)
MHDI	-0.084***	(0.056)	0.033	(0.172)	-0.077**	(0.033)	-0.068	(0.109)
LnEC	0.123**	(0.010)	0.081***	(0.058)	0.114**	(0.011)	0.097***	(0.075)
Constant	0.219**	(0.011)	0.099**	(0.017)	0.191***	(0.067)	0.202*	(0.000)
Sample 4 (LMI & LI): Lower-middle-income and Low-income								
LnY	0.087**	(0.024)	-	-	-	-	-	-
LnY^2	-0.079**	(0.043)	-	-	-	-	-	-
Ln Y_A	-	-	0.096**	(0.040)	-	-	-	-
LnY_A^2	-	-	-0.081***	(0.085)	-	-	-	-
Ln Y_I	-	-	-	-	0.088***	(0.059)		
LnY_I^2	-	-	-	-	-0.084**	(0.014)		
Ln Y_S	-	-	-	-	-	-	-0.117***	(0.087)
LnY_S^2	-	-	-	-	-	-	0.094	(0.124)
LnEP	0.225**	(0.020)	0.201*	(0.003)	0.294**	(0.016)	0.188*	(0.000)
LnT	-0.152*	(0.000)	-0.111**	(0.022)	-0.148*	(0.001)	-0.087***	(0.072)
LnFD	0.132	(0.108)	0.054**	(0.011)	0.046***	(0.082)	0.070**	(0.010)
MHDI	-0.031	(0.215)	-0.072	(0.121)	0.069	(0.192)	-0.038	(0.236)
LnEC	0.098**	(0.029)	0.056	(0.198)	0.098	(0.122)	0.043	(0.215)
Constant	0.197*	(0.000)	0.312*	(0.000)	0.124**	(0.036)	0.176*	(0.003)

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

Table 6

Panel FMOLS Long-run Elasticity Estimates for MEKC.

Independent variables	Dependent variable : Environmental degradation (E)							
	Sample 1: HI		Sample 2: HI & UMI		Sample 3: UMI &LMI		Sample 4: LMI & LI	
	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.	Coef.	Prob.
LnEP	0.084***	(0.057)	0.080**	(0.041)	0.114**	(0.039)	0.136***	(0.073)
LnEP^2	-0.066**	(0.033)	-0.051	(0.108)	-0.011	(0.273)	0.038	(0.136)
LnY	0.191**	0.025)	0.146*	(0.008)	0.111	(0.138)	0.124**	(0.029)
LnT	-0098*	(0.000)	-0.073	(0.124)	0.110	(0.104)	-0.122**	(0.018)
LnFD	0.117**	(0.022)	0.124***	(0.060)	0.084	(0.128)	0.101	(0.146)
MHDI	-0.088***	(0.089)	-0.067**	(0.046)	-0.091	(0.162)	-0.078	(0.124)
LnEC	0.231*	(0.000)	0.219**	(0.014)	0.175*	(0.005)	0.170***	(0.086)
Constant	0.265*	(0.002)	0.456*	(0.000)	0.184***	(0.063)	0.171**	(0.020)

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

After generalizing the result of the effect of per capita GDP on CO_2 emissions across samples, now we answer if the increase of economic growth constitutes a motivation to strive. The results of model 1 (Table 5) show the existence of EKC with a negative and statistically significant coefficient of Y^2 and a positive and statistically significant coefficient of Y across all but the high-income sample and sectors. The existence of an EKC is not conclusively supported for the high-income (HI) sample because the coefficient of Y (or Y_A, Y_I, Y_S) is positive and significant but the coefficient of Y^2 (or $Y^2{}_A$, $Y^2{}_I$, $Y^2{}_S$) is negative and insignificant. This is a robust result which contradicts many empirical findings. Therefore, we cannot fully confirm the first hypothesis.

Finally, we focus on an important gap in the research i.e. understanding how entrepreneurship and different sectoral outputs contribute to environmental improvement in different ways based on countries' stages of economic development or income levels. Table 5 and 6 show that the impact of entrepreneurial activity on environmental degradation is positive and statistically significant for all the samples considered. However, we found that this impact is relatively lower in the case of the high-income sample compared to the other samples. Previous efforts to address this issue focus only on how and why existing firms become greener (Cohen and Winn, 2007; Haal et al., 2010; York and Venkataraman, 2010). Haal et al. (2010) suggest that entrepreneurship may be the solution to many social and environmental problems, and could provide the way to a more sustainable future. However, when we include EP^2 in the estimated model, this parameter becomes negative and statistically significant only for the high-income sample, indicating that in the early stages of economic development environmental degradation increases with entrepreneurial activities but that after a certain level of entrepreneurship, environmental degradation starts to improve. This result confirms our second hypothesis. Despite the existence of an EKC between entrepreneurship and environmental degradation for the high-income sample, since the coefficient of EP is higher than the coefficient of EP^2, an increase in entrepreneurial activities will have a smaller effect on reducing long run environmental degradation. This means that current efforts to reduce environmental pollution will be ineffective. Cohen and Winn (2007: p.30) suggest the need for entrepreneurial actions in order to resolve our environmental problems, and suggest also that “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”.

