Assessment of Sustainable Economic Development in Estonia and Latvia

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Abstract— **Current trend in global development is to manage national economies sustainably, but significant challenge is measuring progress. There is a need for studies that can help to monitor if national economy develops sustainably or not. The aim of this study is to assess the main trends in sustainable economic development in Estonian and Latvian economies. Literature review, regression and correlation analysis are applied for data analysis in this research. The results allow to conclude that Estonia and Latvia have not reached the turning point in sustainable development when larger GDP is produced with using fewer amounts of natural resources and generating less waste (falling Footprint). Both countries have similar sustainable development trends, excluding temp of increase in the number of population.**

Keywords— *Estonia, Latvia, sustainable economic development.*

I. INTRODUCTION

Current problem in global development is to manage national economies sustainably, but huge challenge is to measure its progress. There is an urgent necessity for studies that can help to monitor if national economy develops sustainably or not, because resolving problems and planning activities are impossible without the accurate evaluation of actual conditions (see more 1]. Sustainable development is crucial for creating a balance between economic growth, environmental protection and social well-being because the results of business activity of humans have led to global warming and climate change [see more 2, 3, 4]. The United Nations believes that the urgent action is needed to stop current negative changes in the world to preserve our resources, including biodiversity. In 2015 all member states of the United Nations accepted *the 2030 Agenda for Sustainable Development* [5]. This sustainability framework consists of 17 goals and 169 targets.

Analysis of scientific literature shows that there are different approaches in measuring sustainable economic development at national level because 17 Sustainable Development Goals are very complex in assessment and implementation improving all goals simultaneously, as well as countries have different development problems and priorities [see more 6, 7]. It is not clear nowadays if universal method exists in measuring sustainable development [8]. Considering these facts, the aim of this study is to assess the main trends in sustainable economic development in Estonia and Latvia. This study continues the efforts of authors to apply Latvian approach in evaluating sustainable development using indicators of sustainable development defined in the Sustainable Development Strategy in Latvia until 2030 [9]. Previous study was devoted in measuring sustainable development in Latvia [10]. But this study extends application of selected indicators to comparative analysis between Estonia and Latvia. Latvia and Estonia share similarities as small, open economies in the Baltic region, but they also have distinct economic trajectories, making them great subjects for comparative research. It is useful to compare Latvia with Estonia because Estonia has conducted development processes more successfully that can be seen in the higher well-being represented by the Human Development Index ranking [11].

Two tasks are carried out to reach the aim. Firstly, to identify and compare existing indicators for the evaluation of sustainable economic development. Secondly, to choose an appropriate set of indicators to evaluate historical and nearest perspectives of sustainable economic development in Estonia and Latvia. The research methods applied in this study are the literature review and regression and correlation analysis, which help to assess Estonian and Latvian progress in sustainable economic development.

II. Materials and Methods

Measurement of sustainable economic development is significant in any country in the world because all member states of the UN accepted *the 2030 Agenda for Sustainable Development*. The United Nations' SDGs provide a comprehensive framework for measuring progress towards sustainable development. They include goals related to economic growth, social inclusion and environmental protection. But the 17 Sustainable Development Goals are not the only approach measuring sustainable development in countries. Firstly, other method is Environmental Performance Index (EPI) It ranks countries based on their environmental performance and ecosystem vitality [12]. EPI includes indicators such as air quality, water resources and biodiversity. One other indicator is Carbon Footprint that measures the total greenhouse gas emissions caused by economic activities helping assess the environmental impact of growth. Thirdly, Ecological Footprint measures the amount of natural resources consumed and the waste generated by economic activities. It helps to determine whether a country's growth is within the planet's ecological limits. Fourthly, there are also different other approaches to sustainable development that are set in strategic development plans in different countries. In Latvia sustainable development targets are set in the Sustainable Development Strategy in Latvia until 2030. Sustainable development is measured by set of indicators in the Sustainable Development Strategy in Latvia until 2030, including GDP per capita and Ecological Footprint. The following abbreviations are used further in this paper: Number of inhabitants – POPUL; Gini coefficient – GINI; GDP per inhabitant (per capita) per year (EUR, according to purchasing power parity) – GDPCAP; Ecological footprint (ha per inhabitant)- FOOTPRINT; Human Development Index (place in the world) - HDI. The sources of data are EUROSTAT and the United Nations Development Program (UNDP).

