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Insurance Market Development, Energy Consumption, and Turkey's CO_2 Emissions. New Perspectives from a Bootstrap ARDL Test

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Abstract: Many empirical studies have tested the linkage among CO_2 emissions, economic growth, and consumption of energy; however, most have not tested the possible influence of insurance market development on their frameworks. This research aims to provide new perspectives on the empirical literature by exploring the role of insurance market development on environmental degradation. The study utilizes a new technique of the bootstrap Autoregressive Distributed Lag (ARDL) test as introduced by (McNown et al., 2018). The ARDL testing approach is utilized to explore the short and long linkage between the examined variables. Furthermore, the research utilized the Granger causality to explore the of causality linkage among the selected variables. The findings illustrate that economic growth and consumption of nonrenewable energy have positive influence on CO_2 emissions. Furthermore, the findings illustrate that the insurance market development has a positive influence on the levels of Turkey's carbon emissions; this finding is also confirmed through the economic growth channel. The outcomes of the current study suggested that the Turkish policy makers should make strategies and policies to ensure the sustainable development of insurance markets, to reduce environmental degradation by supporting the projects, and to invest in clean energy sources.

Keywords: insurance market development; energy; CO_2 emission; bootstrap ARDL; Turkey

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1. Introduction

Turkey, as an emerging economy, faced several changes in the economic structure over the period 1981 to 2016; the economic performance in Turkey demonstrated that its GDP increased from 107 billion USD in 1981 to 869 billion USD in 2016. The total international trade in Turkey as a share of GDP increased from 32% in 1989 to 55.14% in 2016. The FDI in Turkey as a share of GDP also rose from 1% in 1989 to 3.6% in 2016. On the other hand, Turkey's consumption of nonrenewable energy increased around 250% over the last three decades from 926.5 Kilogram (s) of oil-equivalent in 1982 to 1600 Kilogram (s) of oil-equivalent in 2016. However, urbanization, demographic trends, and increasing per capita economic growth are boosting the consumption of energy in Turkey. Although nonrenewable energy resources are attractive, they negatively affect the environment. In this sense, CO_2 emissions (metric tons per capita) in Turkey increased from 1.77 in 1981 to 4.69 metric tons in 2016 (See Figure 1). Due to these reasons, the importance of renewable energy has risen in Turkey. However, Turkey needs to lead in renewable energy resources. Thus, the sustainable economic development of Turkey will increase and environmental pollution will be lower within this process, and a contribution that was made to renewable energy resources of Turkey will inevitably rise in overall energy consumption [1]. The main

purpose of this research is to provide new perspectives to the literature by analyzing the role of the insurance market development on the levels of environmental degradation in Turkey over the tested period from 1981–2016.

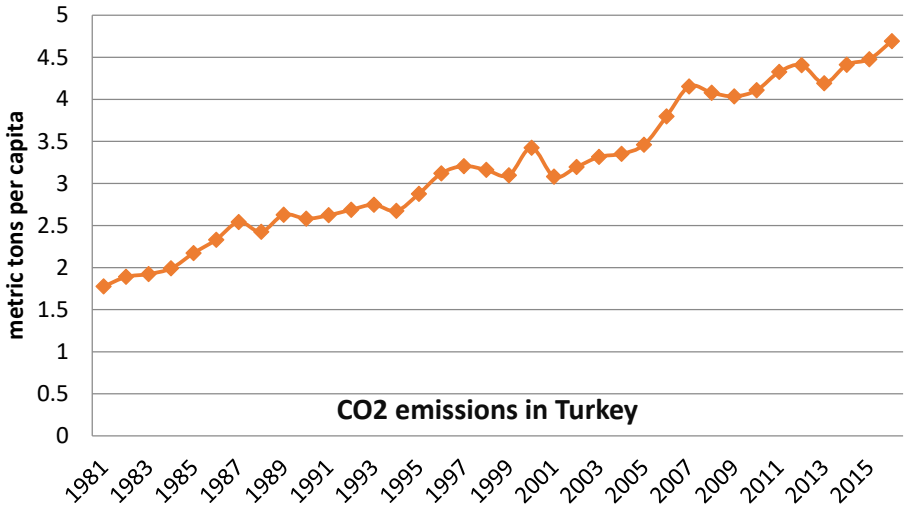

Figure 1. Levels of CO_2 emissions over the period from 1981 to 2015.

The insurance market development in Turkey experienced a positive development over the period 1981 to 2016. According to the Association of the Turkish Insurance and Reinsurance, the Turkish insurance sector became the 35th biggest in the world. The sector claims around 1.6% of Turkey's gross domestic product. The development of the insurance market has a significant influence on economic efficiency, such as reducing the cost of borrowing, financial and business risk, access to greater capital, as well as being able to affect energy demand and consumption by using the newest energy-efficient products and techniques [2]. Hence, the insurance sector may increase the efficiency of capital accumulation and investment. Therefore, it has a positive influence on economic growth rates. In this sense, the development of the insurance sector enhances financial innovation and promotes the adoption of advanced technology.

