Climate Change Impacts on Tourism in the Mediterranean

Roberto Roson*
Martina Sartori§

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Abstract

This paper presents and discusses some quantitative results obtained in assessing the economic impact of variations in tourism flows, induced by climate change, for some Mediterranean countries. Estimates by a regional climate model are used to build a Tourism Climate Index, which indicates the suitability of climate, in certain locations, for general outdoor activities. As climate change is expected to affect a number of variables like temperature, wind and precipitations, it will have consequences on the degree of attractiveness of touristic destinations. We found, contrary to some findings in the literature, that climate change will generate positive effects for tourism in most northern Mediterranean countries. We estimate the macroeconomic consequences of increased tourism flows by means of a computable general equilibrium model. We found that more incoming tourists will increase income and welfare, but this phenomenon will also induce a change in the productive structure, with a decline in agriculture and manufacturing, partially compensated by an expansion of service industries. We found that, in most countries, the decline in agriculture entails a lower demand for water, counteracting the additional demand for water coming from tourists and bringing about a lower water consumption overall.

Keywords: Climate Change, Computable General Equilibrium, Tourism, Tourism Climate Index.

JEL Codes: C68, Q26, Q54, R13.

* Dept. of Economics, Ca'Foscari University, Venice and IEFE, Bocconi University, Milan, Italy. roson@unive.it
§ University of Milan, Italy. martina.sartori@unimi.it

1. Introduction

Among the many impacts that climate change can have on the economy, the impact on tourism activities is one of the most important, especially in some regions. Climate conditions are obviously crucial in determining tourism destination choices, so any change in climate conditions will have consequences in terms of number of incoming/outgoing tourists, tourism revenues, consumption patterns, income and welfare.

A number of studies have been conducted on the likely impact of climate change on tourism. Some studies just describe the new climate conditions that will emerge in the future (Amelung and Moreno, 2009, Perch-Nielsen, Amelung and Knutti, 2010). Some other studies goes beyond that, by estimating the implied variations in tourism flows (Hein, 2007). Very few contributions actually investigate the macroeconomic, systemic implications of changes in the production volume of the tourism industry, especially at the international level (Berrritella et al., 2006, Bigano et al., 2008, Galeotti and Roson, 2012).

Most studies focus on the effects of higher temperatures on tourism destination choices. However, temperature is just one of the various climate variables which may affect tourists' decisions, which also depend on the nature of recreational activities. For example, higher temperatures and lower precipitations may be bad for winter tourism (e.g., at alpine ski resorts), but may be good for summer tourism (e.g., at the beaches).

A very interesting approach is based on building a composite index of “climate suitability” for recreational activities (Mieczkowski, 1985). The most diffused and known index is the Tourism Climate Index (TCI), measuring the appropriateness of climate conditions for outdoor activities, which are especially relevant for summer tourism. Furthermore, summer tourism is by far the most important type of tourism, particularly in areas like the Mediterranean.

This paper uses some recent estimates of monthly TCI for a set of Mediterranean countries, which have been produced in the European research project WASSERMed[1]. Assuming some sensitivity of tourism flows to TCI, forecasts of TCI can be used to predict future tourism flows, as illustrated in Section 2 of this paper. Those findings have subsequently been used to set up a simulation exercise with a multi-regional computable general equilibrium (CGE) model. Considering the average expense per tourist in each country, all variations in tourism flows have been converted into additional income, and introduced in the CGE model as exogenous shocks. Results of the simulation exercise, presented in Section 3, allow assessing the macroeconomic implications of the expansion of the tourism industry. Implications for water demand are considered in Section 4. Variations in water demand are due to the direct effect of water use by tourists, as well as to the indirect change in water consumption coming from production activities, most notably agriculture. Finally, Section 5 provides some concluding remarks.

2. Changing Climate Conditions and Tourism Flows in the Mediterranean

We consider here eight Mediterranean countries: Spain, France, Italy, Malta, Slovenia, Croatia, Greece and Cyprus.[2] Table 1 shows the total number of nights spent by tourists in each country, followed by

1 WASSERMed (Water Availability and Security in Southern Europe and the Mediterranean Region) is a research project funded by the European Commission in the 7th Framework Program (contract no. 244255). For more information: http://www.wassermed.eu .

2 Our choice has been dictated by data availability.

the monthly distribution, where each number represents the percentage of total nights associated with a specific month.

