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Impact of Climate Change on International Tourism Evidence from Baltic Sea Countries

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Abstract: The societal consequences of climate change are still hard to measure, mostly because it is difficult to connect the physical effects of climate change to economic processes and because future climate change and economic estimates are unpredictable. The tourism industry is one of the areas where evaluating the effects of climate change has proven to be especially challenging. The primary influencing environmental elements in the coastal waters of the Baltic Sea are expected to alter as a result of climate change. This study investigates the impact of climate change on the growth of tourism in the Baltic Sea Region, focusing on international tourism. To analyze the possible short-run and long-run impact of climate change on international tourism, a dynamic panel model is used, with data for the period 2005–2022. International tourism is measured through the inbound travel expenditure and the number of overnight visitors. The effect of climate change is captured through the variables of temperature and precipitation, with real GDP and government effectiveness as control variables. Results show a significant negative impact of climate change variables on international tourism in the Baltic Sea countries. There are relatively few studies on the impact of climate change on the tourism industry in the Baltic region; this article complements the existing literature on this very important issue.

Keywords: climate change; international tourism; Baltic sea region; panel ARDL

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1. Introduction

As the world develops and integrates, one of the key elements influencing economic growth, competitiveness in global markets, and population welfare is international tourism [1,2]. In 2023, the global travel and tourism sector market value of USD 9.9 trillion accounted for around 9.1% of the global GDP, which represents an increase of 23.2% from 2022. This market will grow at a rate of 3.7% annually and is predicted in 2034 to value around USD 16 trillion, representing 11.4% of the global GDP. In this market, international tourism spending in 2023 was 33.1% more than in 2022. Twenty-seven million new jobs were created in 2023, 9.1% more than in 2022 [3]. The tourism sector contributed an average of 6.1% of GDP in the Baltic Sea countries (shown in Figure 1) in 2022, employing a total of about 1.56 million people. The average expenditure by international tourists is calculated at about 26% of the total expenditure on tourist services in these countries [4].

The tourism industry relies on the environment, and its quality is an important factor in tourism development. The sustainability of the environment is directly affected by climate change [5].

The term "climate change" describes long-term changes in weather and temperature. Large-scale volcanic eruptions or variations in the sun's activity can cause such shifts naturally. However, since the 1800s, the combustion of fossil fuels like coal, oil, and gas has been the primary cause of climate change, which has been attributed to human activity [6]. Climate change is an alarming factor as the weather patterns we were so used to are

experiencing a change. It is considered one of the biggest risks that humanity will face in the near future [7].

Figure 1. Baltic Sea region map. Source: Authors created, based on Dataset GEOPORTAL OF THE EUROPEAN COMMISSION (EUROSTAT).

Climate change has a high inertia—even if GHG emissions had generally been constant in the last decade [8], climate change would continue, and the global temperature would increase by around 3.28 °C by the end of the century [9]. Average temperatures are rising, and more frequently, extreme weather events can be observed. A significant air temperature increase in the Baltic Sea Region has been observed during the last hundred years [10]. It is larger than the global trend, and this increase is expected to continue. Coastal waters around the globe have become warmer during the past 40 years, and the Baltic Sea's temperature has increased more than the global average [11]. The tourism industry in the region thrives as a correlation between the number of visitors and warmer weather can be observed. The industry contributes to local economies as tourists need transport, food, accommodation, and entertainment.

Many jobs appear just for the tourism season during summer in the Baltic Sea countries. Statistics clearly show that the active season for tourists to arrive in Baltic countries is during the months of June, July, and August [12]. Other research suggests that most visitors are from neighboring countries, e.g., for Estonians, it is Finns, and for Lithuanians, Polish visitors, and for Latvians, Estonians and Lithuanians [13]. An exception to this is Germany and the UK, which throughout the years (2013, 2016, 2023) have shown a trend in visiting the Baltic countries, and of course, the Russian visitor count has decreased significantly since the start of the Russo-Ukrainian War [14].

However, there is a trend for tourists, whether they are native or non-native, to follow the expected summer months of the calendar instead of the astronomically warm time, which limits individuals from extending their tourism endeavors. Overall, existing research suggests that the preference for summer travel is influenced by a combination of

factors, including weather, school holidays, vacation policies, cultural norms, and seasonal events [15,16].

