Economics Bulletin

Volume 40, Issue 3

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The author would like to thank the two anonymous referees for their useful remarks.
Citation: Jean-François Hoarau, (2020) "Is international tourism responsible for the pandemic of COVID-19? A very preliminary assessment with a special focus on small islands", *Economics Bulletin*, Volume 40, Issue 3, pages 2395-2407
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Submitted: April 18, 2020. **Published:** August 31, 2020.

Economics Bulletin

Submission Number: EB-20-00339

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Abstract

This note aims at analysing the role of international tourism attractiveness as a potential factor for the outbreak and the spread of the recent COVID-19 disease across the world with a special focus on small island economies. Econometric testing over a cross-section sample including 205 countries/territories, states that a positive and significant relationship exists between COVID-19 prevalence and inbound tourism arrivals. Thus international tourism must be seen as one of the main responsible factors for the recent pandemic. Accordingly, this finding suggests that the tourism specialization model in the context of small islands is too vulnerable to be considered as sustainable in the medium and long-run.

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1. Introduction

Since the first official case of COVID-19 reported by the Chinese authorities in mid-December 2019, what was initially a Chinese problem became rapidly an international concern. Only three months were sufficient to transform a local epidemic into an unprecedented pandemic affecting now more than 190 economies around the world (WHO, 2020). Even if it is too soon to have a clear idea about the economic consequences, the first assessments suggest that this health crisis would damage dramatically almost all countries. In a recent note, OECD (2020) argues that "the initial direct impact of the shutdowns could be a decline in the level of output of between one-fifth to one-quarter in many economies with consumers' expenditure potentially dropping by around one-third. Changes of this magnitude would far outweigh anything experienced during the global financial crisis in 2008-09[1]." Unsurprisingly tourism will be one of the most impacted sectors. OFCE (2020) has already estimated €14 billion losses for France for each month of confinement measures. More generally, the earlier literature demonstrated that infectious disease outbreaks (SRAS in 2003, Chikungunya in 2005, MERS in 2012, Ebola virus in 2014 or different events of influenza) caused a strong and immediate drop in the tourism frequentation for the affected countries, even if the effect appeared often transitory (Siu and Wong, 2004; Novelli et al., 2018; Peeri et al., 2020). Very recent economic works relative to the COVID-19 go in the same direction, but the adverse impacts both on the supply and demand sides would be undoubtedly deeper and longer (Peeri et al., 2020; Yang et al., 2020).

However, very few works have studied the reverse link that is the impact of tourism attractiveness of a destination on infectious disease outbreaks. International tourism is obviously a victim of infectious epidemics but it is also a major factor of health epidemic spread. Scholars in epidemiological and medicine studies shed light on the potential for dramatically rapid dissemination of virus throughout the world as the world continues to experience expanding global trade markets and increasing international travel (Smolinski et al. 2003 ; Baker, 2015). In particular, infections carried by humans and transmitted from person to person are especially likely to move from one region to another. A virus such as the COVID-19, which can colonize without causing symptoms or can be transmissible at a time when infection is asymptomatic, spread easily in the absence of recognized infection in traveling hosts. Then, assuming that the contemporaneous transportation networks give the opportunity to go around the world in less than 36 hours, international tourism flows could transform local epidemics to global pandemics (Hufnagel et al., 2004). That is the reason why the WHO usually gives the recommendation to close prematurely many borders and discourages tourism in the affected areas[2].

At our knowledge, no article in the field of economics has studied this relationship at date. The aim of this note is to fill this gap by checking if this proposition holds in the context of the COVID-19. First, we test for the correlation between the destinations' tourism attractiveness, proxied by international tourism arrivals, and the domestic magnitude of the epidemic, measured from the number of COVID-19 cases over a worldwide cross-section sample (205 countries/territories including 58 small islands)[3]. Second, we estimate a causal link by using traditional econometric regressions. We make a special focus on small island economies for which the contribution of tourism to economic output generally exceeds that in other regions of the world (Pratt, 2015; Cannonier and Galloway Burke, 2018). Precise that

[1] It is similar to a decrease of about 2-3% in annual GDPs for each month of confinement.

[2] Hufnagel et al. (2004) claimed that simulations strongly support the strategy of travel restrictions, especially isolation of largest cities, as a necessary requirement for controlling highly contagious epidemics.

[3] The full list of the countries/territories is given in the appendix.

this work is a very preliminary study requiring of course in the future a more robust investigation.

The rest of the paper is as follows. Section 2 presents the data and highlights some relevant stylized facts. Section 3 introduces the empirical approach and gives the main results. Section 4 concludes.