Table 1. Total nights and monthly distribution 2009 (source: EUROSTAT, 2010)

COUNTRY	Nights (M)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Greece	61.1	1.6	1.7	2.2	4	9.7	14.8	19.6	21.9	14.5	6.2	2	2
Spain	349.4	4.6	5	6	7.5	8.3	9.9	14	16.4	10.4	8	5.1	4.9
France	294.7	3.9	4	4.6	5.4	8.3	9.2	19.7	22.6	8.6	5.4	3.9	4.3
Italy	357.9	4.1	4.2	4.4	5.7	7.7	11.6	18.1	21.5	10.5	5.4	3	3.8
Cyprus	12.9	2.6	2.7	4.1	6.4	10.2	12.4	14.2	16.1	13	11.3	4.5	2.6
Slovenia	8.1	6.1	6.2	5.7	7.1	7.5	9.3	14.9	16.8	9	7	4.9	5.4
Croatia	37.5	0.9	0.8	1.2	3.6	7.3	14.2	26.2	28.2	12.2	3.5	1	0.8
Malta	6.9	4.8	5.6	6.3	7.9	8.4	9.6	12.9	13.9	10.6	9.4	5.8	4.6

Kampragou et al. (2012) have processed the output[3] of the regional climate model RACMO2 (driven by the global model ECHAM5-r3) to obtain the TCI index for a set of Mediterranean countries, including those considered here. The TCI is calculated on the basis of rates assigned to sub-indices, referring to precipitation, temperature, humidity, sunshine duration and wind speed. An increase in temperature causes a relative increase in TCI values, which explain why (a) the highest value for the TCI index is found in Greece in July (August in the future), and (b) the global warming generally brings about an increase in the TCI.

Table 2. Estimates of TCI at present (1991-2010) and future (2036-2065) time

TCI PRESENT

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Greece	58.23	61.85	67.16	73.62	86.35	94.38	95.01	94.91	91.22	76.08	64.03	58.20
Spain	55.26	60.09	63.63	70.21	78.58	91.18	93.25	93.01	86.51	70.81	59.74	56.04
France	51.35	55.44	61.65	66.58	73.58	85.97	89.79	87.08	77.02	62.36	55.12	51.23
Italy	55.83	59.95	63.93	71.05	80.54	89.90	92.11	91.86	85.93	71.53	60.42	55.80
Cyprus	64.14	68.07	72.21	79.79	91.36	94.29	94.29	94.43	94.29	90.07	78.71	64.57
Slovenia	51.15	56.38	59.90	67.15	74.68	86.83	91.18	89.23	77.45	62.98	54.88	51.33
Croatia	53.36	57.12	63.72	70.23	81.06	91.90	94.35	94.00	85.42	67.89	57.74	53.18
Malta	61.00	63.00	67.00	73.00	77.00	89.00	94.00	94.00	94.00	89.00	74.00	62.00

TCI FUTURE

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Greece	59.16	63.82	68.73	76.35	90.36	94.99	95.09	95.15	93.76	81.47	64.94	59.84
Spain	56.31	60.29	64.91	72.75	83.75	92.67	94.11	94.22	90.50	74.32	61.62	57.85
France	52.00	56.81	61.32	66.53	76.08	88.08	92.05	91.74	81.58	64.79	56.10	51.79
Italy	56.29	61.38	65.13	72.54	83.85	91.76	93.13	92.92	88.59	74.47	61.92	57.42
Cyprus	66.57	70.07	75.86	85.14	94.14	94.21	93.07	91.43	94.43	91.64	83.36	67.71
Slovenia	52.10	57.00	61.38	66.88	77.95	90.50	94.03	92.25	82.23	63.65	55.95	53.08
Croatia	54.18	60.22	64.20	71.20	85.18	93.94	94.80	94.77	89.02	70.25	59.15	54.05
Malta	65.00	69.00	71.00	72.00	82.00	94.00	94.00	94.00	94.00	90.00	79.00	64.00

Amelung and Viner (2006) investigate the relationship between TCI values and arrivals of tourists in Mallorca. From their simple regression analysis it is found that a 1% increase in the TCI would trigger an increase in the number of nights/arrivals of about 21.87%. Assuming this elasticity value for the whole Mediterranean, considering the baseline data of Table 1, together with the estimated variations in the TCI reported in Table 2, it is possible to get an estimate of changes in tourists' nights per country

3 These data have been produced by the European research project ENSEMBLES.

and month, as illustrated in Table 3.

