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The role of natural capital and economic openness in sustainable economic development

VERSÃO FINAL APÓS DEFESA

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Resumo

O desenvolvimento económico sustentável permite estudar a economia de um país no seu todo, uma vez que engloba parâmetros sociais, parâmetros ambientais e parâmetros económicos. O capital natural permite estudar os parâmetros ambientais de uma economia, uma vez que se carateriza por englobar todos os recursos naturais, sejam recursos naturais renováveis ou recursos naturais não renováveis, que as economias dispõem. A abertura económica facilita o estudo de parâmetros económicos, pois carateriza-se pelas trocas comerciais entre as diversas economias mundiais. Este estudo analisa o papel do capital natural e da abertura económica no desenvolvimento económico sustentável, para 28 países da OCDE. Contudo, será realizada uma comparação dos resultados obtidos para o desenvolvimento económico sustentável com os resultados obtidos para o crescimento económico. Estes países foram selecionados por serem todos países desenvolvidos e homogéneos, e ainda pertencem a uma organização mundial que se preocupa com o desenvolvimento económico, portanto, partilham muitas caraterísticas em comum, como políticas comuns, objetivos futuros e valores morais, isto permite os resultados obtidos não sejam distintos. O estudo apresenta um painel dinâmico, com dados anuais e um horizonte temporal compreendido de 1995 a 2018. Como o estudo é composto por variáveis estacionárias em primeiras diferenças e cointegradas entre si, foram utilizados os estimadores DOLS, FOLS e PMG. Estes estimadores permitem estudar as relações a longo prazo, o estimador PMG têm a particularidade de permitir estudar as relações de longo e de curto prazo. Os resultados indicam que o capital natural tem relações de longo prazo com o desenvolvimento económico sustentável, exceto as energias fosseis essas não apresentaram relações de longo prazo. O capital natural não apresentou relações de curto prazo com o desenvolvimento económico sustentável. Foi possível verificar nos resultados a existência de relações a longo prazo para todas as variáveis do capital natural para com o crescimento económico. Contudo, quanto às relações de curto prazo apenas duas variáveis apresentam relação com o crescimento económico. No que diz respeito à abertura economia, existe uma relação de longo prazo tanto para o desenvolvimento económico sustentável como para o crescimento económico por parte das restantes variáveis. Analisando as relações de curto prazo, apenas três variáveis da abertura económica apresentam relação com o crescimento económico, com o desenvolvimento económico sustentável nenhuma variável apresenta. Assim, prossupõem-se que os países da OCDE apresentem sinais positivos para obter ótimos resultados no futuro em relação ao desenvolvimento económico. Uma vez que, existe uma relação de longo prazo entre a abertura económica e o desenvolvimento económico sustentável, os resultados apresentaram que as energias fosseis não apresentam impacto no

desenvolvimento económico sustentável económico, o que já era espectável. Para que os países da OCDE apresentem melhores resultados no desenvolvimento económico sustentável é sugerido que deixe de utilizar e se não for possível que reduza o consumo de recursos fosseis.

Palavras-chaves

Desenvolvimento económico sustentável; crescimento económico; capital natural; abertura económica; OCDE; DOLS; FMOLS; PMG

Resumo alargado

O desenvolvimento económico sustentável é um indicador recente que permite analisar a economia nos aspetos mais importantes, uma vez que é composto por componentes socias, componentes ambientais e componentes económicos. Através deste indicador é possível combater as lacunas apresentadas pelo PIB, uma vez que este último apenas apresenta a componente económica. De forma geral o indicador do desenvolvimento económico sustentável apresenta resultados mais reais das economias.

O conceito do capital natural teve origem no início do século XX, contudo alguns filósofos já o referiam no século XVIII, indicando que a natureza é um bem original metódico e capaz de se auto produzir. O capital natural é composto pelo conjunto de recursos naturais, podendo ser recursos renováveis e recursos não renováveis, e por ecossistemas capazes de produzir excedente económico, podendo existir ou não existir intervenção humana. Este conceito também inclui elementos naturais com elevado valor para a sociedade, como por exemplo, a água, a terra e o ar, entregando elementos vivos e não vivos do ecossistema, assim é possível perceber que estes elementos têm valor económico. Como o capital natural engloba os recursos naturais renováveis e os recursos naturais não renováveis, podemos dividir o capital natural como capital natural renovável e capital natural não renovável. Sendo que o primeiro produz fluxo de bens e serviços do ecossistema essenciais à vida humana, sendo este tipo de capital imprescindível para o desenvolvimento económico, já o segundo não criam serviços diretos, mas geram rendimentos financeiros. Resumidamente o capital natural representa e engloba a natureza no seu todo.

A abertura económica é um conceito macroeconómico com grande importância, que define comercio livre entre as diferentes economias, facilitando as trocas comerciais entre as mesmas. Este conceito reduz as falhas existentes em relação às quantidades de recursos que as economias apresentam, facilitando as trocas comerciais entre as diferentes economias, ou seja, permitindo que as economias com um tipo de recurso em abundância possam exportar os seus recursos para as economias com escassez desse recurso.

Esta dissertação tem como objetivo perceber a influência do capital natural e da abertura económica no desenvolvimento económico sustentável, assim como perceber as principais diferenças do impacto dos mesmos no crescimento económico sustentável. Para tal, será utilizada como pergunta de partida qual o papel do capital natural e da abertura económica no desenvolvimento económico sustentado. O estudo do capital natural e da abertura económica é fundamental para perceber como os países gerem os seus recursos e se tem necessidade de obter mais, e assim concluir o papel deles no desenvolvimento

económico sustentável. Uma vez que estes temas ainda não foram muito abordados torna o estudo importante para a literatura.

Outro aspeto que diferencia este estudo dos restantes que estudam o desenvolvimento económico sustentável é a utilização do indicador *Genuine Progress Indicator*. Este indicador é recente na literatura e engloba diversos componentes, entre o consumo privado e o consumo publico, o GINI, o trabalho não remunerado, o custo da poluição da atmosfera e o custo das alterações climáticas - danos ambientais a longo prazo, tornando-o melhor indicador para o estudo do desenvolvimento económico sustentável.

A literatura acerca do papel da abertura da economia e do capital natural no desenvolvimento económico sustentável ainda é escassa. Contudo, é espectável que exista uma relação positiva entre o capital natural e o desenvolvimento económico sustentável, assim como a abertura económica também existira uma relação positiva com o desenvolvimento económico sustentável.

Para este estudo foram selecionados 28 países da OCDE. A escolha dos países baseia-se em serem países muito semelhantes. As características que tornam estes países semelhantes são serem países homogéneos e desenvolvidos, assim como pertencem a uma organização mundial, o que incentiva a que estes países partilhem os mesmos objetivos, tenham políticas em comum e a mesma orientação para o futuro enquanto ao desenvolvimento económico das suas economias. Os dados presentes neste estudo encontram-se organizados num painel dinâmico com dados anuais, o horizonte temporal está correspondido entre 1995 e 2018. O indicador do desenvolvimento económico foi calculado especificamente para este horizonte temporal e para os países em análise.