It is in the interests of the tourism industry to support global warming within the scope of favorable weather conditions and in the interests of local governments and policymakers to mitigate its effects. There is a rather interesting concept that tourism for the Baltic region could also be represented by all three of the countries as a joint entity and destination rather than separately. One argument to support such a possibility is the fact that both Lithuania and Estonia are interested in buying shares in AirBaltic, which is currently owned by the country of Latvia (97.7%) [17,18]. This would, in turn, lead to higher reach, further destinations, and more frequent flights, providing easier access to the three Baltic countries, not only for tourists from outside but also inside the Baltic region. Since the regaining of independence of the Baltic countries, the number and size of ships that sail the Baltic Sea have increased, and the climate has changed, resulting in a shorter ice season, and the ice could be broken earlier. This, in turn, increases the efficiency and frequency of tourists coming in and out of the country. It is interesting to note how the increase in economic prosperity has allowed more ships that together produce more CO_2, which drives climate change. These ships are manufactured in accordance with the new regulations of CO_2, NO_x, and SO_2, which make them easier for the environment. However, this is only the case for newly manufactured ships. The changing climate increases the duration of the warm period and decreases the length of winter whilst simultaneously making it easier for variations in weather to occur. Summers will become longer and warmer, thus allowing the most typical beachgoers to enjoy an even longer period of tourism. Winters are shrinking in duration, reducing the chances of cross-country skiing and skeleton courses, and enjoying learning how to snowboard or ski in the hills of the Baltic countries. Additionally, having warmer summers does not always mean tourists flooding in from all sides [19]. There is a serious situation in the Baltic Sea related to the burgeoning growth of blue-green algae [20]. At the height of summer, in many places around the Baltic Sea, the water becomes cloudy, acquires a strong greenish tint, and even smells unpleasant, which deters tourists. The Baltic Sea is considered as one of the world's most contaminated seas [21].

However, solutions for mitigating these effects on the coast would be beneficial as they would allow the Baltic state region to prosper further. Research suggests that, in this case, it can potentially exceed the global average [22]. When it comes to the Baltic Sea countries, a unified effort would ensure efficient ways of transporting tourists by both water and air; solutions unique to Baltic Sea countries that mitigate the risks of climate change and, as a bonus, open the door to a combined strategy for all countries to develop marketing and publicity to promote tourism in a more unified way; at the same time, allocating resources and policymaking power to a more sustainable future for the tourism industry in the Baltic region.

Therefore, the purpose of this paper is to investigate the effect of climate change on international tourism in six Baltic Sea countries: Estonia, Finland, Latvia, Lithuania, Poland, and Sweden. The effect of climate change is captured through the variables of temperature and precipitation. International tourism is measured by the number of overnight visitors and the inbound travel expenditure. Control variables in the model include real GDP and government effectiveness. The study covers the 2005–2022 period. This paper is organized as follows: in the second section, a description of the study area and methods used are given. Section 3 gives an overview of sustainability in the tourism sector in the Baltic Sea countries, followed by an analysis of the socio-economic impacts of climate change on tourism in the fourth section. The fifth section summarizes the literature. Section 6 discusses the methodology and results. The paper concludes with some recommendations for mitigating the risk of climate change.

2. Materials and Methods

The Baltic Sea Region is identified by location. The region surrounds the Baltic Sea, the youngest sea on earth, located in the north of Europe, with a surface of about 425,000 km^2,

generally shallow, with an average depth of about 55 m. With a catchment area four times greater than the sea, this unique ecosystem supports more than 85 million people, with around 16 million living in coastal areas. The Baltic Sea contributes to well-being, livelihood, food, and leisure. It is estimated to provide real recreational advantages worth around 15 billion euros annually [23].

In this paper, quantitative analysis is used to investigate the possible impact of climate change on international tourism in some Baltic Sea countries. Publicly available secondary data are used, taken from the World Bank databases, WDI and Climate Knowledge Portal. The literature review is included in Section 5. Through data analysis, this paper tries to answer the research question: What is the impact of climate change on international tourism in Baltic Sea countries?

Two variables are used to measure international tourism: inbound travel expenditure and the number of overnight visitors, so to answer the research question, two hypotheses are formulated:

H_1. *Climate change has an impact on international travel expenditure in the Baltic Sea countries.*

H_2. *Climate change has an impact on the number of overnight visitors to the Baltic Sea countries.*

To test these hypotheses, panel data analysis is used, which is appropriate when the data contains information for a group of countries. The significance level for testing these hypotheses is 5%.

3. A Comparative Discourse on the Sustainable Tourism Industry in the Baltic Sea Countries

Due to climate change, tourists are increasingly disappointed—the tourist season and weather conditions have become more unpredictable and erratic. In many countries, the climate is changing with a tendency to become wetter and warmer. It causes different changes in nature in each region. For example, countries that provide winter sports suffer from shorter, less snowy, and abnormal winters. In contrast, other countries experience long periods of drought and heat, which are replaced by rain. Climate-related natural disasters are becoming more and more frequent, which makes tourists afraid to return to these places [24,25].