Several studies have focused on the effect of financial market development on environmental degradation. A critical aspect of insurance markets that has largely been ignored in the empirical studies is the effect of the insurance sector on environmental degradation. However, the insurance market provides a safety net and security for both individuals and businesses. Furthermore, insurance market activities have powerful influence within an economy. For instance, indemnification services provided by the insurance market to the business and individual aids risk-averse individuals in purchasing and getting large-expense items, such as real estate, automobiles, etc., which in turn will lead to increase the investment and nonrenewable energy consumption. This leads to the insurance market having a significant influence on the economic performance.

The study suggests that insurance market development may affect CO_2 emissions through two channels: the economic growth and energy consumption. In this sense, many empirical studies confirmed that insurance market development has significant influence on economic performance [3–6]. These empirical studies illustrate that the insurance markets have powerful implications for the accumulation of productive capital within an economy. In this line, the insurance market development enables investors to diversify their investment, which leads to increase high-productivity investments. Subsequently, it will lead to enhance the liquidity positions in the markets, and boost the economic growth rates. Reference [7] suggested that insurance market development has a powerful impact on the investment through insurance companies monitoring. Therefore, the investors may promote the productive potential of their investment that they choose to fund, thus causing an increase in the investment through the purchase of new techniques and equip-

ment and, subsequently, this will lead to a raise in the levels of energy consumption and CO_2 emissions.

However, the current research aims to explore the linkage among the insurance sector development index, and the levels of Turkey's CO_2 emissions. Moreover, this research aims to explore the linkage among nonrenewable energy consumption, economic growth, and the levels of carbon dioxide CO_2 emissions in Turkey for the period 1981–2016. The research uses the following unit root tests: Clemente-Montanes-Reyes (CMR), the Perron-Vogelsang, with structural break dates SBD to test the stationary of the selected data. To provide new empirical evidence to the literature, the study uses the (ARDL) bootstrap testing approach, as suggested by [6]. Furthermore, a new co-integration technique of the Bayer-Hanck [8] test is employed to affirm the outcomes of the ARDL test. The study estimates coefficients among the tested variables using the ARDL model.

The research structure of this paper as follows: the Section 2 presents the empirical literature; the Section 3 presents the examined data and tested models; the Section 4 shows the empirical findings of this study; and the conclusion of this paper is presented in Section 5.

2. Review of the Empirical Literature

The environmental Kuznets curve (EKC) is a hypothesized linkage between environmental pollution indicators, such as CO_2 emissions and economic growth. In the early stages of economic growth, the CO_2 emissions levels increase, but beyond some economic growth levels, the trend reverses. This means that CO_2 emissions per capita is presented as a U-shaped function of economic growth per capita. Since the EKC hypothesis was developed, many scholars with different methodologies empirically explored the association between economic growth, consumption of energy, and the levels of CO_2 emissions. In this sense, [9] (2011) illustrated that there is a bi-directional causal linkage among energy consumption and CO_2 emissions in Russia. Other researchers [10] tested the linkage among energy consumption, GDP, and carbon emissions in Turkey over the tested period 1992–2013. The outcomes reveal that consumption of energy and economic growth impacts CO_2 emissions positively. The authors of [11] demonstrated that there is a positive linkage among CO_2 emissions and nonrenewable energy consumption in OECD countries. Furthermore, the authors of [12] tested the interaction among energy consumption and the US CO_2 emissions from 1960 to 2010 period. The outcomes affirmed that consumption of energy and GDP positively affect the levels of CO_2 emissions. The authors of [13] tested the interaction among energy consumption and the CO_2 emissions in BRICS countries. Using the FMOLS and DOLS test, the outcomes affirmed that consumption of energy and GDP positively affect the levels of CO_2 emissions. The authors of [14] used the ARDL model, and showed that energy efficiency is a reducing factor of ecological footprint in ASEAN Region.

Using the ARDL testing model, the authors of [15] examined the period from 1960 and 2005 in Turkey. The findings suggested that the EKC hypothesis is accepted in Turkey. The authors of [16] tested the EKC hypothesis in India over the tested period 1971–2007. The findings suggested an increase in real income and energy consumption increased carbon emissions for this country. Bento and the authors of [17] tested the influence of fossil fuels consumption and economic growth on CO_2 emissions in Italy over the tested period from 1960–2011, the outcomes found that fossil fuels energy and GDP positively affect CO_2 emissions, and suggested that nonrenewable energy consumption has an inverse relation with carbon emission. The authors of [18] used the ARDL approach, and examined the validity of the EKC in Turkey. The findings affirmed that an increase in real GDP and energy consumption increased carbon emissions for this country.