Após a realização de testes preliminares e de raiz unitárias, conclui-se que as variáveis são estacionarias em primeiras diferenças e apresentam cointegração entre elas. Com isto, foi necessário proceder à escolha do estimador mais adequado às características dos dados. Assim, foram utilizados três estimadores, o estimador DOLS, o estimador FMOLS e o estimador PMG. Estes estimadores permitem estudar a relação no longo prazo do capital natural e da abertura económica para como desenvolvimento económico sustentável, o estimador PMG tem a particularidade de estudar as relações no longo e no curto prazo.

Os resultados mostram que existe uma relação positiva a longo prazo entre o capital natural e o desenvolvimento económico sustentável, no curto prazo não se verificou a existência de alguma relação entre o capital natural e o desenvolvimento económico sustentável. Foi ainda possível observar que os recursos fosseis não conseguem explicar o desenvolvimento económico sustentável e que os países devem reduzir o consumo de bens não madeireiros ou seja, recursos de papel e papelão, uma vez que estes influenciam negativamente o desenvolvimento económico sustentável. Nos estimadores também foi

possível observar uma explicação da abertura económica em relação ao desenvolvimento económico sustentável no longo prazo, o mesmo não se verificou no curto prazo, nesse caso apenas algumas variáveis apresentam relação. Segundo os resultados também é possível concluir que os países em estudo devem exportar menos bens alimentares e menos tecnologias, pois estas exportações influenciam negativamente o desenvolvimento económico sustentável.

Concluindo, este estudo sugere que a OCDE implemente medidas para a redução de recursos naturais não renováveis, como por exemplo recursos fosseis, e para que os países se tornem mais autossuficientes em relação aos bens alimentares.

Abstract

Sustainable economic development makes it possible to study the economy of a country as a whole, as it encompasses social parameters, environmental parameters, and economic parameters. Natural capital allows the environmental parameters of an economy to be studied, since it is characterized by encompassing all the natural resources, whether renewable natural resources or non-renewable natural resources, that economies have at their disposal. Economic openness facilitates the study of economic parameters, as it is characterized by trade between the various world economies. This study analyzes the role of natural capital and economic openness in sustainable economic development for 28 OECD countries. However, a comparison will be made of the results obtained for sustainable economic development with the results obtained for economic growth. These countries were selected because they are all developed and homogeneous countries, and also belong to a world organization that is concerned with economic development, therefore, they share many characteristics in common, such as common policies, future goals and moral values, this allows the results obtained not to be different. The study presents a dynamic panel, with annual data and a time horizon from 1995 to 2018. Since the study is composed of stationary variables in first differences and cointegrated with each other, the DOLS, FOLS and PMG estimators were used. These estimators allow the study of long-term relationships; the PMG estimator has the particularity of allowing the study of both long-term and short-term relationships. The results indicate that natural capital has long-term relationships with sustainable economic development, except for fossil energy, which did not show long-term relationships. Natural capital showed no short-term relationship with sustainable economic development. It was possible to verify in the results the existence of long-term relationships for all variables of natural capital to economic growth. However, as for the short-term relationships only two variables show a relationship with economic growth. As far as economic openness is concerned, there is a long-term relationship for both sustainable economic development and economic growth by the remaining variables. Looking at the short-term relationships, only three variables of economic openness show a relationship with economic growth, with sustainable economic development no variable does. Thus, it is assumed that the OECD countries show positive signs for optimal results in the future with regard to economic development. Since there is a long-term relationship between economic openness and sustainable economic development, the results showed that fossil energy has no impact on sustainable economic development, which was already expected. In order for OECD countries to perform better

in sustainable economic development it is suggested that they stop using, and if that is not possible, reduce their consumption of fossil resources.

Keywords

Sustainable economic development; economic growth; natural capital; economic openness; OECD; DOLS; FMOLS; PMG

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List of Acronyms

ARDL	Autoregressive Distributed Lag
CD	Cross-Section Dependence
CIPS	Cross-Sectionally Augmented IPS
DOLS	Dynamic Ordinary Least Squares
FAOSTAT	Food and Agriculture Organization Corporate Statistical Database
FDI	Foreign Direct Investment
FMOLS	Full Modified Ordinary Least Square
GDP	Gross domestic product
GPI	Genuine Progress Indicator
IEA	International Energy Agency
OECD	Organization for Economic Co-operation and Development
OLS	Ordinary Least Squares
PMG	Pooled Mean Group
SWIID	Standardized World Income Inequality Database
UNCTAD	United Nations Conference of Trade and Development
VIF	Variance Inflation Factors test
WDI	World Development Indicators

1. Introduction

The use of GDP to study a country's economic growth and development has some gaps in the measurement of economic development, when it comes to measuring social and environmental benefits, for example. Since these gaps exist, it was necessary to find an alternative indicator that would study and be concerned with environmental, social and economic parameters. Thus, in this study a recent indicator will be used, but it is concerned with these three parameters and will be used to study sustainable economic development. Thus, the role of natural capital and economic openness in sustainable economic development will be studied.

The concept of natural capital originated in the 20th century, although in the 18th century this concept was referred to by the philosopher Carl Linnaeus in which he stated that nature is a systematic original product capable of producing itself. However, it was only at the beginning of the 20th century that it began to be important in economic theories. But it was not defined as it is today, Adam Smith and later classical political economists such as David Ricardo, John Stuart Milli and Max Weber were the first authors to address this issue. These authors considered that there is an increasing unassisted production of nature, however they assigned a marginal significance within their general economic theories (Wolloch, 2020). As economic thought evolved, the concept of natural capital has also evolved into the definition that is known today.

Natural capital is described with the set of natural resources and ecosystems capable of producing economic surplus, and may or may not have human intervention (Wolloch, 2020). This concept is defined as including several natural elements with extreme value for mankind, such as water, land and air, involving living and non-living elements of the ecosystem, thus perceiving that these elements have economic value (HM Treasury, 2018). The Natural Capital Coalition states that "Natural Capital is another term for the set of renewable and non-renewable resources (e.g. plants, animals, air, water, soils, minerals) that combine to produce a flow of benefits for people" (The & Protocol, n.d.). Thus, it can be concluded that the concept of natural capital represents and encompasses all of nature (Özdemiroğlu, 2019).

Natural capital can be subdivided into two types, renewable natural capital (includes renewable natural resources such as water and air) and non-renewable natural capital (includes non-renewable natural resources such as mineral deposits and fossil fuels) (Wolloch, 2020). On the one hand, renewable natural capital promotes the flow of ecosystem goods and services essential to human life, and this type of capital is indispensable for economic development (Blignaut et al., 2013). On the other hand, non-renewable natural capitals do not create direct services, but generate financial income (Gasmi et al., 2020).

