"Biodiversity and International Tourism: A Story of Comparative Advantage"[#]

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Abstract: We analyze whether biodiversity is increasing the receipts of tourism and thus is beneficial for developing countries (DCs). The underlying assumption is that a rich biodiversity provides a comparative advantage for most DCs. We use a simple trade theory framework. The model is supported by an empirical analysis. The main findings are that first DCs, being abundant of biodiversity, seem to have a comparative advantage in (sustainable) tourism, that second incidence of birds as the probably best explored taxonomic group has a positive impact on inbound tourism receipts per capita, and that third the rate of endangered to total birds is negatively influencing tourism receipts. We draw some cautious policy conclusions.

Key Words: Tourism, economic growth, sustainable development, biodiversity conservation.

1. INTRODUCTION

Since the beginning of the twentieth century, tourism has been one of the most remarkable socio-economic phenomena. While in the first half of the last century tourism was an activity only for a small group of predominantly wealthy people, it has become a mass phenomenon after World-War II, particularly from the 1970s on. Today, it can be considered as a vital dimension of global integration and trade. This development suggests that tourism is a superior or luxury good with an income elasticity of demand exceeding one.[1] Although domestic tourism currently accounts for approximately 80% of all tourism receipts (Neto, 2003, p. 212), there is increasing interest in international tourism.[2] It has (now) become the world's largest source of foreign exchange receipts and is therefore an essential part of global trade (World Tourism Organization, 2007). According to the latest figures compiled by the World Tourism Organization, for 2005 international tourism receipts are estimated at US$ 680 billion (including international passenger transport it exceeds US$ 800 billon) and represented approximately 6 per cent of worldwide exports of goods and services (World Tourism Organization, 2006, p. 5f). The share of tourism exports has increased to nearly 30 per cent by considering service exports exclusively.

In developing countries, international tourism may well become an important factor for economic development which depends on a "terms of trade effect" as long as demand increases by a higher rate than world income. In other words, tourism is beneficial for growth if the international terms of trade move in favor of tourism services. This is the case if tourism is a superior or luxury good, such that consumers' demand increases strongly with rising income (income elasticity of demand higher than one) (Lim, 1997; Brau *et al.*, 2003, p 16; Divisekera, 2003; Eilat and Einav, 2004, p. 1325). In particular, it stimulates new economic activity because tourists demand a number of goods and services: e.g. food, accommodation, transportation, entertainment and local handcrafts as souvenirs. Because the tourism sector is labor intensive, an increase in employment can be expected (Nijkamp, 1998; Sinclair, 1998; Deloitte&Touch *et al.*, 1999; Neto, 2003, p. 4ff). Another indirect effect is that international tourism may push the political leaders in the country of destination to establish good governance, grant more civil rights or open the country for international trade. These assumed effects are particularly relevant for developing countries (DCs), which often have high rates of unemployment, "problematic" governments and difficulties in entering international trade.

Recent studies investigate empirically the effects of tourism on economic growth. For instance, Brau *et al.* (2003) analyze if specializing in tourism is an appropriate growth strategy for least developed countries (LDCs). They assess the relative growth performance of 14 "tourism countries" within a sample of 143 countries, observed during the period

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[#]The authors are indebted for helpful suggestions to two anonymous referees, Martin Abel, Joachim Ahrens, Helmut Karl, Christina Klose, Jens Krüger, Nils Laub, Martin Paldam, Gernot Pehnelt and Simon Renaud. An earlier version was presented at the Public Choice Society Meeting 2006 in New Orleans, at the Ruhr Graduate School Seminar 2006 and at the Agrarökonomische Seminar of the University of Göttingen in late 2007. All remaining errors are the authors' responsibility.

[1]In this case, consumers' demand of tourism increases strongly by increasing income. Thus, international terms of trade move in favor of tourism services, so that tourism is beneficial for economic growth.

[2]Developing countries account for a higher share of international tourism receipts as of total tourism receipts than industrialized countries.

1980-95. Using standard OLS cross-country growth regressions, they show that the tourism countries grow significantly faster than all the other sub-groups considered in their analysis (OECD, Oil, LDC, small countries). Moreover, they find that other growth factors - low base value of per capita GDP, high saving/investment propensities or high openness to trade - do not significantly contribute to the positive performance of the tourism countries. In other words, they find that tourism specialization is an independent determinant for economic growth (Brau *et al.*, 2003, p. 11-17). Another empirical study supports and confirms this result. Eugenio-Martin *et al*. (2004) examine the relationship between tourism and economic growth with an analysis based on a panel data approach focusing on Latin American countries between 1985 and 1998. They estimate the relationship between economic growth and an increase in the number of tourist arrivals per capita conditional on main macroeconomic variables. The findings show that the tourism sector is a driver of economic growth in medium or low-income countries, though not necessarily in developed countries (Eugenio-Martin *et al.*, 2004, p. 5-11). This is particularly relevant in the light of climate change. It will certainly not be desirable that all developing countries take the same development path like the old western economies, as this development was linked with rapidly rising environmental damages in the past. So a leapfrogging economic development *via* tourism may be an answer to this trade-off.

Because of these assumed positive effects tourism may have on economic development, a second question to answer is which determinants can promote the demand for tourism. There are many explaining factors for international tourism arrivals such as nature, price level, safety[3], infrastructure and educational level.[4] Entertainment and sightseeing in a certain region or country also play a prominent role in the decision making process of tourists for a destination (Lim, 1997). Proxies for sightseeing and entertainment activities may be the number of beaches, bars, sport facilities, museums, memorial sites, the quantity and quality of accommodation facilities and the like. In addition, geographical aspects such as the number of directly neighboring countries or the distance to rich countries may play a role.