Empirical studies on the linkage between markets and environmental degradation have mainly focused on the effect of financial market development on environmental degradation. The authors of [19] examined the effect of financial sector development on the consumption of energy and carbon emission in China from 1980 to 2009. The results found that financial sector development has a powerful influence on the CO_2 emissions

in China. The authors of [20] explored the influence of financial sector on the levels of carbon emissions in MENA countries. By applying DOLS, the results demonstrated that financial sector development positively affects CO_2 emission. The authors of [21] applied the VECM testing model and supported that financial sector development positively affects CO_2 emissions in India during the period from 1970 to 2012. The authors of [22] explored the linkage among financial sector development and CO_2 emissions in Turkey. Using the ARDL test, the results implied that financial sector development has a significant driver for the increase in the consumption of energy and CO_2 emission in Turkey. The authors of [23] illustrated that there a positive linkage among the financial sector development and the levels of CO_2 emissions in India, Russia, China, and South Africa during the period 1995 to 2014.

However, many empirical studies have tested the linkage among the consumption of energy and economic growth and the levels of carbon emissions. However, most have not tested the possible influence of insurance market development on their tested frameworks. Hence, the current research aims are to investigate and provide new perspectives by exploring the role of insurance market development on environmental degradation using two co-integration techniques, namely, the new technique of bootstrap-ARDL (2019) and the updated test [7] of the Bayer-Hanck (2013) technique. The study suggests that insurance market development may affect CO_2 emissions through the economic growth channel. In this sense, many empirical studies confirmed that insurance market development has a significant influence on economic performance. In this sense, [3] used panel data model, and suggested that insurance market activity positively affect economic growth rates in for different 55 selected countries over the tested period from 1976 to 2004. The authors of [4] tested the linkage among insurance market economic growth for selected OECD countries from the 1999 to 2008 period. The findings illustrated that the insurance market positively affected the economic growth. The authors of [6] tested the linkage among the insurance market and economic growth in 22 selected counties. The findings confirmed that there is a positive linkage among economic growth and insurance market; the findings suggested that the influence of insurance expenses on economic growth is more significant for developing countries than developed countries. The authors of [5] provided updated evidence that there is a positive economic growth, which led to improvement of the insurance market in OCED countries.

3. Model and Data

The economic growth (EG), square of EG^2, and non-renewable are the main determinants of the CO_2 emissions levels. This research is different from the other empirical studies by investigating the link among insurance market development and the levels of CO_2 emissions. Thus, insurance market development will be examined tested model of EKC. The testing model of this study is depicted in Equation (1) as follows:

$$lnCO_{2t} = \beta_0 + \beta_1 lnEG_t + \beta_2 InEG_t^2 + \beta_3 lnNREC_t + \beta_4 lnIMD_t + uit \quad (1)$$

where $lnCO_{2t}$ is the logarithm of carbon emissions (in kilotons), $lnEG_t$ is the economic growth (in constant-2010 USD), $InEG_t^2$ is the square of EG, $lnNREC_t$ represents a consumption of non-renewable energy (coal, oil, and natural gas in BTUs), $lnIMD_t$ Is the total insurance penetration (life and non-life) as a percentage of the GDP, and uit represents the error-disturbance of the examined model. The tested data are collected from the World Bank, Energy Information Administration. The tested data of this study cover the period from 1981 to 2016. However, the limited selected data from 1981 to 2016 can be attributed to the fact that some data are not available after 2016.

Unit Root Tests and Co-Integration Tests

It is vital to test whether the data are stationary or not before testing any interconnections between the time series. The research utilizes Clemente-Montanes-Reyes (CMR) (1998) and Zivot-Andrews (ZA) (2002) tests with one and two dates of structural changes (DSC).

To identify the levels of co-integration among CO_2 emissions and the regressors, the research utilizes the newly developed of ARDL testing approaches suggested by [6] McNown et al. (2019). The updated version of bootstrap-ARDL model contains additional tests of the "T" Test $t_{dependent}$ or "F" test $F_{independent}$ on the estimated coefficients of independent-variables. The null hypothesis of the $t_{dependent}$ test is: $\partial_1 = 0$. The alternative hypothesisof $t_{dependent}$ test is: $\partial_1 \neq 0$. The null hypothesis of the $F_{independent}$ test is $\partial_2 = \partial_3 = \partial_4 = 0$. The H_1 of the $F_{independent}$ test is H_1: $\partial_2 \neq \partial_2 \neq \partial_3 \neq \partial_4 \neq 0$.

The newly developed of bootstrap-ARDL technique is preferred over traditional techniques, such as the Pesaran ARDL testing model (2001) of co-integration. There is no sensitivity nor problem with respect to the order of integration levels, and there is also a high estimation competency when using this technique, while addressing the issues of inconclusiveness of test series, which the traditional tests of co-integration, such as Pesaran ARDL test, fail to overcome [20].

Ref. [6] updated the new technique of the ARDL model by using critical values (CVs) generated by bootstrap simulation. The generation of CVs using the new technique is based on the specific integration levels for each tested series. This advantage leads to the elimination of the problem of ARDL findings stability, which in turn leads to provide better results than the traditional techniques of co-integration [20]. For instance, the CVs in the traditional techniques, such as the Pesaran ARDL testing model, allow for only one variable in the examined model to be endogenous. In contrast, the CVs in the updated technique of the ARDL testing model allow for all explored variables to be endogenous [24,25]. In this sense, the current research aims to provide new testing evidence to the empirical literature by exploring the linkage between Turkey's CO_2 emissions, renewable energy consumption, insurance market development, and economic growth using the new technique of ARDL test.