2. Data and preliminary stylized facts

Tourism attractiveness is measured by the number of international tourism arrivals[4] in 2018 (the last available year with consolidated data) extracted from the WTO's database[5]. The use of the year 2018 for tourism flows ensures that tourism arrivals are exogenous relative to the COVID-19 crisis, then allowing us to interpret the later estimated regressions as causal ones, i.e. the endogeneity bias does not exist. Moreover, following the last report of WTO (2020), the time evolution of annual international tourism arrivals since 2009 is quite stable around a mean of about 4-5%. All regional destinations (may be except for Middle East) are concerned by this stable trend until the breakdown in mid-March 2020 due to the lockdowns in many countries and the closing of many borders around the world (Table 1). Accordingly, we argue that past tourism data (here 2018) are good predictors for tourism traffic relative to the period conductive to the spread of the Covid-19 that is November 2019 to March 2020.

Table 1. Outlook for international tourist arrivals (2016-2020)

	Change				average a year	2020 Projection (issued January)
	2016	2017	2018	2019*	2009-2019*	from
World	**3.8%**	**7.2%**	**5.6%**	**3.8%**	**5.1%**	**+3% to +4%**
Europe	2.5%	8.8%	5.8%	3.7%	4.6%	+3% to +4%
Asia and the Pacific	7.7%	5.7%	7.3%	4.6%	7.1%	+5% to +6%
Americas	3.7%	4.7%	2.4%	2.0%	4.6%	+2% to +3%
Africa	7.8%	8.5%	8.5%	4.2%	4.4%	+3% to +5%
Middle East	-4.7%	4.1%	3.0%	7.6%	2.7%	+4% to +6%

Source: World Tourism Organization (UNWTO) © * Provisional data

Note that in the context of infectious disease outbreaks, studying the role of outbound international tourists would have been also informative, but this data does not exist for numbers of small countries. Moreover, we opt to follow strictly the conventional definition of international tourism so that we do not consider cruise passengers. COVID-19 prevalence for each country/territory is proxied by the number of cases up to April 3 2020 obtained from the database published on line by Johns Hopkins University[6]. For several small island territories the data was obtained from local health institutions. We also take into account the size effect by dividing the original series by the number of population. In order to limit the problem of

[4] Inbound visits include those made for leisure, recreation and holidays, visiting friends and relatives, and business and professional purposes.

[5] See https://www.e-unwto.org/doi/pdf/10.18111/9789284421251.

[6] See https://coronavirus.jhu.edu/map.html. These data must be taken with caution due to a different strategy of domestic testing by each country. However the order of magnitude still stays informative.

outliers, we applied the log transformation[7] to the original series (in levels and per capita). Table 2 gives basic statistics for both original and modified variables.

Table 2. Summary statistics for the variables

Statistics	Nb of obs.	Min	Max	First Quartile	Median	Third Quartile	Mean	Standard deviation
Covid19 cases	205	0	245646	14	156	1015	5051	22729
Int. tourism arrivals	205	2400	86900000	295500	1296000	5360500	6051958	12918663
Covid19 per capita	205	0.00000	0.00728	0.00001	0.00004	0.00021	0.00030	0.00082
Tourism per capita	205	0.00078	34.67262	0.05748	0.31597	1.01053	1.35413	3.61564
LnCovid19_pc	205	-17.16537	-4.92244	-12.00284	-10.12705	-8.45231	-10.32777	2.52452
LnTourism_pc	205	-7.16306	3.54595	-2.85630	-1.15212	0.01047	-1.35333	2.03500

Source: author's calculations. LnCovid19_pc and LnTourism_pc are the log transformations of the variables of Covid19 per capita and Tourism per capita respectively.

