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DECOUPLING ANALYSIS OF ENVIRONMENTAL PRESSURES FROM ECONOMIC GROWTH IN THE EU-27 AND TURKEY

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ABSTRACT

Global climate change has caused great concern due to its negative impact on social and economic development. Tapio decoupling analysis is a method used to analyze the relationship between economic growth and the environment. The purpose of this article is to analyze the relationship between the environmental pressures and economic growth in the EU-27 countries and Turkey from 1990 to 2017 (annual data). Firstly, this article presents the decoupling states (absolute decoupling, relative decoupling and no decoupling) between gross domestic product (GDP) and environmental pressures (Greenhouse gas (GHG) emissions, material flows (MF) , land use (LU)) from 1990 to 2017. The following conclusions are generated: (1) In the case of GHG emissions from GDP, there is absolute decoupling in 10 countries and relative decoupling in 9 countries. In 9 countries, no decoupling occurs. (2) In terms of MF from GDP, in 5 countries absolute decoupling occurs and relative decoupling occurs in 13 countries. In 10 countries, no decoupling occurs. (3) In the case of LU from GDP, absolute decoupling occurs in 17 countries and relative decoupling occurs in 1 country. In 10 countries, no decoupling occurs. Secondly, to determine the source of productivity index, Malmquist productivity index is applied to the same countries based on the same period. GDP is used as output variable, while GHG emissions, MF and LU are used as input variable. The input- oriented Malmquist productivity index results show that: there is productivity gain in the entire EU-27 and Turkey.

Keywords: *Decoupling analysis, Greenhouse gas, Malmquist index, European Union.*

INTRODUCTION

Global warming has become one of the greatest threats for the sustainability of humanity and is mainly caused by the concentration of greenhouse gas (GHG) emissions like carbon dioxide (CO_2), methane (CH_4), perfluorocarbon (PFCs), hydrofluoride (HFCs), nitrous oxide (N_{20}), and sulfur hexafluoride(SF_6). According to the evidence provided by the Intergovernmental Panel on Climate Change (IPCC),among these, CO_2 accounts for more than half of total greenhouse effect. Therefore, the main reason for global warming is the increase in CO_2 emissions. Paris Agreement´s main goal is to keep the average increase of global temperature at least below 2°C to avoid enormous damages of the climate change. Almost half of EU countries are in a group of countries with very low performance in terms of CO_2 emissions. Additionally, Tukey’s CO_2 emissions in 2017 were 410 mt, and accounting for about 11.5% of the Europan Union’s total CO_2 emissions [1]. Due to increasing concern about global climate change, the issue of how to decouple environmental pressures from economic activities has become more and more noticeable.

In parallel to these lines of thought, in the literature, various indicators have been developed to track changes in the relationship between environmental pressures and gross domestic product (GDP). The most popular of these indicators is the decoupling indicator, since it is considered to be an appropriate indicator for evaluating the sustainable development process. The term decoupling firstly used in Physics. It means dissociating the relationship between certain physical variables. Decoupling as a word meaning to separate one variable from the other. The decoupling indicator introduced in OECD [2], defined as breaking the linkage of ‘environmental bads’ from ‘economic goods’. Although this indicator was easy to calculate, it did not provide enough information to reveal the actual actions of economic development and environmental pressures. To overcome this weakness, Tapio [3] introduced an indicator based on the value of elasticity, economic / environmental pressure change and eight logical cases of decoupling relationships.

In this paper, the Tapio decoupling model is applied to research whether the economy is decoupled from environmental pressures (land use, material flows and GHG emission), i.e. how to achieve economic growth without increasing environmental pressures. In this context, at the national level this paper explores the intrinsic drivers of

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the dynamic changes of decoupling index of environmental pressures from GDP. Additionally, this work is used the input-oriented Malmquist productivity index to determine the total factor productivity index of economic systems based on preventive policy instruments.

The remainder of this study is organized as follows: Section 2 summarizes a review of studies concerning environmental performance focused on decoupling. Section 3 presents the data used in the research and methodology. Section 4 presents the decoupling analysis results and shows the Malmquist productivity index results. Finally, Section 5 presents conclusion.