It can be readily seen that tourism flows are generally expected to increase, with only a few exceptions (e.g., Cyprus in July and August, Malta in April). The AVG column shows the yearly increase, which is a weighted average of monthly variations, with weights given in Table 1[4]. The largest improvements in climate conditions and tourism flows are expected to occur in Malta (February, November, January and May), Cyprus (April), Spain (May), Greece (October).

Table 3. Estimated variation in future tourism flows (monthly and yearly average)

	AVG	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Greece	0.40%	0.35%	0.70%	0.51%	0.81%	1.02%	0.14%	0.02%	0.06%	0.61%	1.55%	0.31%	0.61%
Spain	0.60%	0.41%	0.07%	0.44%	0.79%	1.44%	0.36%	0.20%	0.28%	1.01%	1.08%	0.69%	0.71%
France	0.70%	0.28%	0.54%	-0.11%	-0.02%	0.75%	0.54%	0.55%	1.17%	1.30%	0.85%	0.39%	0.24%
Italy	0.45%	0.18%	0.52%	0.41%	0.46%	0.90%	0.45%	0.24%	0.25%	0.68%	0.90%	0.54%	0.64%
Cyprus	0.23%	0.83%	0.64%	1.10%	1.47%	0.67%	-0.02%	-0.28%	-0.69%	0.03%	0.38%	1.29%	1.06%
Slovenia	0.65%	0.41%	0.24%	0.54%	-0.09%	0.96%	0.93%	0.68%	0.74%	1.35%	0.23%	0.43%	0.75%
Croatia	0.40%	0.34%	1.18%	0.17%	0.30%	1.11%	0.49%	0.10%	0.18%	0.92%	0.76%	0.54%	0.36%
Malta	0.62%	1.43%	2.08%	1.31%	-0.30%	1.42%	1.23%	0.00%	0.00%	0.00%	0.25%	1.48%	0.71%

EUROSTAT (2008) provides information, at the country level, on the “tourism balance”, which can be regarded as the difference between tourism expenditure by foreigners and expenditure by nationals traveling abroad. This balance is positive for all countries in our set, which means that they are net exporters of tourism services.

When a country becomes more attractive as a touristic destination, we can expect to see more incoming tourists and less outgoing tourists. However, we have not here enough data to reliably estimate variations in the flow of national tourists traveling abroad. Therefore, in order to roughly calculate the change in net receipts obtained in the future, we have just applied the yearly average of Table 3 to the surplus of the tourism balance in 2006 (2005 for Greece).

Table 4. Changes in net receipts (M€ 2006)

	Surplus 06	Increase
Greece (05)	8591	34.26
Spain	27445	164.23
France	12065	83.87
Italy	11969	54.24
Cyprus	1133	2.55
Slovenia	652	4.23
Croatia	5692	22.88
Malta	355	2.22

Results shown in Table 4 are estimates of additional income spent by foreign tourists in each country, as a consequence of the higher attractiveness induced by the climatic change. They are the starting point for an analysis of the systemic effects induced on the whole economic structure, presented in the following section.

3. Macroeconomic Implications

The economic impact of an increase in foreign tourists is characterized by two main effects: (a) more income, earned abroad, is spent in the hosting country, (b) the pattern of final consumption changes,

4 Therefore, changes in the seasonal distribution of tourism flows have not been considered.

with more demand concentrating on services, which include hotels, restaurants, transports, etc. The additional demand for domestic services pushes upwards the price of internal resources like labour, capital and land. All domestic products, as a consequence, become relatively more expensive than foreign products, causing some substitution of domestic goods with imports in the production and consumption processes. This loss of competitiveness deteriorates the balance of trade and causes a change in the whole structure of the economic system.

In order to effectively assess these system-wide effects, we carry out an analysis with a Computable General Equilibrium model. The model is an adaptation of the standard GTAP model described in Hertel and Tsigas (1997)[5]. A CGE model is a very large non-linear system, including market clearing conditions and accounting identities, tracing the circular flow of income inside an economic system. The model is typically calibrated using national accounting data, and simulation exercises are performed by shocking exogenous variables and parameters.