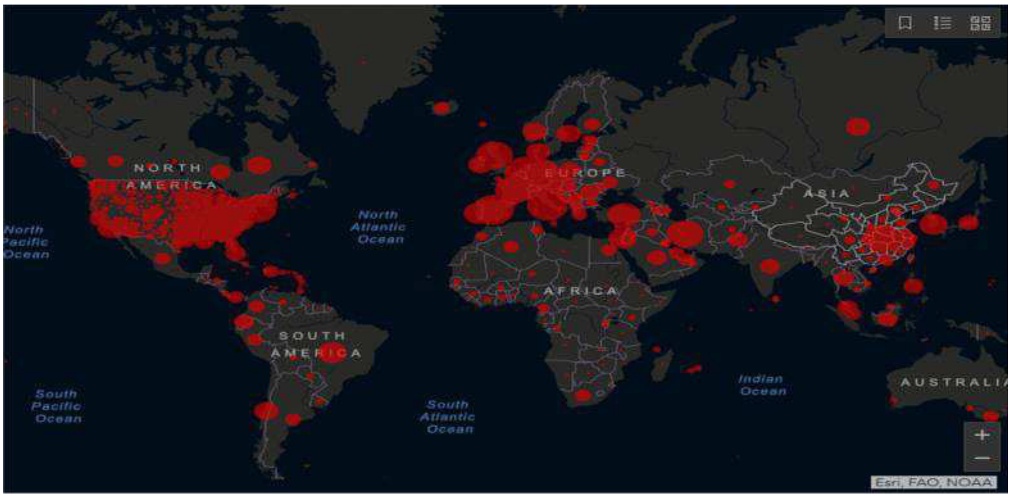
Before implementing econometric testing, simple interesting stylized facts about the nature of the relationship between COVID-19 infection outbreaks and inbound tourism flows must be discussed. Figures 1 and 2 put forward a strong matching between the highly infected areas (East Asia, Western Europe and USA) and the distribution of world transport networks. The apparent connection between the air transport network and the most affected regions is particularly striking but perfectly in line with the literature in medicine sciences. There is a consensus today about the impact of air travel on the spread of emerging and established infectious diseases (Smolinski, 2003; Mangili and Gendreau, 2005; Leder and Newman, 2005)[8]. Concerning the COVID-19, the potential ways for the dissemination consist in (i) of course the ability of a contagious human to travel to virtually any part of the world within only one or two days, (ii) the travel process itself because of infections might be spread on the aircraft through close contact, large droplets and small-particle aerosols, and (iii) the time spent before boarding (the use of mass transportation to get to the airport and the close exposure to many people inside the often crowded terminals[9]). Obviously, several dimensions drive air travel flows such as international tourism (inbound and outbound flows) and "non-tourism" related air traffic. However, as mentioned in WTO (2020), international air passenger traffic, measured in revenue passenger kilometres, grew in line with international tourist arrivals, with a 4.0% increase through November 2019. All regions contributed positively to this result. Consequently, it is not too strong to make the assumption of a positive correlation between international tourist arrivals and global air traffic.

[7] For the numbers of COVID-19 cases we applied the formula log(1+x) because of the presence of 0.

[8] The literature in medicine also mentioned several other potential factors influencing the emergence of infectious diseases: (i) microbial adaptation and change, (ii) human susceptibility to infections, (iii) climate and weather, (iv) changing ecosystems, (v) economic development and land use, (vi) human demographics and behaviour, (vii) technology and industry, (viii) breakdown of public health measures, (ix) poverty and social inequality, (x) war and famine, (xi) lack of political will, and (xii) intent to harm.

[9] Wick and Irvine (1995) stated that the air inside the bus and airline terminal could have a higher level of microbial contamination than that inside the aircraft itself.

Figure 1. Coronavirus COVID-19 cumulative Cases in the world, April 3 2020



Source: the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University.

Figure 2. Global transport networks (road, sea, air)

Note: road transport in green, sea transport in blue, air transport in red.
Source: AndrewGloe, December 6 2017.

Moreover, Table 3 points out that the countries the most concerned by the epidemic are also the countries the most attractive in terms of international tourism. Indeed, looking at the top-10 of the best performers relative to the variable of inbound tourism flows (Panel A), we find 8 of the 10 most infected economies that is USA, Spain, Italy, Germany, China, France, United Kingdom and Turkey. A similar conclusion can be formulated for the small island world (Panel B). 8 out of the 10 most affected small islands (Singapore, Hong Kong, Bahrain, Puerto Rico, Cyprus, Hawaii, Cuba, and Malta) belong to the 10 best insular performers in terms of international tourism arrivals. These first promising findings require of course a more robust investigation.

Table 3. Top-10 of the most concerned countries by COVID-19 cases and international tourism arrivals

Panel A. The Worldwide sample

Countries	**Number of COVID-19 cases**	**Countries**	**Inbound tourism arrivals**
USA	245 646	*France*	86900000
Spain	117 710	*Spain*	82000000
Italy	115 242	*USA*	75600000
Germany	85 903	*China*	59300000
China	82 509	*Italy*	52400000
France	59 929	Mexico	39300000
Iran	53 183	*United Kingdom*	37700000
United Kingdom	38 659	*Turkey*	37600000
Switzeland	19 303	*Germany*	37500000
Turkey	18 135	Thailland	32600000

Panel B. The small island world

Countries	**Number of COVID-19 cases**	**Countries**	**Inbound tourism arrivals**
Iceland	1 364	*Hong Kong*	29263000
Singapore	1 114	Macao	18493000
Hong Kong	862	*Singapore*	12051000
Bahrain	672	*Bahrain*	11621000
Puerto Rico	378	*Hawaii*	9760000
Cyprus	356	*Puerto Rico*	3542000
Reunion	321	*Cuba*	3491000
Hawaii	319	*Cyprus*	3187000
Cuba	233	Jamaica	2182000
Malta	202	*Malta*	1966000

Source: the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University; the UNWTO.

