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A general equilibrium analysis of climate change impacts on tourism

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Abstract

This paper studies the economic implications of climate-change-induced variations in tourism demand, using a world CGE model. The model is first re-calibrated at some future years, obtaining hypothetical benchmark equilibria, which are subsequently perturbed by shocks, simulating the effects of climate change. We portray the impact of climate change on tourism by means of two sets of shocks, occurring simultaneously. The first set of shocks translate predicted variations in tourist flows into changes of consumption preferences for domestically produced goods. The second set reallocate income across world regions, simulating the effect of higher or lower tourists' expenditure. Our analysis highlights that variations in tourist flows will affect regional economies in a way that is directly related to the sign and magnitude of flow variations. At a global scale, climate change will ultimately lead to a welfare loss, unevenly spread across regions.

Keywords: Climate change; Computable general equilibrium models; Tourism

1. Introduction

Climate plays an obvious role in tourist destination choice. The majority of tourists spend their holidays lazing in the sun, a sun that should be pleasant but not too hot. The Mediterranean particularly profits from this, being close to the main holiday-makers of Europe's wealthy, but cool and rainy Northwest. Climate change would alter that, as tourists are particularly footloose. The currently popular holiday destinations may become too hot, and destinations that are currently too cool would see a surge in their popularity. This could have a major impact on some economies. About 10% of world GDP is now spent on recreation and tourism. Climate change will probably not affect the *amount* of money spent but rather *where* it is spent. Revenues from tourism are a major factor in some economies, however, and seeing only part of that money move elsewhere may be problematic. This paper studies the economic implications of climate-change-induced changes in tourism demand.

The literature on tourist destination choice used to be largely silent on climate (Crouch, 1995; Witt and Witt, 1995), perhaps because climate was deemed to be obvious or beyond control of managers and perhaps because climate was seen to be constant. Recently, however, an increasing number of studies have looked at

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the effects of climate change on the behaviour of tourists from a particular origin or on the attractiveness of a particular holiday destination. Few of these studies look at the simultaneous changes of supply and demand at many locations. In fact, few of these studies look at all at economic aspects, the main exception being Maddison (2001), Lise and Tol (2002) and Hamilton (2003) who estimate the changes in demand of British, Dutch and German tourists, respectively. Hamilton et al. (2004) do look at the supply and demand for all countries, but their model is restricted to tourist numbers.

This paper tries to fill this gap in the literature. We study climate-change-induced variations in the demand for and the supply of tourism services. We go beyond a partial equilibrium analysis of the tourism market, however, and also add the general equilibrium effects. In this manner, we get a comprehensive estimate of the redistribution of income as a result of the expected redistribution of tourists due to climate change.

The paper is structured as follows. Section 2 presents our estimates of changes in international tourist flows. Section 3 outlines the general equilibrium model used in this analysis. Section 4 illustrates how tourism is included in this model. Section 5 discusses the basic tourism data. Section 6 shows the results of our climate change supposition and Section 7 offers a conclusion. An Appendix A describes the general equilibrium model structure and its main assumptions.

2. Estimates of changes in international tourist flows

We take our estimates of changes in international tourist flows from Hamilton et al. (2004). Theirs is an econometrically estimated simulation model of bilateral flows of tourists between 207 countries; the econometrics is reported in Maddison (2001), Lise and Tol (2002) and Hamilton (2003). The model yields the number of international tourists generated by each country. This depends on population, income per capita and climate. Other factors may be important too, of course, but are supposed to be captured in a country-specific constant. The tourists from each country are then distributed over the remaining 206 destination countries. The attractiveness of a destination country depends on its per capita income, climate, a country-specific constant, and the distance from the origin country.

Although simple in its equations, the model results are not. This is because climate change has two effects. On the one hand, climate change makes destination countries more or less attractive. On the other hand, climate change also affects the number of people who prefer to take their holiday in their home country rather than travelling abroad. This in itself leads to surprising results. The UK, for instance, would see its tourist arrivals fall because, even though its climate improves, its would-be tourists rather stay in their home country where the climate also gets better. As another example, Zimbabwe would see its tourism industry grow because, even though its climate deteriorates, it is still the coolest country in a region where temperatures are rising.

Table 1
Changes in international and interregional departures, and international arrivals, in 2050 (number of tourists)

Region	International		Interregional	
	Arrivals	Departures	Arrivals	Departures
USA	−7537352	−21688924	0	0
EU	−43222063	−37619622	−48324941	−48324941
EEFSU	3116282	−43201505	−6079379	−6079379
JPN	−417310	−4293235	0	0
RoA1	16063980	−27747421	−68948	−68948
EEx	−31822804	11251183	−2553533	−2553533
CHIND	−484779	−2117862	97167	97167
RoW	−50746662	10366678	−5547398	−5547398

Table 1[1] shows the changes in international and interregional departures and international arrivals for 2050 for the eight regions used in this study, based the SRES A1 scenario for climate change, economic growth, and population growth.[2] The assumed global mean warming is 1.03 °C in 2050 (relative to 1997); in 2010, it is 0.09 °C and in 2030, 0.46 °C. Obviously, the regional aggregation hides many effects, such as the redistribution of the tourists from southern to middle Europe. Fig. 1 shows total international flows for all countries for the same year and scenario.

3. Assessing the general equilibrium effects: model structure and simulation strategy

To assess the systemic, general equilibrium effects of tourism impacts, induced by global warming, we made an unconventional use of a multi-country world computable general equilibrium (CGE) model: the GTAP model (Hertel, 1996), in the version modified by Burniaux and Truong (2002), and subsequently extended by ourselves.

[1]Here is the meaning of acronyms: USA [USA], European Union [EU], Eastern Europe and Former Soviet Union [EEFSU], Japan [JPN], Rest of Annex 1 (developed) countries [RoA1], Energy Exporters [EEx], China and India [CHIND], Rest of the World [RoW]. Annex 1 (part of the Kyoto protocol, on the reduction of greenhouse gases emissions) lists the signing nations—broadly coincident with OECD countries.

[2]The SRES scenarios (Nakicenovic and Swart, 2000) are standard scenarios in climate change (impacts) analysis. The A1 scenario assumes moderate population and emissions growth and fast economic growth.