III. Results and Discussions

Sustainable economic development in Estonia and Latvia is assessed taking five indictors applied in the Sustainable Development Strategy in Latvia until 2030 and based on availability of data for both countries studied in this research. The fallowing indicators are analysed:

1) Number of inhabitants;

2) Gini coefficient;

3) GDP per inhabitant per year (EUR, according to purchasing power parity)

4) Ecological footprint (ha per inhabitant);

5) Human Development Index (place in the world).

Data of the indicators are compared in pairs. It allows, firstly, to find individual trends and secondly, to compare their differences between the two selected countries.

The graph in Fig. 1 shows the changes in HDI over time for both countries. It can be observed that the curves essentially copy each other, and their trend can be well described using a quadratic trend line.
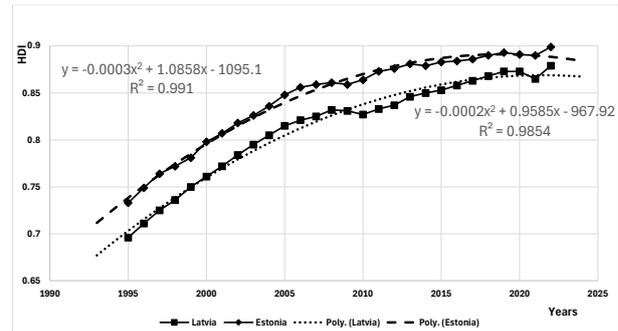

Fig.1. HDI changes over time in Latvia and Estonia

Now it is possible to measure the relationship between development trends for HDI. We will graphically depict the relationship between the indicators and measure it using the correlation coefficient R. If both countries have the same trends in the changes in the indicators, then their mutual dependence is reflected as a straight-line relationship. The correlation coefficient also directly measures how well the relationship is described by a straight-line equation. In this case, we have the following graphical relationship in Fig. 2. An almost perfect linear relationship is visible, with a correlation coefficient of R=0.97. As can be seen from the graph, the corresponding coefficient of determination R^2 is 0.99 equivalent, and 99% of the changes in the indicators are determined by the same factors.
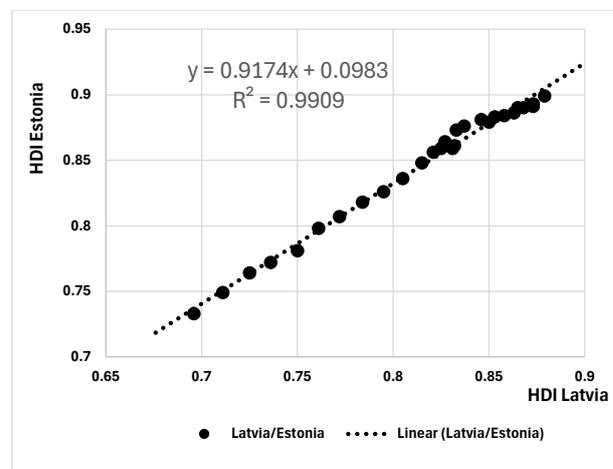

Fig.2. Correlation graph of changes in Humand Development Index (HDI) in Latvia and Estonia.

Analyzing the Fig. 3., the footprint trend for both countries is basically the same, only for Estonia it is significantly larger. Latvia has no peculiarities with FOOTPRINT, and it is slowly growing linearly. This is indicated by the coefficient of determination R2 = 0.86. For Estonia it is fluctuating around the linear trend line and the linear trend can explain only 41% of the variation. Other study should be carried out to investigate why there are such differences between countries.
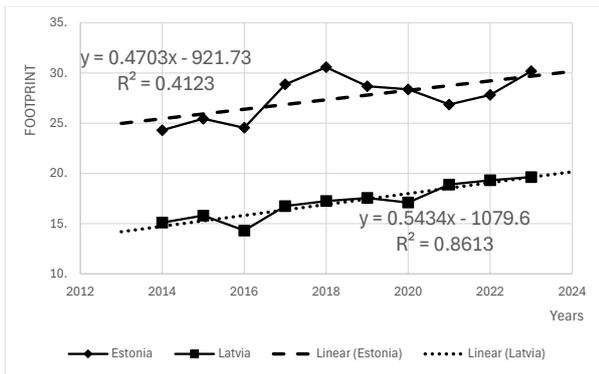
Fig.3. Footprint changes over time in Latvia and Estonia.

