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SOSYAL BİLİMLER ENSTİTÜSÜ
İKTİSAT ANABİLİM DALI
İKTİSAT (İNGİLİZCE) BİLİM DALI

AN ANALYSIS ON THE COMPARISON OF GREEN GROWTH INDICES: THE CASE OF TURKEY AND EU COUNTRIES

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FATMA ŞAHİN

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ISTANBUL, 2022

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SOSYAL BİLİMLER ENSTİTÜSÜ

TEZ ONAY BELGESİ

Anabilim Dalı İktisat Bilim Dalı Yüksek Lisans öğrencisi Fatma Şahin'nin An Analysis on the Comparison of Green Growth Indices: the Case of Turkey and EU Countries adlı tez çalışması, Enstitümüz Yönetim Kurulunun ..... tarih ve .....sayılı kararıyla oluşturulan jüri tarafından oy birliği ile Yüksek Lisans Tezi olarak kabul edilmiştir.

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YEŞİL BÜYÜME ENDEKSLERİNİN KARŞILAŞTIRILMASI ÜZERİNE BİR ANALİZ: TÜRKİYE VE AB ÜLKELERİ ÖRNEĞİ

ÖZET

Yeşil büyüme ekonomilerde gün geçtikçe önem kazanmaktadır.Yeşil büyümenin amacı toplumsal refahı sağlamakla birlikte çevre kirliliğini minimum seviyede tutmaktır. Yeşil Yeni anlaşma yeşil büyüme literatüründe büyük bir paya sahiptir. Antlaşma ekonomik iyileşmeleri ve aynı zamanda iklim değişikliği için adımlar atılması gerektiğini savunur. Toplumsal refahı arttırmak, yoksulluğun azaltmak ve ekonomide sürdürülebilirlik Yeşil Yeni Anlaşmanın temelini oluşturur. Bu kapsamda özellikle Birleşmiş Milletler'in Sürdürülebilir Kalkınma Hedefleri birçok ülke için örnek oluşturmuştur.Çalışma Sürdürülebilir Kalkınma Hedefleri dikkate alınarak Asya Kalkınma Bankası tarafından takdim edilen Türkiye ve Avrupa Birliği ülkeleri Kapsayıcı Yeşil Büyüme Endeksini ve Dengeli Kapsayıcı Yeşil Büyüme Endekslerini sunmaktadır. Endeks sosyal eşitlik, ekonomik büyüme ve çeveresel sürdürülebilirlik başlıklarından oluşmaktadır. Öte yandan, teknoloji ve büyüme arasındaki ilişki her zaman tartışmaya açık bir konudur. Bu çalışma teknolojik gelişmeleri temsilen Ar-ge harcamalarının Gayrı safi yurtiçi hasıla içindeki payı, Bilgi İletişim Teknolojileri ihracatının toplam ihracat içindeki payı ve Bilgi İletişim Teknolojileri ithalatının toplam ithalat içindeki payından oluşan teknolojik gelişme göstergesi ile teknoloji bazlı yeni bir endeks ortaya koymuştur. Çalışmanın oluşturduğu endeks dört farklı yıl: 2005, 2010, 2015 ve 2019 için bize dört endeks sunar. Teknolojik gelişme göstergesiyle birlikte Almanya, Fransa, İrlanda gibi ülkeler Kapsayıcı Yeşil Büyüme Endeksi ile yakın değerlere sahipken; Polonya, Romanya, Letonya, Litvanya gibi ülkeler daha düşük değerlere sahiptir. Bunun temel sebebi ise teknoloji göstergesinin diğer üç ana göstegeden küçük değerlere sahip olmasıdır.

Anahtar kelimeler: Yeşil Büyüme, Kapsayıcı Yeşil Büyüme Endeksi, Yeşil Yeni anlaşma

JEL sınıflandırma: O32, Q56, O4

AN ANAYLSIS ON THE COMPARISON OF GREEN GROWTH INDICES: THE CASE OF TURKEY AND EU COUNTRIES

ABSTRACT

Green growth gradually gains importance in economies. Green growth aims to foster social welfare by keeping environmental degradation at a minimum level. The green new deal plays a crucial role in green growth literature which defends economic improvements and steps for the climate change needs and argues that needed steps for economic recovery as well as for climate change. Fostering social welfare, poverty alleviation, and economic sustainability constitute the basics of the deal. In this context, the Sustainable Development Goals of the United Nations have set an example for many countries. The thesis presents the Inclusive Green Growth Index and Balanced Inclusive Green Growth Index for Turkey and the European Union countries. The indices consist of social equality, economic growth, and environmental sustainability pillars. Besides that, the relationship between technology and economic growth is always a controversial issue. For the measurement of technology the thesis utilizes Research and Development expenditure in GDP ,Information Communication Technology goods export in total goods export and Information Communication Technology goods import in goods import. With the technology pillar, the study introduces a new index that is Tech- oriented Inclusive Green Growth Index. It represents four indices for four different time period:2005, 2010, 2015, 2019. With the technology pillar, while countries like Germany, France, Ireland have similar values with the Inclusive Green Growth Index. Countries like Poland, Romania, Latvia, Lithuania have lower values because the technology pillar has smaller values than the other three pillars.

Keywords: Green growth, Inclusive Green Growth Index, Green New Deal

JEL classification: O32, Q56, O4

PREFACE

Economic growth is the aim of every economy exists in the world. However, economic activities often result in environmental degradation. Rise in environmental deterioration pushes economies to find new ways for economic growth.Thereby, a new concept which is green growth is born. Even though green growth has started to gain importance with the 2015 Paris Agreement, its roots stem from the United Nations Conference on Environment and Development which is also known as Rio Conference. One of the essential outcomes of the conference is the Rio Declaration. The remarkable result of the declaration is transforming economic activities into a greener activities.Green growth prominent goal is to promote economic growth with abolishment of environmental damage.When all the circumstances are taken into consideration, the green growth concept is significant for sustainable and livable environment. Thus, this thesis examines the emergence and development of green growth and introduces inclusive green growth indices.After we measure the inclusive indices, the technology contribution is initiated to the indices.

Of course, there are challenging part during writing the thesis.The most challenging parts are to decide how to measure green growth and how the indices can be different. To overcome these obstacles my advisor helped me. I thank my advisor Prof. Dr. Mahmut Tekçe.I also thank my mother Ayser ŞAHİN my father Mehmet ŞAHİN, and my sister Melike ŞAHİN for always supporting me.

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İSTANBUL, 2022

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ABBREVIATIONS

Asian Development Bank	ADB
Carbon Dioxide	CO2
Conference of Parties	COP
European Union	EU
Global Green Growth Institute	GGGI
Green Growth Knowledge Partnership	GGKP
Gross Domestic Product	GDP
Group Efficiency change	GEC
Group Technical Change Index	GTC
Herfindahl - Hirschman	HH
Inclusive Green Growth	IGG
Information Communication Technologies	ICT
Intergovernmental Panel on Climate Change	IPCC
Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services	IPBES
Metafrontier Malmquist–Luenberger	MML
Nationally Determined Contributions	NDCs
Organization for Co-Operation and Development	OPEC
Potential Technical Relative Change	PTRC
Pure Technical Catch-up	PTCU
Research and Development	R&D
Sustainable Development Goals	SDGs
United Nations Development Programme	UNDP
United Nations Conference on Environment and Development	UNCED
United Nations Framework Convention on Climate Change	UNFCC
World Health Organization	WHO

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1. INTRODUCTION

The purpose of all countries in the global economy is economic growth. However, especially after the Industrial Revolution human economic activities have often destroyed the nature and this destruction has eventually affected the available resources and the performances of the countries' economies. Throughout history, the development in the industries has destroyed nature which pushed people to find a new way out. For instance, the Intergovernmental Panel on Climate Change (IPCC) states that hot and dry regions such as Australia have gotten drier and hotter which causes many living creatures to extinct. In addition to this extinction, the world can run out of natural resources like water services and food systems (Allen et al, 2018). International companies need to consider necessary action to fight against this problem. For instance, Danone works on a decrease in the use of water consumption (Director of Climate Change report, 2019).

One of the actions to fight this environmental detoriation is carbon neutrality which is essential to keep the global warming at 1.5 Degrees Celsius. Thereby, it is expected that the accomplishment of green growth would both save the environment and provide augmented social welfare. According to the IPCC report, a global warming over 2 degrees Celsius would cause heap extinction and most areas of the planet would become useless. Therefore, more investment in renewable energies such as solar, and wind energies would contribute to a carbon-neutral economy. For instance, increase in deforestation and changing agriculture methods put animal diversity at risk (Allen et al, 2018). These signs tell us how important the green growth concept is. The recent changes that our planet has experienced signals that we should take serious actions to save the nature. With this framework, green growth becomes an important concept in recent years. The main purpose of green growth is to decrease environmental degradation by providing sustainability (Global Green Growth Institute, 2020). Countries take some actions and follow some policy implications to make the environment sustainable like Sustainable Development Goals (SDGs). SDGs are represented by United Nations Development Programme and the goals promote both sustainable environment and economic development (The 2030 Agenda for Sustainable Development, 2015).

SDGs purpose sustainable development to serve a better future life. This agenda includes a wide range of dimensions. 17 goals, 169 targets,368 events, and 5432 actions. Eliminating poverty and hunger, promoting good health and well-being, quality education, gender equality, clean water and sanitation are thr primary focus of the goals. Besides that, affordable and clean energy, decent work and economic growth, industry, innovation and infrastructure, inequality reduction, sustainable cities and communities, responsible consumption, and production, climate action, life below water, life on land, peace, justice and strong institutions, partnerships for the goals (The 2030 Agenda for Sustainable Development, 2015). The UN realizes and plans to realize many events to achieve these goals such as Global Sustainable Transport Conference, Nuclear Disarmament, and Our Sustainable Future.

Green growth does not only consider environmental degradation, but also provides sustainable growth (Global Green Growth Institute, 2018). Moreover, each dimension shows an important part of the path for a greener economy. The economic growth pillar explains how stable the economy of a country is; the social equity pillar indicates how well the society's welfare is, and whether a country gives importance to human rights and equality among its citizens; environmental sustainability consists of the most relevant indicators of environmental degradation. Combining the these three dimensions tells us the situation of a country for green growth.

Furthermore, technology makes life more comfortable for us and changes the way we work and communicate with each other. The world today needs new approaches and new strategies. Technology helps countries going further curing diseases, using energy sources more efficiently, having sustainable economies, and so on. However, the contribution of technology to green growth is a controversial issue.

While the relationship between economic growth and technological progress is in question, the paper investigates how this relationship will be within the green growth framework. Although green growth is a difficult phenomenon to measure, there are different measurements for green growth. The paper first introduces Inclusive Green Growth (IGG) and Balanced IGG Indices. After contributing technology pillar into the indices offer the Tech-oriented and Tech-Balanced IGG Indices.

Within the green growth framework, the paper introduces the IGG and Balanced IGG Index for Turkey and European Union (EU) countries between the period 2001-2019. As the data is limited for certain years, the paper represents the indices of 2005, 2010, 2015, and 2019 by taking an average of each five years. The structure of the paper is as follows: Section 2 reviews the emergence and development of green growth. Section 3 provides relevant studies about technology and green growth and Section 4 explains the theoretical background behind the study, Section 5 represents methodology which the paper uses, and data to analyze the results. Section 6 gives data description of the databases that the paper applied. Section 7 evaluates findings and gives any recommendations for further research. Finally, Section 8 concludes the results of the paper.

2. EMERGENCE AND DEVELOPMENT OF GREEN GROWTH

The roots of green growth first emerged at the United Nations Conference on Environment and Development (UNCED) in 1992 with the participation of 179 countries. The conference was held in Rio hence it is also named as Rio Conference. The summit discusses what can be done for fostering social and environmental factors and it signals that there is a need for a different perspective in human actions. More importantly, the conference highlights the possibility of sustainable development. At that point combining economic, social, and environmental activities is crucial to achieving sustainable development.

The conference results in Agenda 21 declaration which consists of four dimensions: social and economic dimensions, conservation and management of resources for development, strengthening the role of major groups, methods of implications (United Nations Conference on Environment and Development, 1992). The agenda takes a wide range from policy recommendations to poverty alleviation. The conference reveals the Rio Declaration and its 27 goals, the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD); and the Declaration on forest management basis (United Nations Conference on Environment and Development, 1992).

CBD aims to protect biological diversity and ecosystem services. It also promotes the protection of habitats of living and improves degraded ecosystems. In addition, the convention suggests the enforcement of regulations to a sustainable environment (Convention on Biological Diversity, 1992). The Forest Management Declaration promotes the recovery of deforestation and improvement of forest management. Especially, developed countries need to combat deforestation. The declaration emphasizes improving industrial and non-industrial planted forest to enhance ecologically national forestation (Report of the United Nations Conference on Environment and Development, 1992).

UNFCCC establishes conferences of the parties (COP) since 1995. The COP discuss necessary actions to prevent climate change and COP'26 realizes between 31 October and 12 November in Glaskow, the UK. Previous COPs introduced reports of developing countries need of implications for the Paris Agreement and also guideline for the least developed countries (United Nations Framework, Convention on Climate Change). Besides that, climate finance flows are another important issue of the conference. Even though the conference is the first agreement that is signed internationally against global warming, Kyoto Protocol is more concrete objectives. UNFCCC establishes Paris Agreement that is approved by 196 countries in 2015, enforced in 2016. Its first aim is to eliminate global warming to below 2, preferably 1.5 degrees celsius according to industrial levels. Countries aim to achieve global peaking greenhouse gas emissions to obtain climate neutrality by mid-century.

The agreement is merestone in the multilateral climate change. All countries come together to take some actions against climate change and they work to adverse its impacts. Countries need social and economic reforms to enforce the agreement. The agreement works on a five -year cycle of rising ambitious climate action that countries maintain. By 2020, parties hand out their climate action plan which is called nationally determined contributions (NDCs) (The Paris Agreement, 2015).

Parties follow the actions to alleviate climate change and the impacts of the increase in temperature in their NDCs. Besides that, parties support each other in terms of financial, technical, and capacity-building aids to countries that need them. Developed countries need to be the pioneer for economy-wide emission decrease. Developing countries had better improve for conducting emission reduction (The Paris Agreement, 2015).

Besides that, less developed countries need to represent some actions for emission reduction. Even though they don't have emissions in the past, emerging powers like China, India has started to increase their emissions in recent years. To reduce greenhouse gas emissions, countries should apply policy tools and implications to prevent deforestation and forest degradation. Emphasizing incentives and non-carbon policies are important concepts that the Agreement highlights (The Paris Agreement, 2015). The Agreement highlights that sustainable development requires technological progress, poverty alleviation, financial support, and capacity improvement. Developed countries had better give support to developing countries about those issues. Capacity improvement needs to be country-oriented. More importantly, with the Agreement, countries have started to aim for zero carbon emissions. This aim represents 25 % of emissions and it is remarkable in the power and transport sectors. The zero-carbon solutions might be representing 70 % of global emissions by 2030 (The Paris Agreement, 2015).

Paris Agreement promotes incentives for a reduction in greenhouse gas emissions and enhances public and private sector support, improvement in non-market approaches. Since developed countries are responsible for the majority of global carbon emissions, they need to be pioneers mobilizing climate finance from different kinds of tools, emphasizing public funds' role by different actions. Besides that, information that developed countries introduce for developing countries need to be transparent and consistent. Countries need to identify their existing technology and they need to take necessary steps to enhance the technology transfer. Financial support is significant for supporting developing countries. Improving innovation is another key instrument against fighting climate change. Comprehensive methods of Research and Development (R&D) particularly for developing countries contribute to sustainable development (The Paris Agreement, 2015).