LITERATURE REVIEW

The theory of decoupling was proposed by Von Weizsäcker [4] and the number of works on this subject matter have increased widely with special emphasis. Decoupling analysis has received great attention in studies of economic growth between in relation to environmental pressure, energy and transport on recent years.

The summary table of decoupling method studies in the literature is given below.

Table 1. Decoupling Theory Studies in the Literature

Authors	Methodology	Research object	Period	Variables
Zhang (2000) [5]	Decoupling method	China	1980-1997	Gross domestic product, CO_2 emissions
Tapio (2005) [3]	Decoupling method	EU-15	1970-2001	Gross domestic product, traffic volumes, CO_2 emissions of transport and road traffic
Juknys et al. (2005) [6]	Decoupling method	New Eastern EU members	1991-2002	Gross domestic product, final energy consumption and emissions
Freitas and Kaneko (2011) [7]	Decoupling method	Brazil	2004-2009	Gross domestic product, CO_2 emissions
Wan et al. (2016) [8]	Decoupling method	China	2000-2014	Economic growth of the equipment manufacturing industry, CO_2 emissions
Bampatsou et al. (2017) [9]	Decoupling method	The EU-13 countries	1990-2011	Gross domestic product, Greenhouse gas emissions, material flows and land use
Roinioti and Koroneos (2017) [10]	Decoupling method	Greece	2003-2013	Gross domestic product, CO_2 emissions from energy use
Wu et al. (2018) [11]	Decoupling method	China's transport industry	1994-2012	CO_2 emissions and transport development
Engo (2019) [12]	Decoupling method	Cameron	1990-2016	CO_2 emissions and transport sector
Shuai C, Chen X, Wu Y, et al. (2019) [13]	Decoupling Method	The World	2000-2014	Gross domestic product, Carbon intensity, carbon emission per capita, and total carbon emission
Wang et al. (2020) [14]	Decoupling method	China	2001-2016	CO_2 emissions and economic growth of China's iron and steel (IS) industry

METHODOLOGY AND DATA

Data, Variables and DMUs

In this study, decoupling analysis is used to analyze the relationship between the environmental pressures (land use, material flows and GHG emissions) and economic growth in the EU-27 countries and Turkey from 1990 to 2017. Additionally, input-oriented Malmquist productivity index is applied to the same countries based on during this period. GHG emissions, MF and LU are used as input variable, while GDP is used as output variable.

GDP data were derived from World Development Indicators [15]. Material flows were obtained from the WU Global Material Flows Database website [16]. The land use and GHG emissions were collected from the EIA Energy Information Administration [17]. Missing data were estimated by regression method. Summary statistics of the data used are summarized in Table 2.

Table 2. Descriptive statistics of data

Variables	Variables Function in Model	Mean	Median	Std. Deviation	Minimum	Maximum
Gross domestic product (dollar)	O	23643,2552	20532,2850	18645,4912	1102,1000	119225,3800
Greenhousegas emissions (tonnes)	I	11,1723	10,4000	4,7515	3,0100	32,6100
Material flows (tonnes)	I	14,7215	13,9500	6,5286	3,3000	35,2400
Land use (hectare)	I	13224,4522	9373,1950	12475,9701	687,7400	61083,7700

I: Input, O:Output

Decoupling Method

The decoupling model is used to measure if there is any relationship between economic growth (e.g. GDP) and environmental pressures (e.g. GHG, LU or MF). When a state of decoupling shows, it implies that the growth rate GHG, LU or MF is less than that of the GDP.

The decoupling model utilized in this analysis was proposed by Tapio [3]. According to Tapio (2005), from a benchmark year 0 to year t, the decoupling indicator of environmental pressures (material flows, land use, GHG) and GDP is defined as D^t. In this paper the D^t as displayed with the following equation:

$$D^t = \frac{\%\Delta Y}{\%\Delta G} = \frac{\frac{Y^t - Y^0}{Y^0}}{\frac{G^t - G^0}{G^0}} \tag{1}$$

where D^t denotes the decoupling elastic coefficient, t is the time, and ΔY denotes changes in environmental pressures (material flows, land use) between a base year 0 to a target year t; ΔG denotes the change of GDP between a base year 0 to a target year t.