The most environmentally friendly type of travel is thought to be eco-tourism. For this reason, protected regions around the Baltic Sea receive a lot of attention. They make up 17.6% of the total area in Lithuania, with thirty regional parks, five national parks, more than 500 natural heritage objects, and more than 300 national reserves [26]. The nation is committed to upholding the principles of UNESCO [27] and EU [28]. The degree of socio-economic development greatly influences how tourism develops in the countries in the Baltic region. The number of tourist arrivals per capita is higher in more developed nations, which are distinguished by higher levels of GDP [29]. Compared to nations with comparable levels of GDP per capita, Estonia has a higher number of arrivals. On the other hand, Poland, Lithuania, and Estonia exhibit notable rates of advancement in the realm of global tourism [29].

Estonia has decided to focus on the development of sustainable tourism on its islands in the Baltic Sea. However, tourism is generally a comparatively recent activity on these islands, given that they were formerly a border region with travel limitations during the Soviet era. At the time, entry to these locations required a resident passport or special permission. A new age of tourism began with the fall of the Soviet Union. The islands have since gained popularity as a travel destination for both domestic and foreign tourists. Under the auspices of UNESCO, the West Estonian Archipelago Biosphere Reserve was created in 1990 [30]. The Reserve's area includes its aquatic areas, totaling 15,600 km. The Reserve was created to safeguard important and delicate ecosystems and to encourage the islands' sustainable and well-balanced development. West Estonian islands, Muhu, Hiiumaa, Vormsi, and Saaremaa, are the islands that make up the West Estonian Archipelago. Terrestrial habitats consist of pine forests, mixed spruce and deciduous woods, juniper

and coastal meadows, marshes, and peat bogs. They are situated in the transition zone between temperate needle-leaf and broad-leaf forests. Of special significance are the alvar forests, which are composed of spruce, pine, or birch trees on limestone plains with thin soils. These islands are well-known for their genuine settlements, which support regional customs and a sustainable way of life. The local populace may readily find work on their own terms. The occupants of the Islands allot the work of looking after guests among themselves: one family takes care of lodging; another keeps cows for meat and milk; a third family looks after hens for eggs; a fourth family plans excursions for bird-watching; a fifth family takes care of horseback riding; and so on. According to this perspective, the impact of tourism in a rural area can extend beyond the scope of the tourism industry itself. In these situations, tourism provides social benefits that are just as significant as the partnership's goals: uplifting the community, empowering marginalized social classes, fostering a sense of place and belonging among locals, bringing people together for social entertainment, and fostering a sense of usefulness and need among rural residents [31].

Latvia stands out from the other Baltic nations due to its social and economic aspects of tourist sustainability. In 2022, it contributed 6.4% to Latvia's GDP; 6.9% of all jobs were related to tourism [32]. This number increases when induced industries are considered. The rail project Rail Baltica (Trans-European Transport Network TEN-T) will link Tallinn, Estonia, Riga, Latvia, and Kauna, Lithuania when it comes into operation. Its application is scheduled to start in 2024 [33]. Nature tourism, event tourism, cultural and creative industries, and health and leisure tourism are the primary sectors that provide a sustained flow of tourists. Health tourism, as well as cross-border product development, are the primary areas of attention [34–37].

The infrastructure for coastal and marine tourism in Poland has been developing at a very rapid rate in the last ten years [38]. The Polish coast is heavily focused on tourism, and plans for social and economic change, as well as for spatial development, are mostly tied to this sector. These changes have an impact on the hotel sector (about one-third of Poland's tourist accommodation facilities are located on the coast) as well as the advancement of environmentally friendly transportation options such as the coast-cruising trips made by the internal coastal passenger fleet. The increasing number of mooring locations provides favorable conditions for quick excursion cruises, which offer sightseers the chance to explore coastal towns. The municipalities explore the potential for funding sustainable tourism in their policies. By designating tourist paths, beach entrances, piers, and the locations of marinas, numerous municipal plans seek to control tourism in a way that would lessen anthropogenic pressure. The "Żuławy Loop" concept entails establishing a network of marinas, moorings, and harbors that enable water sports and other types of tourism on the Vistula Lagoon and Delta's waterways [39]. Three sailing ports (Elbląg, Krynica Morska, and Tolkmicko) have been expanded, six marinas and two mooring piers have been constructed, and two drawbridges have been renovated.

A program called Sustainable Travel Finland was created to assist the tourist sector in Finland in implementing sustainable practices [40]. This is referred to as "Finland's 7-step method for environmentally-friendly travel". This seven-step program is completed online on a platform that offers an "e-guide" e-learning environment. It consists of seven steps that are only available to individuals who have been accepted into the Sustainable Travel Finland Program. Steps one through seven include commitment, knowledge-building, development plans, responsible communication, certification, verification, measurability, and agreement on sustainable travel in Finland.