In addition to the international agreements to tackle climate change, there also exist different institutions and organizations such as Global Green Growth Institute (GGGI) and Green Growth Knowledge Partnership (GGKP). Their initial goal is to support green growth actions and the implications of

member countries. GGKP is an international community to support a transition to a green economy. The Partnership was found in 2012 and consists of three different dimensions: green policy platform, green industry platform, and green finance platform. The GGKP introduces guidelines, research, instruments to its decision-makers, banks, investors, small and medium-sized enterprises, and firms about how to transform greener businesses. The partnership provides knowledge that is evidence-based, reliable, open (Green Growth Knowledge Platform, 2018-2021).

The GGKP aims to achieve its goals with two prominent channels. The first channel is to spread its guiding joint knowledge and share it with other group members. Besides that, the partnership is based on the knowledge to utilize an online expertise change. The expertise change enables industry, finance, and methods to initiate their joint knowledge following green growth. The eventual aim of the GGKP is to accomplish SDGs. Especially more inclusive, sustainable growth, and improvement in employment are the major goals of the partnership (Green Growth Knowledge Platform, 2018-2021).

GGGI is an institution that provides and represents sustainable growth for developing and emerging economies of its 35 member countries in Africa, Asia, the Caribbean, Europe, Latin America, the Middle East, and the Pacific. Its purpose is low carbon economies and inclusive sustainable growth, and the institute promotes its members to convert their economies into green economies. The vision of GGGI is to follow the 2015 Paris Agreement and combine the Paris Agreement with the 2030 SDGs Agenda. In other words, the institute helps member countries to maximize their green outcomes, NDCs application, and SDG agreement. Besides reduction in greenhouse gas emission and climate change, the GGGI support improvement in air quality, and green jobs employment, adequate ecosystem services supply and it promotes sustainability in energy, transportation, and waste (GGGI Strategy 2030 A Low-Carbon, Resilient World of Strong, Inclusive, and Sustainable Growth, 2019).

The GGGI initiates eight precedences to achieve its goals: First, utilizing and expediting climate finance and green investments for its members. Secondly, providing support to the members to strengthen policy and regulation framework, the capacity of institutions to get green growth outputs. Additionally, with enhancing health care system aiming a sustainable and circular bioeconomy. Besides that, transforming cities and communities into sustainable ones while promoting green infrastructures and green jobs employment. Furthermore, eliminating poverty, and providing gender equality. Improving more diverse, sustainable, and stronger funds for the institution. Improving, strengthening, conducting green growth organizations by knowledge spillover. Finally, being a well-functioned, strong, and efficient community (GGGI Strategy 2030 A Low-Carbon, Resilient World of Strong, Inclusive, and Sustainable Growth, 2019).

Twenty years after the Rio Conference, two big difficulties have emerged: a growing population and developing economic activities. In this context, the world needs new approaches to overcome those

difficulties. Green growth can succeed in handles these two obstacles. Organization for Economic Co-Operation and Development (OECD) establishes a Declaration on Green Growth in 2009. Implications should target to enhance green investment to help short-term economic improvement, and constitute an environmentally friendly environment with public investment for a greener economy in the long- term. In that way, green growth is a key concept for combatting environmental damage, climate change, and improvement in the energy sector, searching for new paths of economic growth (Declaration on Green Growth Adopted at the Meeting of the Council at Ministerial Level, 2009).

Economic activities trigger global warming which puts the life of living creatures at risk. For example, according to the World Health Organization (WHO), air pollution leads to one-third of deaths from strokes, lung cancer, and heart disease (World Health Organization, 2021). The main reason for ultra-fine particle pollution (PM2.5) are coal-fired power plants and fossil fuel machines, especially diesel buses and trucks (Defra, Public Health, 2021). The 2019 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report indicates unconscious human social and economic actions lead most species to face extinction. More than 15% of the land and 7% of oceans are under protection (UN Report: Nature's Dangerous Decline 'Unprecedented'; Species Extinction Rates 'Accelerating', 2019).

Searching for alternative energy systems, converting existing energies into more sustainable energies provide environmentally, and economically more sustainable resources. Green buildings, and infrastructures provide a contraction in greenhouse gas emissions. Switching agriculture systems to smart regenerative agriculture enables low carbon solutions. This transformation provides a rise in renewable energy use, intercropping, agroforestry, drought-resistant varieties (GGGI Strategy 2030 A Low-Carbon, Resilient World of Strong, Inclusive, and Sustainable Growth, 2019).

On the other hand, international institutions play a prominent role to achieve a low carbon economy. The institutions can contribute to obtain and preserve carbon, diffusion of clean technologies, improvement of green ICT technologies, foster energy efficiency. OECD assists countries whose goals are to transform a greener economy. The OECD also promotes R&D technologies and low carbon infrastructure to a sustainable environment. The organization supports any tool to achieve a greener economy (Declaration on Green Growth Adopted at the Meeting of the Council at Ministerial Level, 2009).

As far as these are all concerned, climate change, green environment are the main subject of different kinds of organizations and institutions. Even though each of them set their own objectives, they are all willing to take necessary action to eliminate climate change.

3. LITERATURE REVIEW

This chapter introduces related studies about green growth and gives information about the indices that different studies apply. A green economy presents a sustainable economy that aims at reducing environmental degradation by providing environmental sustainability. One of the basic pillars of green growth is the green new deal that promotes actions for climate change for a better environment. In other words, reducing environmental degradation by ensuring sustainability (The Heritage Foundation,2019). The global green new deal underlines four dimensions: economic recovery, poverty alleviation, and carbon emission reduction, and a decrease in environmental degradation. The deal declares that the US, the European Union (EU), and high-income OECD countries, and middle and high-income G-20 countries had better leave over two years at least 1% of their GDP on carbon dependency reduction. The concept highlights not only environmental damage and climate change but also emphasizes improvement in social protection. Poverty reduction and access to health care and education are the main concerns of the deal. The deal also promotes the abolishment of water subsidies and other distortions enforcing market-based tools to improve water direction (Barbier,2009). It proposes a separate program for developing and developed countries and promotes constructing green economies within the countries. Besides, it emphasizes financial aids to developing countries to handle economic downsize (Sundaram,2013).

In this respect, the deal proposes composing public-private collaboration for poverty alleviation and climate change (Sundaram,2011). Providing a more sustainable environment and justice are the other goals of the deal. Implementing carbon tax and some regulations to decrease carbon use and improving technologies for this purpose can be the implication for achieving these goals (Monast,2020).

The deal promises to amend human well-being and reducing social inequality within the nation. Therefore, the deal has a long-term plan which means it needs to follow many steps. In the long term, it also aims to create job opportunities. In this stage, the government can promote job creation (Institute for Public Policy Research, 2019a). It tries to provide all of these goals for society as a hall which means social equality is an important dimension of the deal. Improving investment, recovery in building and construction can contribute to a greener environment (Institute for Public Policy Research,2019b). Transforming the food system into a healthier one which prevents resource waste, introducing some revolution in agriculture can provide more sustainable and greener growth (Institute for Public Policy Research,2019c).

Decarbonization of the economy is the main object of the deal. Thus, economies that are closer to a greener environment are also closer to have greener growth. In that way, countries can improve social welfare and quality of life (Institute for Public Policy Research,2019d). It also provides energy reliability and affordability. If policy implications work well and this implication follows the green new deal

objectives, we can have reliable and affordable energy (Morningstar et al.,2020). Within this framework, throughout the history, Paris Climate Agreement which works for climate-changing promotes lessening environmental pollution by achieving sustainable development of economies. The Agreement highlights combining financial and tax incentives, increase in renewable energy use (United Nations Framework Convention on Climate Change, 2015). Green Growth introduces sustainable development by enhancing ecosystem services. Besides that, evidence highlights that greener technology yields greener growth (Danish and Ulucak, 2020).

Of course, there should be some policy tools for a greener economy. Promoting incentives, reducing carbon intensities should be the main objectives of countries for obtaining green growth (Kadekodi,2013). Reducing market inefficiencies in market pricing provides sustainable and greener growth (Smulders et al.,2014). Even though there exists a long way to achieve green growth, a decrease in environmental degradation and promoting low-interest loans can be the two policy tools for this goal (Derwent and Blachowicz,2015). Market-based incentives that mean imposing taxes, subsidies, or payment for environmental services are instruments for green growth (Barbier,2016).

From another point of view, there should be incentives and regulations to increase the demand for renewable energy. However, despite some attempts for renewable energy use, it consists too a small part of total energy consumption (Sweeney,2015). On the other hand, transforming available technology to greener technology can be an alternative solution (Samad and Manzoor,2011). Besides, renewable energy has a key role in green growth (Bagchi,2014). Economies can achieve sustainable development by fostering green growth with greenhouse gas emission reduction, ecosystem, and biodiversity protection, increase in social welfare (Acosta et al.,2020). Dercon (2014) offers some tools such as environmental pricing and regulations, low-carbon, and other investments and other enhancing investments for this purpose. Not only improving green industries but also fostering green industries are different approaches (Zhang,2020). Financial incentives can also be another policy tool for this purpose (The Way Forward in International Climate Policy,2014). Besides, the greener investment gives rise to a greener economy. A rise in sustainable demand and supply-side efficiency are important policy tools for green growth (Mabey,2012).

We can divide green growth policy tools into horizontal and vertical policy tools. Horizontal tools will be imposing Pigouvian tax to internalize externalities that give rise to environmental degradation. However, imposing the Pigouvian tax is not always applicable to all outcomes of environmental degradation. The environmentally friendly policy tools are alternative solutions to this problem. The vertical policy includes industrial policies. Industrial policies such as promoting innovation can reduce natural resource use and lessen the environmental damage that economic activities causes (Bowen and Hepburn,2014). Besides that, it helps to foster green growth (Jing and Yongfu,2013).

Greener innovation means advanced green growth (Li et al.,2018). Despite transforming to a greener economy seems costly, the outcome will be worth the transformation (Parikh,2014). For this purpose government can take some action by enforcing laws (Praphu,1998). Green growth declares fostering growth while improving living standards and decreasing environmental damage at the same time. Economies can enforce fiscal reforms and taxes, enhance sustainable production, promote green investment, and support green enterprises (Clayton,2013).

3.1 Global Green Growth Index

Green growth promotes both an environmentally sustainable world and countries (O'Donnell,2012). Within the framework, Global Green Growth Institute measures Global Green Growth Index. The index shows the country's performance of green growth it also includes the Paris Agreement, and Aichi Biodiversity Targets with four dimensions: efficient and sustainable resource use, natural capital protection, green economic opportunities, and social inclusion (Global Green Growth Institute.2020). Aichi Biodiversity Targets are determined at the Convention on Biological Diversity which is signed by 150 governments at the 1992 Rio Conference. The targets promote a sustainable environment and they don't only aim at maintaining the ecosystem but also enhancing society's well-being (The Convention on Biological Diversity,2000).

The four dimensions of GGGI consist of a wide range of indicators from average soil carbon content to municipal solid waste generation per capita. However, to measure the country's green growth performance, the availability of data leads us to search for a different index: The Inclusive Green Growth Index. The Index has three components; economic growth, social equity, and environmental sustainability. It is more comprehensive compared to the GGGI. It can serve as a multidimensional index for improving green growth and can be a tool that policymakers can apply. The targets of the index aim to reach every single part of society and the environment. Besides that, IGG Index includes most of the Social Development Goals. The SDGs take a wide range that varies from the Gini coefficient to carbon dioxide emissions. It underlines poverty reduction, women empowerment, carbon emissions reduction, rise in investment, improving access to health care and education services.

3.2 SDG-9 Index

Within this framework, both green growth and inclusive green growth follow these targets to indicate the indices for green growth (The 2030 Agenda for Sustainable Development, 2015). There are different types of indices such as the SDG-9 Index, inclusive and green industrial performance index, Metafrontier Malmquist–Luenberger (MML) index, and the Luenberger indicator. Each one of them uses a different method to measure the inclusive green growth index.

The SDG-9 Index consists of three dimensions: economic, social, and environmental dimensions with 11 different indicators from Research and Development (R&D) to Passenger and freight volumes by mode of transport for the 2030 Social Development Agenda. Similar to IGG Index, the SDG-9 index applies to min- max approach. It is measured for 128 countries between the 2000-2016 period and takes a value between 0 and 1. The study gives an index for different countries based on their economic development. Evidence of the study highlights that developed countries have a higher industrial ranking with less environmental degradation among selected countries, while developing conutries at an early

stage have an advantage to enhance their current economic condition with decreasing environmental damage (Kynčlová et al.,2020).

3.3 The Inclusive and Green Industrial Performance Index

The inclusive and green industrial performance index, on the other hand, has four pillars the capacity to produce and export green manufactures, the role of green manufactures, social and environmental aspects of green manufacturing, and inclusiveness. Green MVA per capita and green manufactured exports, the share of green MVA in total and share of green manufactured exports of total manufactured exports, and green manufacturing employment in total manufacturing employment are the indicators of the index. Carbon dioxide emission from manufacturing per unit of manufacturing value-added, labor force participation of women in manufacturing, gender pay ratio, the share of females in relevant territory education, and inequality measures are indicators (Halkos et al.,2021).

3.4 The Luenberger Indicator

Chung et al (1997) initially introduce Metafrontier Malmquist–Luenberger (MML)index. The index allows us to measure changes in efficiency concerning different technologies. Chen and Chen (2020) offer an index that is MML index based on a group efficiency change index (GEC), group technical change index (GTC), pure technical catch-up (PTCU), and potential technical relative change (PTRC). It indicates technological advance is a key indicator for Inclusive Green growth.

Finally, the Luenberger indicator decomposes inclusive green growth tools and applies the Data Envelopment Analysis (DEA) approach. Labor, capital, and energy are the inputs of the analysis. Good output (GDP) and undesirable output (wastewater and sulfur dioxide industrial soot) are the other indicators. Hence, this paper introduces an inclusive green growth index for Turkey and EU Countries and tries to have IGG and Tech-Oriented IGG Indices.

4. THEORETICAL BACKGROUND: GROWTH& TECHNOLOGY

Economic activities lead to the extinction of diversity of species and threaten the sustainability of nature. Thus, green growth enables economic growth while keeping peripheral degradation at its minimum gains importance. Besides that, the UN has important goals as such SDGs. More importantly, IGG Index that the paper initiates can be a significant measure for countries. Examining growth and technology literature is necessary to understand why technology is an outstanding concept for economic growth.

Measuring the effect of technological advancement on economic indicators is always a controversial and challenging issue that economists deal with. Technological progress is an important phenomenon that can take a wide range of explanations. It can provide knowledge that helps to produce more or produce output that has more qualified than produced before. (Rosenberg, 1982). In the economics of growth, Ramsey and Solow take technological progress exogenous by assuming steady-state growth requires a positive rate of technological progress (Ramsey,1928; Solow,1956). Romer works on the endogenous technological change that stems from investment. More importantly, in this analysis technology is a nonrival and partially excludable good rather than conventional or public good. He concluded that technological change increases output per hour worked (Romer, 1989). After that, Grossman and Helpman build up a model based on endogenous growth. Endogenous models suppose population growth and human capital and knowledge accumulation are the pillars of the economics of growth (Grossman and Helpman, 1991). Basu and Jamasb (2020) works on endogenous growth by examining the possibility of green growth. They utilizes the two different kinds of capital: green and human made capital. The human made capital leads to the deterioration of green capital through carbon emissions. Their findings conclude that carbon tax can provide a decrease in green capital deterioration (Basu & Jamasb, 2020).