Different values of D^t corresponds to different decoupling levels. According to Tapio (2005), the decoupling results can be classified into eight categories as shown in Table 3.

In the case of correlation of economic development and environmental pressure, the decoupling state can be divided into two main types: absolute decoupling and relative decoupling. As shown in Table 3, when environmental pressure decreases while economy grows, the coupling relationship is dissolved; absolute decoupling is taking place, i.e. strong decoupling. When the growth rate in environmental pressure is lower than the economic growth rate, they still have a certain coupling relationship; relative decoupling is taking place, i.e. weak decoupling. In recessive decoupling, GDP and environmental pressure both decrease, but the environmental peressure decreases more rapidly than the GDP. Strong negative decoupling is the most unfavorable state for the economic development, while environmental pressure increases, GDP decreases. An expansive negative decoupling state indicates GDP and environmental pressure both increase and the latest increases faster than the GDP. When D^t>1 and the growth rate of environmental pressure is equal to the growth rate of the economy, in this state no decoupling occurs.

Table 3. The classification of decoupling index states by the Tapio model

Classification	Decoupling state	ΔY	ΔG	D
	Absolute decoupling	<0	>0	D^t<0
Decoupling	Relative decoupling	>0	>0	$0 \leq D^t < 0{,}8$
	Recessive decoupling	<0	<0	$D^t > 1.2$
	Strong negative decoupling	>0	<0	$D^t < 0$
Negative decoupling	Weak negative decoupling	<0	<0	$0 \leq D^t < 0.8$
	Expansive negative decoupling	>0	>0	$D^t > 1.2$
Coupling	Expansive coupling	>0	>0	$0.8 \leq D^t < 1.2$
	Recessive coupling	<0	<0	$0.8 \leq D^t < 1.2$

Among the eight types of decoupling states described above, absolute decoupling (strong decoupling) is the most sought state of sustainable development, followed by relative decoupling.

Productivity Analysis: The Malmquist Productivity Index

The Malmquist productivity index (MPI) is a quantitative index to measure total productivity changes over time and proposed by Sten Malmquist [18]. It was introduced by Caves et al. [19]. Färe et al. [20] decomposed this index into two components: efficiency change (Effch) and technical change (Techch). According to Färe et al. [20], the input-oriented Malmquist productivity index between two adjacent periods as shown in Equation (2):

$$M_I(x^{t+1}, y^{t+1}, x^t, y^t) = \left[\left(\frac{D_I^t(x^{t+1}, y^{t+1})}{D_I^t(x^t, y^t)}\right)\left(\frac{D_I^{t+1}(x^{t+1}, y^{t+1})}{D_I^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}} \tag{2}$$

where I displays an input orientation, y denotes output, x denotes input, M is the productivity of the most recent production point connected to the earlier production point, and D displays the input distance function. The Malmquist total productivity index improves if *M>1*, remains unchanged if *M=1*, and declines if *M<1*. An equivalent representation of Equation (2) is as follow:

$$M_I(x^{t+1}, y^{t+1}, x^t, y^t) = \frac{D_I^{t+1}(x^{t+1}, y^{t+1})}{D_I^t(x^t, y^t)} \times \left[\left(\frac{D_I^t(x^{t+1}, y^{t+1})}{D_I^{t+1}(x^{t+1}, y^{t+1})}\right)\left(\frac{D_I^t(x^t, y^t)}{D_I^{t+1}(x^t, y^t)}\right)\right]^{\frac{1}{2}} = Effch \times Techch \tag{3}$$

The MPI can be further decomposed into two components: the efficiency change, that highlights the change in the relative efficiency at period t+1 and period t; and the technological change, that shows the shift in the frontier technology such as innovation changes, at period t+1 and period t. [21]. If Effch> Techch, the productivity gain is the result of improvement in efficiency. If Effch <Techch, then productivity gains are the result of technological progress [9].

