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The dynamic causality between ESG and economic growth: Evidence from panel causality analysis

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Abstract

The relationship between Environmental, Social and Governance (ESG) performance and economic growth is a controversial topic in economic literature. This paper applies the Granger causality test developed by Dumitrescu and Hurlin (2012) with an optimal lag length selection technique proposed by Han et al. (2017) to examine the causality relationship between ESG performance and economic growth for a set of 118 countries over the period 1999-2015. The empirical results show the presence of a bidirectional relationship between environmental and social performance and economic growth, while a unidirectional relationship from governance to growth for all countries. Unlike the clear overall pattern of the full sample results, the empirical evidence for different income groups of countries is mixed.

Keywords: ESG, GDP per capita, Granger causality estimation
Jel classification: O11, C23, C32.

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1 Introduction

Economic literature provides inconclusive results regarding the causal nexus between country's environmental, social and governance (ESG) performance and its economic growth. There are, typically, three schools of thought: those that contend the presence of bidirectional causality between ESG performance and economic growth ; those what pin down at least partial causal channels: for example, good ESG performance, by correcting the systematic market failure, supporting appropriate regulatory structures and promoting more productive investment leads to higher economic growth; or conversely, an increasing amount of GDP per capita provides the resources and generates popular demand for building and maintaining the quality of the environment, enhancing social progress, and ensuring better quality institutions ; and those that disregard any causal link. This variation may be attributed to the differing time periods under examination, variables used and econometric techniques employed, which eventually makes the role of environmental, social and governance performance rather a controversial topic in economic literature. However, knowing the direction of causality is important as the ESG–growth nexus has important policy implications. For instance, should the country focus on its economic development through market-oriented policies and regulatory instruments that will bring better ESG performance or should it promote its ESG performance by employing additional resources through the implementation of ESG policies?

The ESG performance–Economic growth relationship could be bi-directional. Three main arguments are presented in the literature showing causality from ESG performance to economic growth. First, ESG performance may act as guarantor that reduces uncertainty and hence ensure the efficiency of markets. Efficient markets, in turn, will ensure the maximization of investments and the attraction of advanced technologies, thereby maximizing growth and development. This issue was illustrated by Margaretic and Pouget (2018) who posited that ESG may reduce the asymmetries of information and build trust between investors and the country concerned. As such countries with good ESG performance might attract responsible asset managers and investors who screen investment opportunities based on ESG criteria to avoid investing in countries that are not acting in accordance with international norms. Second, effective ESG performance is likely to assist the allocation of assets and resources to higher productivity and higher growth sectors using both market and non-market mechanisms and assisting absorption and learning of new technologies (UNDP, 1997). Third, ESG policies, including infrastructure, education, property rights and other investments, can reduce the vulnerability of the economy to negative economic shocks. In particular, Belardi and Albertal (2009) stated that adequate ESG policies can directly and significantly affect the ability for the economy to emerge from crisis, impacting both household and private sector responses. More precisely, the authors notice that while good performance -in terms of education policies, governance and urban planning- cannot ensure shocks will not hit, ignoring such issues can arguably ensure that the impacts of shocks will persist.

Furthermore, there are three channels through which economic growth affects ESG performance. First, the increase in the rate of growth implies an increase in the country's capacity to achieve and sustain high investment rates, leading to technology advance that creates innovation. To the extent that innovation is proven to incentive the implementation of ESG policies - for example, innovation is founded to reduce the degree of environmental damage and to enhance the application of sustainable policies - higher economic growth levels might significantly enhance ESG commitments. This way, countries with the capacity to grow faster will push up their ESG aspects. Second, rising levels of employment and income raise the funds from which effective ESG policies can be financed. Indeed, countries with high, durable and socially friendly growth provide the resources for increasing investment in social issues (Montfort et al., 2014), building and maintaining the quality of environment (Fodha and Zaghdoud, 2010) and better quality institutions (McCulloch and Nguyen, 2013). Third, a better standard of living, generated by economic growth, may change lifestyles; people will give greater attention to environmental amenities, social challenges and governance. For instance, Cracolici et al. (2010) argued that high levels of economic well-being may contribute to high levels of non-economic well-being through households, firms and governance.