Taking look at Fig. 4., the correlation between the variables is determined by the coefficient R= 0.68 and the corresponding coefficient of determination R^2 = 0.46 determines that 46% is determined by the same factors. And here, however, there is a difference between the countries, although it cannot be said that the trends are too different. One thing can be said that Estonia uses and exploits resources more intensively.
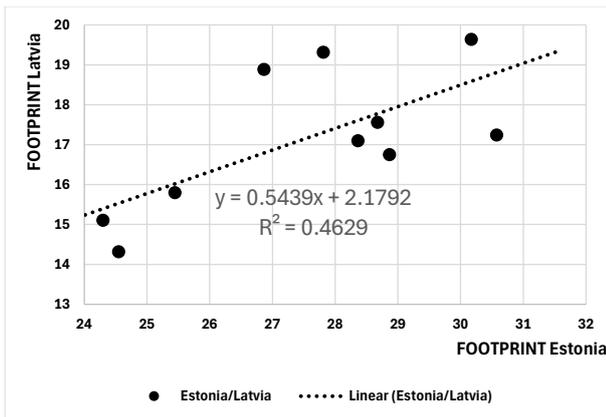

Fig.4. Correlation graph of changes Footprint in Latvia and Estonia.

An important component of sustainable development is GDP or GDP per capita. In the case of this paper, it is GDP per capita. The curves for both countries are shown in Fig. 5.
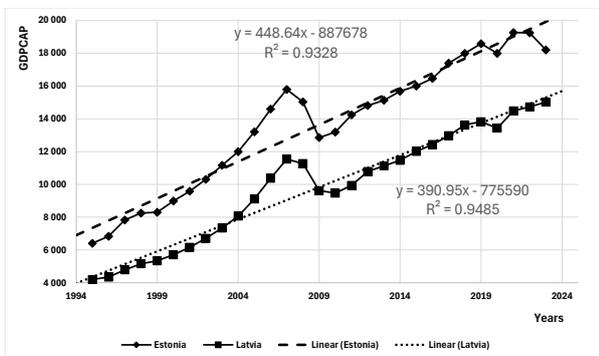

Fig.5. GDP per capita changes over time in Latvia and Estonia.

It could be said that the trends here are very well described by a linear relationship (if we do not consider the crisis and the impact of Covid 19). If we compare the trends using the correlation coefficient for their relationship in Fig.6, it is 0.99. Although Estonia has a higher income per capita, the development trends of the two countries are almost completely the same.
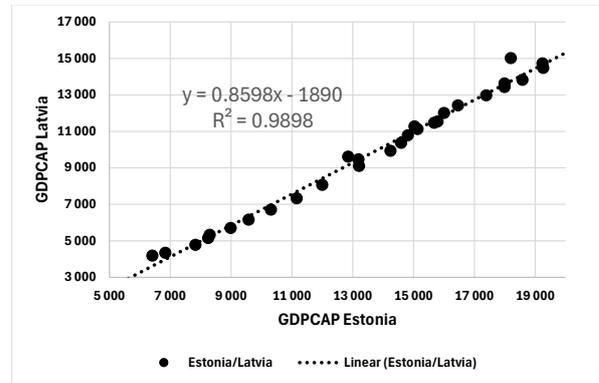

Fig.6. Correlation graph of changes GDP per capita in Latvia and Estonia.

The coefficient of determination of 0.99 indicates that GDP per capita in both countries develops based on the same economic mechanism.

The differences in trends are in the dynamics of the population. To make it easier to see the differences, let's depict them in the form of growth rates.

The calculation temp of increase for base year 2014 is as follows:

$$T_{base} = \frac{X_m - X_{base}}{X_{base}} \%; \qquad (1)$$

Where:
X_m current value of indicator,
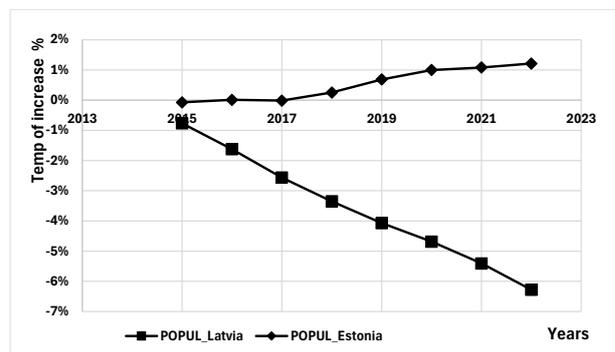$X_{base} = X_{2014}$ value of indicator in the base year 2014

Fig.7. Temp of increase of population in Latvia and Estonia.