Moreover, when we examine technology and growth in the literature, there are various kinds of studies. When Information Communication Technologies (ICT) is a technology proxy to determine the relationship between technology and growth, there is a positive association between ICT and GDP growth (Solomon and Klyton, 2020). According to the findings of Jorgenson et al. (2016), the labor and capital inputs contribute more than productivity growth. Productivity explains 20 percent of the US postwar economic growth period. Similarly, Nguyen et al. (2020) find that ICT and financial improvement contribute to the economic growth of 13 chosen countries. The study also proves that ICT is crucial for economic growth. Maneejuk and Yamaka (2020) highlight the association between R&D expenditure and economic growth is positive for developed and developing countries.

Nunes, Serrasqueiro, & Leitão (2012) examine the relationship between R&D intensity and growth for high-tech and non-high-tech small and medium enterprises (SMEs). Findings present that there exists a

negative association between R& D intensity and growth for non-high-tech SMEs, while this connection is the quadratic form for high-tech SMEs (Nunes, Serrasqueiro, & Leitão, 2012).

Besides that, China's productivity growth improves economic growth in agriculture, manufacturing, and services (Wu, Guo, & Marinova, 2012). R&D tax credits contribute to long-term productivity growth for industry-level data (Minniti & Venturini, 2017). Supporting ICT investment and improving the ICT for health care, education, and infrastructure system can be a way of achieving the SDGs (Institute, Columbia University, & Ericsson, 2016). High capital input growth ends up low capital productivity in Asian countries. ICT development enables to reach productivity (Ahmed, 2010). ICT capital and total factor productivity explain labor productivity growth in EU countries (Timmer & van Ark, 2005).

5. METHODOLOGY

Green growth aims at boosting a countries growth while eliminating environmental degradation. Especially in recent years, most countries try to have a greener economy (OECD,2021). In this respect, there are different measurements for green growth. For instance: GGGI, SDG-9 Index, inclusive and green industrial performance index, MML index, and the Luenberger indicator. However, this paper introduces the Inclusive Green Growth index. The reason why we introduce the IGG Index is it is more comprehensive and it gives overall information about green growth. Besides, it includes most indicators related to SDGs. UN declares SDGs 2030 Agenda on Environment and Development Conference. The SDGs are for a better future and they include poverty alleviation, aiming to achieve social equality, access to water services and electricity, make energy usage more efficient, eliminate gender gap, minimize environmental damage, provide better living standards, ensure economic growth with providing social equity and decreasing environmental pollution (The 2030 Agenda for Sustainable Development, 2015).

The Balanced IGG Index on the other hand includes the IGG Index and cross pillar balance. The Index measures a country's green growth performance with three basic pillars (ADB,2018). There are twenty-eight indicators in total. In the thesis, we apply twenty-seven indicators for the period 2002-2019 for Turkey and the EU countries (See Table 1). We also take a five-year average of each indicator from 2000 to 2005 accounts for IGG 2005 Index, from 2005 to 2010 that accounts for IGG 2010 Index, from 2010 to 2015 accounts for IGG 2015 Index, and from 2015 to 2019 accounts for IGG 2019 Index.

The reason why we choose that period is that it has available data in common. Some variables have no values for the given period. Croatia for instance has no available data for both the Gini Index and poverty headcount ratio until the year 2009. Besides that, the poverty headcount ratio is unavailable for the first two years of the period for all the selected countries. Similarly, Bulgaria lacks the Gini Index and poverty headcount ratio until the year 2006. The primary completion rate has no data available for Belgium, France, and Portugal. Gini index on inequality has no data available for Bulgaria until 2005. There exists no data available in 2019 for all selected countries.

EU countries try to give importance to green technologies and have some policy tools for green growth. The study will provide a guide for policy implications. After measuring IGG and the balanced IGG Index, we add the technology pillar into the analysis and this will be the main contribution of this study to the available literature. This pillar consists of three indicators R&D expenditure, ICT goods import (% of imported goods), and export (%of exported goods). Technology is a prominent indicator for eliminating environmental degradation and having sustainability. The creation of new technology or improving existing technologies can influence green growth. In this respect, R&D expenditure is a common indicator that indicates expenditure on the invention of new technology. Additionally, ICT

goods export gives us a broad category of exported goods as accounted for technological goods. ICT goods import on the other hand can be a complementary tool for ICT goods export. The paper utilizes a min-max approach. Hence all the indicators are in different measures converting all to the same score is necessary. Thereby, they can easily be comparable across countries. Each pillar takes a value between one to six. One refers to worst, six refers to best.

Table 1

Overall Information about indicators

Indicator Name	Pillar	Resource	Description
GDP per Capita Growth	Economic growth	World Development Indicators	measures the economic growth of the country
Inverse of GDP per capita growth			İndicates the economic stability of the country
Trade Openness			demonstrates a share of trade in GDP
Adjusted net savings			a net national savings plus education spending and minus energy depletion, mineral depletion, net forest depletion, CO2, and particulate emissions damage, measured as a percentage of GNI
Age dependency ratio			a percentage of people younger than 15 or older than 64 to the working-age population
Central government debt			the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government
Herfindahl-Hirschman (HH) Index		World Integrated Trade Solution	an indicator of the dispersion of trade value across an exporter's partners
Primary education enrollment gap	Social equity	World Development Indicators	a percentage point difference of male and female enrolled in primary education
The labor force participation gap			a percentage point difference of male and female labor force participation rates
Infant mortality rate			per 1000 live births
Access to sanitation services			percentage of the population that can access sanitation services
Access to drinking water			the percentage of the population that can access safely managed drinking water services electricity
Access to electricity			the percentage of the population that can access electricity
Gini coefficient on inequality			how national income falls apart in a country
Poverty gap			poverty headcount ratio shows "the percentage of the population living less than 3.20 $ a day by 2010 constant US$"
Mean years of schooling		UNDP Human Development Reports	Average years of schooling
Primary completion rate		World Development Indicators	total enrollment percentage without regarding age to the population age that responds to primary school
Political participation gap			percentage point difference of seats held by men and women
Life expectancy at birth			Total expected life years
Employment to population ratio			Total employment to population ratio
Natural Resource rent			The sum of coal, natural gas, oil, mineral, and forest rent in GDP
Renewable Internal Freshwater Resources	Environmental Sustainability	World Development Indicators	Renewable internal freshwater resources per capita are available renewable water per capita in cubic meters
Water productivity			value of water depleted
Air pollution			the percentage of the population that is exposed to air pollution levels exceeding whose 2.5 particulate air quality guideline
CO2 emissions			An annual kilogram of CO2 emission response to annual production in constant 2010 US$ measures CO2 emission
Energy intensity			the primary energy intensity level in mega Jules per GDP in constant 2011 PPP $
Use of renewables			Renewable energy consumption relative to total energy consumption
R&D Expenditure	Technology	World Development Indicators	accounts for total expenditure that is based on a creative work to enhance knowledge stock that reveals a new application
ICT goods export			Share of ICT goods export of total exported goods
ICT goods import			Share of ICT goods import of total imported goods

5.1 Calculation of the IGG Index

Asian Development Bank measures the IGG Index for Asian countries for 2005,2010 and 2015. The formulas that this paper represents were introduced by Asian Development Bank. Since all the indicators are in different measures, we first need to identify each of them as the same value. We transform all indicators into a score. That score takes the value between 0 and 1(ADB,2018). After transforming each indicator into a score, the next step is to convert the score into a scale by using the min-max approach. First, the study finds each indicator's maximum and minimum value of the sample. After finding these values, we subtract the minimum from a country's value. After that, the paper subtracts the minimum value from the maximum, then divides these two results to each other. In the end, multiplying the result to 5 and adding 1 to it gives us the scale of that indicator. It takes the value between 1 to 6.1 refers to worst, 6 refers to best:

$$5 * \frac{(Country\ Score - Sample\ Minimum)}{(Sample\ Maximum - Sample\ Minimum)} + 1$$

For instance, the Life expectancy at birth of Turkey for 2005 is 73,24. In the same year, the lowest value of the sample is 71,27 while the highest value is 83,38. When we subtract the minimum value from the maximum value, we obtain 12,11. After that, substracting Turkey's life expectancy at birth from sample minimum gives 1,97.Dividing 1,97 to 12,11 yields to 0,16.In the end, multiplying 0,16 with 5 and adding 1 yield 1,81. This process applies to all indicator that has a positive relationship between IGG. On the other hand, if having a higher value means a worse result for the indicator, then we reverse the formula.

$$-5 * \frac{(Country\ Score - Sample\ Minimum)}{(Sample\ Maximum - Sample\ Minimum)} + 6$$

For example, the Poverty headcount ratio of Turkey for 2005 is 6,76. In the same year, the lowest value of the sample is 0,27 while the highest value is 12,26. When we subtract the minimum value from the maximum value, we obtain 12,26. After that, substracting Turkey's poverty headcount ratio from sample minimum gives 5,5. Dividing 5,5 to 12.26 yields 0,44. In the end, multiplying 0,44 with -5 and adding 6 yields 3,8. To represent each pillar same formula applies to each indicator that constitutes each pillar. For instance, to calculate the economic growth pillar of Turkey for 2005, we need to take an average of GDP per capita growth rate 3.14, the inverse of GDP per capita growth rate which is the mean of GDP per capita growth over its standard deviation of 3,04, trade openness 1, Herfindahl-Hirschman Market Concentration Index 1,43, age dependency ratio 4,18, and adjusted net savings rate 3.43. The results yield 2,70. The same process applies to the other three pillars. Eventually, Turkey's 2005 pillars are environmental sustainability is 2,55 and social equity is 3,16, and technological progress is 1,38. After measuring three pillars, we add the three pillars up and dividing three.

$$IGG = \frac{Economic\ growth + environmental\ sustainability + Social\ equity}{3}$$

$$IGG(Turkey\ 2005) = \frac{2{,}70+2{,}55+3{,}16}{3} = 2{,}8$$

5.2 Calculation of the Balanced IGG Index

After measuring IGG Index, the next step is to measure the total absolute gap. As it seems each pillar has a different value. We measure the total absolute gap.

$$Total\ Absolute\ Gap\ = |Economic\ pillar - equity\ pillar| + |equity\ pillar - environmental\ pillar| + |environmental\ pillar - economic\ pillar|$$

If a country has an identical score between pillars, the gap will be zero. A higher total gap implies higher imbalances within the pillars. The total absolute gap of Turkey for 2005:

$$Total\ Absolute\ Gap = |2{,}7 - 3{,}16| + |3{,}16 - 2{,}55| + |2{,}55 - 2{,}7| = 1{,}22$$

We then normalize the gap using the min-max approach. Transforming the scores converts imbalances to a balance which is called Cross Pillar Balance. This pillar again takes the value between 1 and 6.1 still refers to the worst outcome, similarly, 6 refers to the best outcome:

$$Cross\ Pillar\ Balance = -5 * \frac{(Country\ Score - Sample\ Minimum)}{(Sample\ Maximum - Sample\ Minimum)} + 6$$

The lowest value for 2005 within the sample is 0.65, while the highest value is 7. Turkey's 2005 value is 0.65. $Cross\ Pillar\ Balance(Turkey) = -5 * \frac{(0{,}65-0{,}65)}{(7-0{,}65)} + 6 = 6$

To illustrate Balanced IGG, we added CPB as a fourth pillar of the analysis. We take one-quarter of the CPB pillar, and three over four times of the IGG index. Finally, we sum both of them up.

$$Balanced\ IGG = \frac{3}{4} IGG + \frac{1}{4} CPB$$

Turkey's 2005 CPB is 6, while IGG is 2,8. Hence Balanced IGG results in:

$$Balanced\ IGG = \frac{3}{4} 2{,}8 + \frac{1}{4} 6 = 3{,}52\ .$$

5.3 Calculation of the Tech- Oriented IGG

After that, we add a technology pillar to measure Tech-Oriented IGG Index. Our indicators for the technology pillar are ICT goods export in exported goods and ICT goods import in imported goods, and

R&D expenditure as a percentage of GDP. We apply the same process: first, convert the variables into a score is ranging from 0 to 1, then transforming them into a scale ranging from 1 to 6. It is the same as other variables one refers to the worst outcome, six refers to the best outcome. For Turkey's 2005 R&D expenditure is 1,55, ICT goods import is 1,4, and ICT goods import is 1,17. By taking an average of these values, we obtain 1,37. We treated it as a new pillar in the IGG index for representing technology-oriented IGG.

$$Tech - Oriented\ IGG = \frac{Economic\ growth + environmental\ sustainability + Social\ equity + Technology}{4}$$

$$Tech - Oriented\ IGG(Turkey\ 2005) = \frac{2{,}70+2{,}55+3{,}16+1{,}37}{4} = 2{,}44$$

The same process applies to all countries for 2005,2010,2015,2019.

5.4 Calculation of the Tech- Balanced IGG

After we measure Tech-Oriented IGG, we also measure Tech-Balanced IGG. The reason is this index gives us whether the technology pillar has balanaced indicators. Existance of unbalanced indicators in the technology pillar for example having lower values of any indicator lowers the score.In the same direction, having higher values of any indicator yields us to have higher scores than the Tech-Oriented Index scores. Within the same framework of Balanced IGG. We take one-quarter of CPB, and three times over four times of Tech-Oriented IGG.

$$Tech - Balanced\ IGG = \frac{3}{4}\ Tech - Oriented\ IGG + \frac{1}{4} CPB$$

Turkey's 2005 CPB is 6, while Tech-Oriented IGG is 2,44. Hence Tech-Balanced IGG results in:

$$Tech - Balanced\ IGG = \frac{3}{4} 2{,}44 + \frac{1}{4} 6 = 3{,}33.$$

Eventually, the same process applies to all Tech-Oriented IGG to define Tech-Balanced IGG.

6. DATA DESCRIPTION

Inclusive Green Growth Index measures the green growth performance of any country (Asian Development Bank, 2018). It consists of three pillars, 28 indicators: Social equity, environmental sustainability, and economic growth. The economic growth pillar consists of GDP per capita growth; a five-year GDP per capita growth means over the country's standard deviation initiates Inverse GDP per capita growth, adjusted net savings. It also includes Age dependency ratio, Central government debt, Trade openness, and Herfindahl-Hirschman(HH) Index. They are all available in World Development Indicators. The inverse of GDP per capita growth indicates the economic stability of the country(Asian Development Bank,2018). World Bank defines adjusted net savings as "a net national savings plus education spending and minus energy depletion, mineral depletion, net forest depletion, CO2, and particulate emissions damage, measured as a percentage of GNI (World Bank, 2021)". The World Bank defines the age dependency ratio is "a percentage of people younger than 15 or older than 64 to the working-age population (World Bank, 2021)".

Trade openness demonstrates a share of trade in GDP (World Bank, 2021). It defines Herfindahl-Hirschman Market Concentration Index as "an indicator of the dispersion of trade value across an exporter's partners (World Bank, 2021)". Besides that, the World Bank's definition for central government debt is "It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government". We exclude the central government debt, due to lack of data. Except for Hungary, Spain, Ireland, and Turkey have no available data for the given period. For this reason, we decide to remove it from the index which yields 27 indicators left. The social equity pillar consists of employment to population ratio, Primary education enrollment gap that is a percentage point difference of male and female enrolled in primary education (Asian Development Bank, 2018). The labor force participation gap is a percentage point difference of male and female labor force participation rates (Asian Development Bank, 2018).

Life expectancy at birth, Infant mortality rate, Access to improved sanitation, drinking water, and electricity, Gini coefficient on inequality, Poverty gap are concepts of the social equity pillar. Mean years of schooling, Primary completion rate, and political participation gap that is a percentage point difference of seats held by men and women are other indicators of the social equity pillar. Life expectancy at birth demonstrates total expected life years (Asian Development Bank, 2018). According to the World Bank, "the infant mortality rate is per 1000 live births (World Bank, 2021)".

Access to improved drinking water and electricity indicates the percentage of the population that can access safely managed drinking water services and electricity (World Bank, 2021). Access to sanitation services similarly percentage of the population that can access sanitation services (World Bank, 2021). Gini coefficient on inequality indicates how national income falls apart in a country (World Bank, 2021).