In the Nordic nations, engaging in outdoor recreation goes beyond simple pleasure. Known as friluftsliv in Sweden, it translates as "life in the open air". The Nordic tourist brand was created by combining the untamed landscape, the Swedish way of life, and the country's reputation as a "green" nation in recent decades. Simultaneously, it effectively illustrates that sustainability yields economic benefits. In 2022, total tourism expenditure was USD 34.3 billion, and international tourism accounts for 28.6% of it [41].

4. Socio-Economic Impacts of Climate Change on Tourism

In addition to effects that can be directly linked to altered weather patterns or their physical ramifications (such as a storm flood with a high potential for erosion), changes in the socio-economic status of visitors and tourism stakeholders will also have an impact on coastal infrastructure and travel hotspots. The tourism season will probably move into spring and autumn as a result of rising temperatures and reduced summer precipitation, especially for sites in southern Europe. Besides extending the travel season generally, it might improve summertime travel conditions in the Baltic Sea. Variations in demand for travel influence travel flows, which in turn affects other industries, including building, farming, and crafts. There will be negative effects from the Baltic Sea becoming more appealing to cruise ships, like a surge in port traffic and pressure on nearby coastal towns. In the peak travel season, roadways, streets, and airports may fill to capacity due to the region's heightened allure for visitors wishing to bathe in the sea and the potential rise in visitor numbers throughout the summer. As a result, certain areas may need to expand existing coastal traffic networks. In order to accommodate the growing number of tourists, basic and supra-infrastructure for supply, accommodation, entertainment, and gastronomy must be created. Renewal is required in significant coastal resort towns of the former Soviet Union that have underutilized tourism infrastructure. These areas may be easier to adapt to than other regions in the near future if adaptation measures are implemented. Infrastructure adaptation to socio-economic issues can be built, at some point, upon prior experiences, regardless of how significant future changes may be. This is in contrast to relatively recent challenges resulting from direct and indirect physical climate impacts. With the growing tourist numbers, the subsequent strain they place on resources and infrastructure, and the patterns they create are no novel phenomenon; the Baltic Sea Region can adapt to it by drawing on the experiences and understandings of other locations. However, there is a maximum capacity for each location. Zoning laws, building codes, preventive planning, and growth strategies are a few examples of potential adaptation strategies [42,43].

Besides seasonality, interannual variability, extreme events, and long-term changes brought about by the climate system, the tourism business is also subject to macro-scale sectoral-affecting variables such as economic growth or recession, affordability and accessibility of transportation, political security or stability, technical advancements, demographic shifts in culture and politics, exchange rates, and border agreements [44–48].

The location of tourism is influenced by transportation technology and costs; long-distance travel is especially affected by energy prices and the effects of regulations aimed at mitigating climate change. The tourist industry in the Baltic region does not rely on long-haul travel because the majority of visitors are from inside the country, visit neighboring countries, and stay for a night or two. According to Eurostat [49], Europeans are interested in "proximity" tourism or travel to locations or areas near their usual place of residence (weekend trips). They are also becoming more interested in independent travel, low-cost travel options, flexible travel schedules, and tourism-related activities. Finally, they want to experience authentic local culture and nature [50].

Travel is a key economic sector for cities situated along the coast, islands, and archipelagos, as well as for the coastal districts of the southern Baltic Sea. The rise in tourism in the Baltic Sea Region and beyond in recent times is indicative of the allure of resorts and their potential economic benefits for the area. Seasonal characteristics are influenced by the regional climate. In contrast to the winter travel season, which is becoming shorter, global warming will extend the summer travel season in the Baltic Sea Region. The combination of institutional and natural seasonality determines the demand for seasonal tourism [44,51,52]. During the busiest public and school holidays, weather variations have a significant impact on the tourism industry. As a result of the flow of tourism, other industries are also impacted. The infrastructure related to tourism is also impacted by weather variability. In harsh winter climes, more and more freeze–thaw cycles combined with rising temperatures can lead to early deterioration of the road network, pavements, and concrete structures, as well as increased corrosion and faster fracturing, spalling, early weathering, and degrada-

tion of building facades [53,54]. Climate change is projected to modify seasonal patterns of tourism demand as well as seasonal points of interest [55,56]. Any modifications to the duration of the operating season will have a significant impact on the short- and long-term sustainability of the tourism and recreation industries. They will also enable faster returns on investment through the use of facilities more intensively over an extended period of time. The length and makeup of seasons are predicted to alter based on forecasts from climate models. In the future, summer travel in Europe may account for twice as much as winter travel [57]; a longer season of outdoor activities is anticipated to be facilitated by rising air and sea temperatures as well as decreased summer precipitation. This is especially advantageous for the northern part of the Baltic region.

5. Literature Review

Though the viability of various climates for various forms of tourism is becoming more dynamic due to technological, societal, and environmental developments, this will have an impact on the future growth of the travel and tourism sector [55,58].