Furthermore, the current research uses the ARDL testing model to analyze the linkage among CO_2 emission and tested regressors in short- and long-term levels. The ARDL testing model is depicted in Equation (2) as follows:

$$\begin{aligned}\Delta lnCO_{2\ t} = \beta_0 \quad & + \sum_{i=1}^{L} y_1 \Delta lnCO_{2\ t-j} + \sum_{i=1}^{L} y_2 \Delta lnGEG_{t-j} + \sum_{i=1}^{L} y_3 \Delta lnEG_{t-j}^2 + \sum_{i=1}^{L} y_4 \Delta lnNREC_{t-j} \\ & + \sum_{i=1}^{L} y_5 \Delta lnIMD_{t-j} + \partial_1 lnCO_{2\ t-1} + \partial_2 lnEG_{t-1} + \partial_3 lnEG_{t-1}^2 + \partial_4 lnNREC_{t-1} \\ & + \partial_5 lnIMD_{t-1} + u_{1t}\end{aligned} \tag{2}$$

In Equation (2), Δ represents the first difference process of the investigated series. $lnCO_2$, $lnEG$, $lnEG^2$, $lnNREC$, $lnIMD$ are the investigated variables of this study in the logarithms; L denotes the optimal of lags. The error correction of estimated model ($ECTerm_{t-1}$) is depicted in Equation (2) as follows:

$$\begin{aligned}\Delta lnCO_{2\ t} = \beta_0 \quad & + \sum_{i=1}^{L} \beta_1 \Delta lnCO_{2\ t-j} + \sum_{i=1}^{L} \beta_2 \Delta lnEG_{t-j} + \sum_{i=1}^{L} \beta_3 \Delta lnEG_{t-j}^2 + \sum_{i=1}^{L} \beta_4 \Delta lnNREC_{t-j} \\ & + \sum_{i=1}^{L} \beta_5 \Delta lnIMD_{t-j} + ECT_{t-1} + u_t\end{aligned} \tag{3}$$

where Δ represents a change in $lnCO_2$, $lnEG$, $lnEG^2$, $lnNREC$, $lnIMD$. The statistically significant $ECterm_{t-1}$ coefficient has a negative sign (less than -1); this sign stands for the velocity of the adjustment from convergence to equilibrium.

Moreover, the current research uses an additional test to affirm the levels of co-integration among the tested variables, namely the Bayer and Hanck test (2013) [7]. This test was utilized to affirm the findings of the co-integration results of this study. The advantage of this technique is that it can be applied for different examined orders of integration levels, and it includes four tests of co-integration, i.e., (1) Engle and Granger (1987) ($EG87_t$) [26], (2) Johansen (1988) ($JOH88_t$) [27], (3) Boswijk (1994) ($BO94_t$) [28], and (4) Banerjee et al. (1998) ($BA98_t$) [29]. In addition, this technique has Fisher F-statistics

to promote the co-integration findings, with Fisher's formula depicted in Equations (5) and (6) as follows:

$$EG87_t - JOH_{88t} = -2\left[IN(P_{EG87t}) + \left(P_{JOH88t}\right)\right] \tag{4}$$

$$\begin{aligned} EG87_t - JOH88_t \quad & - BO94_t - BA98_t \\ & = -2\left[IN(P_{EG87t}) + \left(P_{JO88t}\right) + (P_{BO94t}) + (P_{BA98t})\right] \end{aligned} \tag{5}$$

where $EG87_t$, $JOH88_t$, $BO94_t$, $BA98_t$ represent tests of co-integration in Bayer and Hanck test. The co-integration hypothesis will be rejected if the calculated $Fishe\ F-_{statistics}$ exceed the CV of Bayer and Hanck.

Moreover, the study uses LM, Breusch-Pagan Godfrey, Ramsey's Reset, and Normality tests to affirm stability of the tested model, and it has normal distribution. Furthermore, the current research utilizes the Granger causality test to analyze the causality linkage among $lnCO_2$, $lnEG$, $lnEG^2$, $and\ lnIMD$. In the causality test, ECT is used to determine the short-term deviations of the tested series. The equation of EC-Model is depicted in Equations (6)–(10) as follows:

$$\begin{aligned} \Delta lnCO_{2\ t} = \beta_0 \quad & + \sum_{i=1}^{p} \beta_1 \Delta lnCO_{2\ t-1} + \sum_{i=1}^{q} \beta_2 \Delta lnEG_{t-1} + \sum_{i=1}^{q} \beta_3 \Delta lnEG^2_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta lnNREC_{t-1} \\ & + \sum_{i.=1}^{q} \beta_5 \Delta lnIMD_{t-1} + \partial_1\ ECT_{t-1} + u_{1t} \end{aligned} \tag{6}$$