The variables that describe renewable natural capital are timber and non-timber forest resources, protected areas, agricultural land, and pastureland. The variables that make up non-renewable natural capital are subsoil, oil, natural gas, hard and soft coal, and minerals (Gasmi et al., 2020).

This concept is based on three social values, which are intrinsic value, use value and option value. Thus, more natural capital implies higher productivity and will cause high welfare for the future generation (Kurniawan et al., 2021). In conclusion, natural capital extols the role of nature in supporting the economy and human well-being (Gasmi et al., 2020).

Natural capital is calculated for monetary value by multiplying the estimated stock of each component that makes up natural capital with the respective prices. Thus, it is possible to reflect on the marginal contribution that natural capital has on social welfare (Kurniawan et al., 2021).

The by-product of economic systems, such as waste, returns to the environmental system, which in turn makes up a portion of natural capital. These can degrade the environmental system which in turn reduces the services it provides.

This dissertation will also study the economic openness of the countries under study. This concept is important in this work because in this way, its role in sustainable economic development is understood, and also to get a sense of whether the country exports more natural resources.

Economic openness is an important macroeconomic concept, which represents free trade among world economies(Zeren & Akkuş, 2020). Economic openness is defined as a trading system that facilitates trade between different countries (Yanikkaya, 2003). Consequently, free trade leads to an increase in the volume of international trade, reducing the gaps in the quantity of resources between countries, facilitating the flow of the resource from the economy with the greatest supply to the economy with demand for a certain resource. Economic openness also stimulates economic growth as there are economies with similar offerings will allow competitiveness which will consequently cause economic growth (Shahbaz et al., 2014). However, there is still no agreement among researchers on the impact of open economy on environmental sustainability (Alam & Murad, 2020). Foreign direct investment is used as a variable to study economic openness. Open economies have the goal of getting investment abroad, and this type of investment is the most important in these economies, through this investment the economies evolve in terms of technology.

As mentioned, the economic growth of a country has some gaps when it comes to studying a country, because it only presents the economic parameter, so in this study the sustainable economic development of a country will be studied. Thus, this work will focus on these concepts and understand their influence on sustainable economic development

and understand the main differences in their impact on economic growth. Using as a starting question what role natural capital and economic openness play in sustainable economic development. This topic is important because it studies how natural resources and economic openness influence sustainable economic development, these topics are not yet widely addressed which makes this topic important to the literature.

This study aims to study the role of natural capital and economic openness in sustainable economic development for 28 countries of the Organization for Economic Co-operation and Development (OECD). The Genuine Progress Indicator (GPI) is used to measure sustainable economic development and the results will be compared with the indicator representing economic growth (GDP). Throughout the study the long-run relationship of natural capital and the openness of the economy in the long run will be investigated. For this purpose, three estimators were used, the DOLS, the FMOLS and the PMG.

The structure of the remaining dissertation is organized as follows: Section 2 presents the literature review; Section 3 describes the data and methodology used; Section 4 discusses the results; and finally, Section 5 presents the conclusion.

2. Literature review

The concept of natural capital encompasses ecosystem services and support for human well-being, including for example renewable resources, soil prevention and generation, crop development, pollutant waste filtration (Scale, 1996). In short, natural capital is concerned with the perseverance of the environment and the quality of life of living beings, as well as the quality of the environment and life that the next generations will find. Regrettably, natural capital continues to be subjected to pressures from population growth and economic growth. These pressures result in large-scale deforestation, ecosystem depletion, and reduced recreational value and natural beauty. Thus, as the Earth approaches its full capacity it is more difficult for economic growth and social welfare to follow the same goal (Daly, 1987).

The relationship between natural resource wealth and economic growth is a subject of disagreement among economists (Erum & Hussain, 2019). On the one hand, there are scholars who claim that countries richer in natural resources have higher economic growth (Lawal et al., 2016). On the other hand, there are authors who claim that natural resource abundance decreases economic growth in the long run because natural resources run out (Alexeev & Conrad, 2011).

The first papers in the literature on this topic state that economic growth is negatively influenced by natural resources. This negative impact of natural resources on economic growth is known as the natural resource curse or Dutch disease (Topcu et al., 2020). The relationship between economic growth, or the long-term economic development process, shows that natural capital decreases as the capital and intangible capital produced after manufacturing and service deployment increases ("Chang. Wealth Nations," 2010). When one analyzes perfect economic development, one concludes that economic growth and social welfare increase proportionally. Since economic development takes into account social, economic and environmental aspects, so when growth increases social welfare increases in the same way. However, the literature states that excessive consumption especially reduces natural capital (Kurniawan et al., 2021).

According to Aşici (2013) if income is higher so will consumption which in turn creates greater pressure on nature, particularly in increasing carbon dioxide emissions and the extraction of minerals. Future generations are expected to have a decreasing level of well-being if the natural capital productivity of this generation is decreasing (Kurniawan et al., 2021).

The variables used in this study represent forestry, agriculture, fossil fuels, and minerals. The variables used to characterize the forest were the timber resources and the non-timber resources, resources used in paper manufacturing. To specify agriculture, the value added of agriculture, forestry, and fishing was used. The variable showing electricity

production from coal, peat, oil shale, oil and natural gas characterizes fossil fuels. Due the lack of data, no variables were used to characterize the minerals and protected areas component (Gasmi et al., 2020).

Economic openness represents international inclusion, that is, it is through economic openness that it is possible to analyze the relationship of an economy with the other world economies, in this case only the economic ties will be analyzed, but it is also possible to analyze the social ties (Dollar, 1992; Sachs & Warner, 1995). The authors (Sachs & Warner, 1995) state that this type of economy is less prone to financial crises than closed economies, which in turn are more prone to financial crises.

The openness of the economy can be seen through export growth, export diversification, and foreign direct investment. However, simply opening up an economy for international inclusion does not guarantee the country's sustained economic development unless this measure influences the growth of its constituent indicators (Ramanayake & Lee, 2015). According to the literature (Balassa, 1985; Tyler, 1980) is a consensus that exports are an indicator of economic growth. As the literature developed, other variables besides exports were found to study economic openness, such as comparative advantage of products, export competitiveness, export diversification and Foreign Direct Investment (FDI) (Brenton et al., 2010; Hausmann et al., 2007). However, there is no consensus on the effects of this variable on economic growth. According to Zhang (2001) FDI increasingly influences economic growth the higher it is. On the other hand, according to (Ramanayake & Lee, 2015) they state that foreign direct investment has a positive effect on economic growth, showing a greater impact in developing countries.

According to (Ramanayake & Lee, 2015) export diversification is expected to reveal a positive relationship with economic growth, with an economy with more diversified and sophisticated exports showing faster economic growth.

Agosin (2009) and Hausmann et al. (2007) state that the key factor for sustained economic growth is export diversification. Later, it was found that developed and high-income countries have a wide range of diversified, sophisticated, and different exports have a positive impact on economic growth (Balaguer & Cantavella-Jordá, 2004).