We have used the CGE model to simulate the effects of more incoming tourists in the Mediterranean countries considered in the previous section. The exercise is implemented by increasing international income transfers (with values as displayed in Table 4), while simultaneously shifting, by the same amounts, the demand for services produced in each of the eight Mediterranean countries. A counter-factual equilibrium is then computed by the model, in which all markets clear and all agents comply with their budget constraints (receipts equal expenditures).

Figure 1 shows the estimated percentage change in national income, which depends on the magnitude of the shock, as well as on the share of the tourism industry in the overall domestic production.

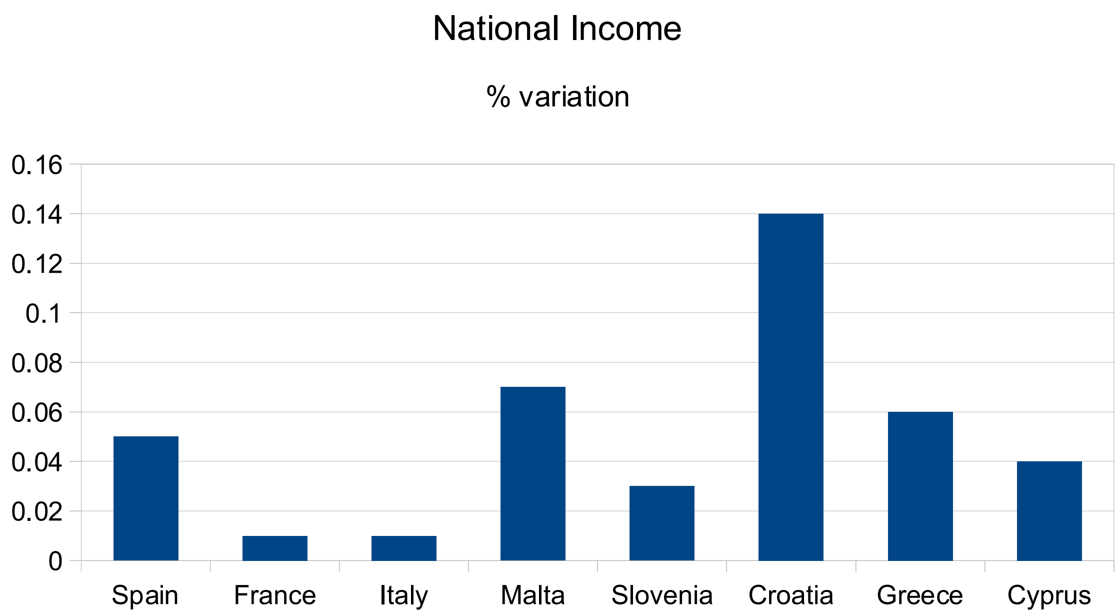

Figure 1

Higher income levels allow to expand consumption by households, thereby raising welfare. The Equivalent Variation (EV) is a money-metric measure of welfare effects, indicating what change in initial income would have had the same impact on welfare. Figure 2 shows the estimated EV for the countries at hand, measured in millions of U.S. Dollars (2004). Our findings indicate that the increased

5 Extensive documentation on the GTAP model is available at http://www.gtap.org .

attractiveness of northern Mediterranean countries expand welfare in a way which is equivalent to receiving money, from a minimum of 2.85 (Malta) to a maximum of 253.65 (Spain) millions of dollars.