The focus of our examination is laid upon the factor nature, in particular on the question of whether and to what extent biodiversity[5], as a directly influencing factor for sightseeing activities (safaris etc.) and an indirectly influencing factor for "nice nature", determines the demand for tourism, as it is assumed in a number of theoretical papers (e.g. Nijkamp, 1998; Muir-Leresche and Nelson, 2000; Ashley and Elliott, 2003; Creaco and Querini, 2003; Valente, 2005). Zhang and Jensen (2005) confirm in a panel data analysis dealing with the supply-side of tourism flows that country fixed effects are highly relevant for the destination choice. They conclude - albeit without a proof - that this result depends on the natural endowment and cultural heritages of the respective country. Naidoo and Adamowicz (2005) evaluate tourists' and foreign residents' demand for elevated biodiversity levels (increased numbers of bird species to be watched) conducting a choice experiment in Uganda. They wanted to determine how preferences for particular protected areas are formed relative to other protected areas attributes. Their analysis provides evidence that biodiversity *per se*, i.e. the number of different species in a given situation, contributes to nature based tourism by enhancing the attractiveness of a protected area to tourists. This is a very relevant outcome not only for ecological purposes but also for economic development, as it further supports the view that the alleged trade-off between the economy and the environment is not a necessary phenomenon of development. Because it may be assumed that developing countries are relatively rich in biodiversity, it can be an important precondition for a growing tourism industry, which then contributes to sustainable development in these countries. A rich biodiversity may provide a comparative advantage for tourism in the developing world.

Economic growth, trade and especially tourism (e.g. Nijkamp, 1998; Berno and Bricker, 2001; Neto, 2003) may also have a negative impact on biodiversity. As trade and tourism - in particular through the introduction of damaging invasive exotic species - can affect the local biodiversity negatively, there may be rebound effects for a nature based tourism industry (e.g. McAusland and Costello, 2004; Polasky *et al.*, 2004).[6] Thus, if it can be shown that biodiversity is beneficial for tourism and economic development, it is sensible to invest into biodiversity or create incentives to protect biodiversity.

This paper builds upon this literature and concentrates on the determinants of tourism in an empirical analysis. To deal with this problem, we first present theoretical considerations and derive three hypotheses about the relation between biodiversity (measured as the number of bird species in a country) and international tourism. In section 3, we empirically assess the hypotheses in cross-country regressions. In section 4, we draw cautious policy conclusion with respect to biodiversity conservation and development.

2. THEORETICAL FOUNDATIONS

As the aim is to explain the determinants of international tourism, the analysis is based upon a standard Heckscher-Ohlin framework in international trade. Consider a world formed of two small countries, country B (well endowed with biodiversity) and country C (relatively rich of capital). Each country is characterized by a two sector economy which produces manufactures and tourism with two factors of production: capital (*C*) and biodiversity (*BD*). Trade then is based on differences in factor endowment.

[3]Eilat and Einav (2004) show in three-dimensional panel data analysis about the determinants of international tourism that the political risk is quite important for the choice of destination, while the price level only matters for tourism to developed countries.

[4]Eugenio-Martin *et al.* (2004) try to explain tourist arrivals conditional on GDP and other control variables such as safety, prices and educational level, as well as investment in infrastructure empirically. Their results provide evidence that low-income countries seem to need adequate levels of infrastructure, education and development to attract tourists, while medium-income countries need high levels of social development like health services and relatively high GDP per capita levels. Finally, the results show that the price level of the destination, in terms of exchange rate and PPP is irrelevant for tourism growth.

[5]Biodiversity is differentiated in the standard literature into ecological, organism and genetic diversity (Heywood 1995). Although our variable introduced below (BIRDS) relates to organism diversity, we have in mind a more general concept of biodiversity covering the three subcategories.

[6]For general empirical assessments of the relation between biodiversity and economic welfare see Naidoo and Adomowicz (2001); Asufu-Adjaye (2003); Barbier and Bulte (2004); Lomborg (2004) as well as Freytag *et al.* (2009).

The assumption of biodiversity being a factor instead of a result of production is not standard (see e.g. Brander and Taylor, 1997, 1998; Hannesson, 2000; Polasky *et al*., 2004; Smulders *et al*., 2004). These authors treat nature as a product. However, for the problem discussed in this paper, it is highly plausible to treat biodiversity as a factor rather than as a product: tourists are only rarely interested in the number of species. In general, they consume services such as recreation, sightseeing and education. Nature is an input to provide these services. Moreover, assuming that the property rights are assigned correctly, biodiversity can be analytically treated like any given factor of production. If property rights exist, the factor has a positive price.

The factor prices are determined differently for both factors. The capital market is decisive for the interest rate as the price for capital. This is standard. The price for the factor biodiversity is the marginal cost of preserving nature. This assumption has important implications for the long-run use of this factor, in particular as a market for biodiversity does not exist without political support. Without a positive price, there is the danger of an overuse, as biodiversity then can be treated as a common pool property that is used by anyone but owned and preserved by no one. Thus, the assignment of property rights plays a major role for the factor price and factor use. In our case it is important that someone claims biodiversity as private property.

The two goods are produced with different factor intensities. Manufactures are produced relatively capital intensively, while the production of tourism requires relatively more biodiversity. In autarky, both countries produce both goods and reach a social optimum under different relations of the prices of factors and goods. Next, we assume that these countries engage in international trade.[7] In a Heckscher-Ohlin world, international trade will lead the individuals in the two countries to specialize according to their comparative advantage. Thus, country B focuses on the production of tourism, while country C produces relatively more manufactures.[8] The trade implications of this model are the following: country B exports tourism services *via* mode 2 (consumption of foreign services abroad) of GATS (General Agreement on Trade in Services). In exchange for the consumption of tourism, the citizens of country C export manufactures. We will use this result in hypothesis 1, claiming that countries with biodiversity abundance have a comparative advantage in tourism.