The technical efficiency change can be further decomposed into pure technical efficiency change and scale efficiency change [22]. The formula for calculation is given below:

$$\text{Effch} = \text{Pech} \times \text{Sech} \tag{4}$$

According to the above decomposition, Equation (2) can eventually be expressed as:

$$M_I(X^{t+1},y^{t+1},x^t,y^t)=\overbrace{\underbrace{\frac{D_{VRS}^{t+1}(x^{t+1},y^{t+1})}{D_{VRS}^{t}(x^t,y^t)}}_{}^{Pech}\times\overbrace{\left[\left(\frac{D_{CRS}^{t+1}(x^{t+1},y^{t+1})/D_{VRS}^{t+1}(x^{t+1},y^{t+1})}{D_{CRS}^{t}(x^t,y^t)/D_{VRS}^{t+1}(x^t,y^t)}\right)\right]}^{Sech}}^{Effch}\times$$

$$\times\overbrace{\left[\left(\frac{D_{CRS}^{t}(x^{t+1},y^{t+1})\times D_{CRS}^{t+1}(x^t,y^t)}{D_{CRS}^{t+1}(x^t,y^t)/D_{CRS}^{t+1}(x^t,y^t)}\right)\right]}^{Techch}=Pech\times Sech\times Techch \quad (5)$$

The increase in pure technical efficiency, which is one of the components of efficiency change, shows the development of management practices between t and t + 1 periods. An improvement in scale efficiency is considered as an improvement towards optimal scale size in terms of cost control.

If the Pech value is greater than the Sech value, the change in efficiency is the result of the improvement in Pech. If the Pech value is less than the Sech value, the change in efficiency is the result of the improvement in the Sech [9].

APPLICATIONS AND RESULTS

The decoupling indices of greenhouse gas emissions, material flows, land use from economic growth are depicted in the EU-27 countries and Turkey from 1990 to 2017. Decoupling analysis results are calculated and given in Table 4. Afterwards, the Malmquist total factor productiviy index changes of same countries (Figure 1, Figure 2) and their driving forces (Table 5) are also presented during this period.

Table 4. Decoupling elasticities results of countries during the period 1990-2017

Country Name	$D^t{}_{GDP,GHG}$	$D^t{}_{GDP,MF}$	$D^t{}_{GDP,LU}$
Austria	0.2802	0.3503	-7.7641
Belgium	-0.7019	2.4516	-6.6654
Bulgaria	1.3166	-0.2851	11.3209
Cyprus	1.1616	0.6104	-4.6223
Czech Republic	-5.8964	4.1512	-20.8159
Denmark	0.7014	0.0622	-11.2606
Estonia	0.5830	1.9680	0.6550
Finland	0.5502	1.4656	-11.5902
France	3.7784	0.4386	-18.7094
Germany	-3.5002	-0.0950	5.7896
Greece	-1.2561	1.3163	-11.6088
Hungary	-0.3797	0.3505	19.3502
Ireland	0.1244	0.4649	-5.1439
Italy	0.5696	0.3739	-15.8075
Latvia	4.4730	-0.6714	1.2775
Lithuania	1.0718	0.6945	3.5580
Luxemburg	1.2048	0.2240	-3.9500
Malta	1.1522	-0.3794	-5.4600
Netherlands	0.6774	1.3331	-12.7215
Poland	1.9127	2.5378	65.6331
Portugal	-1.3478	0.2893	-9.8292
Romania	0.7793	0.9768	6.3453
Slovakia	-4.5342	2.2408	26.8947
Slovenia	-0.0068	1.1628	-34.2407
Spain	0.9594	0.1552	-7.9195
Sweden	-1.4431	1.0509	2.4123
Turkey	2.4866	0.6804	1.5099
United Kingdom	-0.4474	-0.4403	-0.9313

Table 4 shows the results of analysis of decoupling indices for the EU-27 countries and Turkey, during the period 1990-2017.

In terms of Austria, Denmark, Ireland, Italy, and Spain the decoupling elasticity indices of GHG emissions and MF positive, relative decoupling is available, during this period. This result indicates that the GHG emissions, MF consumption growth rate is lower than the economic growth rate. In these countries, in terms of LU, there is a negative elasticity during this period. Absolute decoupling is available, which means that the LU decreases and the economy continues to increase.

In terms of Belgium, Greece, Czech and Slovenia, the decoupling elasticity indices of GHG emissions and LU are negative, during this period. Absolute decoupling is available. This situation indicates that the economy is increasing while GHG emissions and LU are decreasing. The results show that MF consumption of these countries, no decoupling is available during this period. The increase in MF consumption is higher than economic growth.