Destinations that were previously thought to have an ideal climate will no longer be connected with such images due to extreme weather events and shifting tourist opinions and preferences [55,59]. Both locally and globally, there is a shift in the climate [60–62], and rather than the climate, travelers are responding to what they perceive to be transient weather patterns. The proportional effects of wind, humidity, sun radiation, and an individual's degree of activity will all affect the thermal conditions they experience [63,64]. While weather extremes are unpredictable, they are nonetheless very likely even more significant for tourism activity than the variations in average circumstances predicted by climate models [65,66]. When travelers select their destinations, climate variables can also have a variety of effects: some are solely physical (like rain); some are physiological (like air temperature); some are psychological (like clear blue skies); and some are combinations of all three [67,68].

A growing body of research aims to investigate the direct and indirect effects of climate change on different indicators of international tourism.

Seetanah and Fauzel [69], using a dynamic panel model, analyzed the impact of climate change on the tourism sector for a group of islands. They used temperature and precipitation as variables for climate change. Their analysis showed a significant negative impact of these variables on tourist arrivals both in the long term and short term, even though the incidence was lower in the short term. The same conclusion was reached by Liu [70] in a study on the number of visitors to natural parks in Taiwan. The paper investigated the relationship between the number of visitors and climate conditions, using monthly data for the period January 2001–December 2008. The author suggested that the magnitude of the impact of rainfall was higher than that of temperature. Nunes et al. [71] analyzed the arrivals of domestic and foreign visitors in 254 municipalities of the region of Tuscany, Italy. Temperature was used as a variable for climate conditions. The authors tried to highlight the differences in the preferences of local and international tourists. The two-panel data models they used, fixed effects and dynamic GMM, gave similar results: a continuous increase in temperature will lead to a decrease in the number of domestic visitors in this region, but the authors did not find an impact on the number of international visitors. This is not just because international tourists lack information on climatic conditions but also because international trips are usually organized in advance, reducing the possibility that the climate is considered during these trips.

Ngxongo [72] suggested that climate change is the main factor influencing the number of visitors as well as their expenses in one of the largest and most important natural parks in South Africa.

The impact of climate change, expressed as an increase in temperature and precipitation, has a direct or indirect effect on tourism [73]. Not only is the number of tourists negatively affected, but climate change causes health problems, changes in forest areas, etc.

Cevik and Ghazanchyan [74] studied the factors that affect international tourism revenues in a panel of 15 Caribbean countries. As independent variables in the model, they included GDP, real exchange rate, crime rate, government effectiveness, and a climate change vulnerability index. Their analysis suggested a decrease in the number of international tourists in countries most vulnerable to climate change.

Using data from 269 European regions, Matei et al. [75] suggest that climatic conditions are expected to significantly affect tourism in the long term in these regions. Using simulations for different scenarios of warming levels, from 1.5 degrees Celsius to 4 degrees Celsius, they suggest mixed results: northern regions are expected to benefit from global warming, while coastal areas will see a significant reduction in the number of tourists. The authors also suggest a change in the seasonal distribution of demand.

Xiong et al. [76], using a spatial model for 31 provinces of China, analyzed the impact of climate change, measured through temperature and rainfall, on inbound overnight tourism. As control variables, the authors included real GDP per capita, traffic convenience, and hospitality capacity. The study suggests a spillover effect of climate change; in local areas, the increase in temperature and precipitation positively affects the number of overnight tourists, while in adjacent areas, their impact is negative. Du [77] studied the influence of temperature on the number of tourists in a group of Mediterranean countries: Spain, Greece, and Turkey. The study suggests that the increase in temperature will lead to a reduction in international visitors to these countries.

With data for the period 2008–2018, Susanto et al. [78] used a panel model for five provinces of Indonesia, which are visited by about 80% of international tourists in this country. The authors suggest that both temperature and relative precipitation negatively affect the number of inbound tourists: every 1% increase in these two climatic factors is accompanied by a decrease in the number of tourists by 1.37% and 0.59%, respectively. The negative impact of temperature on inbound tourism is also found by Pintassilgo et al. [79] in Portugal, where tourism is one of the most important sectors of the economy. The authors estimate a decrease in the number of international tourists by about 2.5–5.2% for different scenarios of the Intergovernmental Panel on Climate Change. The effect on economic activity is estimated to be between 0.19% and 0.4% reduction in GDP.

Haldane et al. [80] presented an analysis of scientific research on the effect of climate change on tourism in Prince Edward Island for the period 2000–2022. This island is suffering the effects of climate change. Climatic phenomena such as floods or prolonged droughts, extreme temperatures, and coastal erosion have become very frequent on this island in recent decades. The authors suggest that tourism should be considered as an industry at risk, and policymakers and tourism operators should work closely with climate experts to design policies and develop business models that ensure sustainable tourism.