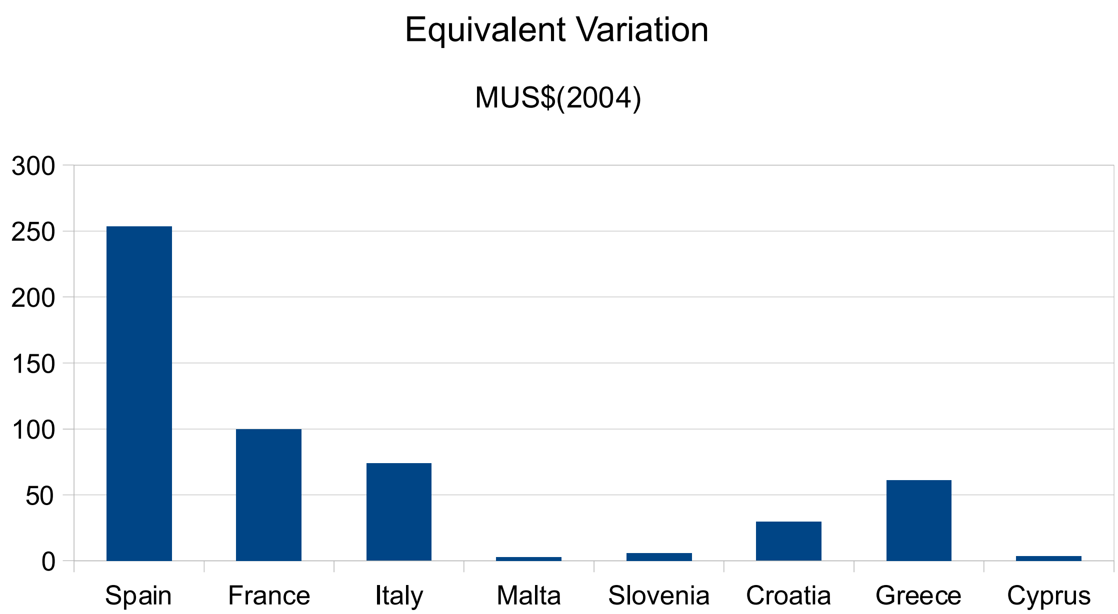

Figure 2

Not everybody gains in this game, though. As stated above, the additional demand from foreign tourists creates an inflationary pressure, which amounts to an appreciation of the real exchange rate, affecting the terms of trade, the trade balance and the firms' competitiveness on the foreign markets. Figure 3 displays the estimated change in the production volume of three aggregate sectors (Agriculture, Manufacturing and Services) in the Mediterranean countries.

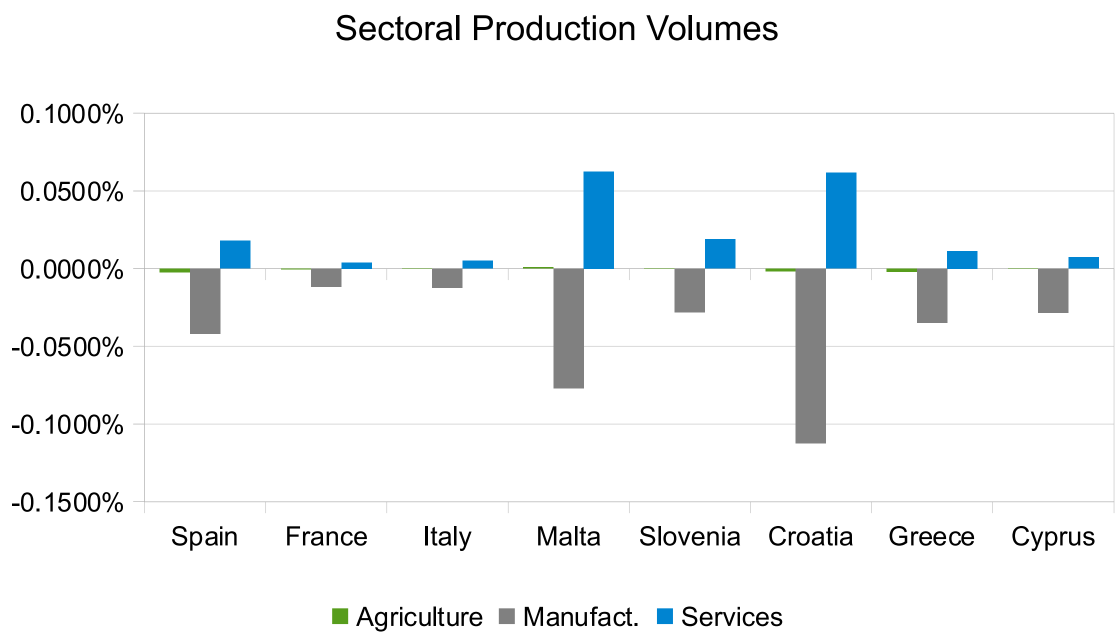

Figure 3

As one can see, the expansion in the service industries comes at the expense of the other two sectors, particularly Manufacturing. This is an example of a phenomenon, which is known in the literature as "the Dutch disease"[6], and the meaning is that higher competitiveness in the tourism industry brings about lower competitiveness elsewhere. The whole productive structure of a country changes, with possible consequences in terms of distribution of income and wealth.