$$\begin{aligned} \Delta lnEG_t = \beta_0 \quad & + \sum_{i=1}^{p} \beta_1 \Delta lnEC_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta lnCO_{2\ t-1} + \sum_{i=1}^{q} \beta_3 \Delta lnEG^2_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta lnNREC_{t-1} + \sum_{i=1}^{q} \beta_5 \Delta lnIMD_{t-1} \\ & + \partial_1\ ECT_{t-1} + u_{1t} \end{aligned} \tag{7}$$

$$\begin{aligned} \Delta lnEG^2{}_t = \beta_0 \quad & + \sum_{i=1}^{p} \beta_1 \Delta lnEG^2{}_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta lnCO_{2\ t-1} + \sum_{i=1}^{q} \beta_3 \Delta lnEC_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta lnNREC_{t-1} \\ & + \sum_{i=1}^{q} \beta_5 \Delta lnIMD_{t-1} + \partial_1\ ECT_{t-1} + u_{1t} \end{aligned} \tag{8}$$

$$\begin{aligned} \Delta lnNREC_t = \beta_0 \quad & + \sum_{i=1}^{p} \beta_1 \Delta lnNREC_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta lnCO_{2\ t-1} + \sum_{i=1}^{q} \beta_3 \Delta lnEC_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta lnEG^2{}_{t-1} \\ & + \sum_{i=1}^{q} \beta_5 \Delta lnIMD_{t-1} + \partial_1\ ECT_{t-1} + u_{1t} \end{aligned} \tag{9}$$

$$\begin{aligned} \Delta lnIMD_t = \beta_0 \quad & + \sum_{i=1}^{p} \beta_1 \Delta lnIMD_{t-1} + \sum_{i=1}^{q} \beta_2 \Delta lnCO_{2\ t-1} + \sum_{i=1}^{q} \beta_3 \Delta lnEC_{t-1} + \sum_{i=1}^{q} \beta_4 \Delta lnEG^2{}_{t-1} \\ & + \sum_{i=1}^{q} \beta_5 \Delta lnNREC_{t-1} + \partial_1\ ECT_{t-1} + u_{1t} \end{aligned} \tag{10}$$

To examine the causal linkage, the study uses the Wald testing model to estimate causal linkage between the variables in the short run. Furthermore, the study uses the *t*-test of the lagged *ECTerm* to explore the causal linkage in the long run. Figure 2 presents the summary of the tested model of this study.

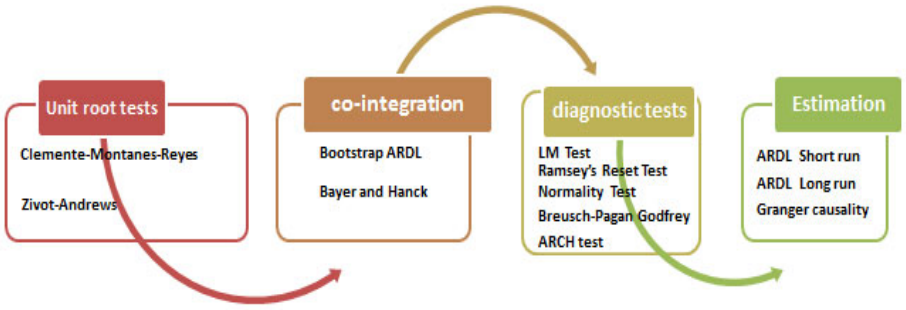

Figure 2. Structure of the methodology.

4. Empirical Findings

The findings of stationary tests (Zivot-Andrews, and CMR tests) are presented in Tables 1 and 2. The findings illustrate that all the examined variables of this study are stationary at the first difference. The findings of these tests confirm that $lnCO_2$, $lnEG$, $lnEG^2$, $NREC$, and $lnIMD$ variables have I(1) order of integration. Hence, the Equation (1) can be accepted as a tested model of co-integration.

Table 1. Findings of the ZA test.

	Series at-Level			**Series at-Δ First-Difference**	
	t-Stat	**DSC**		**t-Stat**	**DSC**
$lnCO_2$	−2.711	1990	$\Delta lnCO_2$	−6.001 **	2001
$lnEG(\text{lnEG}^2)$	−1.310	2001	$\Delta lnEG(lnEG^2)$	−6.350 **	2009
$lnNREC$	−2.195	1997	$\Delta lnNREC$	−6.173 **	2010
$lnIMD$	−3.210	2011	$\Delta lnIMD$	−8.051 ***	2008

*** and ** symbolize the significance of variables at 1 and 5 percentage levels, respectively.

Table 2. Findings of CMR test.