Empirically, at least three problems arise when assessing causality nexus between ESG performance and economic growth. First, the direction of causality between ESG performance and economic growth is unclear. An unidirectional causality running from ESG performance to economic growth implies that countries with sound ESG performance might have both a direct and indirect effect on economic growth. In this case, a country's development is matter not only of long-run economic growth but also of environmental policies (Saboori et al., 2014), social opportunities (Bloom and Fink, 2014) and institutions quality (Ajilore and Elumilade, 2007). An unidirectional causality running from economic growth to ESG performance means that the capacity of the economy to grow fast pushes up the ESG performance of a country. The rationale for this is that better economic conditions (i.e. income, human standard of living) should increase the demand for environmental protection, leading to pollution abatement (Saidi et al., 2017), should support the formation of a high level of human capabilities as improved health or knowledge (Hall and Jones, 2007) and should enhance the institutional framework (Castiglione et al., 2015). A bidirectional causality between ESG performance and economic growth implies that ESG policies and economic growth are mutually affected. Any change in one will impact the other (Cracolici et al., 2010; Law et al., 2013; Aye and Edoja, 2017).

Second, the direction of causality between ESG performance and economic growth varies according to the dimension of ESG examined and the proxy of economic growth used. For instance, when looking at the causal link between environmental performance and economic development, we can refer to at least three strands of study: first, the relationship between environmental pollution and economic development; second, the study of the energy use -economic development nexus; and finally, the marriage of the first two strands into the study of the causal relationship between between CO2 emissions, energy consumption, and economic development. All these studies make the role of environmental performance rather a controversial topic in economic literature.

Third, a crucial difference exists between the economic effects of ESG performance in countries regarding their income level. Intuitively, the high-income countries would successfully couple ESG performance with economic growth. Indeed, necessary prerequisites should exist, so that ESG factors and economic growth may be jointly determined (Castiglione et al., 2015; Bloom and Fink, 2014; Mazumdar, 2000). The absence of these favorable conditions in low-income countries largely account for the divergence between growth levels and ESG performance with no clear linkage between the former and the latter. This logic refers to

Simon Kuznets' argument (i.e. the Environmental Kuznets Curve, EKC) which posits that, initially, as per capita income rises, environmental degradation becomes excessive; but after the achievement of a critical level of economic growth, it tends to fall down. However, several empirical studies cast doubt over the reliability of the EKC.

This paper aims to contribute to the literature on economic growth. We propose an analysis in which we focus on the causal link between environmental, social and governance performance of a country and its economic growth, with particular attention to the response of three broad income groups: low income, middle income and high income. We rely on three indicators of Environmental, Social and Governance issues: CO2 emission, life expectancy at birth and Corruption Control index. All indicators are obtained from the World Bank. We employ Dumitrescu and Hurlin (2012) panel non-causality test on a set of 118 countries over the period 1999-2015. This method requires stationary data and can be used in case of cross-sectional dependency.

This study contributes to the existing empirical literature in three aspects. First, we address the issue of causality in the relationship between ESG performance and economic growth, which has not been done. Second, we apply the recently developed Granger non-causality test in heterogeneous panels using the technique of optimal lag length selection developed by Han et al. (2017). Third, the ESG-growth relationship has been explored among different income groups.

The remainder of the paper is organized as follows. Section 2 describes the data and the methodology. Section 3 shows the results and the discussions. Section 4 concludes.

2 Data and Methodology

2.1 Data description

The study aims to identify the dynamic causality between ESG and economic growth in a sample of 118 countries over the period 1999-2015. Data availability is the main criterion for both country sample and time period. Since the countries in our sample are at various stages of economic development, in addition to the full sample, the countries are divided into three sub-samples according to the World Banks income classification. Specifically, one sub-sample comprises high-income countries, another sub-sample comprises upper-middle-income countries, and a third subsample comprises lower-middle-income and low-income countries.[1]

As is standard in the literature, we opt for the GDP per capita (USD 2010 constant price) as a proxy for economic growth, the corresponding data are from World Bank Development Indicators.

We acknowledge that the measurement of a country's ESG performance is a critical and highly debated issue in economic research. There are two underlying reasons for this lively debate. The first one is related to fact that ESG performance refers to a wide range of practices that may offset the bias, making it difficult to test for convergence and for comparability. The second one concerns the absence of a clear definition of the methodology applied to as-

[1]The appendix summarizes the list of countries in the sample.

sess the performance of countries in terms of ESG issues. In the light of this, we think that the main indicator of environmental performance should be related to the quality of air (i.e. measured by the CO2 emissions metric tons per capita), that of social performance should be associated to long life prospects (i.e. measured by the life expectancy at birth), and that of governance performance should be related to corruption level (i.e. measured by the control of corruption indicator).