After discussing the concept of comparative advantage, we now focus on absolute tourism flows. Both the second and third hypotheses deal with absolute tourism receipts and therefore critically depend on the problem of factor prices. First consider that the property rights of capital (and biodiversity) are correctly defined in country C, but the property rights for biodiversity in country B are not exactly assigned. In that case biodiversity is a common property and it is impossible to exclude consumers from consumption of biodiversity, but these consumers compete for the consumption. Hence, it is rational for the individual consumer to overuse biodiversity. If property rights on biodiversity are not assigned correctly to private or public (land-) owners, its factor price is zero as the formation of prices for the good biodiversity is impossible if there is nobody who owns and therefore can sell or buy this good. Country B thus faces the typical problem of a common property and nature will be overused. Yet, if a species is completely extinct it can not be recovered (Asufu-Adjaye, 2003, p. 182). The supply of tourism increases, the price for this service is lower than needed to regenerate the factor and nature will be overused. It takes time to regenerate biodiversity. In the long run, this effect leads to a decrease in international tourism receipts as the input factor degenerates. As factor prices tend to not be equalized in this situation country B may even experience a loss from trade (Brander and Taylor, 1998, Smulders *et al*., 2004). We use this result in hypothesis 2 in a general manner by claiming that an overuse of biodiversity reduces absolute tourism exports of country B.

By contrast, the third hypothesis is based on a long-term political calculus in country B. This approach leads to a correct assignment of property rights not only for capital, but also for biodiversity; positive factor prices exist in both countries for both factors. The holders of biodiversity have an incentive to reproduce their resource and to prevent an overuse of it. Therefore, trade is taking place according to comparative advantage. Hypothesis 3 claims that the absolute international tourism receipts are positively influenced by the degree of biodiversity in a country.

3. DETERMINANTS OF TOURISM: CROSS-COUNTRY EMPIRICAL EVIDENCE

This section of the paper is dedicated to an assessment of the three hypotheses of our theoretical considerations, in a cross-country analysis. **First**, we claim that countries with abundant biodiversity endowment are likely to export tourism services; they attract high tourism receipts because they have a comparative advantage in tourism services. There should be a positive correlation between the degree of biodiversity and a measure reflecting comparative advantage, namely the revealed comparative advantage (RCA) for the tourism industry T in country *i* in the year 2003. The RCA-index is calculated as follows: $RCA(1)_{Ti} = \ln \frac{X_{Ti}/M_{Ti}}{\sum X_i / \sum M_i}$, were X_T are the inbound tourism receipts, M_T are the outbound tourism expenditure, both reported by World Tourism Organization (2007). The variables X and M are the total amount of goods and services exported and respectively imported of country i (WTO, 2006).[9] This hypothesis will be assessed by estimating the influence of proxies for biodiver-

[7]To simplify we do not consider trade-induced habitat effects (see Smulders *et al*., 2004).

[8]We do not solve a formal model, as an equilibrium resulting in new world market prices for the traded goods with factor price equalisation is not in our focus.

[9]Another measure reflecting revealed comparative advantages for the tourism industry T in country i is calculated as follows: $RCA(2)_{Ti} = \ln \frac{X_{Ti}/\sum X_{Ti}}{X_i/\sum X_i}$, were X_{Ti} are the inbound tourism receipts in 2003, reported by World Tourism Organization (2007). The variables X_i is the total amount of goods and services exports of country i (in 2003), reported by WTO (2006). By calculating also this RCA-index we estimate the same model below. The results are similar, and holds stable throughout the four regressions. This is not astonishing as both RCA-Indices are highly correlated $(corr(RCA(1)_{Ti}; RCA(2)_{Ti}) = 0.8747)$.

sity and some control variables on the RCA in a cross country analysis using a simple OLS model.[10]

The **second hypothesis** reflects the short-term perspective of a biodiversity abundant country. Assuming that a permanent biodiversity loss diminishes the export in tourism of the very country at least in the long run, we assess how a proxy for potential biodiversity loss and therefore for a wrong or incomplete assignment of the property rights of biodiversity influences the inbound tourism receipts per capita. The literature review of econometric tourism demand models show that there is not a standard measure of tourism flows (see also Vietze 2008b). The majority of the studies in this area define international tourism demand by using one of the following measures: the number of foreign visitors crossing the border (tourism arrivals), or the tourism receipts (respective tourism expenditures)[11] (Proença and Soukiazis, 2005). As the paper concentrates on the determinants of inbound tourism the dependent variable in this study is - like in many tourism analyses (Song and Li, 2008)[12] - the flows of inbound tourism receipts per capita for 2003 (*TRi*) as reported by the World Tourism Organization (2007) for 208 countries. In tourism studies 'the dependent variable is an aggregate of several separate activities definable in money terms and not a quantity as in the conventional way of estimating such coefficients' (Kanellakis 1975, p. 17). Yet, the matter of an appropriate demand measure is further compounded by the fact that tourism demand in monetary terms represents both an amount of expenditure and the quality of consumption and is, therefore, not unproblematic (Smeral, 1988; Crouch, 1994). As tourism arrivals do not control for either the length or the spending intensity (actual value consumed) of the tourist stay at the individual destination, measuring demand in real monetary terms is preferable (Anastasopoulos, 1984; O'Hagan and Harrison, 1984). Hence, flows of tourism receipts (respectively expenditures) are superior to flows of tourism arrivals (Zhang and Jensen, 2007; Vietze 2008a). The proxy for a substantial biodiversity loss is the ratio of endangered bird species to bird species in a country (see below). For this estimation, we expect a negative sign. The necessary data is available for more than 160 countries. The controls are the same as in hypothesis 1.