	Series at-Level			**Series at-Δ First-Difference**		
	t-Statist	**DSD1**	**DSD2**	**t-Stat**	**DSD1**	**DSD2**
$lnCO_2$	−2.100	199	1994	$\Delta lnCO_2$	−7.005 **	1996	2010
$lnEG(lnEG^2)$	−3.358	2001	2008	$\Delta lnEG(lnEG^2)$	−9.148 ***	2001	2003
$lnNEEC$	−2.008	200	2011	$\Delta lnNREC$	7.798 ***	1989	1996
$lnIMD$	−2.745	1990	1999	$\Delta lnIMD$	−6.250 **	1999	2006

*** and ** symbolize the significance of variables at 1% and 5% levels, respectively.

The Bootstrap-ARDL testing approach findings are presented in Table 3. The findings illustrate that the estimated statistics of $F_{Pesaran}$, $T_{dependent}$, and $F_{dependent}$ exceed the critical value at 5% of significant level. Hence, the findings provide statistical evidence that (no co-integration) hypothesis is not accepted. Therefore, the findings demonstrated the co-integration among $lnCO_2$, $lnEG$, $lnEG^2$, $lnNREC$ and $lnIM$ is vaild. Moreover, the findings of the Bayer and Hanck test (Table 4) demonstrated that the "F" statistics of "EGT-JOT" and "EGT-JOT- BOT-BAT" exceed the 5% critical value. However, the findings Bootstrap-ARDL (2019) and Bayer and Hanck test (2013) [7] provide strong evidence to accept the hypothesis of co-integration level in the tested model at the 5% statistical significance level.

Table 3. Findings of the Bootstrap-ARDL test.

ARDL(1,0,0,2,1)		$F_{Pesaran}$	$t_{dependent}$	$F_{independent}$
$(CO_2, lnEG, lnEG^2, lnNREC, lnIMD)$		5.908 ***	−4.001 ***	7.19 ***
Bootstrap-CV	1%	3.97	3.85	6.98
	5%	3.36	3.08	4.80
	10%	2.88	2.81	3.91

*** symbolizes significance at the 1 percent level.

Table 4. Findings of the BH test.

Fisher-Statistics	
16.411 **	21.019 **
10.991	19.281

** symbolizes significance at the 5 percent level.

The findings of the ARDL testing approach are illustrated in Table 5. The findings demonstrate that the EG (Economic Growth) has a positive and statistically significant

influence on the levels of CO_2 emissions in Turkey in both the short and long run. In contrast, the findings illustrate that the EG^2 (Economic Growth square) has a negative and statistically significant influence on carbon emissions levels in Turkey in both the short and long run. It demonstrates that one percent increase in the EG leads to a 3.1% increase in Turkey's carbon emissions in the long run. Moreover, the finding demonstrates that a 1% increase in the EG^2 led to a 0.90% decline in Turkey's CO_2 emissions in the long run. These findings affirm that the hypothesis of EKC is accepted in Turkey, which suggests, in the early stages of economic growth, that the CO_2 emissions levels increase, but beyond some economic growth levels, the trend reverses. These findings are in agreement with [30,31].

Table 5. Findings of ARDL in the short run.

Variable	Coeff.	t-Statistics
$\Delta lnEG$	3.139 ***	2.310
$\Delta lnEG^2$	−0.901 ***	−1.091
$\Delta lnNREC$	0.932 ***	1.310
$\Delta lnIMD$	0.063 **	0.071
$LnGDP$	2.091 ***	1.986
$lGDP^2$	−0.650 ***	−0.798
$LnGDP$	0.832 **	1.110
$\Delta lnIMD$	0.013 *	0.091
ECT_{t-1}	−0.920 ***	3.901

*, **, *** symbolize the significance of variables at 1%, 5%, 10%, respectively.

Moreover, the outcomes reveal that nonrenewable energy consumption in Turkey's positively impacts CO_2 emissions in the short and long run, as it illustrates that one percent increase in the NREC led to a 0.93% increase in Turkey's CO_2 emissions. Moreover, it suggests that an increase in oil, gas, and electricity consumption will lead to an increase the levels of environmental degradation in Turkey. This finding is in agreement with [32,33].

Furthermore, the coefficient of IMD (Insurance Market Development) has positive effect on the levels of CO_2 emissions in Turkey for short- and long-term levels; it demonstrates that a 1% increase in the IMD in Turkey leads to a 0.063% increase in Turkey's carbon emissions. Thus, it suggests that an increase in the total insurance penetration (life and non-life), as a share of the GDP, will lead to an increase in environmental degradation in Turkey.

Table 5 proves that the convergence rate from the short-run to long-run equilibrium is 92%. Table 6 presents the findings of diagnostic tests. The findings of the normality test affirms that the examined model has a normally distribution. Furthermore, the findings of diagnostic tests (LM, ARCH, the Breusch-Pagan) affirm that the explored model of this study is homoscedastic, and autocorrelation is absent. The findings of Ramsey's Reset test affirm that there the testing model is stable. Moreover, Figures 3 and 4 (CUSUM and squares of CUSUM) prove the stability of the testing model. The figures demonstrate that the black lines are among the red lines at 5 percent of statistical significance, while Figure approves the stability of the estimated model.

Table 6. Findings of the diagnostic tests.