The CO2 emissions metric tons per capita, extracted from World Development Indicators, are a weighted average of Carbon dioxide emissions stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. We chose CO2 emissions in our study since Carbon dioxide (CO2) makes up the largest share of the greenhouse gases contributing to global warming and climate change. Converting all other greenhouse gases (methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6)) to carbon dioxide (or CO2) equivalents makes it possible to compare them and to determine their individual and total contributions to global warming.

The life expectancy at birth, provided by the World Development Indicators, is the average number of years a newborn is expected to live if mortality patterns at the time of its birth remain constant in the future. It reflects the overall mortality level of a population and summarizes the mortality pattern that prevails across all age groups in a given year. Life expectancy at birth allows the reporting of life expectancy at other ages to track health improvements for specific age groups in populations. It is included as a basic indicator of health and social development in, among others, the Minimum National Social Data Set endorsed by the United Nations Statistical Commission and the OECD/DAC core indicators.

The control corruption (Percentile Rank), obtained from the The Worldwide Governance Indicators (WGI), captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture"of the state by elites and private interests. Percentile rank indicates the country's rank among all countries covered by the aggregate indicator, with 0 corresponding to lowest rank, and 100 to highest rank.

The descriptive statistics of all the variables are reported in the Table 1.

Table 1: Descriptive statistics

	All (118)		HI (46)		MI (34)		LI (38)	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
GDP	15700.40	20190.98	34750.29	20931.63	5888.40	2470.91	1419.14	877.53
CO2	28.77	30.72	11.75	8.11	4.03	2.88	1.03	1.27
LE	71.49	8.15	77.7	3.61	71.20	6.04	64.24	7.64
CR	52.03	28.95	79.71	17.71	42.97	20.15	26.62	14.62

Note: HI stands for high income countries, MI for Upper-middle income countries and LI for Lower-middle and low-income countries. CO2 is the CO2 emissions metric tons per capita. LE is the life expectancy at birth. CR is the corruption control and GDP is the GDP per capita. All the data are obtained from the World Bank. They are included on logarithms in order to include the proliferative effect of time series.

2.2 Empirical approach

2.2.1 Granger causality on panel data

To explore the causality issue, we apply the Granger non-causality test for panel data models extended by Dumitrescu and Hurlin (2012). The test of Dumitrescu and Hurlin (2012) requires a heterogeneous panel data with fixed effects and stationary variables. Moreover, they extend the standard causality test in the panel data that allows for the presence of cross sectional dependence. The Granger non-causality relationship between the growth and E, S, G factor and is estimated as follow:

$$y_{it} = \alpha_{i1} + \sum_{k=1}^{K} \beta_{i2}^{(k)} y_{i,t-k} + \sum_{k=1}^{K} \gamma_{i1}^{(k)} x_{i,t-k} + \varepsilon_{it1} \tag{1}$$

$$x_{it} = \alpha_{i2} + \sum_{k=1}^{K} \beta_{i2}^{(k)} x_{i,t-k} + \sum_{k=1}^{K} \gamma_{i2}^{(k)} y_{i,t-k} + \varepsilon_{it2} \tag{2}$$

where y is the GDP per capita (USD 2010 constant price); x is a variable represented by environment index, social index and governance index. α_i is individual effects. $i = 1, ..., N$ and $t = 1, ..., T$ is cross-section unit and time period of the panel data. K is the lag order identical for all cross-section units of the panel.

Dumitrescu and Hurlin (2012) propose to test the homogeneous non-causality (HNC) hypothesis that is the homogeneous non causality hypothesis from x to y. A rejection of the null hypothesis, indicating that there is a causality relationship from x to y for at least one cross-section unit. The HNC Wald statistic associated with this test is computed by the average of individual Wald statistic:

$W_{N,T}^{HNC} = \frac{1}{N} \sum_{i=1}^{N} W_{i,T}$

Then, Z_{HNC} and $\tilde{Z}_{HNC}$ statistic are calculated to test the HNC test. The Z_{HNC} is used for large N and T samples, $Z_{HNC} = \sqrt{N/(2*K)} * (W_{N,T}^{HNC} - K)$; whereas the approximated value $\tilde{Z}_{HNC}$ is applied for finite T samples, $\tilde{Z}_{HNC} = \sqrt{\frac{N}{2K} \frac{T-2K-5}{T-K-3}} * \frac{T-2K-3}{T-2K-1} * (W_{N,T}^{HNC} - K)$.