4. Water Consumption

It is often feared that an expansion of tourism in areas like the Mediterranean, which are already water stressed (particularly during the summer), may exacerbate the water management problems, especially by creating conflicts for access to water resources between agriculture and tourism activities.

Savvides et al. (2001) estimate that one night stay by one tourist generates a demand for 0.465 cubic meters of water. Assuming this value for the whole Mediterranean, one can easily covert results like those in Table 3 in terms of additional demand for water, coming from the tourism sector. However, we showed in the previous section that the expansion of tourism is associated with a decline in agriculture and manufacturing.

The reduction in agricultural production is especially relevant here, because agriculture covers about 2/3 of total water usage in the region. Therefore, even a modest decline in agriculture could more than compensate the increased tourists' demand. In any case, not all water savings obtained in agriculture could be redirected to support water consumption by tourists. Much of the water used in agriculture is

6 The Dutch disease (Corden and Neary, 1982) is a concept that explains the apparent relationship between the increase in exploitation of natural resources and a decline in the manufacturing sector. The mechanism is that an increase in revenues from natural resources (or inflows of foreign aid) will make a given nation's currency stronger compared to that of other nations, resulting in the nation's other exports becoming more expensive for other countries to buy, making the manufacturing sector less competitive. While it most often refers to natural resource discovery, it can also refer to any development that results in a large inflow of foreign currency, like an increase in tourism receipts.

"green water" (Antonelli, Roson and Sartori, 2012), which is water embedded into the soil moisture, typically employed by rainfed agriculture. Water used for irrigation, which could potentially be transferred to other uses, is termed instead "blue water". Possible conflicts over the utilization of water resources only refer to blue water resources.

The green/blue water composition of agricultural water demand is very variable in the countries under consideration. Almost all water used in Croatia is green water; therefore, agriculture is not significantly subtracting water resources to tourism in that country. The opposite occurs in Cyprus, where about 71% of all water usage in agriculture is blue water.

Roson and Sartori (2010), using data from Chapagain and Hoekstra (2004), estimate water consumption per unit value of production in a set of agriculture industries. These data can be used to roughly calculate the change in water demand associated with changes in industrial outputs. The result, which refers to the indirect effect on water demand associated with the expansion of tourism, can therefore be compared with the direct consumption of water by tourists, as shown in Table 5 and graphically displayed in Figure 4.

Table 5. Changes in water consumption (m^3/year)

	Spain	France	Italy	Malta	Slovenia	Croatia	Greece	Cyprus
Ind. Green	-14649234	-6372604	-1857608	0	-100970	-1113174	-2683715	-14571
Ind. Blue	-3894100	-1903505	-1290880	0	-2061	-22718	-1864954	-35673
Direct	973189	951613	754171	19980	24398	70010	113524	13520
Global Balance	-17570145	-7324496	-2394317	19980	-78633	-1065881	-4435145	-36723
Blue Balance	-2920911	-951892	-536709	19980	22337	47292	-1751431	-22153

We see that the net effect of higher demand from tourism and lower demand from agriculture is net savings in water usage for all countries, with the exception of Malta, where the decline in agricultural production is negligible. Even the difference between tourism demand and blue water consumption by agriculture turns out to be positive for most countries under consideration, suggesting that the expansion of tourism activities is not likely to create conflicts for access to water resources.

This is a somewhat surprising and non trivial finding of our analysis. It has been obtained here because the change in water demand has been assessed into a general equilibrium framework, in which systemic and second-order effects can be detected.

Water Demand

variations (m3)