Test	*p*-Value
LM	0.395 (0.695)
the Breusch-Pagan	1.990 (0.795)
Normality	1.310 (0.932)
ARCH	1.131 (0.851)
Stability Ramsey's Reset	0.950 (0.635)

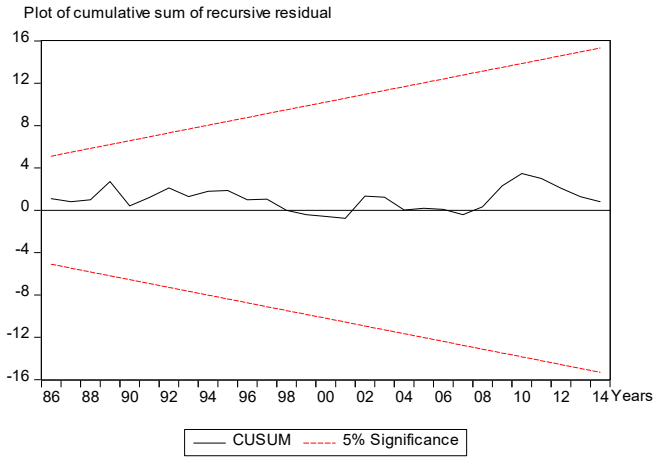

Figure 3. Stability test using (CUSUM).

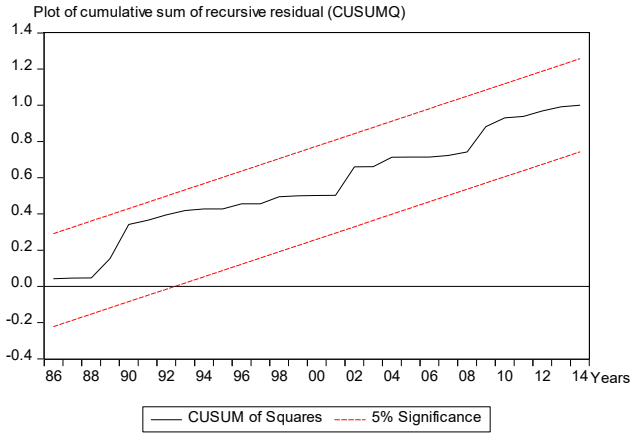

Figure 4. Stability test using (CUSUMQ).

Table 7 illustrates that the (t) statistics of the lagged the ECT value confirms that there is a long-term causality among the test variables (EG,EG^2, NREC, IND→CO_2). Furthermore, the findings proves that the value of (F) statistics confirms that there is a unidirectional causal linkage among economic growth, consumption of non-renewable energy, and insurance market development and Turkey's CO_2 emissions (EG, EG^2, NREC, IMD→CO_2). Moreover, there is a unidirectional causal linkage from the IMD to non-renewable energy consumption, and economic growth (IMD→EG, NREC). Hence, the findings of this research affirm that insurance market development has a powerful statistical effect on Turkey's CO_2 emissions through economic growth and consumption of nonrenewable energy.

Table 7. Findings of granger causality.

			Short−Run			*Long−Run*
(Y/X)	$\Delta lnCO_2$	$\Delta lnEG$	$\Delta lnEG^2$	$\Delta lnNREC$	$\Delta lnIMD$	ECT_{t-1}
$\Delta lnCO_2$	-	6.31 **	3.88	5.47 **	6.74 **	−0.03 (−2.31) ***
$\Delta lnEG$	1.31	-	-	3.41	6.74 **	−0.03 (−1.25)
$\Delta lnEG^2$	1.09	2.85	2.74	1.87	3.25	−0.17 (−1.31)
$\Delta lnNREC$	2.22	6.51 **	2.730	2.47	7.47 **	−0.02 (−0.55)
$\Delta lnIMD$	2.96	1.19	2.88	3.33	-	−0.01 (−0.33)

, * denotes significance at 5% and 10% levels.

In the last few decades, Turkey faced several changes in the economic structure; the economic performance in Turkey showed that the GDP has increased from 107 billion USD

in 1989 to 869 billion USD in 2016. The total amount of international trade in Turkey as a share of the GDP increased from 33.08% in 1980 to 55.14% in 2016. The FDI in Turkey as a percentage of the GDP also increased from 1% in 1980 to 3.6% in 2016. On the other hand, the consumption of nonrenewable energy has reached high levels. In this sense, the consumption of fossil fuel is around 87% of Turkey's energy consumption. Although nonrenewable energy resources are attractive, they negatively affect the environment. However, several studies have focused on the effect of energy consumption, and macroeconomic variables on the levels of carbon emissions in both developed and developing countries. A critical aspect of insurance markets that has largely been ignored in empirical studies is the role of the insurance sector on environmental degradation. The main objective of this study is to investigate the relationship between insurance market development and environmental degradation in Turkey from 1981 to 2016. The empirical findings of this research illustrate that economic growth and non-renewable energy consumption exert have positive and significant effects on the level of CO_2 emission. These findings are in line with [16,29], who revealed that nonrenewable energy consumption and economic growth positively impact CO_2 emissions in Turkey. Although nonrenewable energy resources are attractive, they negatively affect the environment. At the same time, they will increase the dependence on foreign countries for energy. Due to these reasons, the importance of renewable energy has risen in Turkey. However, Turkey needs to lead in renewable energy resources. Thus, the sustainable economic development of Turkey will increase and environmental pollution will be lower within this process.