Dumitrescu and Hurlin (2012) did not demonstrated how to find optimal lag in the HNC estimation. Hence, the causality result is sensitive with lag chosen. Generally, the best model is chosen by minimizing information criteria. Stone (1979) proved the inconsistency of BIC due to the presence of incidental parameters whereas Moon et al. (2007) demonstrated that these criteria information are inconsistent in dynamic panel models. Han et al. (2017) proposed a new information criteria to choose optimal lag in dynamic panel which is called the Modify Bayesian information criteria (MBIC)[2]. Therefore, we apply the latter extension in this study.

[2] We acknowledge the summary review of optimal lag chosen in Tran et al. (2017)

The MBIC is computed based on an autoregressive model $AR(k)$:

$$y_{it} = \sum_{s=1}^{K} \rho_s y_{i,t-s} + \varepsilon_{it}$$

$$MBIC(K) = ln(\hat{\sigma_k}) + K * \frac{ln(\sqrt{N}(T-K))}{\sqrt{N}(T-K)} \quad (3)$$

where $\hat{\sigma}_k^2 = \dfrac{1}{N(T-K)} \sum_{i=1}^{N} \sum_{t=k+1}^{T} \hat{\sigma}_{k,it}^2$

$\hat{\sigma}_{k,it}^2 = y_{it} - \hat{\beta}_k X'_{k,it}$; $X_{k,it} = (y_{it-1}, ..., y_{it-k})$; $\beta_k = (\rho_1, ..., \rho_k)'$

2.2.2 Preliminary tests

The Dumitrescu and Hurlin's causality technique with panel data requires some preliminary tests that involve verifying heterogeneity between units, cross sectional dependence, stationarity of the variables and selection of optimal lag length.

First, we apply Hsiao (2003) approach to perform the heterogeneous test for panel data. The null hypothesis is homogeneity panel data. The null hypothesis of F1, F2, F3 statistics is slopes and intercepts simultaneously homogeneous; slopes are the same and intercepts are the same. The results shown in the Table 2 indicate that the panel data is heterogeneity significantly at the 1% level.

Table 2: Heterogeneous coefficients tests for panel data

	CO2	LE	CR
All countries (118)	F1 = 1.39***	F1 = 1.59***	F1 = 1.41***
	F2 = 0.51***	F2 = 0.77***	F2 = 0.53
	F3 = 3.35***	F3 = 3.32***	F3 = 3.37***
HI (46)	F1 = 137.01***	F1 = 170.65***	F1 = 72.39***
	F2 = 0.60	F2 = 2.29***	F2 = 1.58***
	F3 = 430.82***	F3 = 437.65***	F3 = 199.62***
MI (34)	F1 = 8.47***	F1 = 3.58***	F1 = 0.94
	F2 = 10.61***	F2 = 3.25***	F2 = 0.37
	F3 = 1.92***	F3 = 3.33***	F3 = 2.26***
LI (38)	F1 = 3.26***	F1 = 2.48***	F1 = 2.39***
	F2 = 1.92***	F2 = 1.88***	F2 = 1.06
	F3 = 5.33***	F3 = 3.32***	F3 = 5.03***

Note: F1 tests whether slopes and intercepts are simultaneously homogeneous among different individuals at different times. F2 tests whether the regression slopes are collectively the same. F3 tests whether the regression intercepts are (given the same slope coefficients).HI stands for high income countries, MI for Upper-middle income countries and LI for Lower-middle and low-income countries. ***, **, * determine significance at 1%, 5%, and 10% level respectively.

Second, we determine whether our panel data is cross-sectionally independent. To that end, we use the methodology proposed by Pesaran(2004). Table 3 reports that the null hypothesis of no cross-sectional dependence is rejected at the 1% level of significance in both the whole sample and sub-samples. Therefore, cross-sectional dependencies exist in our data, which confirms that the panel causality is appropriate

Table 3: Cross-sectional dependence test

	CO2	LE	CR
All countries (118)	83.53***	82.00***	82.22***
HI (46)	78.88***	80.28***	76.26***
MI (34)	10.24***	24.73***	25.12***
LI (38)	13.49***	14.36***	15.86***

Note: The cross-sectional dependence test is performed following Pesaran(2004) approach. The null hypothesis is the cross sectional independence. HI stands for high income countries, MI for Upper-middle income countries and LI for Lower-middle and low-income countries. ***, **, * determine significance at 1%, 5%, and 10% level respectively.