The poverty headcount ratio shows "the percentage of the population living less than 3.20 $ a day by 2010 constant US$" (World Bank, 2021). "Primary completion rate is total enrollment percentage without regarding age to the population age that responds to primary school (Asian Development Bank, 2018)". Environmental sustainability finally consists of Natural Resource rent, Renewable Internal Freshwater Resources, Water productivity, air pollution, CO2 emissions, energy intensity, and use of renewables. "Natural resource rent is the sum of coal, natural gas, oil, mineral, and forest rent in GDP (World Bank, 2021)". "Renewable internal freshwater resources per capita are available renewable water per capita in cubic meters (World Bank, 2021)". "Air pollution shows the percentage of the population that is exposed to air pollution levels exceeding whose 2.5 particulate air quality guideline (World Bank, 2021)"."An annual kilogram of CO2 emission response to annual production in constant 2010 US$ measures CO2 emission (World Bank, 2021)".

"Energy intensity is the primary energy intensity level in mega Jules per GDP in constant 2011 PPP $(World Bank, 2021)". Renewable energy is a ratio of renewable energy consumption relative to total energy consumption (World Bank, 2021). The paper measures the IGG Index of Turkey and EU countries by taking five year average of each indicator from 2001 to 2019. Since technology is outstanding for an economy, we try to integrate technology with IGG Index(Popp,2012). After we measure IGG and balanced IGG index, we add technology pillar into the index. The technology pillar consists of three dimensions: share of Research and Development expenditure in GDP, ICT exports in total goods export, and ICT goods imports in total goods import. They are available in World Development Indicators.R&D expenditure “accounts for total expenditure that is based on a creative work to enhance knowledge stock that reveals a new application(OECD Stat,2021).” “ICT goods cover computers and peripheral equipment, communication equipment, consumer electronic equipment, electronic components, and other information and technology goods(World Bank,2021)." After we add the technology pillar, the paper introduces IGG and balanced IGG, technology-oriented IGG, and balanced tech-oriented IGG. Additionally, the paper represents these four indices for the period 2005,2010,2015, and 2019.

The paper interprets four indices: IGG, Balanced IGG, Tech-Oriented IGG, and Tech Balanced for 2005, 2010, 2015, and 2019. Values range from 1 to 6. 1 indicates the worst outcome, while 6 for the best outcome for Turkey and EU countries. While the IGG Index shows a green growth performance of a country, the Balanced IGG Index indicates performance gaps between three pillars of the IGG Index. The Balanced IGG “is the first index that computes the gap among the three pillars, and shows country's effort to push growth pattern. It also provides us to conclude how well the three pillars are distributed. "(ADB, 2018).

The reason why there is a need for Balanced IGG is, for instance, a country with a high IGG Index gives unclear information on how equally perform on three pillars. For instance, while the two pillars of the

index have a lower score, one pillar has a higher score which raises the score. To eliminate the gap imbalance, the index includes the cross pillar balance index as a fourth pillar. When the weak pillar decreases the IGG Index, with the CRB, the score can be better off. If a country performs equally well among pillars, it yields zero-gap among the pillars, and finally, the IGG and Balanced IGG scores result in similar scores. The Balanced IGG score finally provides us to review green growth quality among selected countries(ADB, 2018). Including the technology pillar into the indices gives us lower outcomes respectively. Having lower technology pillar scores than the other three pillars leads to lower IGG and Balanced IGG Indices.

When we examine descriptive analysis of the countries unemployment rate to population ratio(modeled ILO estimate), inflation GDP Deflator(Annual%), GDP (current US $) and GDP per capita (current US $) which are gathered from World Development Indicators, Greece and Spain have the highest unemployment rate.Most countries have the negative effect of pandemic.While some countries suffer from low inflation in 2020 such as Crotia, Estonia, Latvia and Greece, other countries have similar values.Besides, Turkey has the highest inflation rate among the selected countries in 2020.GDP has higher values in Germany, France, and Spain.Contrary to this, GDP per capita on the other hand is quite high in Northern Eurepean Countries such as Denmark, Finland and Ireland. These four macroeconomic indicators are obviously related to economic pillars of the IGG Indices of the selected counries and these indicators can determine the policy tools and actions that contribute to the green growth (See Table 1).

TABLE 2

Descriptive Analysis of the Countries

DESCRIPTIVE ANALYSIS OF THE SELECTED COUNTRIES				
Country	Unemployment	Inflation	GDP per capita	GDP
Austria	5,36	2,31	48.586,80	433.258.467.676,52
Belgium	5,55	1,28	45.159,35	521.861.292.586,62
Bulgaria	5,12	4,20	10.079,20	69.889.347.433,43
Croatia	7,51	-0,13	14.134,16	57.203.783.203,03
Cyprus	7,59	-1,18	27.527,85	24.612.646.487,72
Czech Republic	2,55	4,40	22.931,27	245.339.322.066,76
Denmark	5,64	2,61	61.063,32	356.084.867.685,64
Estonia	6,80	-0,29	23.027,03	30.650.285.471,72
Finland	7,76	1,24	48.744,99	269.594.831.987,55
France	8,01	2,52	39.030,36	2.630.317.731.455,26
Germany	3,81	1,60	46.208,43	3.846.413.928.653,71
Greece	16,30	-0,84	17.622,54	188.835.201.625,91
Hungary	4,25	5,92	15.980,74	155.808.436.238,49
Ireland	5,62	-1,21	85.267,76	425.888.950.992,00
Italy	9,16	1,17	31.714,22	1.888.709.443.687,48
Latvia	8,10	-0,09	17.726,25	33.707.320.816,30
Lithuania	8,49	1,46	20.233,64	56.546.957.475,49
Luxembourg	6,77	4,27	116.014,60	73.353.132.793,71
Malta	4,26	1,45	27.884,64	14.647.384.607,60
Netherlands	3,82	2,29	52.397,12	913.865.395.789,89
Poland	3,16	4,10	15.720,99	596.624.355.719,67
Portugal	6,79	1,94	22.176,30	228.539.245.045,34
Romania	5,03	3,75	12.896,09	248.715.551.366,64
Slovak Republic	6,69	2,37	19.266,51	105.172.564.491,57
Slovenia	4,97	1,23	25.517,33	53.589.609.580,71
Spain	15,53	1,10	27.063,19	1.281.484.640.043,58
Sweden	8,29	1,72	52.274,41	541.220.059.459,25
Turkey	13,11	14,83	8.536,43	719.954.821.683,31

7. FINDINGS

7.1 Analysis of Selected Countries' Indices

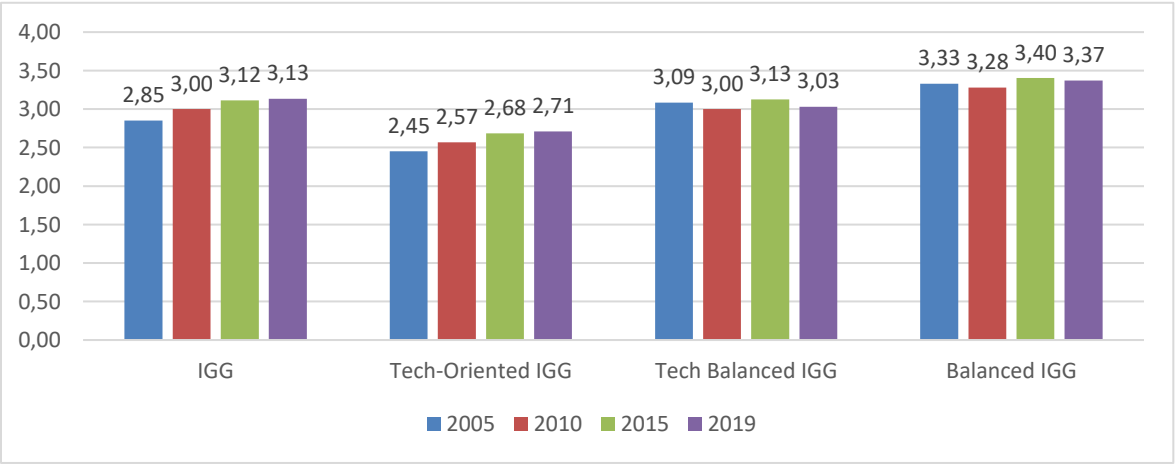
Green growth is an essential concept that many organizations and institutions works for. In this respect, this paper conducts IGG and Balanced IGG Indices. Considering the challanging relationship between growth and technology, we contribute the technology pillar that yields us to have Tech-Oriented, and Tech- Balanced IGG. Furthermore, we measure the indices by taking five year average. Thereby, the study computes those four indices of year 2005, 2010, 2015, and 2019 for Turkey and the EU countries.

Starting with Bulgaria, there is an increasing trend in IGG Index. Balanced IGG has higher scores than IGG Index means some indicators lower the IGG Index score. However, measuring cross pillar balance among the pillars, it has a higher Balanced score. Besides that, a balanced IGG score eliminates the unequal performance of the index. The Tech-oriented IGG index also has an increasing trend among the selected years. The Tech Balanced IGG Index similarly has higher values than Tech oriented Index, we can conclude that The Balanced scores stem from measuring total absolute gaps and CPB in four pillars of the IGG Index, hence the scores are better off (See Figure 1. 1).

Figure 1.1

Bulgaria

Green Growth Indices

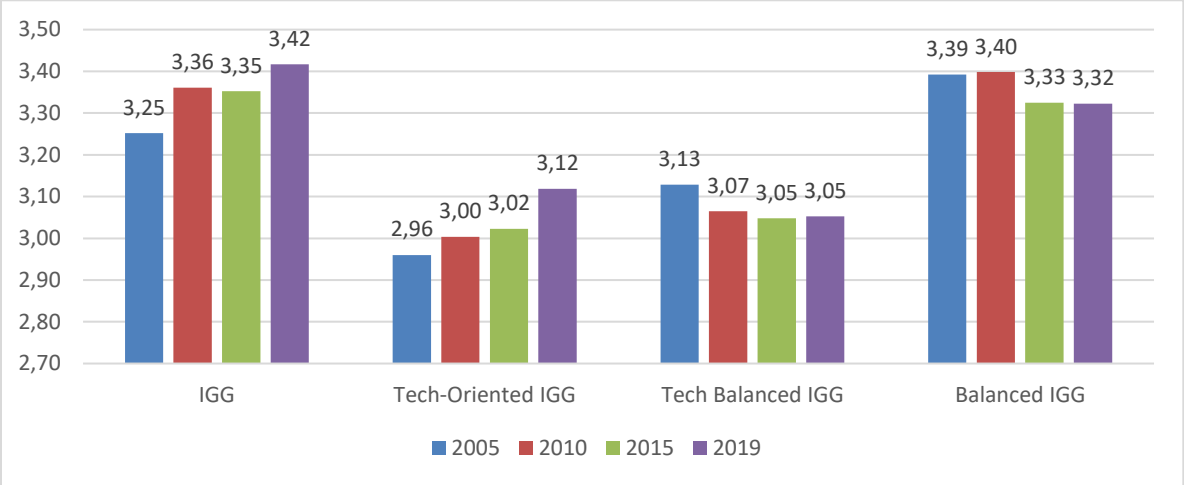


Belgium on the other hand has a rising trend on IGG Index, Tech Oriented IGG Index similarly has a rising trend among selected years. From another point of view, when we examine the Balanced IGG Index, we can conclude that it has a decreasing trend which can be resulted from unstable scores among the three pillars(see Figure 1.2). Tech-Balanced IGG has also decreasing trend which gives us the path of the IGG Index (ADB,2018).

Figure 1.2

Belgium

Green Growth Indices

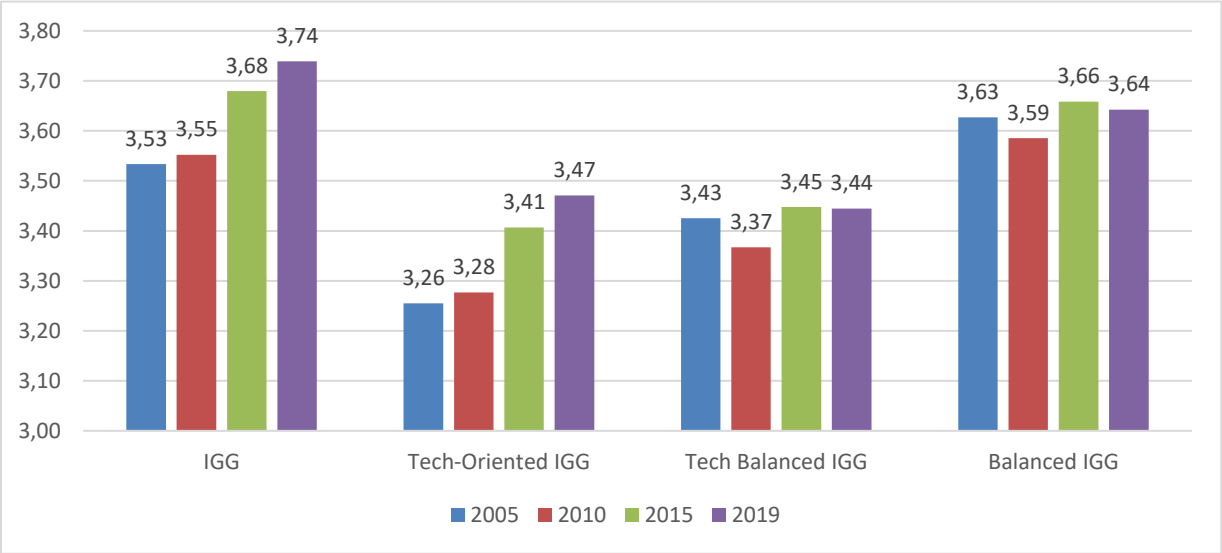


IGG Index scores of Austria follow a raising trend that yields us to view there is an improvement in the index for the periods. Tech-Oriented IGG Index similarly has a rising trend, with the contribution of the technology the trend keeps increasing. Balanced IGG is quite the same among periods which highlights all the pillars are stable among the selected years and it is an exact balanced IGG. Tech-Balanced IGG has also had the same values across the periods which indicates that with technology contribution the scores have equally distributed (See Figure 1. 3).

Figure 1.3

Austria

Green Growth Indices



To examine Croatia, the IGG Index scores of Croatia have a decreasing trend among periods. There is a need for an improvement of the pillars of the index. Balanced IGG scores similarly have a decreasing trend. Moreover, the Balanced IGG scores decrease rapidly. This rapid decrease can stem from IGG scores. The pillars of the IGG scores are unbalanced and not equally distributed. It leads to a sharp boost in the Balanced IGG Index Scores. Tech-Oriented IGG and Tech- Balanced IGG Indices scores are quite the same despite some decreases in the trend (See Figure 1. 4). Excluding a shrink in 2015 score, the IGG Index scores of Cyprus have an increasing trend. Tech-Oriented IGG has similar scores among all periods means a balance among the selected years. Tech-Balanced IGG has a decreasing trend except for the 2010 score. The unequal distribution of technology pillars scores results in lower scores. Balanced IGG similarly has a decreasing trend except for the 2010 score. The reason behind the decreasing trend can be due to imbalances in the pillars of the IGG Index (See Figure 1. 5).