Furthermore, the findings of this research demonstrate that there is a positive influence of insurance market development on Turkey's CO_2 emissions levels. This paper draws a significant finding that in the case of Turkey, insurance market development is a significant generator of the levels of carbon dioxide emissions. This significant impact is also affirmed through the consumption of energy and economic growth channels. This study suggests that insurance market development may affect CO_2 emissions through two channels: the economic growth and energy consumption. In this sense, many empirical studies confirmed that insurance market development has significant influence on economic performance [3–6]. However, the insurance market development enables investors to access diversified investment, which leads to increase high-productivity investments. Subsequently, it will lead to enhance the liquidity positions in the markets, and boosts the economic growth rates, thus causing an increase in the investment through the purchase of new techniques and equipment. Subsequently, it will lead to a raise in the level of energy consumption and CO_2 emissions.

However, the findings of the current research study are important for several reasons. Sustainable development of the insurance markets such as the insurance market is a significant issue for Turkey. Environmental pollution is a significant barrier preventing sustainable development of insurance markets in Turkey. Therefore, it will be difficult to reduce the levels of CO_2 emissions if the impacts of insurance market development is not considered. Insurance market development has significant repercussions for the economy by affecting investment and economic growth, which may subsequently affect consumption of fossil fuels and the levels of carbon emissions. The findings of the current paper suggest that Turkish policy makers should make strategies and policies to ensure the sustainable development of insurance markets, to reduce environmental degradation by supporting projects, and to invest in clean energy sources.

5. Conclusions

The main purpose of this research is to provide new perspectives to the literature by analyzing the role of insurance market development on environmental degradation using two co-integration testing techniques, namely, the new technique of bootstrap-ARDL (2019) and the updated test of the Bayer-Hanck (2013) technique [7]. The Autoregressive Distributed Lag testing approach (ARDL) is applied to examine the short and long linkage

between the examined variables. Furthermore, the study used the Granger causality to analyze the causality linkage between the variables.

The findings of this study show that economic growth and nonrenewable energy consumption have positive and significant influence on carbon emissions. These findings are in agreement with [30,31], who confirmed that EKC-H is valid. Furthermore, these findings are in agreement with [32,33], who confirmed that an increase in nonrenewable energy consumption positively affected the level of carbon emissions. However, the study confirmed the findings of these studies, and provided new evidence using the bootstrap ARDL testing approach. In this line, the study suggested that Turkey should take into account energy requirements that take the environmental considerations in order to achieve sustainable development, which is considered an important issue for Turkey, which aims to be among the world's top ten largest economies. Environmental degradation is an essential barrier to preventing sustainable development in Turkey.

Furthermore, the findings illustrate that in the long run, insurance market development has a positive and significant influence on the levels of Turkey's CO_2 emissions. In fact, many empirical studies have tested the linkage among carbon dioxide emissions, and financial market development; however, most have not tested the possible influence of insurance market development on their frameworks. Hence, the study provided new empirical evidence to the literature by analyzing the role of insurance market development on environmental degradation. This paper draws an important conclusion that in the case of Turkey, insurance market development is long-term and a significant generator of carbon dioxide emissions. This significant influence is also affirmed through the consumption of energy and economic growth channels.

The outcomes of this paper are important for several reasons. Sustainable development of the insurance markets is a significant issue for Turkey. Therefore, it will be difficult for policy makers to meet CO_2 emissions targets if the impacts insurance market development is not considered. Insurance market development has significant repercussions for the economy, as it affects the levels of the investment and economic growth, which may subsequently affect the consumption of nonrenewable energy and the levels of carbon emissions. The insurance market development enables investors to access diversified investment, which leads to increase high-productivity investments. Subsequently, it will lead to enhance the liquidity positions in the markets, and boosts the economic growth rates, thus causing an increase the investment through the purchase of new techniques and equipment, which in turn leads to a raise in the levels of nonrenewable-energy consumption and CO_2 emissions.

The empirical findings of this study provide valuable policy implications for Turkey heading to sustainable and green financial markets. In this line, the findings of current study suggested that the Turkish policy makers should make strategies and policies to sustainable development of insurance markets to reduce environmental degradation. In this line, the policymakers should design plans to reduce nonrenewable energy consumption emissions through efficient energy consumption channels and should plan the implementation of various policies aimed at utilizing clean energy resources, such as investment incentive programs in clean energy projects.

This research has introduced new evidence by exploring the role of insurance market development on the levels of CO_2 emissions in Turkey; more empirical studies for developing and developed economies are suggested using different methodologies to explore the effect of insurance market development on the environmental.

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