Third, to verify the stationarity of our panel data-sets, we perform the panel unit root tests introduced by Im et al. (2003). The null hypothesis is that the series contains a unit root. Based on Schwarz information criterion, the panel unit root tests are shown in Table 4 for both variables in levels. We take the first difference of non-stationary variables because the test of Granger non-causality of Dumitrescu and Hurlin (2012) requires stationary variables.

Table 4: Panel unit root test

	GDP	CO2	LE	CR
All countries (118)	4.41 (-16.52***)	-6.83***	-5.34***	-2.37***
HI (46)	-1.47**	5.58 (-18.68***)	1.43 (-18.78***)	-1.60***
MI (34)	2.26 (-8.46***)	-0.04 (-15.60***)	-3.41***	-0.07 (-13.56***)
LI (38)	7.09 (-9.25***)	1.21 (-15.21***)	-7.40***	-2.32**

Note: The unit root test is performed following Im et al. (2003). The null hypothesis is that the series contains a unit root. The unit root test is applied the first difference if the series are not stationary in level, shown in parenthesis. HI stands for high income countries, MI for Upper-middle income countries and LI for Lower-middle and low-income countries. ***, **, * determine significance at 1%, 5%, and 10% level respectively.

Choosing an appropriate lag length is important in the Granger causality test because the results are sensitive to the number of lags. Table 5 provides the optimal lag for each regression. We choose 3 as the lag maximum because the lag order K must satisfy the condition of the size $T - K$ must be larger than $5 + 2 * K$.

Table 5: Finding optimal lag based on Han et al. (2017)

Group	Lag	GDP → CO2	CO2 → GDP	GDP → LE	LE → GDP	GDP → CR	CR → GDP
All (118)	1	**-1.684889**	**-3.01**	-7.95	**-3.01**	**-0.41**	**-3.01**
	2	-1.66	-2.94	-8.44	-2.93	-0.37	-2.96
	3	-1.684841	-2.86	**-8.61**	-2.86	-0.34	-2.88
HI (46)	1	-3.76	-4.66	-9.23	-4.64	**-4.23**	-4.64
	2	**-3.77**	**-4.68**	-9.19	**-4.68**	-4.19	**-4.69**
	3	-3.72	-4.67	**-9.245**	-4.66	-4.15	-4.67
MI (34)	1	-3.582	**-3.64**	-8.82	**-3.64**	**-1.77**	**-3.65**
	2	**-3.585**	-3.55	-9.97	-3.55	-1.74	-3.60
	3	-3.53	-3.46	**-10.18**	-3.46	-1.66	-3.53
LI (38)	1	**-3.029**	**-4.58**	-9.16	**-4.58**	**-0.73**	**-4.58**
	2	-2.979	-4.52	-11.28	-4.51	-0.64	-4.55
	3	-2.975	-4.43	**-11.34**	-4.45	-0.62	-4.46

Note: Value in bold is the minimum value of MBIC corresponding to the optimal lag. HI stands for high income countries, MI for Upper-middle income countries and LI for Lower-middle and low-income countries.

3 Results and Discussions

The preliminary analysis having been completed, we now turn to the Granger causality test. Table 6 shows the results of the Dumitrescu-Hurlin Panel Causality test with an optimal lag length selected.

Regarding the GDP-CO2 emissions, the null hypothesis is rejected at 1% level of significance in both directions, taking the whole sample into consideration. This tends to suggest a bidirectional causality relationship between GDP and CO2 emissions, indicating that economic growth and environmental quality are mutually affected. The same Granger causality analysis has conducted across sub samples with different income levels. For the high-income and low-income economies, we observe a partial positive causal link. More specifically, this link runs from economic growth to environment, for high-income economies, while the reverse link exists for low-income economies. Regarding the upper-middle income economies, a bidirectional relationship is observed between GDP and CO2 emissions.