Lately, researchers have been studying export subsistence in relation to economic growth more than export growth. Therefore, researchers have attached more importance to export diversification, since export diversification better defines economic growth. According to Hausmann et al. (2007) exports of luxury goods lead to faster growth. However, according to Ramanayake & Lee (2015) export diversification and export growth are more robust than foreign direct investment in relation to economic growth.

In this study, foreign direct investment and export diversification were used as variables to characterize economic openness. Therefore, FDI in millions of dollars,

agricultural raw material exports, food exports, fuel exports, and medium and high technology exports were used.

Sustainable development is concerned with taking care of everything around us, that is, it takes care of the environment, people, animals, and society in general so that they support the economy. But the main goal of this concept is to be concerned with the development of current generations without compromising the next generations (Ndubisi et al., 2020).

Sustainable economic development can be an alternative indicator to GDP to analyze economic growth. As the GDP does not analyze all the parameters needed to measure the economic growth of different countries it was necessary to think of an indicator that would cover all the parameters.

As the years went by, society began to concern itself with other fields essential to human life besides economic factors. Thus, indices of sustainable economic well-being have emerged in which they encompass the fundamental parameters for today's society, which are economic parameters, social parameters, and environmental parameters. Thus, if a country meets these three parameters it presents a better place for its inhabitants, if the country does not perform well in the social and environmental parameters it usually presents better results in the GDP and not in the sustainability indices presenting a worse place to live (Menegaki & Tugcu, 2018).

There are several measures in the literature that focus on studying development and that differ by studying the sustainability of the country, among these measures there is the ISEW, green GDP and adjusted net national income (Beça & Santos, 2010; Talberth & Bohara, 2006). The United Nations has implemented goals for sustainable development, which are to protect the planet and consequently alleviate climate change, ensure peace and prosperity for all human beings over the next 10 years, and eradicate poverty (PNUD, 2014).

For an organization, financial performance is the most important and has the greatest focus, which causes its social and environmental performance to be forgotten, potentially damaging the association in the long run. Social performance represents the organization's responsibility to its workforce, its community, and society in general. Environmental performance refers to the impact that an organization's activity has on its environment, from resource consumption, pollutant emissions, and the ecological footprint it leaves behind (González-Benito & González-Benito, 2006).

Once the results of financial performance, social performance, and environmental performance are measured the organization gets its business results. For companies to achieve sustainable economic development they should optimize these three developments. Ensuring that the next generations will have the resources necessary for a quality existence is a concern present in economic development, so when thinking about economic and social

development there is concern about preserving the environment so that future generations will not have serious consequences (Ndubisi et al., 2020).

Sustainable economic development shows a concern with achieving economic well-being in a way that encompasses social development and environmental protection, with the aim of ensuring a better and safer future for the next generations. Thus, it presents caution when managing the land's resources, essentially the non-renewable resources (Ndubisi et al., 2020).

In short, some authors have relied on GDP cri studies for which this measure of economic activity was not designed, that is, the GDP was not created to measure well-being, this variable was created to measure the wealth of an economy. With the need to consider other components besides the economy, some alternative indicators have emerged in the literature, which consider the economic, welfare, and sustainability components.

In spite of the drawbacks, there are some indicators that cover the three essential parameters for measuring sustainable economic development, however it presents some gaps. The first shortcoming is the lack of a theoretical basis for the free choice of the indicators incorporated. The next gap is the difficulty of representing well-being and sustainability in the same indicator. Finally, they present weak sustainability, that is, they present perfect sustainability between natural and human-made capital (Pais et al., 2019).

The Genuine Progress Indicator (GPI) that allows all the other components to be analyzed and thus understand what the openness of the economy and natural capital contribute to society. This indicator has a gap, because of the problem of comparability between countries due to missing data for some components and there is no harmonization of statistics to allow a more complete indicator.

3. Methods and Data

3.1. Methods

During the development of this study some preliminary tests were used to analyze the variables used for the different concepts present in this study. The estimators used were FMOLS, DOLS and PMG because they will allow us to reach the intended conclusions. In this section a detailed description of the tests and estimators used will be presented.

This study will focus on two concepts, natural capital and economic openness. Thus, natural capital is characterized by:

$$\boldsymbol{cgpipc} = \boldsymbol{F}(\boldsymbol{agriculture}, \boldsymbol{nowood}, \boldsymbol{wood}, \boldsymbol{fossil}, \boldsymbol{renewable}) \quad \textbf{(1)}$$

Where *cgpipc* represents the dependent variable. *agriculture* represents agriculture, forestry, and fishing; *nowood* represents non-timber resources; *wood* represents timber resources; *fossil* represents energy from fossil resources; and *renewable* represents energy from renewable resources.

$$\boldsymbol{gdppc} = \boldsymbol{F}(\boldsymbol{agriculture}, \boldsymbol{nowood}, \boldsymbol{wood}, \boldsymbol{fossil}, \boldsymbol{renewable}) \quad \textbf{(2)}$$

Where *gdppc* represents the dependent variable. *agriculture* represents agriculture, forestry, and fishing; *nowood* represents non-timber resources; *wood* represents timber resources; *fossil* represents energy from fossil resources; and *renewable* represents energy from renewable resources.

Economic openness can be defined as:

$$\boldsymbol{cgpipc} = \boldsymbol{F}(\boldsymbol{fdi}, \boldsymbol{agri\_exp}, \boldsymbol{food\_exp}, \boldsymbol{fuel\_exp}, \boldsymbol{ict\_exp}) \quad \textbf{(3)}$$

Where, the dependent variable is defined by *cgpipc*. The independent variables: *fdi; agri_exp; food_exp; fuel_exp;* and *ict_exp* represent FDI, agricultural exports, food exports, oil exports, and medium and high technology exports, respectively.

$$\boldsymbol{gdppc} = \boldsymbol{F}(\boldsymbol{fdi}, \boldsymbol{agri\_exp}, \boldsymbol{food\_exp}, \boldsymbol{fuel\_exp}, \boldsymbol{ict\_exp}) \quad \textbf{(4)}$$

Where, the dependent variable is defined by *gdppc*. The independent variables: *fdi; agri_exp; food_exp; fuel_exp;* and *ict_exp* represent FDI, agricultural exports, food exports, oil exports, and medium and high technology exports, respectively.

The first preliminary test performed was the Variance Inflation Factors test (VIF), in order to study the multicollinearity of the variables in order to ensure that there are no exact linear relationships between the variables. After that, the Hausman test will be performed to decide which model is more appropriate, the random effects model or the fixed effects model, under the null hypothesis that the variables have random effects. Following, specification tests were performed to check for autocorrelation, heteroscedasticity, and cross-sectional dependence. Therefore, the Wooldridge test was used to study autocorrelation in panel data, the null hypothesis of this test is that there is no first order autocorrelation. The heteroscedasticity test was also performed by applying the modified Wald test, which says that there is no heteroscedasticity according to its null hypothesis. Finally, the CD-test was performed in the variables, to study cross-sectional dependence, the null hypothesis of this test is cross-sectional independence. This test should be used in panel data, since if it checks it means that the countries are not independently observed, which means that they affect each other's results.