If 2014 is chosen as the base year, then in 2022 the population of Latvia decreased by 6.28%, while that of Estonia increased by 1.28%. If we calculate the correlation coefficient for the population of Latvia and Estonia, it is -0.93. So, there are opposite trends that are close to linear.

It is not possible to find a relationship between the Gini coefficients of the two countries in Fig. 8. For Latvia, it is slowly decreasing linearly. For Estonia, it first decreased rapidly and is now increasing. And if we look at the trends, then in both countries these indicators could equal (unfortunately, there is no data for 2024).
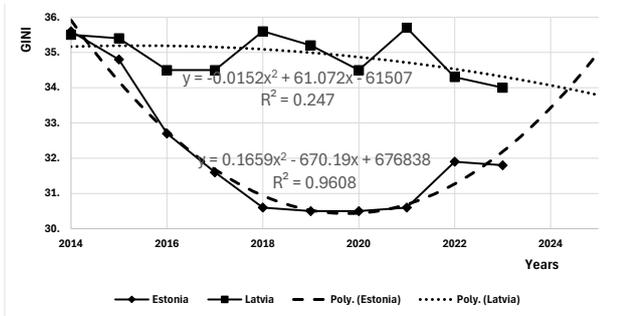

Fig.8. Gini coefficient (GINI) changes over time in Latvia and Estonia.

The correlation between all variables is presented in Table 1. The correlations in the table are located one above other to allow us to assess the structural difference.

	Country	HDI	PO PUL	GINI	GDP CAP	FOOT
HDI	Latvia	1				
	Estonia					
POPUL	Latvia	-0.92	1			
	Estonia	0.84				
GINI	Latvia	-0.41	0.27	1		
	Estonia	-0.73	-0.62			
GDPCAP	Latvia	0.89	-0.98	-0.15	1	
	Estonia	0.91	0.87	-0.83		
FOOT	Latvia	0.79	-0.91	0.00	0.92	1
	Estonia	0.64	0.35	-0.79	0.64	

Fig.10. Correlation for set of studied indicators for Latvia and Estonia.

The most significant difference in trends between the two countries is in population dynamics, so all correlations involving this indicator are reversed. The absolute value, however, indicates the closeness of the relationship to linear.

For both countries there is a strong correlation between POPULATION and HDI and between POPULATION and GDPCAP. Latvia has a strong inverse correlation between POPULATION and FOOTPRINT, whereas Estonia has a positive and not very strong correlation. However, if we look at the correlation between POPULATION and GINI, there is an opposite trend: Estonia has the opposite well-defined trend, while Latvia has a positive trend and not a very strong one.

If we look at the HDI, both Latvia and Estonia have a strong positive relationship with both GDPCAP and FOOTPRINT. Both countries have opposite correlations with GINI. Estonia has a stronger correlation and Latvia a weaker one. If we look additionally at FOOTPRINT, both countries have a positive correlation with GDPCAP. On the

other hand, Estonia has a negative correlation of Footprint with GINI whereas Latvia has no such correlation at all.

IV. CONCLUSIONS

Apart from the opposite trends in POPULATION, the sustainable economic development trends of the two countries are similar enough. Their change curves practically replicate each other, but with a certain lag.

If we assume that the structural development of countries is determined by GDP per capita, FOOTPRINT and Human Development Index, then both countries are developing similarly, although Estonia has better GDP per capita and Human Development Index. At the same time, Estonia has a higher FOOTPRINT, which is not so positive. There is no clear evidence that Estonia and Latvia have reached the turning point in sustainable development when larger GDP is produced with using fewer amounts of natural resources and generating less waste (falling Footprint). Latvia has painful problems with POPULATION, and how much it affects Latvia's positive development is a special issue to be studied.

The confusion is with GINI coefficient. Here, no unambiguous explanations for the trends can be found. To be clear, a specific study is needed for this indicator. Its measurement mechanism, accuracy, unambiguity, dependence on the region, etc.

The indicators studied in this paper are a reflection of a complex economic system. The article examines only correlations between indicators. However, the same indicator can be influenced by different factors, so a more complete understanding requires the application of more sophisticated statistical research models, such as factor analysis. This would allow the identification of complex hidden factors that determine the performance of the system as a whole.

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