Figure 1.4

Croatia

Green Growth Indices

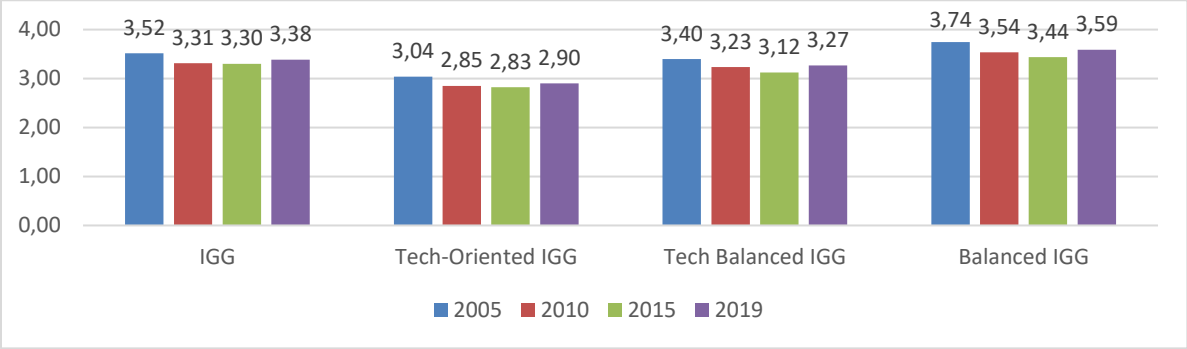
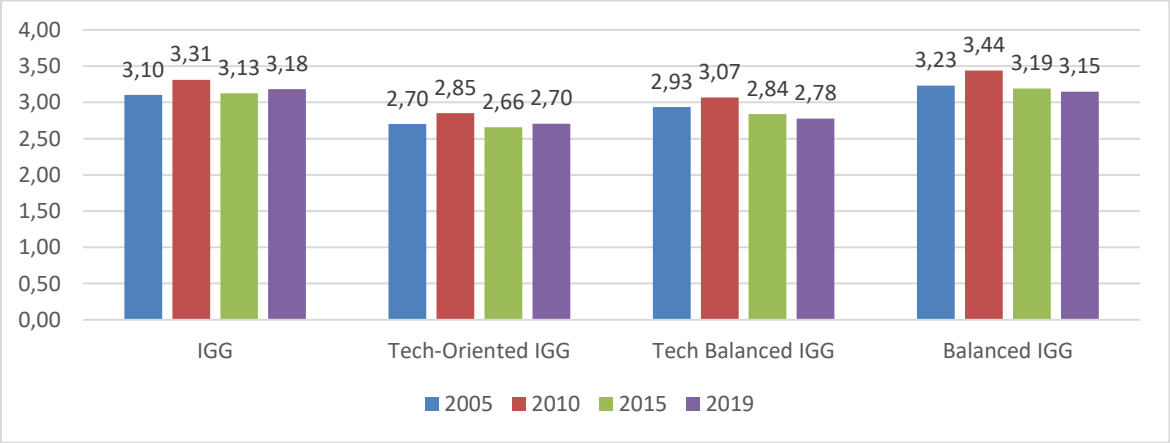


Figure 1.5

Cyprus

Green Growth Indices



IGG Index scores of Denmark have an increasing trend. It has developed in the selected periods. Tech-Oriented IGG has similarly a rising trend among the measured scores. We can educe that with the contribution of the technology pillar, the index keeps the raising trend. Balanced IGG Index scores have the same trend as IGG Index scores, the scores are quite lower than IGG Index scores which can be due to unbalanced distribution among the pillars. Furthermore, Tech Balanced IGG Index scores have also raising trends. The scores are only lower than Balanced IGG Index scores that can be stem from the contribution of the technology pillar. The pillar is equally distributed. However, there is still a new for further improvement in the technology pillar (See Figure 1. 6). Both the IGG and Balanced IGG Indices scores of the Czech Republic have an increasing trend. Likewise, Tech Oriented and Tech-Balanced IGG Indices scores have a rising trend. These results conclude that some augmentation in the four pillars of scores yields an upward trend. The Czech Republic keeps rise in the indicators among the pillars (See Figure 1. 7).

Figure 1.6

Denmark

Green Growth Indices

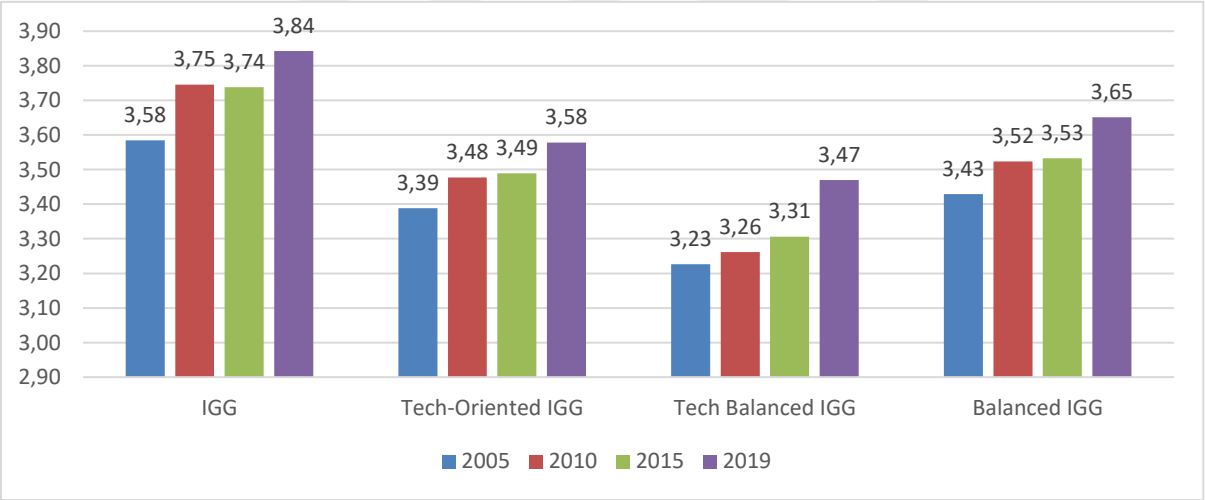
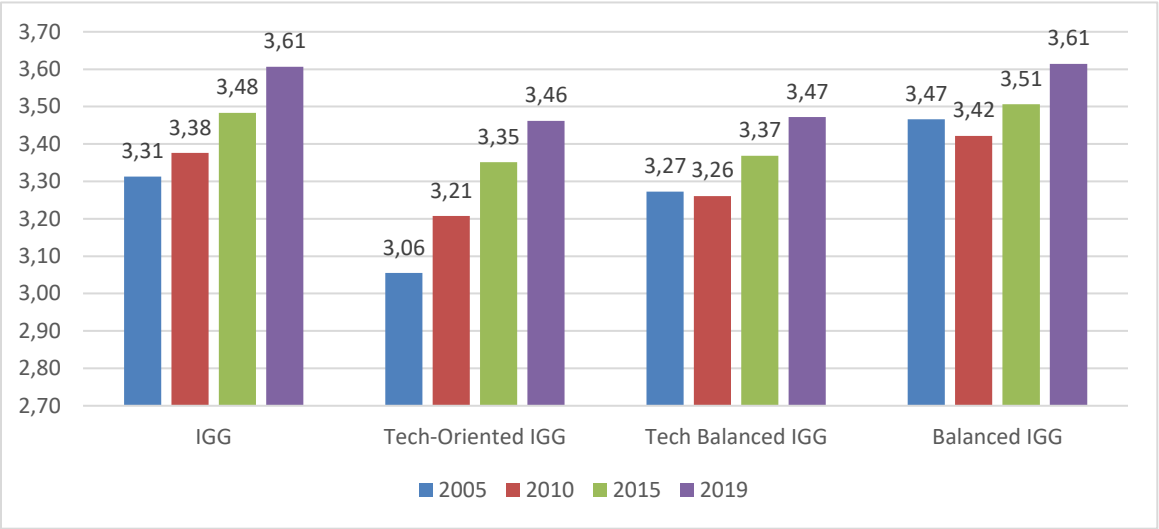


Figure 1.7

Czech Republic

Green Growth Indices

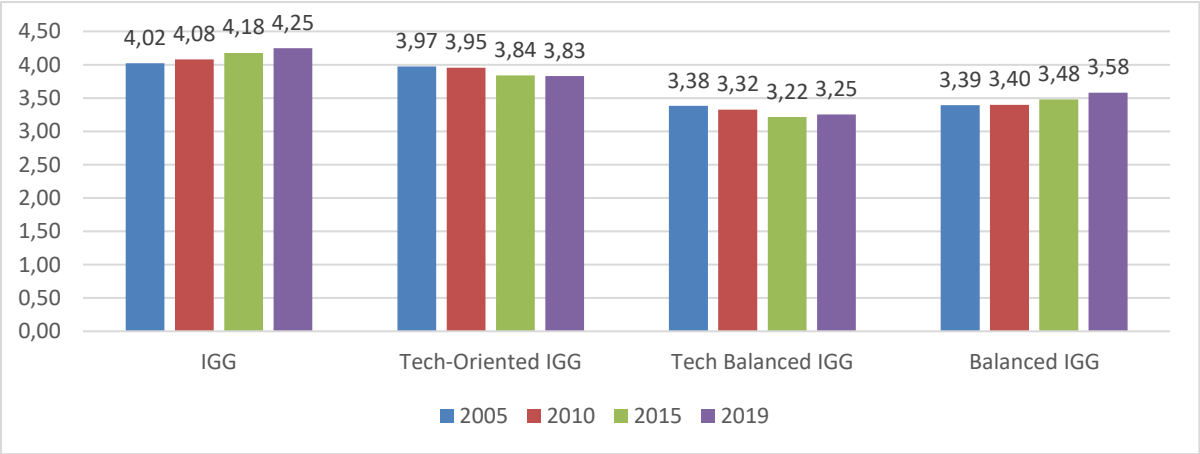


Besides that, Finland has the highest IGG Index scores among selected countries. Moreover, the IGG Index has an augmented trend among the given years. Balanced IGG Index scores have also augmented trend. Besides that, the Tech- oriented IGG Index along the same line has a rising trend. The Tech Balanced IGG scores have only a decreasing trend. The reason for that can be imbalances in the tech-oriented IGG Index (See Figure 1. 8).

Figure 1.8

Finland

Green Growth Indices



Except the Tech Balanced IGG France has an increasing trend among the measured scores. The tech Balanced IGG Index scores have a declining trend. It can be because of unequal performance among the pillars of Tech Oriented IGG Index scores (See Figure 1. 9). For Germany, except for the Balanced IGG, all the indices have an augmented trend. The pillars of IGG and Tech oriented IGG has increased in the given years. Tech Oriented IGG Index values perform equally so the Tech Balanced IGG also has a rising trend. However, the Balanced IGG has a declining trend. There can be unequal distribution among the IGG pillars. There can be some development for balancing the indicators included in the IGG Index(See Figure 1. 10). IGG Index scores of Greece have an increasing trend. Besides that, the Balanced IGG Index scores are almost equal to the IGG Index scores. This highlights that the pillars of the IGG Index are equally distributed and all the indicators are stable within the selected years. The Tech Balanced IGG has similarly an upward trend. Contrary to the other trends, the Tech Balanced IGG Index scores have a declining trend (See Figure 1. 11).

Figure 1.9

France

Green Growth Indices

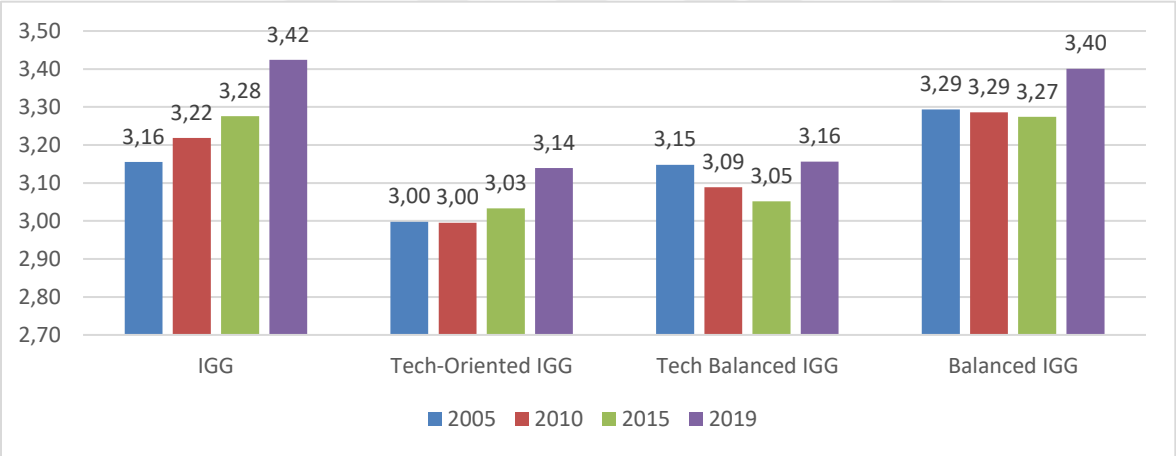


Figure 1.10

Germany

Green Growth Indices

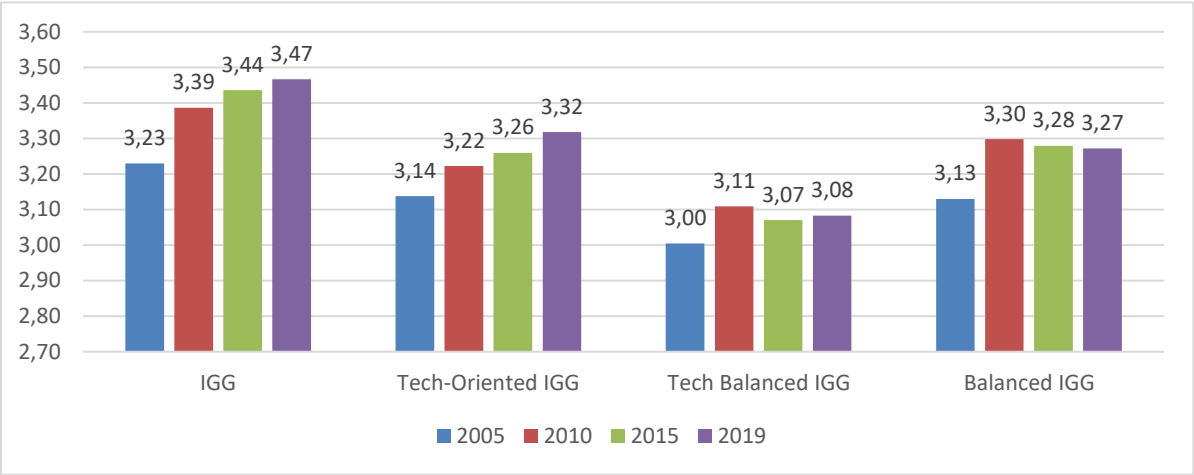
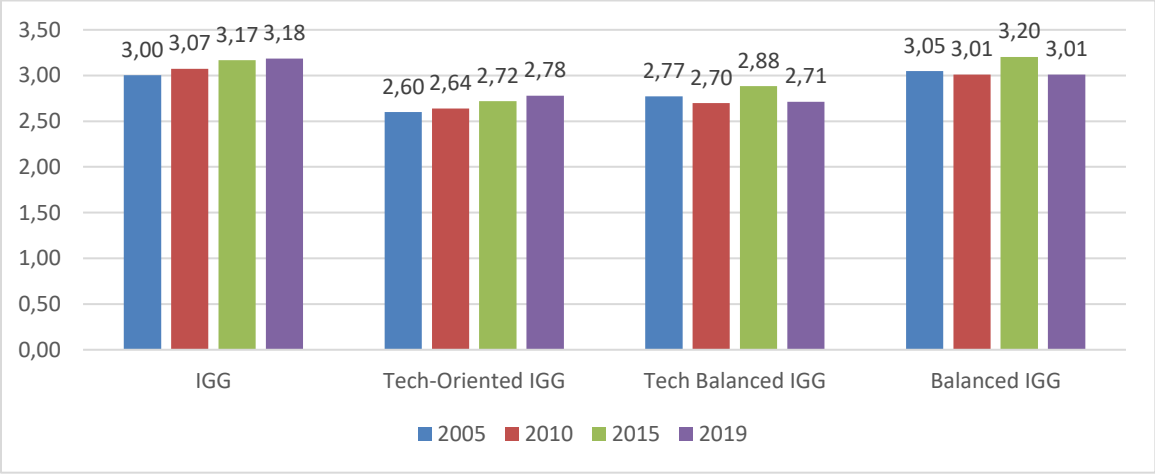


Figure 1.11

Greece

Green Growth Indices



IGG Index trend of Ireland has an upward trend. Similarly, the Balanced IGG trend has an upward trend. The Balanced IGG Index scores have even higher values other than IGG Index scores. It can occur by eliminating unbalance distribution among the pillars of the IGG Index. The Tech-Oriented Index scores have gradually improved. The Tech Balanced IGG trend with the same line has a growing trend. Scores of the Tech Balanced IGG Index are higher than the Tech Oriented IGG Index. Because of elimination imbalances among pillars of the Tech-Oriented IGG Index (See Figure 1. 12). The IGG Index scores of Italy have an increasing trend. Even if the Balanced IGG scores have higher scores than the IGG Index, the Balanced IGG scores have a downward trend. The Tech Oriented IGG Index grows among the

periods. However, the Tech Balanced IGG has a decreasing trend. With the abolishment of imbalances among the Tech Oriented IGG, we have lower and declining scores (See Figure 1. 13).