Taking the whole sample, we observe that at 1% level of significance, it is evident to reject the null that GDP does not homogeneously cause life expectancy. This tends to imply that economic growth across the countries can be used to predict life expectancy and consequently the prospects for longer life and better health conditions. At 1% level of significance, it is also evident to reject the null that life expectancy does not homogeneously cause GDP. This should suggest that well-being indicators across the countries can be used to predict economic growth. Hence, it has been decided that a bidirectional causality relationship may exist between life expectancy and GDP per capita. This may indicate that neither social conditions nor economic growth can be considered exogenous because feedback may occur. This bidirectional causality remains significant across subsamples with different income levels, providing a strong evidence for this bidirectional relationship exists.

If we now turn to the governance dimension, we find the same heterogeneity in results as observed for the environmental dimension. In particular, for the whole sample, there exists a unidirectional relationship running from governance to economic growth. Control of corruption has a positive significant effect on GDP per capita. We find the same finding for low-income economies. Concerning high-income economies, there is a bidirectional relationship between GDP per capita and control of corruption while for upper-middle income countries, it seems that no causal link exists between economic growth and governance as measured by control of corruption.

Table 6: Dumitrescu-Hurlin Panel Non-causality Test

Group	Null hypothesis	W-bar statistic	Z-bar
All (118)	H0: *GDP* does not Granger-cause *CO2*	1.48	3.69***
	H0: *CO2* does not Granger-cause *GDP*	2.14	8.79***
	H0: *GDP* does not Granger-cause *LE*	5.11	9.36***
	H0: *LE* does not Granger-cause *GDP*	1.82	6.30***
	H0: *GDP* does not Granger-cause *CR*	1.03	0.29
	H0: *CR* does not Granger-cause *GDP*	1.87	6.71***
HI(46)	H0: *GDP* does not Granger-cause *CO2*	5.20	10.88***
	H0: *CO2* does not Granger-cause *GDP*	1.73	-0.88
	H0: *GDP* does not Granger-cause *LE*	4.99	5.53***
	H0: *LE* does not Granger-cause *GDP*	2.63	2.15**
	H0: *GDP* does not Granger-cause *CR*	1.46	2.22**
	H0: *CR* does not Granger-cause *GDP*	3.41	4.79***
MI (34)	H0: *GDP* does not Granger-cause *CO2*	2.93	2.73***
	H0: *CO2* does not Granger-cause *GDP*	1.60	2.49**
	H0: *GDP* does not Granger-cause *LE*	5.49	5.94***
	H0: *LE* does not Granger-cause *GDP*	2.31	5.42***
	H0: *GDP* does not Granger-cause *CR*	0.84	-0.65
	H0: *CR* does not Granger-cause *GDP*	1.31	1.29
LI (38)	H0: *GDP* does not Granger-cause *CO2*	1.15	0.65
	H0: *CO2* does not Granger-cause *GDP*	1.48	2.12**
	H0: *GDP* does not Granger-cause *LE*	4.46	3.67***
	H0: *LE* does not Granger-cause *GDP*	2.04	4.53***
	H0: *GDP* does not Granger-cause *CR*	0.97	-0.12
	H0: *CR* does not Granger-cause *GDP*	2.14	5.00***

Note: ***, **, * mean the rejection the null hypothesis of homogeneous non-causality at 1%, 5%, and 10% level respectively.

In conclusion, our findings are as follows. First, there are two-way causal relationships between GDP per capita and CO2 emissions for all countries. Unlike the clear overall pattern of the full sample results, the empirical evidence for different income groups of countries is mixed. The results for the subsample of upper middle-income countries are qualitatively similar to those of the full sample results. However, the results for the subsamples of high-income and low-income countries differ from the full sample results. Why are the results heterogeneous? For high-income economies, the unidirectional link (from GDP to CO2 emission) may establish that extensive output growth leads to more fossil fuel consumption that contributes towards higher level of emissions. This statement implies that, as the economy grows, more CO2 emissions are released perhaps due to more industrial activities without necessarily employing environmentally friendly policies that should enhance environmental quality. For upper-middle income countries, the presence of bidirectional causality between CO2 emissions and economic growth suggests that GDP growth can help to determine whether CO2 emissions would increase or decrease and at the same time CO2 emissions could spur the economic growth to embark on developments that would help to mitigate such emissions. For low-income economies, the unidirectional link (from CO2 emissions to GDP) may indicate that CO2 emission is likely to be a determinant of economic growth: aside the previous value of GDP, the past value of CO2 emissions can help to predict the path of GDP.