In terms of Bulgaria and Latvia, the decoupling elasticity indices of GHG emissions and LU are positive, during this period. The decoupling elasticity indices of these countries GHG emissions and LU are greater than 1, during this period. No decoupling is available. This state indicates that the GHG emissions and LU growth rate are higher than economic growth rate. The results show that MF consumption of these countries, absolute decoupling is available during this period. This stiuation indicates that the MF decreases and the economy continues to increase.

In terms of Cyprus, France, and Luxemburg, no decoupling is available. This case indicates that the decoupling elasticity indices of GHG emissions is greater than 1, during this period. GHG emissions growth rate is higher than economic growth rate. In addition, in terms of these countries MF, the decoupling elasticity indices are positive, during this period. Relative decoupling is available. This result indicates that the growth rate in MF consumption is lower than the economic growth rate. Finally, in terms of LU, these countries have a negative elasticity condition during this period. Absolute decoupling is available, which means that the LU decreases and the economy continues to increase.

In terms of Lithuania and Turkey, the decoupling elasticity indices of MF consumption are positive, during this period. Relative decoupling is available. This case indicates that, the growth rate in MF consumption is lower than the economic growth rate. GHG emissions and LU the decoupling elasticity indices of these countries are greater than 1 during this period. No decoupling is available. This result indicates that the GHG emissions and LU growth rate are higher than economic growth rate.

In terms of Slovakia and Sweden, the decoupling elasticity indices of GHG emissions are negative, during this period. Absolute decoupling is available. This situation indicates that the economy is increasing while GHG emissions is decreasing. The results show that MF consumption and LU of these countries, no decoupling is available, since the decoupling elasticity indices are greater than 1, during this period. This state indicates that the growth rate of MF consumption and LU is higher than that of economic growth.

In terms of Finland and the Netherlands, the decoupling elasticity indices GHG emissions are positive during this period. Relative decoupling is available. This state indicates that the growth rate in GHG emissions is lower than the economic growth rate. The results show that MF consumption of these countries, the decoupling elasticity indices is greater than 1, during this period. No decoupling is available, so MF consumption growth rate is higher than economic growth rate. Finally, LU decoupling elasticity indices of these countries are negative, during this period. Absolute decoupling is available. This result indicates that the economy is increasing while the LU is decreasing.

The results show that Estonia, GHG emissions and LU, the decoupling elasticity indices are positive, during this period. Relative decoupling is available. This case indicates that the growth rate in GHG emissions and LU is lower than the economic growth rate. In terms of MF consumption of this country, the decoupling elasticity indices is greater than 1 during this period. No decoupling is available. This result indicates that the MF consumption growth rate is higher than economic growth rate.

In terms of Germany, GHG emissions and MF consumption, the decoupling elasticity indices are negative, during this period. Absolute decoupling is available. This state indicates that the economy is increasing while GHG emissions and MF comsumption are decreasing. The results show that LU of this country, the decoupling elasticity indices is greater than 1, during this period. No decoupling is available. This situation indicates that the LU growth rate is higher than the economic growth rate.

The results show that Hungary, the decoupling elasticity of GHG emissions is negative, during this period. Absolute decoupling is available. This case indicates that the economy is increasing while GHG emissions is decreasing. In Hungary, the decoupling elasticity index of MF is positive, during this period. Relative decoupling is available. This situation indicates that the growth rate in MF consumption is lower than the economic growth rate. Finally in terms of LU of this country, the decoupling elasticity index is greater than 1, during this period. No decoupling is available. This result indicates that the LU growth rate is higher than the economic growth rate.

In terms of Malta, the decoupling elasticity of GHG emissions is greater than 1, during this period. No decoupling is available. This state indicates that the growth rate of GHG emissions is higher than that of economic growth. The decoupling elasticity indices of this country MF consumption and LU are negative, during this period. Absolute decoupling is available. This result indicates that the MF consumption and LU decrease while the economy increases.

In terms of Portugal, the decoupling elasticity indices of GHG emissions and LU are negative during this period. Absolute decoupling is available. This state indicates that the economy is increasing while GHG emissions and LU are decreasing. The MF consumption of this country, the decoupling elasticity index is positive, during this period. Relative decoupling is available. This result indicates that the growth rate in MF consumption is lower than the economic growth rate.