Figure 1.12

Ireland

Green Growth Indices

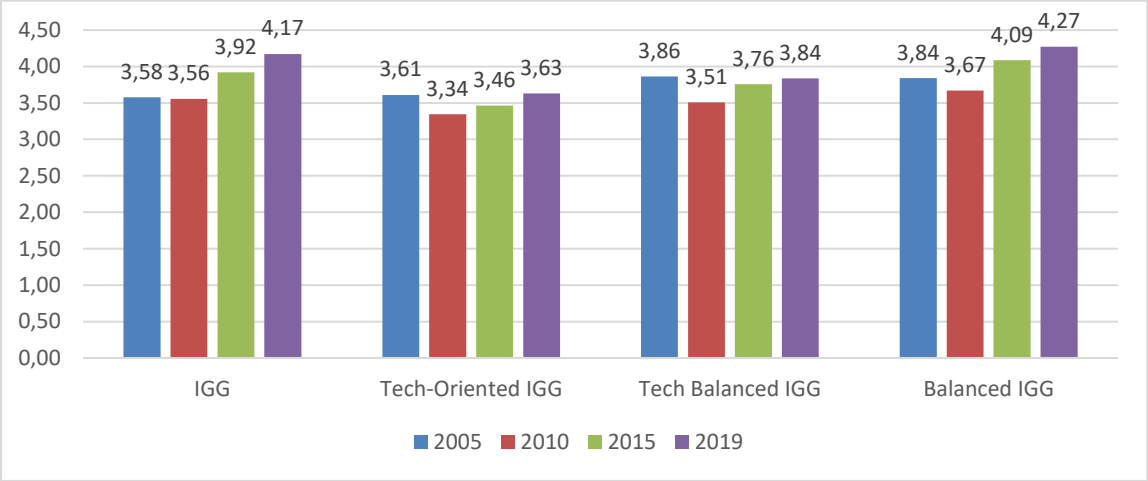
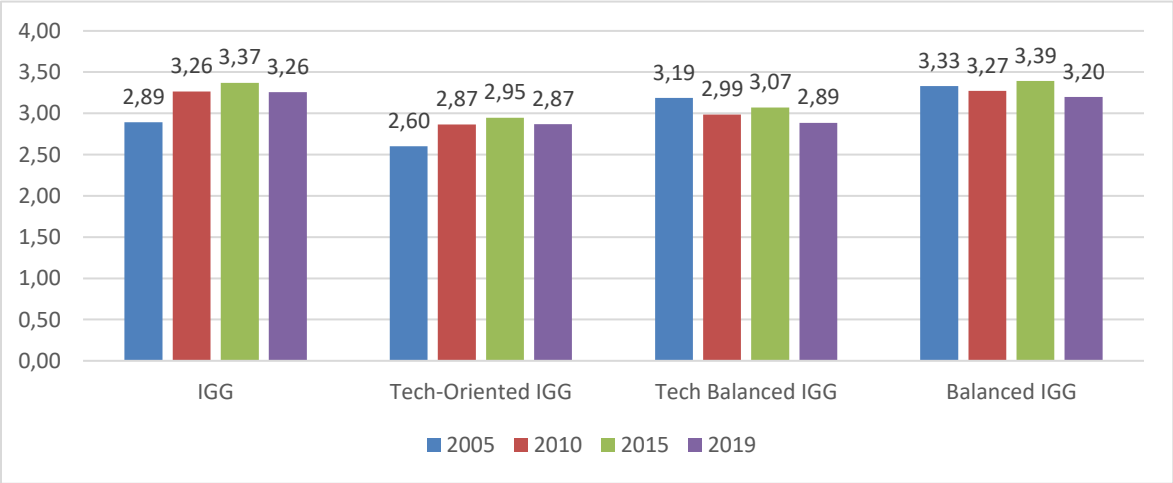


Figure 1.13

Italy

Green Growth Indices

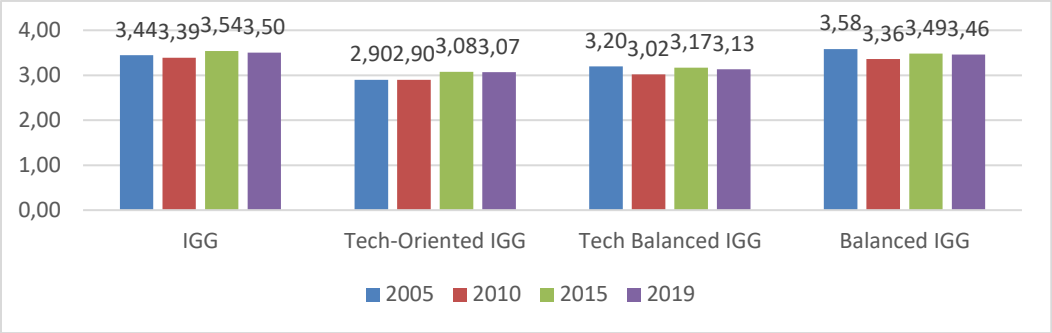


The Index scores of Latvia have an upward trend. Balancing the pillars yields a rise in the Balanced IGG Index scores. Despite having the same Tech-Oriented IGG for 2005 and 2010, the scores have risen. Except for last year's score, The Tech Balanced IGG follows the same trend as the Tech Oriented IGG (See Figure 1. 14).

Figure 1.14

Latvia

Green Growth Indices



IGG Index scores of Lithuania augment, while the Balanced IGG Index scores follow a balanced trend. The Tech Oriented and Tech Balanced IGG scores follow the same line with them. The indices are sort of equal to each other. Hence they have similar values(See Figure 1.15). IGG Index scores of Luxemburg have booms. However, the Tech Oriented and Tech Balanced IGG Index scores keep a declining trend. The Balanced IGG Index scores have the same direction as the IGG Index, have a growing trend (Figure 1.16).

Figure 1.15

Lithuania

Green Growth Indices

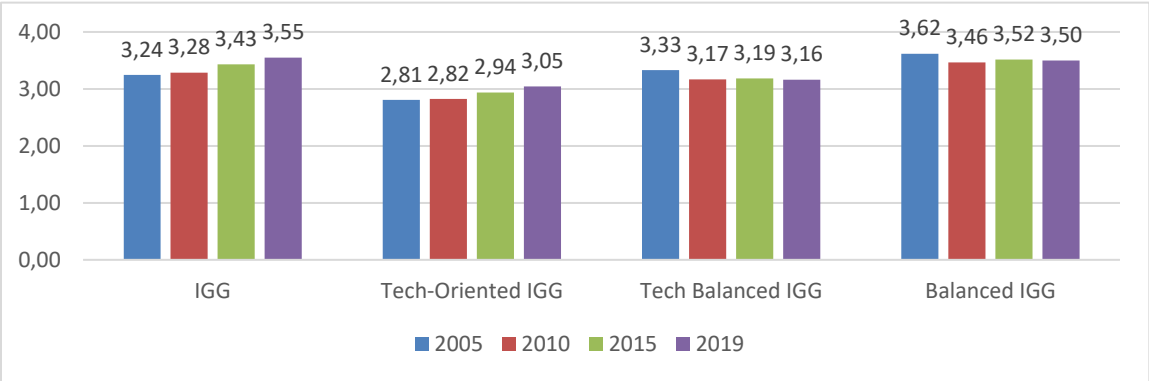
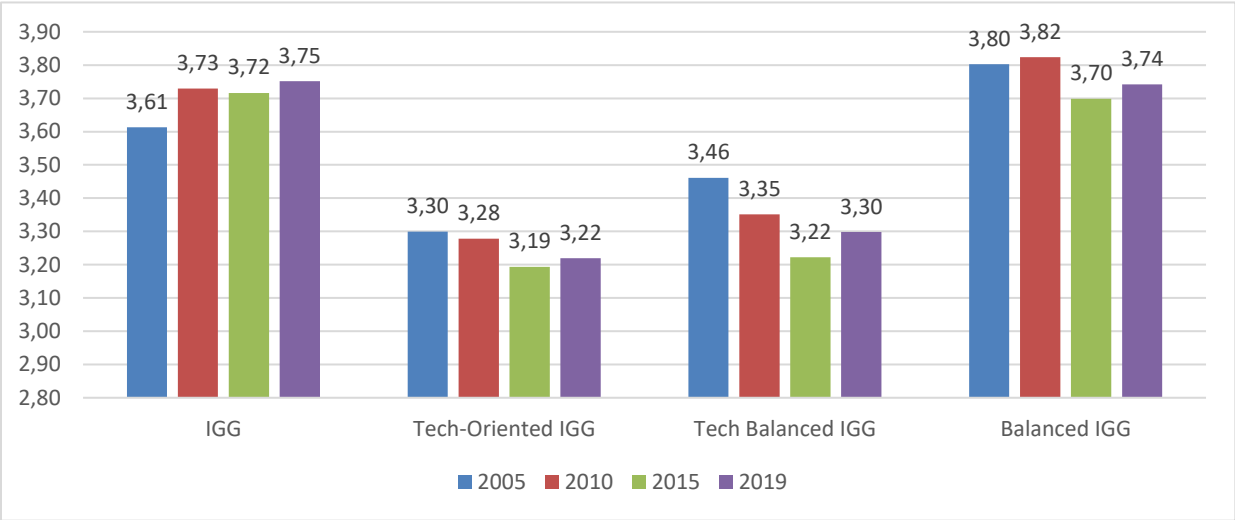


Figure 1.16

Luxemburg

Green Growth Indices

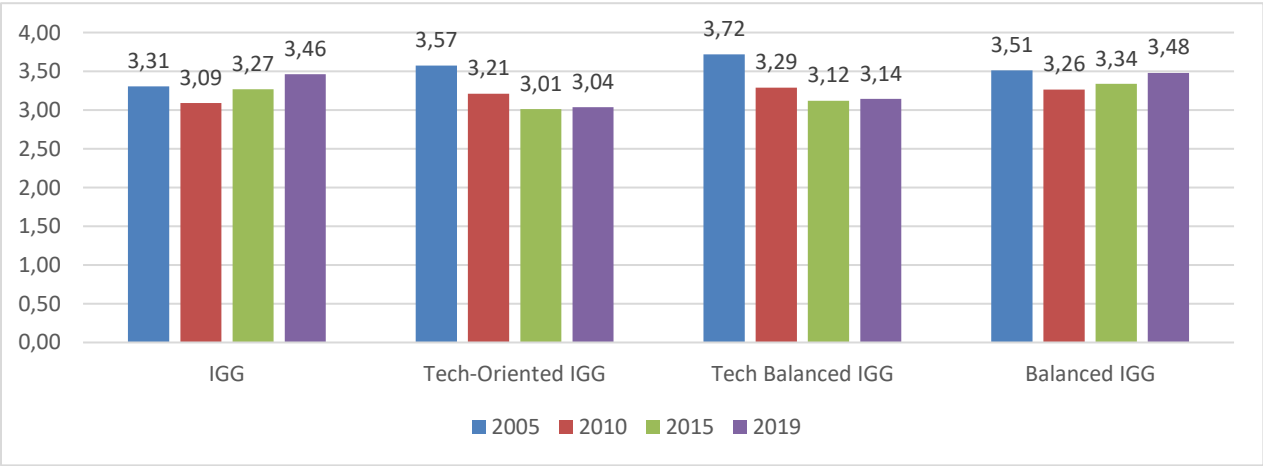


IGG Index scores of Malta follow a kind of a balanced trend. However, Tech Oriented IGG Index scores keep rapid decreases. With the contribution of the technology pillar, the path of IGG Index scores has changed. There can be some implications through technology pillars. In the same direction, the Tech Balanced IGG Index scores keep decreasing. On the other hand, Balanced IGG Index scores have a growing trend with the same direction as the IGG Index trend. The result yields that with the CPB the path of IGG keeps the values (See Figure 1.17).

Figure 1.17

Malta

Green Growth Indices

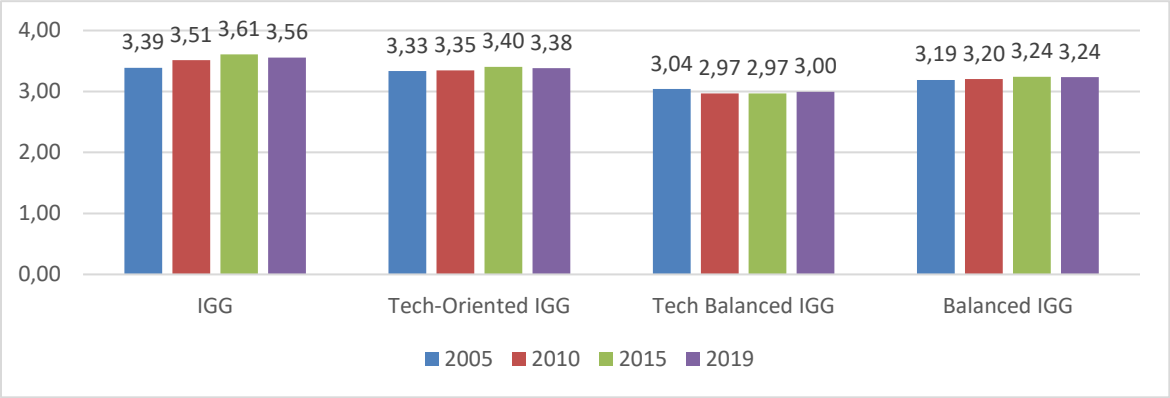


The IGG Index scores of the Netherlands follow a rapid increase throughout the years. Even though the Balanced IGG scores have lower values the scores keep in a balance. The reason for lower scores can be imbalances in the IGG Index pillars. However, measuring the total absolute gap and hence CPB yields us to obtain a Balanced IGG Index. The Tech Oriented and Tech Balanced IGG Index scores have identical values. The contribution of the technology pillar provides well-balanced pillars(See Figure 1.18).

Figure 1.18

Netherlands

Green Growth Indices



The IGG and Balanced IGG scores of Poland have similar scores. Furthermore, both of the indices have sort of an increasing trend. The Tech Balanced and Oriented IGG Index scores follow that trend (See Figure 1. 19). The IGG and Balanced IGG Index scores of Romania have identical values, while the Tech Balanced IGG Index scores decrease. The Tech Oriented Index scores also have similar values among the period(See Figure 1.20).