Although Greece is mostly known for coastal tourism, in many areas within the country, especially the remote ones, ski tourism is also developed, and this sector makes a very important contribution to the development of these areas. Tsilogianni et al. [81] studied the impact of climate change on ski tourism, specifically in the region of Parnassos, where the largest ski resort in Greece is located. The results of their study suggest that the increase in average temperatures and the decrease in snowfall will have a great impact on the tourism sector in this area. A similar conclusion was reached by Mariani and Scalise [82] in a study on the Italian Alps, which are very affected by climate change, where the increase in temperatures in recent years has been three times more than the global average. The authors suggest that the snowfall in this region has a significant impact on the number of tourists and that the use of artificial snow does not cancel out the negative effect of the lack of natural precipitation.

Gebbisa et al. [83] found that weather variability has an impact on the tourism sector in Ethiopia. The authors used the Johansen model of cointegration, with data for the period 1995–2019, where the number of international tourists and their receipts are used as variables for tourism, while the model also included economic and political stability

variables. The authors suggest that an increase in the average level of temperatures and rain causes a negative effect on international receipts in the short and long term.

Using an ARDL model with data for 1980–2017, Fauzel [84] analyzed the possible impact of climate change on international tourism in Mauritius. The author suggests that the increase in rainfall had a negative impact on the number of tourists, both in the long term and in the short term, while for the temperature, the study did not find a significant impact on the number of tourists.

Regev and Palatnik [85] studied the effect of climate change on natural parks in Israel for the period 2012–2017. They suggest that both precipitation and temperature have a negative effect on the number of domestic and international tourists in these natural parks, where temperature has a relatively stronger effect compared to precipitation.

In all the above-mentioned literature, climate change is given through the variables of temperature and precipitation. However, the impact of climate change on tourism is not subject to the variables used to indicate it. For example, Atasoy and Atasoy [59] used greenhouse gas emissions and forest land as variables for climate change. They found a significant negative impact on receipts of international tourists and their number in Turkey. Sharma [86] reached the same conclusion in a panel study of 160 countries for the period 1995–2018, where climate change impact was measured through CO_2 emissions and greenhouse gas emissions. The author suggests a negative effect of them on international inbound tourism, where the strongest effect is in countries where the tourism industry is a very important sector of the economy.

6. Empirical Analysis

6.1. Model Specification

The possible impact of climate change on international tourism in the Baltic Sea countries is analyzed through the panel Autoregressive Distributed Lag (ARDL) model [87]. Panel data models offer more efficient parameter estimates. They generally have more degrees of freedom and variability than cross-sectional data. Panel data models account for both spatial and temporal variation; they control for the omitted variables effect [88]. The ARDL model takes an approach from general to specific, solving econometric problems, such as misspecification and autocorrelation, in order to generate the most appropriate model [89]. It is useful as a cointegration method used to determine the long-run relationship between variables with different orders of integration [90].

To estimate the possible impact of climate change on international tourism, two econometric models are built:

$$TREXP = f\ (TEMP, PRECIP, GDP, GE), \quad (1)$$

$$NIGHTS = f\ (TEMP, PRECIP, GDP, GE), \quad (2)$$

Table 1 gives a description of the variables used and data sources.

Table 1. Summary of variables and data sources.

Variable	Description	Data Source
TREXP	Total travel inbound expenditure	UNWTO [14]
NIGHTS	Total number of overnight visitors	UNWTO [14]
TEMP	Annual average mean surface air temperature	WB Climate Change Portal [91]
PRECIP	Observed annual precipitation	WB Climate Change Portal [91]
GDP	Real gross domestic product	WDI [92]
GE	Government efficiency	WDI [92]

Source: Authors compilation.

The climate change effect is captured through the variables of TEMP and PRECIP, while international tourism is measured through the TREXP and NIGHTS variables. A

negative impact of TEMP and PRECIP on international tourism variables is expected. For the variable NIGHTS, the entry of 2022 is missing for Latvia, Poland, and Sweden, and interpolation is used to complete the dataset [93]. The GDP variable is used as a proxy for the development of tourism infrastructure. GE shows the government's effectiveness; it reflects the opinion about the public service quality. For both of these variables, a positive impact is expected. All variables are transformed into log form, so their coefficients show elasticities.