The results for the contribution of sectoral outputs to the environmental degradation (table 5) provide some robust conclusions. Models 1-3 show that the industrial sector has a positive and statistically significant impact on environmental degradation in all four country samples, indicating that environmental degradation is elastic with respect to industry output, and that a 1% increase in industry output increases environmental degradation within the range 0.147% for the high-income sample and 0.088% for the lower-middle-income and low-income sample. So, countries with higher levels of income generally rely on their industrial sector to enhance economic growth. Clearly, this sector uses more energy - either directly or indirectly - which engenders more environmental damage. In addition, the impact of service sector on the CO_2 emissions across samples generally confirms that a move from an industrial economy to a services economy is not favorable to economic transformation in high-income countries. However, it does reduce environmental degradation in the upper-middle-income and lower-middle-income (samples 3) countries, and the lower-middle-income and low-income (Sample 4) countries. The service sector contributes positively to environmental degradation in the case of the high-income sample (0.164) but has a statistically negative impact for the other samples. Finally, the impact of agricultural output is positive and statistically significant in all the samples except sample 3 (middle-income countries). It shows that a 1% increase in agricultural output increases environmental degradation by 0.096 for the lower-middle-income and low-income countries, by 0.102 for the high-income and upper-middle-income countries, and by 0.125 for the high-income countries. Thus, agricultural output makes the smallest contribution to environmental degradation in low income countries which depend heavily on primitive agricultural technologies and logistics which reduce environmental emissions. The above results allow us to conclude that the services sector in high-income countries makes a much higher contribution to environmental degradation compared to the agriculture and industry sectors. In this context, Alcanatra and Padilla (2008), O'Mahony et al. (2012) show that the services sector is responsible for the lion's share of CO_2 emissions compared to other economic sectors, and that the transport sector which is one of the major subsectors of services accounts for most of these emissions. Due to the strong impact of services on other economic sectors, the direct and indirect impact of services output on environmental pollution is rising steadily. Since the services sector in high-income countries is the highest contributor to environmental pollution compared to other sectors, policies to reduce their emissions require a better understanding of the services sector which takes account of wholesale and retail trade, hotels and restaurants, transportation, tourism , and other subsectors. In this context, O'Mahony et al. (2012) show that services subsectors contribute a great deal to environmental pollution compared to other sectors, and that increases in the transport sector are resulted in significantly increased environmental damage. However, services tend to be less of a focus in the design of policies aimed at reducing environmental pollution.

5. Conclusions and implications

This paper contributes to the existing literature on environmental sustainability by explaining how entrepreneurship and different sectoral outputs can help to improve environmental quality for 69 countries split across four homogeneous income-based panels: high-income, upper-middle-income, lower-middle-income, and low-income economies.

It provides several important results. First, the CO_2 emissions due to the output growth is larger for high-income countries which generally rely on the service and industry sectors for enhanced growth and development, and these sectors use more energy which results in the larger CO_2 emissions. Second, the services sector is the biggest contributor to environmental pollution compared to other sectors in high-income countries. For the middle-income and lower-middle-income and low-income countries its contribution is negative; indicating that the move from an industrial and agricultural economy to services economy is beneficial for these countries. Third, there is an EKC relationship between output growth and environmental degradation across all panels and sectors except the high-income group. Fourth, the contribution of entrepreneurship to environmental degradation is lower in the case of high-income countries compared to the other country samples. Fifth, entrepreneurial activity contributes to the environmental improvement only for the high-income countries. Sixth, trade openness and human development generally have reduced the world's emissions.

Our findings helped us to give some serious policy implications in order to improve the environmental quality across the world. First, since high-income countries are responsible for most of the world's environmental pollution, the level of their environmental conservation efforts is evidently insufficient. Given their prosperity and economic size, they should channel more resources and logistics to reduce CO_2 emissions arising from energy use, most of which comes from fossil fuels. It is important for these countries to use cleaner and more efficient fossil fuel sources such as natural gas and higher-grade coal. It is important for them to increase use of renewable energy sources such as hydro, solar, geothermal, and wind. These countries should devote serious effort to technology advances to achieve a balance between economic growth and environmental conservation which is a public good. Such efforts would control and reduce environmental pollution without harming economic growth and development. Second, despite the existence of an EKC between entrepreneurship and environmental degradation for the high-income sample, since the coefficient of EP is higher than the coefficient of EP_2, an increase in entrepreneurial activities will have a smaller effect on reducing long run environmental degradation. This means that current efforts to reduce environmental pollution will be ineffective. In this context, Cohen and Winn (2007: p.30) suggest the need for entrepreneurial actions in order to resolve our environmental problems, and suggest also that “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”. To encourage these businesses, large and small, to comply with the different principles of sustainable development, two means are regularly identified: coercive means and more determined (voluntary) means. The first ones are employed by governments through laws and regulations, while the latter relate to voluntary commitments from companies themselves through corporate social responsability (CSR).

Appendix

Table A1

List of countries included

High-income	Upper-middle-income	Lower-middle-income	Low-income
- Austria	- Algeria	- Albania	- Bangladesh
- Australia	- Angola	- Argentina	- Benin
- Belgium	- Brazil	- Cameroon	- Burkina Faso
- Finland	- Bulgaria	- Cape Verde	- Bolivia
- France	- Chile	- Cote d’Ivoire	- Ethiopia
- Hungary	- China	- Egypt	- Kenya
- Ireland	- Colombia	- El Salvador	- Liberia
- Italy	- Costa Rica	- Ghana	- Mozambique
- Japan	- Jordan	- Honduras	- Uganda
- Korea Republic	- Mexico	- India	- Zimbabwe
- Luxembourg	- Romania	- Indonesia	
- Netherlands	- South Africa	- Mongolia	
- New Zealand	- Thailand	- Nicaragua	
- Norway	- Turkey	- Pakistan	
- Poland		- Guinea	
- Portugal		- Paraguay	
- Singapore		- Philippines	
- Spain		- Senegal	
- Sweden		- Syrian Arab Republic	
- Switzerland		- Sri Lanka	
- United Kingdom		- Sudan	
- United States		- Vietnam	
		- Zambia	

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