Figure 1.19

Poland

Green Growth Indices

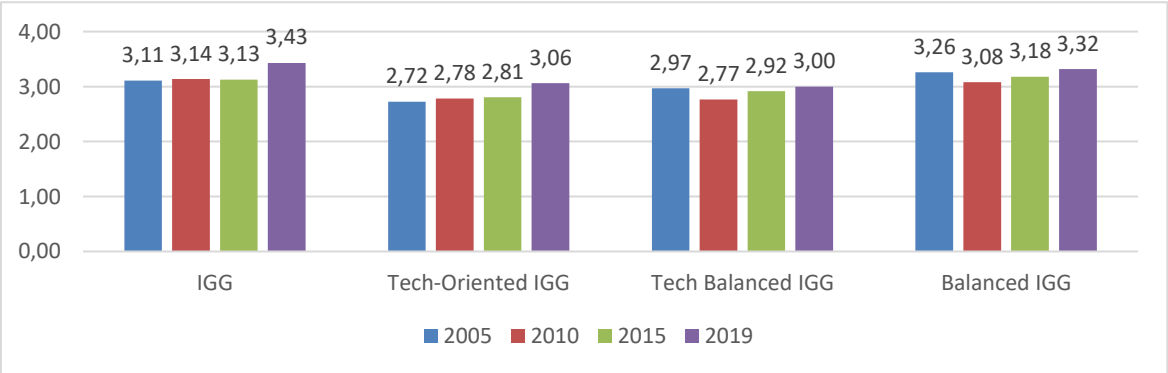
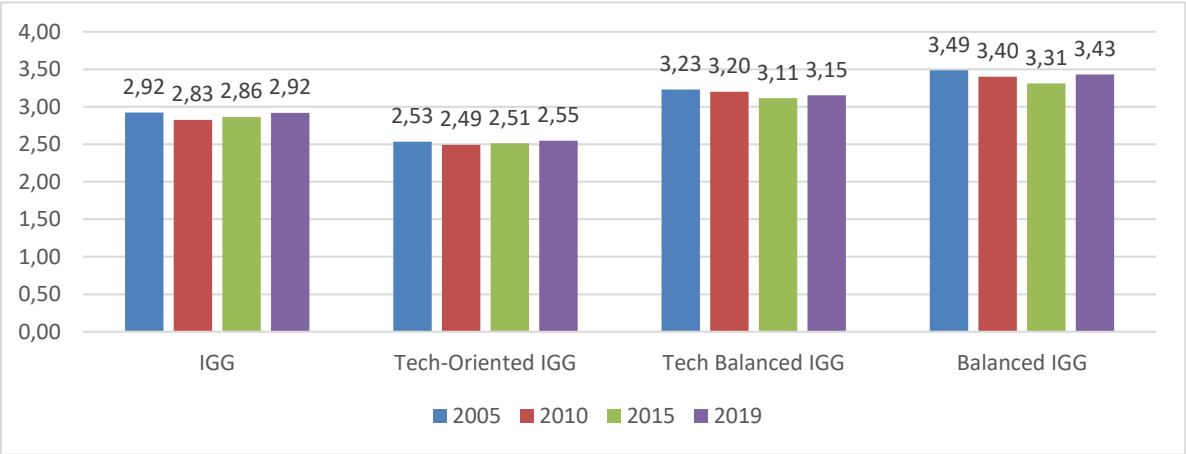


Figure 1.20

Romania

Green Growth Indices

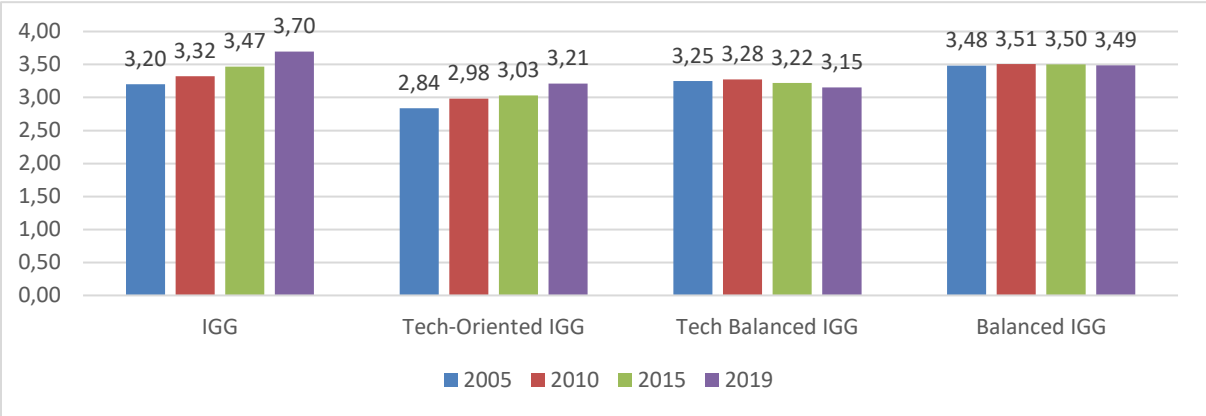


The IGG Index scores of Portugal keeps a rising trend with a jump in the 2019 IGG Index score. The Tech Oriented IGG Index of the same year has a boom. Although the Balanced IGG Index scores have higher values than the IGG Index scores, balancing the pillars causes a decreasing trend. The Tech Balanced IGG Index scores have decreases and increases, but it keeps the similar values (See Figure 1.21).

Figure 1.21

Portugal

Green Growth Indices



Moreover, Slovenia has a growing trend on all the indices. The rate of increase of IGG Index scores is higher than the other indices. We also see that the IGG and Balanced IGG Index 2010 scores are identical. It tells us the pillars are equally distributed. The indicators keep the trend they have which

results in a balanced index. With the technology pillar, the Tech Oriented IGG Index keeps an increasing trend. The Tech Balanced IGG Index scores similarly follow the trend(See Figure 1.22). The Slovak Republic has identical scores on the indices. There are some decreases and increases in all indices. However, the Balanced IGG Index score is higher than the IGG Index scores are due to imbalances and some lower values in the three pillars of the indices. The Tech Balanced IGG scores also have higher values than Tech Oriented IGG Index. The total absolute gap informs us whether we have a well-distributed and balanced Tech Oriented IGG Index (See Figure 1.23).

Figure 1.22

Slovenia

Green Growth Indices

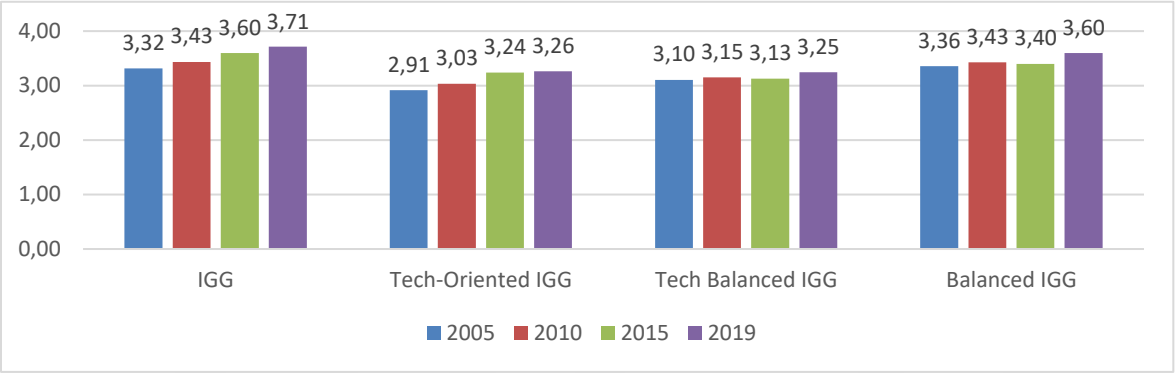
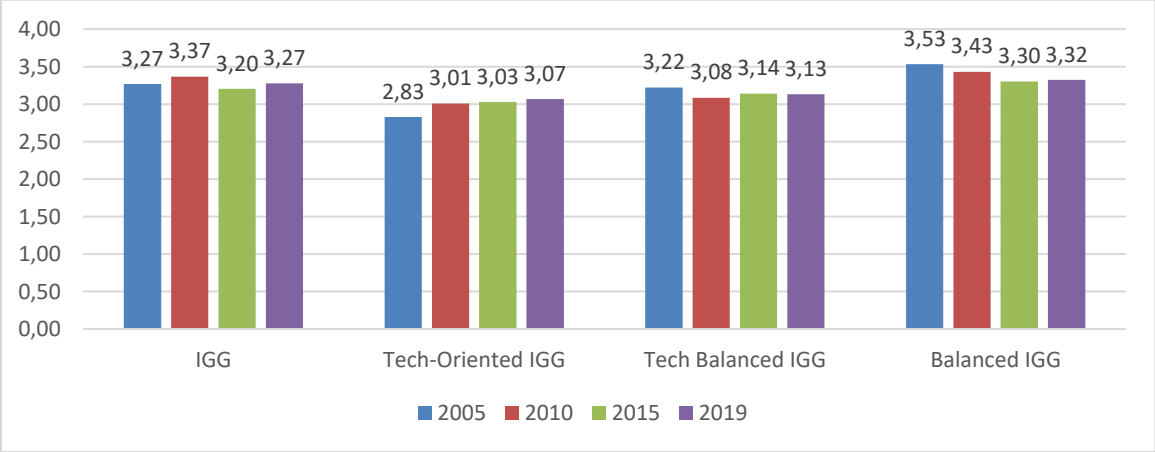


Figure 1.23

Slovak Republic

Green Growth Indices



The IGG and Balanced IGG Index scores of Sweden keeps an increasing trend. However, the difference between the IGG and Balanced IGG Indices is high. The reason can be there are quite a lot of imbalances and unbalanced indicators that lower the Balanced IGG Index scores. The Tech-Oriented and Balanced

IGG Indices follow a rising trend. Additionally, the Tech Balanced IGG Index has a growing trend. Besides that, Sweden has the highest Tech-Oriented scores among the EU countries (See Figure 1.24). Spain has only an increasing trend on the IGG Index scores. The other indices follow a sort of balanced trend (See Figure 1.25). With having a growing trend, Hungary has a rapid increase in the 2019 IGG Index score. The country keeps the path on the Balanced IGG Index scores. The Tech-oriented and Balanced IGG Index scores similarly have increasing values. The Tech Balanced IGG Index scores are even higher than the Tech Oriented Index scores. Elimination of unbalanced indicators scores yields higher results (See Figure 1.26).

Figure 1.24

Sweden

Green Growth Indices

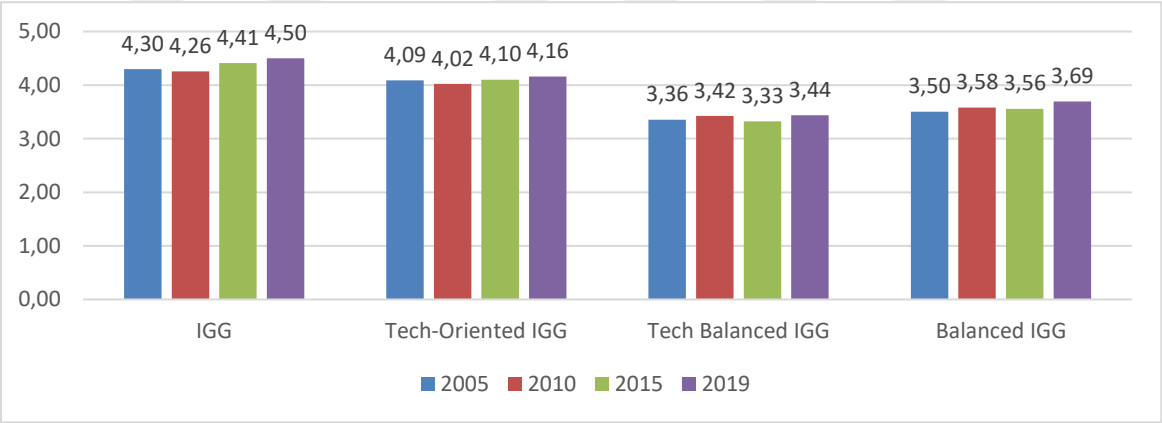


Figure 1.25

Spain

Green Growth Indices

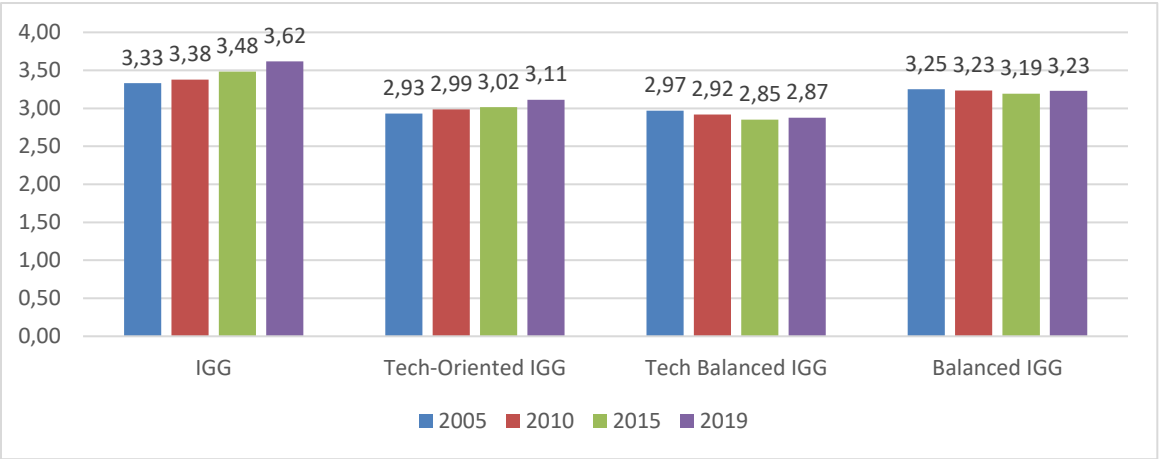
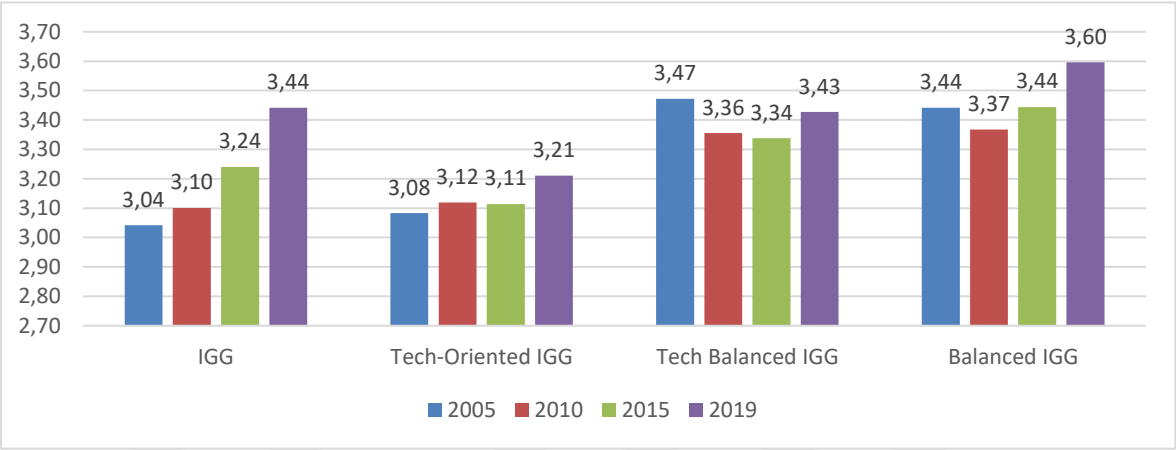


Figure 1.26

Hungary

Green Growth Indices



Estonia has a rising trend on the IGG and Balanced Index scores. Besides, there are some decreases and increases on the Tech Oriented and Tech Balanced Indices. However, the increases and decreases follow each other at the same time. When the Tech Oriented IGG Index score raises, the Tech Balanced IGG Index scores expand, as well (See Figure 1.27). On the other hand, the IGG Index score of Turkey keeps increasing. However, the Balanced IGG Index score keeps decreasing. The decrease shows us the imbalance among the pillars rises among periods. Similarly, while the Tech-Oriented IGG Index scores keep rising, the tech Balanced IGG Index scores keep declining due to rapid decreases in the indicators in the pillars of the IGG and Tech Oriented IGG Index (See Figure 1.28).