The first step in the empirical analysis is the study of the stationarity of the variables included in the model. This is very important as it affects the determination of the test used for data analysis. The ARDL model used in this study requires that the variables be integrated of an order no higher than I (1) [94]. To determine the order of integration, we use the unit root test of Levin et al. [95], who suggested that panel unit root tests are superior against time series unit root tests.

$$\Delta y_{it} = \gamma_i y_{i,\,t-1} + \sum_{j=1}^{p} \varphi_j \Delta y_{i,\,t-j} + \varepsilon_{it}, \tag{3}$$

$$\text{where : } \gamma_i = \rho_i - 1. \tag{4}$$

The null hypothesis Ho: $\gamma_i = 0$ ($\rho_i = 1$) is tested against the alternative hypothesis Ha: $\gamma_i < 0$ ($\rho_i < 1$). If the p-value < 5%, then we can conclude that variables are stationary at level. If the p-value > 5%, then we test the first difference for stationarity:

$$\Delta Y = Y_t - Y_{t-1}. \tag{5}$$

With variables integrated in level or first difference, we apply the panel ARDL model, which is suitable for small samples, giving consistent coefficients in the short- and long-run. The baseline ARDL (p, q) model equation is:

$$y_{it} = \sum_{j=1}^{p} \alpha_{ij}\, y_{i,t-j} + \sum_{j=1}^{q} \beta_{ij} x_{i,t-j} + \omega_i + \varepsilon_{it}, \tag{6}$$

where $x_{i,t-j}$ shows the vector of independent variables and ω_i shows the fixed effects.

The baseline ARDL model is reparametrized as a Vector Error Correction Model (VECM):

$$\Delta y_{it} = \sum_{j=1}^{p-1} \alpha_{ij}\, \Delta y_{i,t-j} + \sum_{j=1}^{q-1} \beta_{ij} \Delta x_{i,t-j} + \theta_i \left(y_{i,t-1} + \beta_i' x_{i,t-1} \right) + \omega_i + \varepsilon_{it}, \tag{7}$$

where β_i' shows the long-run coefficients, and θ_i shows the error correction terms. The panel ARDL regression model is built through the dynamic pooled mean group (PMG) estimator, which suggests homogeneity of coefficients for all countries in the long-run but allows for individual coefficients for each country in the short-run. PMG is suitable when the number of cross-sectionals is small. It is not sensitive to the presence of outliers in the data and can eliminate autocorrelation [96].

Because of the short time series, the maximum lag length is 2.

6.2. Model Analysis

Table 2 gives the results of the unit root test. The variables of TREXP, NIGHTS, TEMP, and PRECIP are stationary at level because all their coefficients are negative, and p-values are less than 5%. The variables of real GDP and GE have p-values of more than 5% at level, but they become stationary at first difference. Since none of the variables is I (2), we can apply the PMG estimation.

The first PMG/ARDL model analyzes if there exists a long-run association between international tourism, measured by the total inbound travel expenditure, and independent variables included in the model. The upper part of Table 3 gives the results of the model. All variables are significant because their p-values are less than 1%. Climate change variables TEMP and PRECIP have a negative sign, while the other two independent variables have the expected positive sign, with the coefficient of real GDP higher than of the GE.

Table 2. Unit Root Test Results.

Variable	Coefficient	*p*-Value	Integration Order
TREXP	−5.10525	0.0000	I (0)
NIGHTS	−4.37856	0.0000	I (0)
TEMP	−6.47143	0.0000	I (0)
PRECIP	−8.54873	0.0000	I (0)
D(GDP)	−6.56078	0.0000	I (1)
D(GE)	−8.89864	0.0000	I (1)

Source: Authors' calculations.

Table 3. Inbound Travel Expenditure Long-Run and VECM Model.

Variable	Coefficient	St. Error	t-Statistic	*p*-Value
Long-Run Equation				
TEMP	−4.778106	1.315453	−3.632290	0.0008
PRECIP	−2.762470	0.847825	−3.258303	0.0024
GDP	1.932705	0.344660	5.607564	0.0000
GE	0.374879	0.076302	4.913093	0.0000
Short-Run VECM Equation				
COINTEQ01	−0.287761	0.087555	−3.286648	0.0022
D (PRECIP (−1))	−0.901406	0.398224	−2.263565	0.0294
D (GDP (−1))	4.601182	1.609756	2.858311	0.0069
c	−4.655081	1.437900	−3.237417	0.0025

Source: Authors' calculations.

In order to assess the short-run impact, we analyzed the Vector Error Correction model. The bottom part of Table 3 summarizes significant variables only. The ECM coefficient is negative and significant at 1%, confirming the long-run cointegration. Results show that in the short-run, only PRECIP and GDP are statistically significant, with *p*-values less than 5%.

The second model analyzes the impact of climate change variables on the number of overnight visitors. The upper part of Table 4 summarizes the results. Both climate change coefficients are negative and significant at 1%, with the coefficient of PRECIP higher than that of TEMP. The other two variables in the model are not significant because their *p*-values are very large.

Table 4. Overnight Visitors Long-Run and VECM Model.