The **third hypothesis** of the theoretical section is that sustainable tourism is a superior good and can "in the long run" create substantial export receipts in tourism, if the regeneration of the natural resource *BD* is taken seriously and the property rights of biodiversity are assigned completely. We assess whether inbound tourism receipts per capita are determined by the same exogenous variables as above, with the exception that we use the number of bird species per square kilometer in a country as a proxy for the absolute biodiversity endowment (per size) instead of one for endangered biodiversity in relation to all biodiversity as above. We expect a positive influence of biodiversity endowment on inbound tourism receipts. Furthermore, we use a proxy for property rights of biodiversity as well as a number of control variables to asses their influence on inbound tourism receipts. Beside those used in hypotheses 1 and 2 these mainly consist of institutional variables (see below).

The most important exogenous variables (variable BIRDS and ENBIRDS) as proxies for biodiversity and its loss respectively are measured by the number of *Bird Species* living in the country for the year 2003, as documented by BirdLife International (2005). Birds are suitable indicators for biodiversity for several reasons (Riecken, 1992; DOG, 1995; Boening-Gaese and Bauer, 1996; Plachter *et al.*, 2002; Gregory *et al.*, 2003; BirdLife International, 2004; Naidoo and Andamowicz, 2005), especially for studies on a global scale (Bibby *et al*., 1992; Burgess *et al*., 2002):

- Individual birds usually have large home ranges in complex habitats that require specific structures for several parts of the life-cycle (e.g. nesting sites, hibernation sites). Thus, they respond often very sensitively to changes in their habitat (e.g. due to economic efforts or due to nature protection efforts).
- Many species are carnivorous, representing high positions in the food chain. Thus, they also need a complexly structured habitat, fulfilling the requirements for a high prey density. Consequently, many bird species are considered as "flagship species" (Lawton *et al.*, 1998) whose presence indicates the presence of a species-rich animal and plant community.
- Birds may represent the best-known animal taxon, and an avifauna is usually available not only for countries, but also for other geographical or political units.
- The number of bird species can not be politically instrumentalized (Metrick and Weitzman, 1998; Rawls and Laband, 2004), as long as the counting is done independently.

An alternative to the use of number of species for monitoring changes in biodiversity is a biodiversity index relying on individual countries' richness as favored by Magurran (2004) and by Bruckland *et al*. (2005). The theoretical rigor of their argument is convincing, but our indicator (BIRDS) is the only indicator which is available worldwide on country scale. The variable BIRDS is expressed as number of bird species in relation to the size of the country in square kilometers (km^2) as it is done by Asufu-Adjaye (2003). In addition to BIRDS, we calculate the ratio of endangered bird species to all bird species in a country (variable ENBIRDS). To use ENBIRDS is sensible. It indicates the incentives in a country to preserve nature and represents the common pool property.[13] The list of endangered birds is applied worldwide. Therefore, even if some distortions are in the list, this holds for all countries similarly. These two variables are

[10]It has to be noted that RCA scores may be distorted by trade policy measures. Given that we do not have better indicators, we have to accept this problem and be cautious when deriving policy conclusions.

[11]The number of nights spent by visitors from abroad and the length of stay of visiting tourists is also used.

[12]Crouch (1994) indicates that of the 85 tourism studies reviewed, 48 per cent chose tourists arrivals as the measure of demand. To control the size effect we use tourism receipts as per capita measure.

[13]One may argue that the government in a country with a high number of endangered species is aware of the problem and has avoided extinction so far. Following this argument, the opposite interpretation seems to be justified: countries are concerned about endangered species; otherwise the list would be shorter. For us, this is a very apologetic interpretation. We argue that endangered birds are endangered because governments do not take them into account and not the other way round.

statistically not interdependent (see Table **2**). Other exogenous control variables are the following:

- real *GDP per capita* in current US-$ for the year 2000 (GDP2000) and 2003 (GDP2003), source is Heston *et al.* (2006) and IMF (2006),
- the length of the *Coast Line* (in km) in relation to the size of the country in square km (COAST) as a proxy for beaches, source is CIA (2005),
- the number of *UNESCO World Heritage* sites in relation to the size of the country in square km (WHS). This variable is used as control for the influence of important historical and cultural sites on tourism. Source is the German Commission for UNESCO (2005),
- the *Distance* of the country (approximate geographic center) *to the Equator* in grad (longitude) (EQ) as a proxy for differences in climate, source is CIA (2005),
- the *Size* of the country (SIZE), source is CIA (2005),
- the *Population* of the country (POP), source is Heston, *et al.* (2006),
- the number of *National Borders* (BORD), source is CIA (2005),
- *Life Expectancy* (LE) as a proxy for the safety and the quality of the health system of a destination, source is CIA (2005),
- the World Bank governance indicators in 2002 for *Control of Corruption* (CCORR), *Political Stability* (POLST), *Rule of Law* (LAW) and *Voice and Accountability* (VOICE); all of these also as proxy for the safety of a destination, source is Kaufmann *et al*. (2006).
- the ratio of *IUCN* category I-IV *Protected Areas* per total land area of the country (IUCN) as an additional proxy for assigned property rights of biodiversity to public land owners, source is WRI (2006),
- finally the number of *Internet Accesses* per thousand inhabitants (NET) as a proxy for communication possibilities, source is World Bank (2007).