From the Hausman test a distinction was made between the models mentioned above, so there will be four models for each test, starting by studying natural capital and then economic openness. Therefore, a model distinction will be used, starting by using the variable *lcgpipc* as the dependent variable for the natural capital model, and then the variable *lgdppc* will be used as the dependent variable for the same model, the economic openness model will follow the same method.

Subsequently, the stationarity of the variables was studied, for this, first and second-generation tests were used. The first generation test used was the Maddala and Wu and the second generation test performed was the Pesaran (CIPS), both tests were performed with and without trend, the null hypothesis of these tests is that the series is integrated at 1, I(1), being stationary in first differences. The following tests performed were to study the cointegration of the variables, thus two tests were used: the Kao test and the Pedroni test these tests have as null hypothesis that there is no cointegration. These tests were only performed for the variables that presented integration of order 1.

Since the countries used are developed, similar countries and all belong to a worldwide organization that shares goals and policies, it was necessary to perform the heterogeneity test where the null hypothesis says that the slope coefficients are homogeneous. This test studies the slope heterogeneity, to do this it estimates two models and compares them. Thus, the first model stimulates weighted fixed effects which determines homogeneity slope, and the second model has no restrictions, the model under

the alternative, is a cross-sectional unit specific OLS regression model, the test at the end is based on the difference of the two models.

Then the following models, Dynamic Ordinary Least Squares (DOLS), Full Modified Ordinary Least Square (FMOLS) and the Pooled Mean Group (PMG) were used for estimation. These models are intended to study the long-run effects of the models used in this study. If the variables in a panel series are cointegrated in the long run, the use of pooled least squares estimates may lead to the production of biased estimates due to autocorrelation and possible endogeneity problem. Both DOLS and FMOLS are efficient estimation techniques in the sense that they can overcome these problems.

The DOLS panel estimation technique is a parametric technique that comprises the forward and lag values of the variables. To estimate the cointegration vector, DOLS used the following equation (5).

$$y_{it} = \alpha_i + \beta_i X_{IT} + \sum_{k=-Ki}^{Ki} Y_{ik} \Delta X_{it-K} + \varepsilon_{it} \quad \textbf{(5)}$$

Where, *Ki* and -*Ki* are arrears and prepayments, respectively.

The FMOLS panel method is a nonparametric technique. The FMOLS panel estimator can be estimated using the following panel regressions model equation (6).

$$\widehat{B}^* GFM = N^{-1} \sum_{i=1}^{N} \widehat{B}^* FM, i \quad \textbf{(6)}$$

Where, $\hat{B}^* FM$, *i* is the usual FMOLS estimator applied to the i-th panel member.

This model has a robust structure, allowing variables to have different orders of integration and different lags within the model, which makes it less restrictive. Thus, allowing a dynamic effects analysis of the variables, allowing short-run and long-run effects to be observed separately.

Subsequently PMG was performed, this model is used when the variables present heterogeneity and integration equal to or less than 1. This model allows the «study of short- and long-term relationships, preferring that the variables present slope heterogeneity in the short term and presenting restrictions in the long term.

The unconstrained ARDL model is defined as follows, where t=1,2, ... T, time periods i= 1, 2, ... N countries for the dependent variable Y:

$$y_{it} = \sum_{j=1}^{p} \lambda_{ij} Y_{i,t-j} + \sum_{j=1}^{p} \delta'_{ij} X_{i,t-j} + \mu_i + \varepsilon_{it} \quad \textbf{(7)}$$

Where *Xi*, *t-j* is the vector (*k*1*) of explanatory variables for group *i*, and μi represents the fixed effects.

The group average clustered restriction is that the elements of β are common across all countries:

$$\Delta\gamma_{it}=\theta_i\left(\gamma_{i,t-1}-\beta'x_{i,t-1}\right)+\sum_{j=1}^{p-1}\gamma_{ij}\,\Delta\gamma_{i,t-j}+\sum_{j=1}^{q-1}\gamma'_{ij}\,\Delta x_{i,t-j}+\mu_i+\varepsilon_{i,t} \quad \textbf{(8)}$$

The variables present in this study were converted into natural logarithms to scale the data and turn the nonlinear into linear relationships (l shows the natural logarithm before the variable name). The variables in this study are also in per capita values, so the variables are logarithmized and in per capita values.

3.2. Data

In this study 28 OECD countries are used: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Japan, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Korea, Slovakia, Slovenia, Spain, Sweden, United Kingdom and United States. These countries were chosen because they are developed, homogeneous, and all belong to a worldwide organization that is concerned with economic development. This organization requires that these countries share the same goals, the same moral values, and common policies. Since the countries have the same characteristics, it is expected that the results obtained will not be very different.

The data used in these studies have an annual frequency with a corresponding time horizon between 1995 and 2018. The sample was selected according to data availability in order to obtain the largest possible panel.

Table 1. *Variable's description and sources*

Variables	Definition	Sources
gdppc	Gross Domestic Product per capita: constant prices LCU	WDI
cgpipc	Comparable Genuine Progress Indicator per capita: constant $2015	OCDE/SWIID/IEA/WDI
agriculture	Agriculture, forestry, and fishing: value added constant $2010	WDI
nowood	Paper and cardboard	FAOSTAT
wood	Roundwood	FAOSTAT
fossil	Shows electricity generation from coal, peat, oil shale, oil, and natural gas. (GWh)	IEA
renewable	Renewables Sources Electricity Output GWh	IEA
fdi	FDI stock in millions of USD	UNCTAD
agri_exp	Agricultural raw materials exports: % of merchandise exports	WDI
food_exp	Food exports: % of merchandise exports	WDI
fuel_exp	Fuel exports: % of merchandise exports	WDI
ict_exp	Medium and high-tech exports: % manufactured exports	WDI

Note: WDI stand for World Development Indictors. OECD stans for Organisation for Economic Co-operation and Development. SWIID stands for Standardized World Income Inequality Database. IEA stands for International Energy Agency. FAOSTAT stands for Food and Agriculture Organization of the United Nations Database. UNCTAD stands for United Nations Conference on Trade and Development.

The variables present in this study represent natural capital and economic openness. Natural capital is represented by: *agriculture, nowood, wood, fossil, renewable*; and economic openness is represented by*: fdi, agri_exp, food_exp, fuel_exp, ict_exp*. Throughout the study four models will be conducted, where the first will be the study of the impact of natural capital on *cgpi*, in the second model *gdp* is used as an dependent variable to study the impact of natural capital on this variable, the third model studies the impact of economic openness on *cgpi*, and lastly the influence of economic openness with *gdp* as an dependent variable will be studied.