In terms of Romania, GHG emissions and MF consumption, the decoupling elasticity indices are positive, during this period. Relative decoupling is available. This situation indicates that the growth rate in GHG emissions and MF consumption is lower than the economic growth rate. The decoupling elasticity of this country LU is greater than 1, during this period. No decoupling is available, which means that LU growth rate is higher than the economic growth rate.

In terms of Poland, the decoupling elasticity indices of GHG emissions, MF consumption and LU is greater than 1, during this period. No decoupling is available. This result indicates that the growth rate of GHG emissions, MF consumption and LU is higher than that of economic growth.

The results show that UK, the decoupling elasticity indices of GHG emissions, MF consumption and LU are negative, during this period. Absolute decoupling is available. This case indicates that the economy is increasing while GHG emissions, MF consumption and LU decrease.

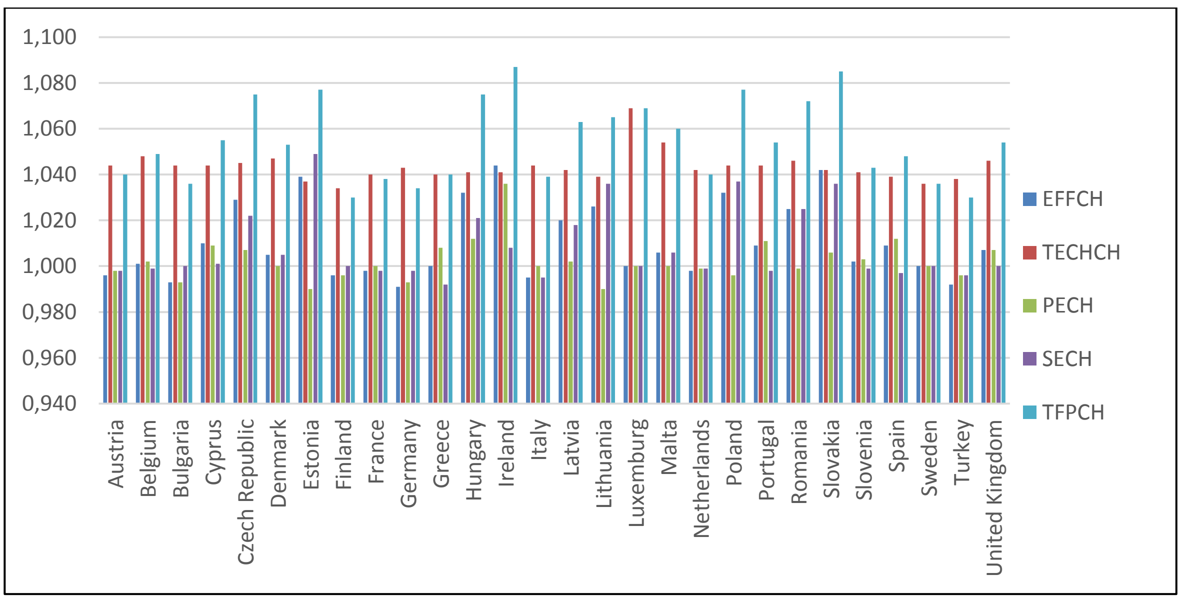
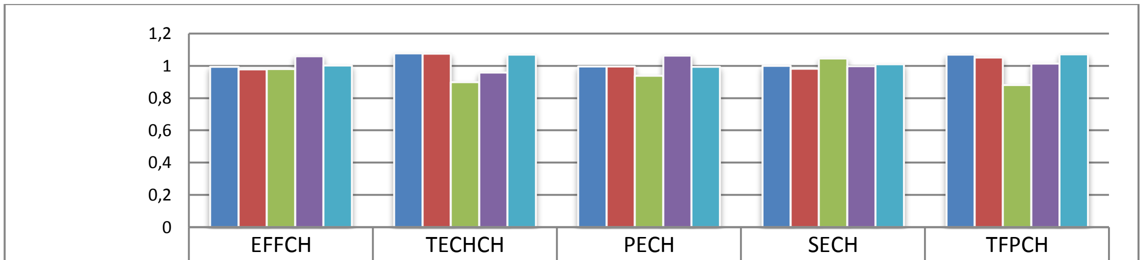


Figure 1. Annual means of Malmquist index and its components of countries

Figure 1, obtained by Malmquist productivity index method, shows the results of Tfpch index and its components (Effch, Techch, Pech, Sech) for EU-27 and Turkey.