The descriptive statistics referring to Revealed Comparative Advantage of tourism exports (RCA), inbound tourism receipts per capita (TR), bird species in relation to the size of the country (BIRDS), the ratio of endangered bird species to all bird species (ENBIRDS) and the number of UNESCO world heritage sites in relation to the size of the country (WHS) are reported in Table **1**.

Because it is apparent that the sample does not have disturbances with identical variance, we generally run a White-Heteroskedasticity Residual Test and use an adjusted OLS-estimator robust to heteroskedasticity in these estimations. We also test for reverse causality between the dependent variable and explanatory variables, running a Granger causality test between BIRDS and tourism receipts per capita (TR_i). According to this test, we cannot reject the hypothesis that TR_i does not Granger cause BIRDS but we can reject the hypothesis that BIRDS does not Granger cause TR_i. Therefore, it appears that Granger causality runs one-way from BIRDS to TR_i and not the opposite way. Another problem may be multicollinearity, in particular high correlation between the World Bank governance indicators as control variables. To avoid this problem, we do not use all indicators simultaneously. Including a set of dummies and time invariant variables (above all the variables BIRDS and ENBIRDS which are counted in a four year frequency (Birdlife International 2008) in our estimation model, a country fixed effects panel estimation cannot be applied. A panel model is also not possible, regarding low time series data availability (WHS, BIRDS). As it is our intent to explain the heterogeneity in tourism demand within the world with exogenous socio-geographic variables, we cannot apply the '*fixed-effects modeling [as] a result of ignorance*' (Cheng and Wall, 2005, pp. 54). Instead, according to Wei and Frankel (1997), we endeavor to estimate the exact effects of geographical variables (EQ, SIZE, COAST) that are time constant. The inclusion of country dummies will undermine these efforts, because the time-constant geographical variables are hidden from analysis as they are subsumed into the fixed effects (see also Vietze, 2008a). A widely described problem in pooled panel estimations, with respect to fixed effects estimations, is the problem of omitted variables (e.g. Cheng and Wall, 2005). However, because of the structure of our data, we *must* include country and time constant variables (EQ SIZE, BIRDS, and WHS). Thus, we use an ordinary least square estimation model.

The correlation matrix of the main explanatory variables is presented in Table **2**.

In the following empirical assessments, we work with all countries available in the sample. We do not distinguish between developing and developed countries.

a) Biodiversity and Comparative Advantage

The first hypothesis states that biodiversity is influencing the comparative advantage of countries. The higher the biodiversity abundance in a country, the higher is the RCA in-

Table 1. Descriptive Statistics

	MIN	MAX	Mean	Median	Std-dev.	N
RCA	-3.660	3.2079	0.5879	0.5671	1.1054	126
TR	0.0177	12,352	815.65	121.81	2,089.3	167
BIRDS	3.69E-05	1.1969	0.0662	0.0038	0.1823	202
ENBIRDS	0.0000	0.4943	0.0709	0.0516	0.0701	203
WHS	0.000	0.0394	0.0004	5.74E-06	0.0030	191

Table 2. Correlation Matrix

	BIRDS	ENBIRDS	WHS	GDP2000	GDP2003	LE	CCORR	POLST
BIRDS	1.000	0.1675	-0.0242	0.2499	0.1336	0.1368	0.2233	0.1494
ENBIRDS	0.1675	1.000	-0.1342	0.1190	-0.0131	0.2847	0.1287	0.1248
WHS	-0.0242	-0.1342	1.000	0.3062	0.3420	0.3470	0.3009	0.1860
GDP2000	0.2499	0.1190	0.3062	1.000	0.9365	0.6485	0.8845	0.6524
GDP2003	0.1336	-0.0131	0.3420	0.9365	1.000	0.5552	0.8605	0.6183
LE	0.1368	0.2847	0.3470	0.6485	0.5552	1.000	0.5680	0.4676
CCORR	0.2233	0.1287	0.3009	0.8845	0.8605	0.5680	1.000	0.7700
POLST	0.1494	0.1248	0.1860	0.6524	0.6183	0.4676	0.7700	1.000
LAW	0.1837	0.1556	0.3263	0.8734	0.8449	0.6071	0.9682	0.8147
VOICE	0.0592	0.1598	0.3330	0.6966	0.7118	0.5437	0.7898	0.7397
EQ	-0.1526	-0.0668	0.3636	0.5382	0.5697	0.5503	0.5417	0.5167
COAST	0.6202	0.2155	0.0024	0.3473	0.2709	0.2491	0.2893	0.2380
BORD	-0.2206	-0.2594	-0.0685	-0.2224	-0.1786	-0.1628	-0.2451	-0.2274
POP	-0.0538	0.1631	-0.0787	-0.0455	-0.0372	0.0716	-0.0465	-0.0755
SIZE	-0.0935	0.1697	-0.1888	0.1519	0.1174	0.1240	0.1034	0.0151
IUCN	-0.0298	0.0757	-0.0078	0.0602	0.0701	0.0541	0.0608	-0.0352
NET	0.2282	0.1764	0.3044	0.8715	0.8446	0.6249	0.8556	0.6660