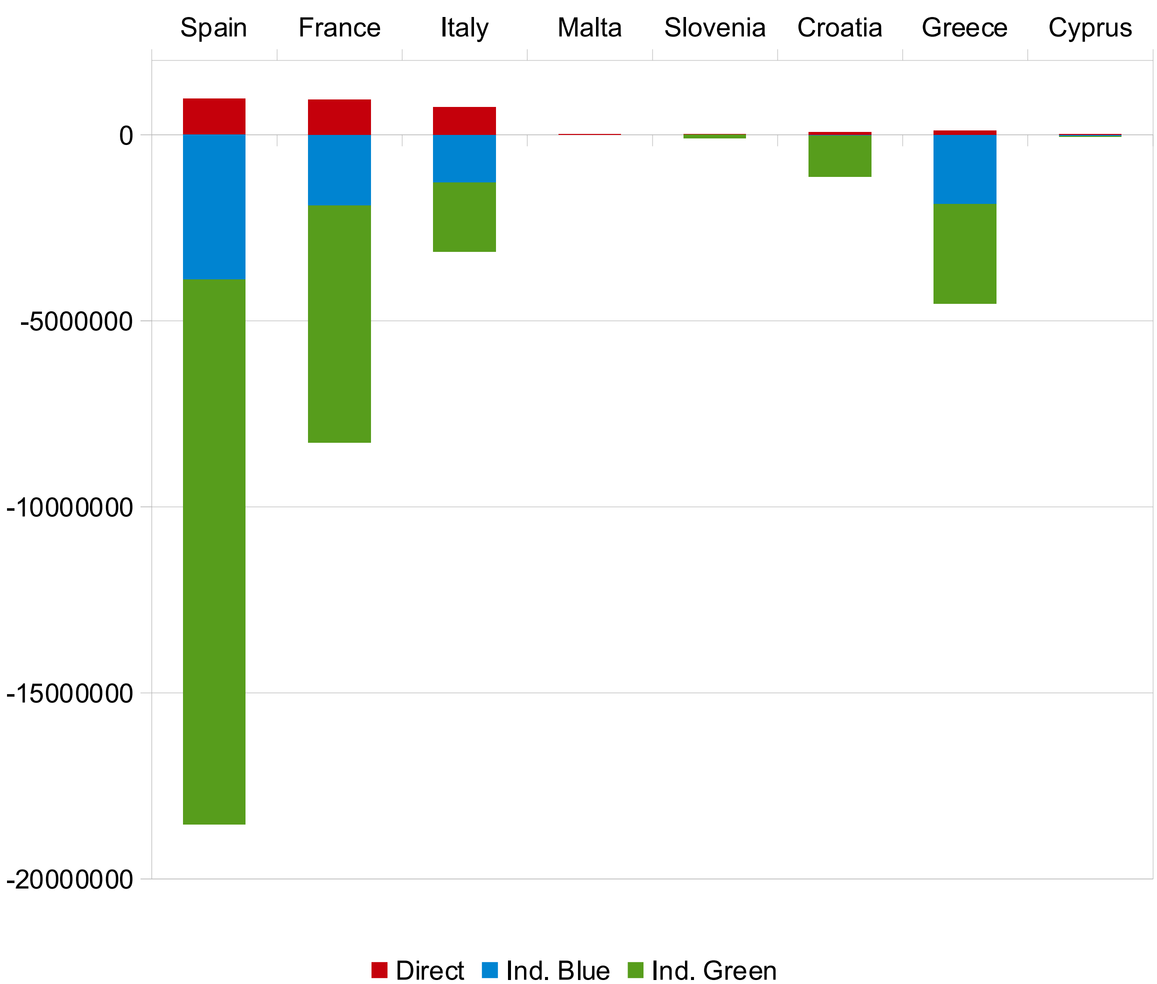

Figure 4

4. Conclusions

Climate change may generate positive effects for tourism in most northern Mediterranean countries, at least in the medium term. This is because much of the tourism in the area is related with outdoor activities during the summer, which actually benefit from higher temperatures and reduced precipitations. This effect is well captured by a composite index (TCI), which considers temperatures alongside other climatic variables.

In this paper, we presented some early estimates of the likely impact of changing climate conditions for tourism flows in eight Mediterranean countries. In addition to assessing the increase in incoming tourists' flows and receipts, we analyzed the system-wide consequences of the inflow of foreign currency. For all countries in the set, the stronger tourism attractiveness results in higher national income, consumption levels and welfare. However, distributional effects are felt through the contraction of production and competitiveness in those industries not directly linked to tourism.

This generates some interesting and unexpected consequences in terms of water consumption. The increase in tourists' arrivals and stays implies a higher demand for water from the tourism industry but, nonetheless, the reduction of production volumes in agriculture brings about a global reduction in water demand. Even if attention is confined to "blue water", that is the water used for irrigation and potentially transferable to alternative uses, net water savings remain positive in most Mediterranean countries.

To the best of our knowledge, this is the first study in which, by assessing higher tourism attractiveness into a general equilibrium framework, this kind of effect is detected and highlighted.

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