The *cgpi* indicator was calculated with the following equation:

$$CGPI=WPC+PriC-ExDur+SDur-DRE-GINI+NDRE+SPI+UW-CAP-ED-CCC \quad \textbf{(9)}$$

Where, *wpc* mean Ewighted private consumption expenditure. *PriC* mean Private consumption. *ExDur* mean Expenditures on durable goods. *SDur* mean Services provided by the durable goods. *DRE* mean Private defensive and rehabilitative expenditures. *GINI* mean Income distribution inequality. *NDRE* mean Public non-defensive and rehabilitive expenditures. *SPI* mean Services provided by public infrastructure. *UW* mean Unpaid work. *CAP* mean Cost of air pollution. *ED* mean Energy depletion - non-renewable resources depletion. *CCC* mean Cost of climate change -long-term environmental damage.

This indicator was calculated for the countries and for the time horizon of this paper. As referenced in the equation, the indicator has several components, among private consumption and public consumption, the GINI, unpaid labor, the cost of air pollution and

the cost of climate change - long-term environmental damage. Thus, this indicator is the best option for studying sustainable economic development.

4. Results and Discussion

4.1. Preliminary results

In this section of the study a description of the data is shown in Table 2. This study covers a total of 24 years with 28 countries per variable, that is, for each variable in the panel is constituted by a total of 672 observations.

According to Table 2, the mean value of the variable *lgdppc* in the selected countries is 10.300014 and has a minimum value of 8.546217 and a maximum value of 11.62597. The other independent variable, *lcgpipc*, has a mean value of 20.18465 and has a minimum value of 14.24745 and a maximum value of 28.90147. Table 2 also provides a description of the remaining variables, showing the mean number, standard deviation, minimum number, and maximum number of variables used throughout the study.

Table 2. *Descriptive statistics*

variables	Observations	Mean	Std.Dev	Min	Max
lgdppc	672	10.30014	0.6439103	8.546217	11.62597
lcgpipc	672	20.18465	2.90135	14.24745	28.90147
lagriculture	672	6.220451	0.4508106	4.659878	7.288282
lnowood	672	-2.143985	1.287684	-6.229419	0.9970581
lwood	672	-0.3856092	1.586346	-5.796035	2.516184
lfossil	672	-5.919473	0.9647469	-9.678324	-4.564421
lrenewable	672	-7.220872	1.667676	-12.68215	-3.453257
lide	672	8.874191	1.365839	4.575333	12.98232
lagri_exp	672	0.503264	0.8897192	-5.361792	3.40987
lfood_exp	672	1.912288	0.8229724	-0.7923403	3.528451
lfuel_exp	672	1.313386	1.263299	-3.742555	4.245858
lict_exp	672	3.98282	0.286088	2.672698	4.44721

This study starts by analyzing cross section dependence, to which it is concluded that there is cross section dependence between all variables in the two concepts. That is, there is cross-sectional dependence between the variables that define natural capital with both *lcgpipc* and *lgdppc*, and the same happens with the variables that define economic openness. As it possible to observe in the following table.

Table 3. *Cross-section dependence*

Natural Capital		***Economic Openness***	
Variable	CD-test	**Variable**	CD-test
lcgpipc	39.065***	*lcgpipc*	39.065***
lgdppc	81.568***	*lgdppc*	81.568***
lagriculture	8.842***	*lide*	85.393***
lnowood	10.686***	*lagri_exp*	35.696***
lwood	15.865***	*lfood_exp*	37.95***
lfossil	26.637***	*lfuel_exp*	46.329***
lrenewable	68.691***	*lict_exp*	21.91***

Note: ***, denotes statistical significance at the 1% level

Subsequently, the summary of the results obtained in the unit root tests will be presented, first generation tests, Maddala-Wu, and second-generation tests, (CIPS), were used, both in the calculation with and without bias.

To verify the stationarity of the variables, this study first performed unit root tests for the dependent variables, then for the variables representing natural capital, and finally for the variables representing economic openness. The following table only shows the results with 1 lag, but the test with 1 lag was also performed, however the results overall *remain unchanged.*

Table 4. *Unit root tests lag 1*

	Level			
Variables	**Maddala-WU**		**CIPS (Zt-bar)**	
	without trend	**with trend**	**without trend**	**with trend**
lcgpipc	67.722	72.456	-4.934	-0.842
l*gdppc*	67.188	70.725*	-3.022	-1.726
lagriculturepc	93.306	88.147	-1.518	1.233
lnowood	76.523	69.983*	-0.648	-2.284
lwood	78.685	76.068	-0.546	0.213
lfossil	49.963	49.322	0.661	-1.05
lrenewable	54.391	107.225	-4.247	-2.866
lide	94.686	25.233	-2.895	-3.444
lagri_exp	106.737	63.186	-3.022	-0.769
lfood_exp	119.388	148.786	-4.203	-3.429
lfuel_exp	53.094	53.635	-4.464	-4.057
lict_exp	230.923	182.549	-2.485	-0.409
	1st differences			
dlcgpipc	249.568***	189.014***	(-)6.837**	(-)5.429***
dlcgpipc	220.696***	167.808***	(-)4.648***	(-)2.149**
dlagriculturepc	463.050***	377.557***	(-)10.185***	(-)8.366***
dlnowood	359.402***	332.582***	(-)10.294***	(-)9.433***
dlwood	355.318***	278.183***	(-)7.499***	(-)5.301***
dlfossil	342.862***	313.171***	(-)9.629***	(-)8.017***
dlrenewable	433.856***	344.903***	(-)12.126***	(-)10.612***
dlide	229.976***	311.676***	(-)8.921***	(-)7.259***
dlagri_exp	302.431***	242.068***	(-)8.407***	(-)5.949***
dlfood_exp	348.836***	269.767***	(-)11.660***	(-)8.782***
dlfuel_exp	360.381***	295.803***	(-)11.454***	(-)10.670***
dlict_exp	291.346***	206.646***	(-)8.753***	(-)7.233***

Note: ***, **, * denotes statistical significance at 1%, 5%, 10% level, respectively

Analyzing Table 4, it is concluded that the two independent variables are stationary in first differences in both the first- and second-generation tests.

Then, the unit root tests for the variables that constitute natural capital are presented. Through its analysis it is possible to conclude that all variables are stationary in first differences, both with trend and without trend, this stationarity happens in the first- and second-generation unit root tests.

Finally, unit root tests were applied for the variables of the economic openness model. As with the other variables analyzed above, in this case the variables are also stationary in first differences, for the first- and second-generation unit root test and with

and without trend. In conclusion, all variables used in the study, independent variables and dependent variables are stationary in first differences, meaning that they have a unit root.

After examining the stationarity properties of the variables, the long-run relationship between variables was studied. To do this, it was necessary to separate the variables by models, as represented in equations 1, 2, 3 and 4.

In this study it is possible to explore cointegration between the variables because all variables become stationary in first differences. Thus, to investigate the long-run relationship between the variables in the different models, the tests used were the Kao and Pedroni panel cointegration test.