	LAW	VOICE	EQ	COAST	BORD	POP	SIZE	IUCN	NET
BIRDS	0.1837	0.0592	-0.1526	0.6202	-0.2206	-0.0538	-0.0935	-0.0298	0.2282
ENBIRDS	0.1556	0.1598	-0.0668	0.2155	-0.2594	0.1631	0.1697	0.0757	0.1764
WHS	0.3263	0.3337	0.3636	0.0024	-0.0685	-0.0787	-0.1888	-0.0078	0.3044
GDP2000	0.8734	0.6966	0.5382	0.3473	-0.2224	-0.0455	0.1519	0.0602	0.8715
GDP2003	0.8449	0.7118	0.5697	0.2709	-0.1786	-0.0372	0.1174	0.0701	0.8446
LE	0.6071	0.5437	0.5503	0.2491	-0.1628	0.0716	0.1240	0.0541	0.6248
CCORR	0.9682	0.7898	0.5417	0.2893	-0.2451	-0.0465	0.1034	0.0608	0.8556
POLST	0.8147	0.7397	0.5167	0.2380	-0.2274	-0.0755	0.0150	-0.0352	0.6660
LAW	1.000	0.8289	0.5761	0.2733	-0.2278	-0.0085	0.0971	0.0762	0.8580
VOICE	0.8289	1.000	0.5433	0.1747	-0.2650	-0.0647	0.0486	0.1193	0.7602
EQ	0.5761	0.5433	1.000	0.0101	0.0378	0.0075	0.0459	-0.1939	0.5792
COAST	0.2733	0.1747	0.0101	1.000	-0.3003	-0.0496	-0.1049	0.0703	0.3445
BORD	-0.2278	-0.2650	0.0378	-0.3003	1.000	0.4059	0.2966	0.0890	-0.2506
POP	-0.0085	-0.0647	0.0075	-0.0496	0.4059	1.000	0.5294	-0.0323	-0.0369
SIZE	0.0971	0.0486	0.0459	-0.1049	0.2966	0.5294	1.000	-0.0087	0.1472
IUCN	0.0762	0.119	-0.1939	0.0703	0.0890	-0.0323	-0.0087	1.000	0.0942
NET	0.8580	0.7602	0.5792	0.3445	-0.2506	-0.0369	0.1472	0.0942	1.000

dex for tourism in this country. We add the current GDP per capita as a proxy for the state of development (expected sign negative), the number of World heritage sites (positive) and the length of the coastline (positive) as control variables. For a test of this hypothesis, we apply the following OLS estimation:

$$RCA_T = ß_0 + ß_1 BIRDS + ßx_{1+i} + \varepsilon \quad (1)$$

x_{1+i} *representing controls, namely GDP*2003*, WHS and COAST*

The interpretation of Table **3** is fairly simple. The abundance of biodiversity has a positive impact on the RCA-index. Countries with a rich biodiversity have a comparative

advantage in tourism services and are able to exploit it. At the same time, these countries have a relatively low GDP per capita, implying that the potential for convergence is given. Both results make sense and are in line with the theoretical reasoning. These two results remain robust, even if we introduce further control variables, i.e. the number of UNESCO world heritage sites and the length of the coastline. The latter variables do not improve our estimates, which is probably due to the fact that the RCA index is directed at relative trade flows. These variables may rather influence absolute flows (Tables **4** and **5**).

b) Biodiversity and Tourism Receipts: the Short-Term Perspective

The next function we estimate is directed at absolute receipts from tourism, i.e. trade flows. Therefore, it can be interpreted as an aggregate demand function for tourism services by foreigners. As we take the short-term perspective, we analyze the loss of biodiversity. We expect a negative impact of potential biodiversity loss, namely the share of endangered bird species in all bird species living in a country, on inbound tourist receipts per capita. The additional

Table 3. Biodiversity and Revealed Comparative Advantage

	I	II	III	IV
Constant	0.467*** *(4.803)*	0.742*** *(6.741)*	0.741*** *(6.684)*	0.724*** *(6.469)*
BIRDS	2.597*** *(4.267)*	2.628*** *(4.627)*	2.767*** *(3.963)*	2.415*** *(3.161)*
GDP2003	- -	-3.09E-05*** *(-4.483)*	-3.08E-05*** *(-4.438)*	-3.08E-05*** *(-4.436)*
WHS	- -	- -	-41.3 *(-0.394)*	-56.5 *(-0.535)*
COAST	- -	- -	- -	0.487 *(1.127)*
R^2adj	0.1218	0.2365	0.2296	0.2314
N	125	124	123	123

Dependent variable is the RCA-index in 2003 as calculated above.
Absolute t-values in parenthesis.
* Significant at the 90 percent level.
** Significant at the 95 percent level.
*** Significant at the 99 percent level.

Table 4. Endangered Biodiversity and Tourism Receipts: Empirical Evidence

	I	II	III	IV
Constant	38.5 *(0.383)*	-856* *(-1.843)*	-874*** *(-3.630))*	-1,149*** *(-2.875)*
ENBIRDS	-2,228** *(-2.001)*	-3,035* *(-1.843)*	-2,896* *(-1.831)*	-4,616** *(-2.055)*
WHS	250,281*** *(14.360)*	273,977*** *(16.638)*	276,187*** *(17.212)*	275,827*** *(12.687)*
GDP2000	0.052*** *(3.772)*	- -	- -	- -
LE	- -	21.78*** *(3.933)*	22.28*** *(3.772)*	28.33*** *(3.393)*
EQ	- -	0.029 *(0.007)*	-0.58 *(-0.128)*	- -
COAST	223.8 *(1.226)*	85.9 *(1.108)*	- -	198.3 *(1.143)*
R^2adj	0.5843	0.4859	0.4872	0.3700
N	159	149	149	161

Dependent variable is the amount of Tourism Receipts per capita in 2003.
Absolute t-values in parenthesis.
* Significant at the 90 percent level.
** Significant at the 95 percent level.
*** Significant at the 99 percent level.