Figure 1.27

Estonia

Green Growth Indices

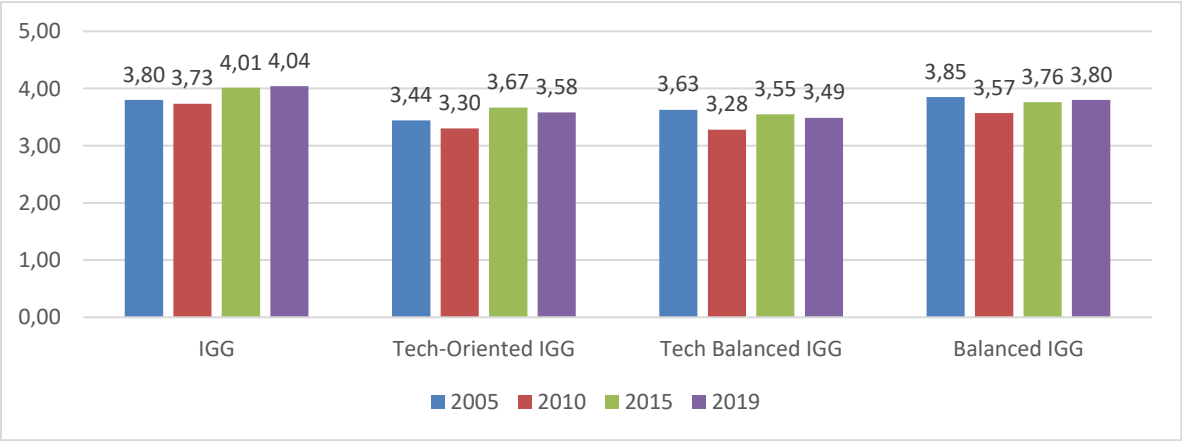
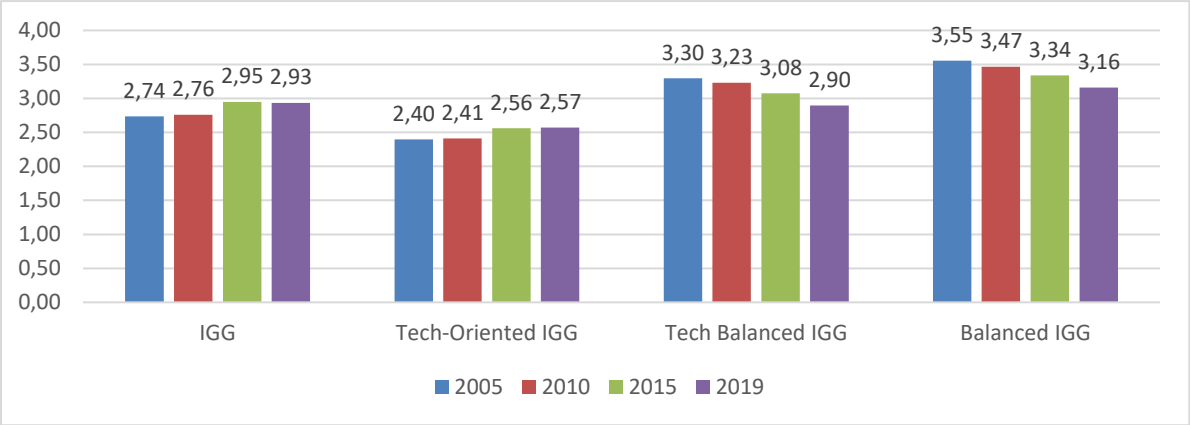


Figure 1.28

Turkey

Green Growth Indices



7.2 Social Equity Pillar

All countries have an increasing trend of social equity pillar. Bulgaria makes incremental progress during the period. This progress stems from improvements in employment ratio, decrease in infant mortality rate and rate of population that can access sanitation services, and finally rapid increase life expectancy at birth. With the help of a decline in school enrollment and labor force participation gap, poverty headcount ratio, and employment ratio, the social equity pillar of Belgium experiences an improvement. Similarly, the social equity pillar of Austria has experienced progress during the period. An increase in population rate that has access to safely managed drinking water services and life expectancy rate yield to progress. The social equity pillar of Ireland follows a growing trend. Improvement in mean years of schooling, infant mortality rate, life expectancy, and labor force participation gap provide us to have a higher pillar.

7.3 Economic Growth Pillar

The decrease in the adjusted net savings rate and GDP per capita coefficient leads to a decline in the economic growth pillar of Belgium after the year 2010. Similarly, a decrease in market concentration ratio and GDP per capita causes a lower trend for Austria after the year 2010. Although Croatia experiences a growing growth pillar in 2019 is still lower than the initial score, it follows a decreasing trend until that year. Cyprus has a rapid decrease in the year 2010. This rapid decline is because of a sharp decrease in market concentration ratio, and in GDP per capita. Because of lower scores in GDP coefficient, adjusted net savings, and age dependency ratio, Luxemburg has experienced a declining trend. With the help of all scores of the pillar, the growth pillar of Hungary has a rapid improvement.

7.4 Environmental Sustainability Pillar

When we examine the environmental sustainability pillar, almost each pillar score of Austria has progressed in the period. While the environmental sustainability pillar of Croatia starts with a high score, in the next year it decreases. Although the score raises after that, it hasn't caught the 2005 score. The downsize in the pillar occurs due to a rapid decrease in air pollution. Besides that, it keeps the air pollution higher in the following years. Denmark improves in the pillar that comes from a decline in CO2 emissions, air pollution, and a rise in renewable energy consumption and renewable internal freshwater resources. However, Germany, France, Netherlands have similar environmental sustainability scores. Although the scores of Poland gradually grow, the country has the lowest score pillar in 2005 among the selected countries. Having too low scores in almost every indicator yields us to have the lowest pillar for Poland.

7.5 Technology Pillar

The technology pillar of Croatia follows decreasing path despite an increase in the year 2019. Every three indicators of the pillar keep decreasing. Although R & D expenditure rises in the period, decreases in ICT goods export and import for Denmark decline the technology pillar in 2010. In the following year, it has increased and finally, in the last period, it has a catch. Besides that, Finland has the highest pillar score in 2005. However, due to sharp decreases in all three indicator scores, the country can't maintain the score. Similarly, because of decreases in the scores of all indicators France has experienced a declining pillar score. Ireland has also sharp decreases in the pillar indicators which result in a low score. In addition, the pillar of Sweden has decreased year by year higher R& D scores provide a high technology pillar score compared to other countries. When we examine Turkey, with the help scores of R& D increases and ICT goods import the pillar score raises.

8. CONCLUSION

This paper examines the scope and implications of green growth and introduces an inclusive and balanced inclusive index for Turkey and the EU countries for 2005, 2010, 2015, 2019. After measuring the indices, the study tries to measure the contribution of technology. Since R&D expenditure is an important tool for new technology creation, the paper utilizes R&D expenditure. Besides that, for new technology creation and improvement of the existing technology, ICT goods are necessary. Hence the paper also uses ICT goods export and import for technological progress. Since all 27 indicators have different measures each of them is converted into the same scale. With the technology pillar, the scores have quite a lower value due to the lower score of the technology pillar compared to other pillars. The outcomes of the indices highlight that there should be some policy implications for all pillars to have more balanced indices. The contribution of the thesis to literature is that in a technology driven world try to improve the explanatory power of the green growth index.

While some countries have similar values in all indices, some have certain differences among the indices which depends on the scores of the indicators in the technology pillar. If the technology pillar score is quite lower than the other three indices, the tech-oriented and tech-balanced IGG indices have a lower score. Since technology is in every part of our life and it has developed gradually, at this point countries can implement policy tools to increase the R&D expenditure. Countries can also have some regulations and actions to rise ICT goods export in total goods export and ICT goods import in total goods import. More importantly, equalizing the pillars gives us more balanced indices. Equalizing the pillars can be done by having a more comprehensive approach for all pillars which means for instance not only considering economic growth but also fostering social welfare.

While countries such as Denmark, Sweden, Ireland have quite higher green growth indices scores among the selected countries, countries such as Greece, Malta, France, and Turkey have lower scores. Having lower pillar scores can lead to a lower index score as in the case of Malta. The technology contribution lowers the IGG score which stems from a lower technology pillar score compared to other pillars. On the other hand, differences in the pillars also lower the index's scores. The best way for a higher IGG index score is to first have higher indicators in each pillar. After that, higher pillar score; more importantly balanced and equally distributed pillars that mean if there will be any implication, they should be inclusive and comprehensive.

Having greener growth has eventually started each economy's purpose. Sustainable growth means keeping environmental damage at a minimum with accelerating growth. In the framework of the paper, countries can implement some policies to enhance every 27 indicators in the IGG index. Moreover, countries should give more importance to improve R&D expenditures, ICT goods export, and import. Improving the technology pillar will help to boost the IGG Index. More importantly, whilst

implementing some policies,policies should be inclusive which means the policy implications should include each four pillars.

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APPENDICIES

TABLE 3

Green Growth Indices Pillars

Country Name	Time	Social Equity	Economic Growth	Environmental Sustainability	Technology
Bulgaria	2005	3.72	2.49	2.09	1.25
	2010	3.98	2.48	2.05	1.27
	2015	4.11	2.68	2.15	1.39
	2019	4.19	2.90	2.24	1.43
Belgium	2005	4.68	3.11	2.25	2.08
	2010	4.93	3.19	2.25	1.93
	2015	5.05	3.02	2.30	2.03
	2019	5.21	3.01	2.35	2.22
Austria	2005	4.89	2.98	2.68	2.42
	2010	5.02	3.14	2.76	2.45
	2015	5.11	3.05	2.85	2.59
	2019	5.24	3.04	2.93	2.66
Croatia	2005	4.00	2.95	3.54	1.60
	2010	4.22	2.79	2.71	1.46
	2015	4.22	2.68	2.80	1.40
	2019	4.32	2.85	2.85	1.47
Cyprus	2005	4.60	2.64	1.97	1.50
	2010	4.77	3.02	2.01	1.47
	2015	4.74	2.49	2.03	1.25
	2019	4.95	2.44	2.04	1.26
Denmark	2005	5.11	2.82	2.45	2.80
	2010	5.25	2.97	2.62	2.67
	2015	5.21	2.96	2.77	2.74
	2019	5.32	3.06	3.03	2.79
Czech Republic	2005	4.58	2.91	2.21	2.28
	2010	4.73	2.89	2.22	2.70
	2015	4.91	3.05	2.29	2.96
	2019	5.02	3.36	2.32	3.03

TABLE 4

Green Growth Indices Pillars

Country	Time	Social equity	Economic growth	Environmental sustainability	Technology
Finland	2005	5.08	2.63	4.51	3.82
	2010	5.26	2.68	4.48	3.57
	2015	5.34	2.79	4.56	2.83
	2019	5.41	2.91	4.55	2.58
France	2005	4.61	2.72	2.40	2.53
	2010	4.78	2.76	2.39	2.33
	2015	4.94	2.73	2.44	2.31
	2019	5.08	2.82	2.68	2.28
Germany	2005	4.98	2.42	2.15	2.86
	2010	5.16	2.65	2.19	2.73
	2015	5.27	2.69	2.25	2.73
	2019	5.33	2.65	2.34	2.87
Greece	2005	4.50	2.25	2.17	1.38
	2010	4.67	2.25	2.19	1.34
	2015	4.65	2.47	2.31	1.38
	2019	4.89	2.27	2.32	1.57
Ireland	2005	4.60	3.25	2.95	3.70
	2010	4.88	3.11	2.94	2.70
	2015	5.02	3.65	3.14	2.09
	2019	5.26	4.00	3.32	2.01
Italy	2005	3.92	2.47	2.13	1.73
	2010	4.86	2.56	2.21	1.67
	2015	4.96	2.73	2.28	1.67
	2019	4.96	2.51	2.22	1.71
Latvia	2005	4.18	2.84	2.94	1.26
	2010	4.44	2.59	2.90	1.44
	2015	4.64	2.78	2.99	1.69
	2019	4.90	2.86	2.48	1.76

TABLE 5

Green Growth Indices Pillars

Country	Time	Social equity	Economic growth	Environmental sustainability	Technology
Lithuania	2005	4.18	2.86	2.43	1.50
	2010	4.47	2.73	2.49	1.45
	2015	4.76	2.84	2.54	1.46
	2019	5.00	2.84	2.67	1.53
Luxembourg	2005	4.81	3.78	2.54	2.36
	2010	4.80	3.87	2.68	1.92
	2015	4.96	3.56	2.85	1.62
	2019	4.94	3.47	3.15	1.62
Malta	2005	4.42	2.74	2.71	4.37
	2010	4.54	2.72	1.89	3.58
	2015	4.83	2.93	1.93	2.24
	2019	5.07	3.11	2.06	1.76
Netherlands	2005	5.25	3.01	2.11	3.17
	2010	5.47	3.13	2.10	2.86
	2015	5.63	3.26	2.10	2.78
	2019	5.64	3.27	2.05	2.86
Poland	2005	4.36	2.75	1.92	1.56
	2010	4.54	2.56	1.94	1.73
	2015	4.85	2.59	1.99	1.85
	2019	5.09	2.87	2.04	1.95
Romania	2005	3.39	2.56	2.84	1.38
	2010	3.62	2.60	2.17	1.49
	2015	3.82	2.45	2.22	1.46
	2019	3.68	2.81	2.31	1.43
Portugal	2005	4.39	2.78	2.69	1.75
	2010	4.63	2.80	2.81	1.97
	2015	4.87	2.82	3.02	1.71
	2019	5.14	2.82	3.18	1.76

TABLE 6

Green Growth Indices Pillars

Country	Time	Social equity	Economic growth	Environmental sustainability	Technology
Slovenia	2005	4.62	2.62	2.67	1.70
	2010	4.85	2.75	2.65	1.82
	2015	5.23	2.77	2.72	2.16
	2019	5.30	3.05	2.76	1.91
Slovak Republic	2005	4.40	2.95	2.36	1.51
	2010	4.89	3.26	2.25	1.93
	2015	4.61	2.62	2.30	2.51
	2019	4.70	2.74	2.36	2.44
Sweden	2005	5.66	2.85	4.51	3.47
	2010	5.46	2.95	4.55	3.32
	2015	5.82	2.95	4.58	3.17
	2019	5.92	3.11	4.58	3.13
Spain	2005	4.97	2.54	2.37	1.72
	2010	5.12	2.57	2.40	1.81
	2015	5.30	2.53	2.57	1.61
	2019	5.47	2.59	2.76	1.60
Hungary	2005	3.99	2.96	2.00	3.21
	2010	4.23	2.82	2.05	3.17
	2015	4.46	2.92	2.18	2.74
	2019	4.73	3.21	2.20	2.52
Estonia	2005	4.56	3.19	3.37	2.36
	2010	4.78	2.90	3.38	2.00
	2015	5.05	3.17	3.49	2.63
	2019	5.19	3.24	3.59	2.19
Turkey	2005	3.19	2.70	2.16	1.38
	2010	3.36	2.64	2.12	1.36
	2015	3.97	2.65	2.09	1.39
	2019	4.16	2.52	2.10	1.48