Table 5 presents the results of the Kao panel cointegration test for natural capital with the two independent variables. Thus, through its analysis, it was concluded that through this test all variables are cointegrated. On the one hand, the model with *lcgpipc* the variables are cointegrated in all the components present in this test, on the other hand, the model with *lgdppc* as independent variable presents cointegration for the Dickey-Fuller and Augmented Dickey Fuller component.

Table 5. *Kao panel cointegration test for Natural Capital*

	lcgpipc	**lgdppc**
Modified Dickey-Fuller t	-1.9631**	-0.4556
Dickey-Fuller t	-3.3079***	-1.6194*
Augmented Dickey-Fuller t	-1.6118*	-1.4845*
Unadjusted modified Dickey-Fuller t	-1.8881**	0.5635
Unadjusted Dickey-Fuller t	-3.2700***	-0.9442

Note: ***, **, * denotes statistical significance at 1%, 5%, 10% level, respectively

Subsequently, Table 6 presents the results of the Pedroni panel cointegration test for natural capital. After observing them, it was concluded that the variables are cointegrated in all components of this test and for the two dependent variables.

Table 6. *Pedroni panel cointegration test for Natural Capital*

	lcgpipc	**lgdppc**
Modified Phillips-Perron t	3.4467***	4.0056***
Phillips-Perron t	-4.0585***	-2.6199***
Augmented Dickey-Fuller t	-2.6617***	-1.4367*

Note: ***, * denotes statistical significance 1%, 10% level, respectively

After examining cointegration for natural capital, cointegration for economic openness will be investigated, using the same tests and the same method as for natural capital.

Table 7. *Kao panel cointegration test for Economic Openness*

	lcgpipc	**lgdppc**
Modified Dickey-Fuller t	0.5728	-2.3782***
Dickey-Fuller t	-0.6667	-2.1387**
Augmented Dickey-Fuller t	-0.7204	-0.9045
Unadjusted modified Dickey-Fuller t	0.5266	-2.0587**
Unadjusted Dickey-Fuller t	-0.7024	-1.9766**

Note: ***, ** denotes statistical significance 1%, 5% level, respectively

Thus, according to Table 7 it is possible to conclude that according to the test used the variables do not present cointegration when the independent variable that represents sustainable economic development is used. The same result is not observed in the model of the economic growth, since it presents cointegration in all components of the test except in the Augmented Dickey-Fuller t component.

After, Table 8 presents the results for the Pedroni panel cointegration test for economic openness. Observing the table, it is noticeable that according to this test there is cointegration for the variables of the two models. For the *lcgpipc* variable there is cointegration for all parameters of the test and with the independent variable *lgdppc* it only shows cointegration for the Modified Phillips-Perron t parameter.

Table 8. *Pedroni panel cointegration test for Economic Openness*

	lcgpipc	**lgdppc**
Modified Phillips-Perron t	3.8154***	5.0267***
Phillips-Perron t	-3.0936**	0.5636
Augmented Dickey-Fuller t	-1.6761**	0.1974

Note: ***, **, * denotes statistical significance at 1%, 5%, 10% level, respectively

In conclusion, it is possible to verify the existence of cointegration among the variables of the models used in the study. On the one hand, natural capital presents cointegration for the two independent variables in both Kao's panel cointegration test and with Pedroni's panel cointegration test. On the other hand, economic openness exhibits cointegration for the two independent variables in Pedroni's panel cointegration test and only exhibits cointegration with Kao's panel cointegration test for the *lgdppc* variable.

4.2. Results of the estimated models

The results of panel cointegration tests only verify the existence of a long-run relationship between the variables in a panel series and cannot identify casual relationships. Therefore, to determine the causality relationships this study used the DOLS, FMOLS and PMG estimators to estimate the panel cointegration vectors. However, some conditions need to be satisfied in order to run the mentioned methods. First, all variables must be stationary in first differences, second all variables must cointegrate in the long run. Having satisfied these two conditions and having confirmed them earlier, the present study attempted to estimate DOLS, FMOLS and PMG for natural capital and for economic openness with the two dependent variables used in the present study.

Subsequently, the results obtained from these methods will be interpreted, the coefficients of these estimators can be understood as elasticities, because all variables were expressed in natural logarithms.

Table 9 presents the results obtained for the DOLS method for natural capital, comparing the results obtained from the two independent variables. Thus, it can be seen that *lagriculture* and renewable variables are statistically significant at 1% on both independent variables and also show a positive coefficient for both. On the one hand, only the variable *lnowood* is only statistically significant in the model that uses the variable *lcgpipc* as dependent variable and presents a negative coefficient. On the other hand, the variables *lwood* and *lfossil* are only statistically significant for the model that uses *lgdppc* as the independent variable, both variables present a positive coefficient.

Table 9. *DOLS for Natural Capital*

Explanatory Variables	lcgpipc	lgdppc
lagriculture	0.610225***	0.249351***
lnowood	-0.194104***	0.046383
lwood	0.189908	0.187537**
lfossil	-0.012698	0.078813***
lrenewable	0.113335***	0.114760***

Note: ***, **, * denotes statistical significance at 1%, 5%, 10% level, respectively

After, the results obtained with the FMOLS method for natural capital will be presented. The results obtained with this method were better than the results obtained with the FMOLS estimator.

Table 10. *FMOLS for Natural Capital*

Explanatory Variables	lcgpipc	lgdppc
lagriculture	0.627709***	0.189311***
lnowood	-0.1777181***	0.059632***
lwood	0.134732***	0.159350***
lfossil	0.001216	0.069714***
lrenewable	0.135287***	0.124496***

Note: *** denotes statistical significance 1% level, respectively

Analyzing Table 10, it can be concluded that all variables are statistically significant at 1% with positive coefficients when exploring the impact of natural capital on economic growth. When analyzing the natural impact on sustainable development only the variable representing electricity produced through fossil fuels is not statistically significant. The remaining variables are statistically significant at 1% and with positive coefficients, except for the variable representing paper and cardboard resources that has a negative coefficient.

Then, the results obtained for the PMG method with the natural capital variables will be presented on table 11. This method presents the results for both long- and short-term equations.

Table 11. *PMG for Natural Capital*

Long Run Equation		
Explanatory Variables	**lcgpipc**	**lgdppc**
lagriculture	1.827858***	0.959390***
lnowood	0.024980	-0.137288***
lwood	-0.771847***	0.531325***
lfossil	-0.045929	0.064785
lrenewable	-0.171057***	-0.007970
Short Run Equation		
cointeq01	-0.062667***	-0.052601***
lagriculture	-0.048613	0.000434
lnowood	0.014505	0.099197***
lwood	0.017702	0.012246
lfossil	-0.009316	0.060098***
lrenewable	0.004759	0.008384

Note: *** denotes statistical significance 1% level

Most of the variable are statistically significant in the long-run, with only a few short-term statistical significances, this result corroborates the use of DOLS and FMOLS estimators. Thus, analyzing this table it is possible to conclude that the variables *lagriculture, lwood* and *lrenewable* are statistically significant and with negative coefficients, except the variable *lagriculture* that presents a positive coefficient, for natural capital with *lcgpipc* as independent variable Analyzing the natural capital model with the dependent variable *lgdppc*, it can be seen that the variables *lagriculture, lnowood* and *lwood* are statistically significant at 1% and with positive coefficients, minus the variable *lnowood* that presents a negative coefficient. Analyzing the short-term equations, it is possible to conclude that there are no statistically significant variables for the dependent variable *lcgpipc*. However, for the dependent variable *lgdppc* the variables *lnowood* and *lfossil* show significance for 1% and positive coefficients.