determinants of inbound tourism receipts of a country depend on roughly the same exogenous control variables as in model 1. However, we expect that the GDP per capita in the host country is positively influencing inbound tourism receipts per capita, as foreigners expect certain standards in the host country. As tourists plan some time in advance (Lim, 1997), we use data of 2000. Similarly, life expectancy can be interpreted as a proxy for personal security and the quality of the country's health system (positive). The distance to the equator increases the attractiveness for tourist.

$$TR_i = ß_0 + ß_1 ENBIRDS + ßx_{1+i} + \varepsilon$$
$$x_{1+i} \text{ representing controls, namely } GDP2000, WHS, LE, EQ \text{ and } COAST \quad (2)$$

The results support our second hypothesis. A potential biodiversity loss discourages international tourism; the result is robust when other control variables are added. The same holds with the positive impact of GDP on inbound tourism receipts and the number of world heritage sites. Whereas the latter are attracting foreign demand for domestic tourism services, potential biodiversity loss is deterring tourists. However, the explanatory power of other variables (with the exception of life expectancy) is relatively low, but the signs are as expected.

c) Biodiversity and Tourism Receipts: the Long-Term Perspective

Again we estimate an aggregate demand function for tourism services by foreigners, employing all of the foregoing and some additional exogenous variables to explain inbound tourism receipts of a country. Instead of biodiversity loss, we employ actual biodiversity abundance (BIRDS). We expect a positive influence from the presence of bird species to inbound tourism receipts per capita. For the rest of the control variables we also expect a positive sign.

$$TR_i = ß_0 + ß_1 BIRDS + ßx_{1+i} + \varepsilon$$
$$x_{1+i} \text{ representing controls, namely } GDP2000, WHS, LE, CCOR, POLST, LAW, VOICE, EQ, COAST, BORD, ICNU \text{ and } NET \quad (3)$$

The results in Table **5** indeed support the third hypothesis. Those countries rich in biodiversity are attracting high inbound tourism receipts per capita. This result is absolutely robust across all nine estimations. Our finding implies that it is sensible to assign the property rights of biodiversity to preserve biodiversity in the long run. The ratio of IUCN protected areas per total land area is used as an additional proxy for (imperfect) public assigned property rights of biodiversity, because in such protected areas the overuse of biodiversity is not permitted, the not exhaustible use for tourism purposes however is. This variable shows the right sign but is not significant, except in estimation V in which IUCN is significant at the 90 % level. Nevertheless, the result is encouraging as anecdotal evidence shows. Muir-Leresche and Nelson (2000) describe that in the past 30 years, Namibia and South Africa have given private landowners full control (and the full opportunity to profit) over the use of wildlife of their land. Consequently, wildlife tourism on private land has boomed. This task has had more success in promoting biodiversity in the southern African region than any other policy measure.

The other control variables, high GDP per capita (GDP2000) or high life expectancy (LE), good governance expressed with the World Bank governance indicators (CCOR, POLST, LAW, VOICE), as proxy for safety are relevant predictors for tourists' choice of a destination.[14] A high number of world heritage sites (as control for the 'cultural endowment' of a country) seemed to be beneficial for inbound tourism. For example, Rome and Athens but also Mexico, Peru and Guatemala would rank high in terms of cultural and historical outstanding UNESCO world heritage sites that stimulate substantial amounts of there tourism. Moreover, a mild climate (increasing distance to the equator) and good communication possibilities (a high rate of internet access) are also important for the demand for tourism, as tourists care for complementary goods and services. The higher the number of national borders the lower are the tourism receipts. Because long-range travelers generate high tourism receipts but will be discouraged by cross-border mass tourists, this finding is astonishing only at first glance, as the number of national borders is a typical determinant promoting the demand for mass-tourism (low travel costs), which is often not linked with high tourism receipts (see Freytag and Vietze 2009).The variable length of the coastline in relation to the size of the country (as a proxy for beaches) does not add much to the explanatory power of the model.

4. SUMMARY AND POLICY CONCLUSIONS

In this paper we discuss how biodiversity contributes to trade structures. While we are able to find a robust positive impact of biodiversity on the comparative advantage in tourism services in poor countries, the potential of sustainable tourism can be seen indirectly *via* absolute inbound tourism receipts per capita. These are positively influenced by the richness of biodiversity and negatively determined by a potential biodiversity loss. These results support the idea that sustainable tourism is growth friendly, although they do not provide strong evidence. Further research is necessary to learn more about price and income elasticities for sustainable tourism. Nevertheless, our results give us an indirect and

[14]As in regression model 2) we do not use GDP2000, LE, CCORR, POLSTAB, LAW and VOICE simultaneously in the same estimation because they are highly correlated. This counts also for LE and CCORR, POLSTAB, LAW and VOICE. See Table 2.