Figure 2 displays the change of Tfpch index and its components (Effch, Techch, Pech, Sech) during the period 2012-2017. If Tfpch index value is greater than 1 are referred to as productivity improvements [9].



	EFFCH	TECHCH	PECH	SECH	TFPCH
2012-2013	0,994	1,076	0,995	0,999	1,069
2013-2014	0,978	1,074	0,996	0,981	1,05
2014-2015	0,98	0,898	0,938	1,045	0,88
2015-2016	1,059	0,957	1,062	0,997	1,014
2016-2017	1,002	1,069	0,994	1,009	1,071

Figure 2. The changes of Malmquist index and its components of countries by years

Table 5. The driving forces of Tfpch of economic systems by countries during the period 1990-2017

DMU	Total factor productivity	The primary driving force of productivity	The primary driving force of efficiency change
Austria	Productivity gains	Technological progress	
Belgium	Productivity gains	Technological progress	
Bulgaria	Productivity gains	Technological progress	
Cyprus	Productivity gains	Technological progress	
Czech Republic	Productivity gains	Technological progress	
Denmark	Productivity gains	Technological progress	
Estonia	Productivity gains	Improvement in efficiency	Improvement in scale efficiency
Finland	Productivity gains	Technological progress	
France	Productivity gains	Technological progress	
Germany	Productivity gains	Technological progress	
Greece	Productivity gains	Technological progress	
Hungary	Productivity gains	Technological progress	
Ireland	Productivity gains	Improvement in efficiency	Improvement in pure technical efficency
Italy	Productivity gains	Technological progress	
Latvia	Productivity gains	Technological progress	
Lithuania	Productivity gains	Technological progress	
Luxemburg	Productivity gains	Technological progress	
Malta	Productivity gains	Technological progress	
Netherlands	Productivity gains	Technological progress	
Poland	Productivity gains	Technological progress	
Portugal	Productivity gains	Technological progress	
Romania	Productivity gains	Technological progress	
Slovakia	Productivity gains	Technological progress Improvement in efficiency	Improvement in scale efficiency
Slovenia	Productivity gains	Technological progress	
Spain	Productivity gains	Technological progress	
Sweden	Productivity gains	Technological progress	
Turkey	Productivity gains	Technological progress	
United Kingdom	Productivity gains	Technological progress	

Table 5 shows all countries have productivity gains. if the Effch value is g reater than the Techch value, the gain in efficiency is due to improvement in efficiency. If the Effch value is less than the Techch value, the gain in efficiency results from technological progress. If the Effch value is equal to the Techch value, the gain in efficiency results from both improvement in efficiency and technological progress (Slovakia).

The main source of change in Effch is divided into two as Pech and Sech. If the Pech value is greater than the Sech value, the change in efficiency is the result of the progress in Pech (Ireland). If the Pech value is less than the Sech value, the change in efficiency is the result of the progress in the Sech (Estonia, Slovakia).

CONCLUSION

Turkey is a candidate country to the European Union. Therefore, this article makes a comparison in terms of the theory of decoupling, Turkey and EU-27 countries. By determining the Tfpch index and its components, GHG emissions, MF consumption and LU can contribute to optimum management. The main conclusions are as follows:

- In all countries except Ireland and Estonia, technological progress (Techch) is the primary productivity force of the observed productivity gain. The Techch index refers to changes in product technology as a response to the efforts behind each innovation to save resources.
- UK, has already achieved absolute decoupling in the case of GHG emissions, MF consumption and LU from GDP. As well as, the entire of EU countries have achieved decoupling in the case at least one of GHG emissions, LU and MF indices (except Poland).
- Turkey has already achieved absolute decoupling in the case of MF consumption from GDP. Further development of production technology will force to move towards absolute decoupling in the case of GHG emissions and LU.

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