Variable	Coefficient	St. Error	t-Statistic	*p*-Value
Long-Run Equation				
TEMP	−2.704264	0.445164	−6.074760	0.0000
PRECIP	−3.184411	0.970859	−3.279993	0.0022
GDP	0.301423	0.473165	0.637035	0.5279
GE	−0.176013	0.313197	−0.561986	0.5774
Short-Run VECM Equation				
COINTEQ01	−0.524044	0.098985	−5.294164	0.0000
D (PRECIP (−1))	−1.157355	0.236478	2.904011	0.0061
D (TEMP (−1))	−0.872829	0.438947	−1.988461	0.0540
D (NIGHTS (−1))	0.686736	0.325261	−3.558233	0.0010
c	13.24427	2.391906	5.537119	0.0000

Source: Authors' calculations.

The bottom part of Table 4 summarizes the results for the short-run impact on overnight visitors. The error correction term is significant at 1% and negative, suggesting a short-run negative impact of PRECIP and TEMP at one lag at 1% and 10%, respectively.

6.3. Discussion

The purpose of this article is to analyze the possible impact of climate change on international tourism in the countries of the Baltic Sea Region. Two econometric models are analyzed, where climate conditions are given through temperature and precipitation variables, while international inbound travel expenditure and the number of overnight visitors are used as dependent variables.

The analysis of the first model shows that in the long-run, all variables are significant at 1%. Variables of TEMP and PRECIP have a negative sign, suggesting a negative impact of these two indicators of climate change on inbound travel expenditure. The coefficient of TEMP suggests that an increase of 1% in the annual average surface temperature will decrease the inbound travel expenditure by around 4.8%, while for an increase of 1% in precipitation, the inbound travel expenditure will decrease by around 2.8%. The other two independent variables are significant and with the expected positive sign, with the coefficient of real GDP higher than that of the GE. As for the second model analyzed, the climate change variables of TEMP and PRECIP are statistically significant at 1%, while the *p*-values of the other two independent variables are very large, suggesting that there is not a long-run association of them with the number of overnight visitors. The coefficients of TEMP and PRECIP are both negative, with the coefficient of PRECIP higher than that of TEMP: an increase by 1% of the average temperature is associated with a decrease in overnight visitors of around 2.7%, while an increase of 1% in precipitation is associated with a decrease of around 3.2% of them. The results of our analysis are consistent with the previous research that found a negative association of climate change variables on international tourism in the long-run [69,70,74].

In the short-run, the variable of PRECIP has a negative impact on both international inbound expenditure and the number of overnight visitors. This conclusion is the same as in the work of Gebbisa et al. [83] and Fauzel [84]. The variable of temperature TEMP does not have a short-run impact on the inbound travel expenditure and number of overnight visitors. Fauzel [84] reaches the same conclusion.

After this analysis, we conclude that the two hypotheses are verified.

The analysis shows that regardless of how international tourism is measured, there is a long-term relationship between it and climate change in the countries of the Baltic Sea Region. The increase in temperature is expected to have the greatest impact on the reduction of inbound expenditure, while the increase in precipitation will have the greatest impact on the reduction of overnight visitors. Our study also suggests a short-run relationship between climate change, measured by precipitation and inbound travel expenditure and overnight visitors.

7. Conclusions

Adapting to the effect of climate change is in the best interests of the tourism sector, and reducing its impacts is in the best interest of local governments and policymakers. The idea that all the countries in the Baltic Sea Region can represent tourism together in a single body, as opposed to individually, is one that is rather intriguing. Climate change will significantly affect tourism destinations' competitiveness and sustainability, necessitating adaptation to minimize risks and capitalize on opportunities while also considering the broader tourism system's impacts. The tourism sector's preparedness for climate change remains low despite the emerging adaptation imperative. To advance adaptation mainstreaming and contribute to the green economy and poverty alleviation, concerted research and capacity-building efforts are needed. It is also necessary to realign the mainstream conversation on climate change, which only presents it as a threat. Indeed, we also need to learn more about the opportunities that climate change presents. Involving locals in decision-

making processes can help better understand the third dimension of vulnerability and local features of concern. While climate forecasts offer a valuable perspective for assessing future vulnerability, the historical and contemporary developments offer an equally significant forum for discussions regarding adaptation.

We acknowledge that this work has some limitations that we actually consider as indications for future research. To measure the impact of climate change, precipitation and temperature were used, while climate change can also be measured through other variables. It is our intention to study the impact of these variables on tourism. Only six countries of the Baltic Sea Region are included in the study; in the future, the sample will be extended to all the Baltic Sea countries. The relationship between climate change and international tourism, in particular, and the tourism industry, in general, is two-way: the tourism industry is also thought to be one of the contributors to climate change. We plan to study the impact of the tourism industry on climate change in the future.

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