Table 5. Biodiversity and Tourism Receipts: Empirical Evidence

	I	II	III	IV	V	VI	VII	VIII	IX
Constant	-145.7 *(-1.488)*	595.7*** *(-3.184)*	-203.9 *(-0.725)*	-211.21 *(-0.722)*	-71.35 *(-1.552)*	296.8*** *(5.519)*	301.7*** *(4.850)*	306.0*** *(5.457)*	352.5*** *(4.607)*
BIRDS	1,905** *(2.056)*	2,447** *(2.340)*	2,149** *(2.068)*	2,167** *(2.048)*	1,004*** *(3.004)*	1,803** *(1.993)*	2,856* *(1.895)*	1,793** *(2.029)*	2,044** *(2.055)*
WHS	219,390*** *(9.663)*	236,164*** *(10.599)*	236,556*** *(10.679)*	236,690*** *(10.499)*	916,134** *(2.069)*	245,049*** *(12.236)*	232,126*** *(10.033)*	236,934*** *(11.647)*	234,538*** *(9.938)*
GDP2000	0.048*** *(3.459)*	- -	- -	- -	- -	- -	- -	- -	- -
LE	- -	9.90*** *(3.423)*	6.31* *(1.912)*	5.98* *(1.888)*	- -	- -	- -	- -	- -
CCORR	- -	- -	- -	- -	- -	372.7*** *(4.074)*	- -	- -	- -
POLST	- -	- -	- -	- -	- -	- -	290.7*** *(3.783)*	- -	- -
LAW	- -	- -	- -	- -	- -	- -	- -	386.6*** *(4.193)*	- -
VOICE	- -	- -	- -	- -	- -	- -	- -	- -	375.4*** *(3.690)*
EQ	- -	9.10* *(1.972)*	11.07** *(2.333)*	11.47** *(2.143)*	2.001 *(1.464)*	- -	- -	- -	- -
COAST	131.8 *(0.832)*	0.593 *(0.015)*	-21.55 *(-0.660)*	-19.88 *(-0.608)*	- -	- -	- -	- -	- -
BORD	- -	- -	-58.12** *(-2.160)*	-59.58** *(-2.301)*	- -	- -	- -	- -	- -
IUCN	- -	- -	- -	1.837 *(0.418)*	8.97* *(1.788)*	- -	- -	- -	- -
NET	- -	- -	- -	- -	0.8528*** *(4.594)*	- -	- -	- -	- -
R²adj	0.6128	0.5311	0.5394	0.5364	0.5131	0.5912	0.5676	0.5916	0.4240
N	159	149	149	149	117	159	152	159	160

Dependent variable is the amount of Tourism Receipts per capita in 2003.
Absolute t-values in parenthesis.
* Significant at the 90 percent level.
** Significant at the 95 percent level.
*** Significant at the 99 percent level.

encouraging hint that it makes sense for developing countries to preserve their biodiversity by assigning the property rights of these natural resource to private or governmental land owners or even to invest into more biodiversity.

ACKNOWLEDGEMENTS

The authors are indebted for helpful suggestions to two anonymous referees, Martin Abel, Joachim Ahrens, Helmut Karl, Christina Klose, Jens Krüger, Nils Laub, Martin Paldam, Gernot Pehnelt and Simon Renaud. An earlier version was presented at the Public Choice Society Meeting 2006 in New Orleans, at the Ruhr Graduate School Seminar 2006 and at the University of Göttingen in 2007. All remaining errors are the authors' responsibility.

Appendix A. Countries included in the Analysis

Afghanistan	Dominica	Libya	Saint Vincent and the Grenadines
Albania	Dominican Rep.	Liechtenstein	Samoa
Algeria	Ecuador	Lithuania	San Marino
American Samoa	Egypt	Luxembourg	Sao Tome and Principe
Andorra	El Salvador	Macao	Saudi Arabia
Angola	Equatorial Guinea	Macedonia, FYR	Senegal
Antigua and Barbuda	Eritrea	Madagascar	Seychelles
Argentina	Estonia	Malawi	Sierra Leone

Appendix A. Contd….

Armenia	Ethiopia	Malaysia	Singapore
Aruba	Fiji	Maldives	Slovakia
Australia	Finland	Mali	Slovenia
Austria	France	Malta	Solomon Islands
Azerbaijan	French Polynesia	Marshall Islands	Somalia
Bahamas	Gabon	Mauritania	South Africa
Bahrain	Gambia	Mauritius	Spain
Bangladesh	Georgia	Mayotte	Sri Lanka
Barbados	Germany	Mexico	Sudan
Belarus	Ghana	Micronesia	Suriname
Belgium	Greece	Moldova	Swaziland
Belize	Grenada	Monaco	Sweden
Benin	Guam	Mongolia	Switzerland
Bermuda	Guatemala	Morocco	Syria
Bhutan	Guinea	Mozambique	Taiwan
Bolivia	Guinea-Bissau	Myanmar	Tajikistan
Bosnia and Herzegovina	Guyana	Northern MarianaIs	Tanzania
Botswana	Haiti	Namibia	Thailand
Brazil	Honduras	Nepal	Togo
Brunei	Hong Kong	Neth. Antilles	Tonga
Bulgaria	Hungary	Netherlands	Trinidad and Tobago
Burkina Faso	Iceland	New Zealand	Tunisia
Burundi	India	New Caledonia	Turkey
Cambodia	Indonesia	Nicaragua	Turkmenistan
Cameroon	Iran, Islamic Rep.	Niger	Uganda
Canada	Iraq	Nigeria	Ukraine
Cape Verde	Ireland	Norway	United Arab Emirates
Cayman Islands	Israel	Oman	United Kingdom
Central African Rep.	Italy	Pakistan	United States
Chad	Jamaica	Palau	Uruguay
Chile	Japan	Panama	Uzbekistan
China	Jordan	Papua New Guinea	Vanuatu
Colombia	Kazakhstan	Paraguay	Venezuela
Comoros	Kenya	Peru	Vietnam
Congo, Dem. R.	Kiribati	Philippines	Virgin Island
Congo, Rep. of	Korea, DPRp	Poland	Yemen
Costa Rica	Korea, Republic of	Portugal	Zambia
Cote d'Ivoire	Kuwait	Puerto Rico	Zimbabwe
Croatia	Kyrgyzstan	Qatar	
Cuba	Laos	Romania	
Cyprus	Latvia	Russian Federation	
Czech Republic	Lebanon	Rwanda	
Denmark	Lesotho	Saint Kitts and Nevis	
Djibouti	Liberia	Saint Lucia	

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Received: December 19, 2008 Revised: January 20, 2009 Accepted: January 20, 2009