Second, the evidence we present suggests a bilateral causal relationship between GDP per capita and life expectancy. This evidence is robust across subsamples with different income levels. This implies that good social performance and economic growth are jointly affected by shocks and any austerity measures regarding social conditions may have an adverse effect on economic growth. This finding is consistent with (Cracolici et al., 2010) who find, using a simultaneous equation model (SEM), a strong bidirectional causal relationship between GDP (the economic performance indicator) and life expectancy for 64 developed and developing countries over the 1980-1999 period.

Third, we find a unidirectional relationship between control of corruption and GDP in which control corruption positively affects GDP per capita for all countries. This result is also observed for low-income countries. In the case of high-income economies, a bidirectional relationship between GDP per capita and corruption is observed while there is no causal relationship in the case of upper-middle-income economies. This result is remarkable since it contradicts the idea of (Khan, 2007) that good governance is not effective for the economies where markets are too weak (i.e low income countries). One way to read this finding is that income level of a country significantly affects the governance-growth relationship.

Practical implications of our results are twofold. First, they indicate that environmental, social and governance factors may account for the divergence in economic performance across countries. Such a conclusion is interesting for governments and policy makers, concerned about the determinants of the growth. It is also relevant for foreign investors who screen investment opportunities based on ESG criteria to avoid investing in countries that are not acting in accordance with international norms. Second, ESG performance seems to make a major contribution to economic growth in the case of low-income countries. This finding has policy relevance for many economies looking for enhancing their economic growth.

4 Conclusion

The question of whether a country's ESG performance is a good predictor for economic growth or vice versa is of high significance. This issue is all the more significant since the ESG-growth nexus has important policy implications. For example, should the country focus on its economic development through market-oriented policies and regulatory instruments that will bring about better ESG performance or should it promote its ESG performance by employing additional resources in encouraging such commitment?

The objective of the present paper is to investigate the causal link between ESG performance and economic growth for a set of 118 countries over the period 1999-2015, with a particular attention to the response of three broad income groups: low income, middle income and high income. We rely on three indicators of Environmental, Social and Governance issues: CO2 emission, life expectancy at birth and control of corruption. All indicators are obtained from the World Bank. We employed Dumitrescu and Hurlin (2012) panel non-causality test on a set of 118 countries over the period 1999-2015 after choosing the optimal lag length following Han et al. (2017). Our empirical results show, for the whole sample, a bidirectional relationship between environmental and social performance and economic growth, unlike a unidirectional relationship from governance to growth. Unlike the clear overall pattern of the full sample results, the empirical evidence for different income groups of countries is mixed. Thus, we may conclude that the income level of a country may significantly affect the causality ESG-growth nexus. For future research, it would be interesting to study more specifically what underlies the ESG-growth relationship.

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5 Appendix

World Banks income classification. The groups are: low income, \$1,045 or less; lower middle income, \$1,0464,125; upper middle income, \$4,12612,735; and high income, \$12,736 or more.

Name of each group:

High-income 46: Argentina, Australia, Austria, Bahrain, Belgium, Canada, Chile, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, South Korea, Kuwait, Latvia, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Oman,Poland, Portugal, Qatar, Russia, Saudi Arabia, Singapore, Slovakia, Slovenia, Spain, Sweden, Switzerland, Trinidad and Tobago, United Arab Emirates, United Kingdom, United States.

Upper Middle income 34: Albania, Algeria, Azerbaijan, Belarus, Bosnia and Herzegovina, Botswana, Brazil, Bulgaria, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Gabon, Jamaica, Jordan, Kazakhstan, Lebanon, Libya, Malaysia, Mauritius, Mexico, Mongolia, Namibia,Panama, Paraguay, Peru, Romania, South Africa, Thailand, Tunisia, Turkey, Turkmenistan.

Lower Middle and Low income 38: Armenia, Bangladesh, Benin, Bolivia, Cambodia, Cameroon, Egypt, El Salvador, Ethiopia, Georgia, Ghana, Guatemala, Haiti,Honduras, India,Indonesia, Kenya, Kyrgyz Republic, Moldova, Morocco, Mozambique, Nepal, Nicaragua, Niger, Nigeria, Pakistan, Philippines, Senegal, Sri Lanka, Tajikistan, Tanzania, Togo, Ukraine, Uzbekistan, Vietnam, Yemen, Zambia, Zimbabwe.