Then, the same methods will be analyzed for the variables that characterize economic openness.

Table 12. *DOLS for Economic Openness*

Explanatory Variables	**lcgpipc**	**lgdppc**
lfdi	0.093364***	0.122839***
lagri_exp	-0.116277	-0.051941
lfood_exp	-0.072874	0.065778
lfuel_exp	-0.016100	-0.032812***
lict_exp	0.577352***	0.431550***

Note: *** denotes statistical significance 1% level

Thus, Table 12 presents the results obtained from the DOLS method. The variables *lfdi* and *lict_exp* are statistically significant at 1% and with positive coefficients for the two independent variables, while the variable *lfuel_exp* is only statistically significant for the independent variable *lgdppc* and presents a negative coefficient.

Thereafter, Table 13 presents the results obtained from the FMOLS method. After its analysis, it is concluded that the two independent variables present the same significance, and the coefficients present the same sign. Thus, the variable *lfdi* and *lict_exp*

present significance at 1% with the positive coefficient and the variable *lagri_exp* presents significance and a negative coefficient.

Table 13. *FMOLS for Economic Openness*

Explanatory Variables	lcgpipc	lgdppc
lfdi	0.134403***	0.148260***
lagri_exp	-0.105570**	-0.074278***
lfood_exp	-0.006253	-0.001785
lfuel_exp	-0.031437	-0.012475
lict_exp	0.601037***	0.353162***

Note: ***, ** denotes statistical significance 1%, 5% level, respectively

Following, the results obtained for the estimated PMG will be presented. Analyzing the long-term equation, it is understood that all variables are statistically significant for both independent variables, all variables have a positive coefficient, except the variables *lfood_exp* and *lict_exp* have a negative coefficient with the independent variable *lcgpipc*, with the independent variable *lgdppc* only the variable *lfuel_exp* has a negative coefficient. Now analyzing the short-term equation there are only statistically significant variables for the independent variable *lgdppc*, these variables are *lfdi, lagri_exp* and *lfood_exp*, in these variables only the variable *lfdi* presents a positive coefficient, the others present a negative coefficient.

Table 14. *PMG for Economic Openness*

Long Run Equation		
Explanatory Variables	**lcgpipc**	**lgdppc**
lfdi	0.119687***	0.365435***
lagri_exp	0.222299***	0.296855***
lfood_exp	-0.236215***	0.103047***
lfuel_exp	0.078995***	-0.043044*
lict_exp	-0.248859***	0.433016***
Short Run Equation		
cointeq01	-0.161864***	-0.036716
lfdi	0.021105	0.017820*
lagri_exp	-0.023449	-0.035709**
lfood_exp	0.021624	-0.102851***
lfuel_exp	-0.003149	0.001303
lict_exp	-0.122884	0.055599

Note: ***, **, * denotes statistical significance at 1%, 5%, 10% level, respectively

In general, the countries that are analyzed in this study are on a good path towards sustainable economic development, at least in the use of natural capital and economic openness. When it comes to natural capital, it is suggested that they stop using fossil resources for energy production, as this is not statistically significant for economic development. Although countries are on the right track regarding natural capital management in relation to economic development it is advisable that they reduce their consumption of paper and cardboard. With regard to economic openness, the OECD countries are also on a favorable path to achieving good results in sustainable economic

development. It is only recommended that they export less food and less technology. In short, the OECD could implement measures to reduce the use of fossil resources and paper resources, and those countries belonging to this organization produce their own food.

Overall, the OECD has been making good progress in sustainable economic development. At its inception, this organization was primarily concerned with increasing the wealth of its member countries. But today, their main concern is not with the economic growth of their economies, but mainly with the prevention of the environment. Thus, it was necessary for this organization to encourage member countries to be more careful with the environment, suggesting that they decrease the use of non-renewable resources and opt to use renewable natural resources, encouraging recycling and reuse of resources, but the main measure was the incentive for economies to reduce their pollution. This set of measures helped natural capital and economic openness to explain economic development, for economic development to show even better results it is necessary that OECD countries continue to adopt these measures and adopt the measures suggested above.

5. Conclusion

In this study, the role of natural capital and economic openness in sustainable economic development was analyzed using DOLS, FMOLS and PMG. The comparable Genuine Progress indicator was calculated for the sample countries. This indicator considers social components and environmental components that are not included in GDP, it also considers economic components just like GDP. With this in mind, the impact of natural capital and economic openness in GDP on the Genuine Progress Indicator was assessed.

Analyzing the results obtained for the natural capital model, with the DOLS estimator it is concluded that the variable representing agriculture, forestry and fishing has a positive impact of 1% on sustainable economic development and economic growth, the same is also true for the variable representing renewable energy. Non-timber resources, i.e., paper and cardboard resources have a negative impact on sustainable economic development as well as on economic growth according to the PMG estimator, whereas according to the FMOLS estimator it has a positive impact on economic growth. On the one hand, the variable representing timber resources according to the PMG estimator shows a negative long-term impact on sustainable economic development, on the other hand the same variable with the same estimator shows a positive long-term impact on economic growth.

As for economic openness, it is understood that, according to the PMG estimator, there is a long relationship of all variables with economic development. On the one hand, foreign direct investment has a positive impact on economic development for all estimators. On the other hand, exports of agricultural raw materials have a positive long-run impact on economic development according to the PMG estimator, but according to the FMOLS estimator it has a negative impact. The opposite happens with medium and high technology exports, which according to PMG show a negative impact and according to FMOLS a positive impact.

Briefly, the variables that make up natural capital and that are environmentally friendly have a positive impact on economic development as was indicated in the literature. With regard to the variables that make up economic openness, it is perceived that foreign direct investment and exports with higher value goods have a positive impact on economic development and exports with lower economic value have a negative impact on economic development, which is in line with the literature.

In conclusion, after analyzing the results obtained, it is clear that OECD countries are on the right track to obtain excellent results in relation to sustainable economic development. According to the results obtained, it is suggested that OECD countries reduce and if possible, stop using fossil resources for electricity consumption. It is also suggested

that they reduce the use of paper and cardboard, so these countries will achieve better results for natural capital in relation to sustainable economic development. For these countries to be able to show better results from economic openness for sustainable economic development, it is recommended that they export less food and less technology. This study suggests that the OECD implement measures to reduce non-renewable natural resources, such as fossil and paper resources, and for countries to become more self-sufficient in food.

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