3. Empirical methodology and main results

A worldwide application

Our main goal is to detect an empirical causal link between the prevalence of COVID-19 disease and international tourism attractiveness for a large worldwide sample including 205 countries/territories. Then, the hypothesis we want to validate is the more an economy characterized by high international tourism levels per capita the more this economy concerned with high levels of COVID-19 infections per capita. The empirical strategy is based on two steps: (i) testing for the correlation between COVID-19 infections per capita and international tourism arrivals per capita, and (ii) estimating within a cross-section framework a causal linear regression of COVID-19 infections with inbound tourism flows as an explanatory variable. All econometric simulations use the XLSTAT software. Note that the log transformation should strongly limit the influence of outliers. However, considering the fact that the 8 most affected countries by the COVID-19 represent together 77% of total cases, we ran the estimations also onto a reduced worldwide sample that is without USA, Spain, Italy, Germany, China, France, Iran and the United Kingdom.

On the one hand, we applied the usual procedures of Pearson, Spearman and Kendall, to test for the correlation between the number of COVID-19 infections per capita and inbound tourism flows per capita. Regardless of the sample, the correlation coefficients and the associated p-value (at the 1% significance level) displayed in Table 4 indicate that a strong, positive and significant correlation holds between the two variables.

Table 4. Correlation tests between COVID-19 prevalence and International tourism arrivals

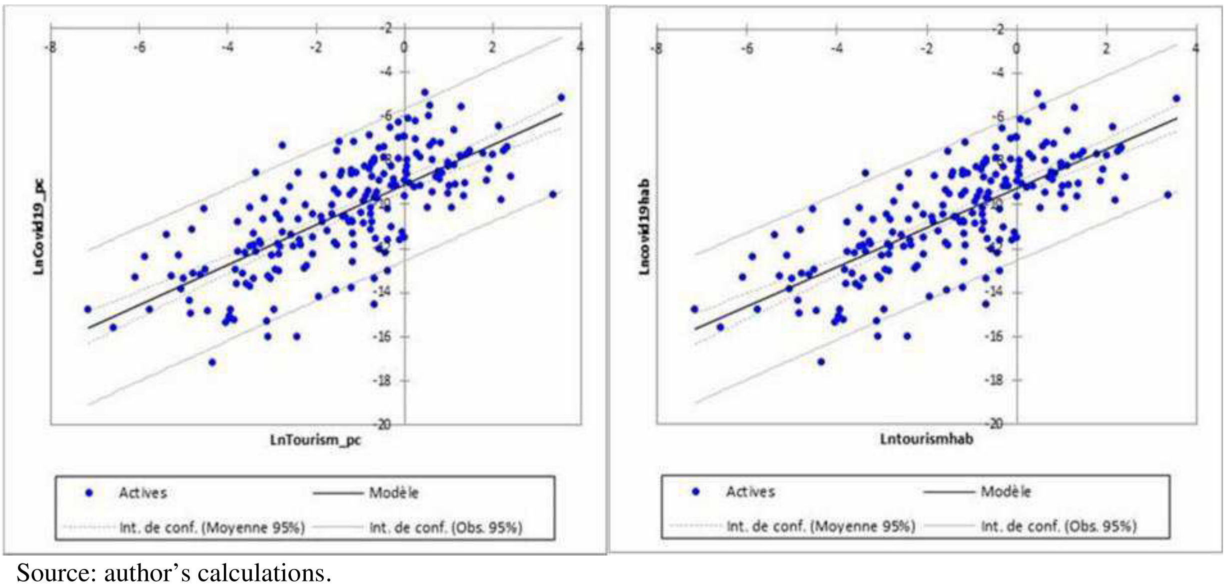
	The whole sample			The reduced sample		
Variables	**Pearson**	**Spearman**	**Kendall**	**Pearson**	**Spearman**	**Kendall**
Coefficient	0.728	0.741	0.538	0.743	0.762	0.557
p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Source: author's calculations. The tests are implemented at the 1% significance level.

On the other hand, as already noted earlier, considering that the endogeneity bias is not expected to exist enables us to estimate the number of COVID-19 cases per capita (the dependant variable) as a linear function of international tourism arrivals per capita (the explanatory variable). The results are displayed in Figure 3 and Table 5[10].

Figure 3. Representation for the linear models, the whole and reduced samples

Panel A. The whole sample **Panel B. The reduced sample**



Source: author's calculations.

[10] The robustness tests usually applied to check the statistical reliability of the specifications have been implemented with success. Indeed, the linear form is accepted (Harvey Reset test) together with the normality (tests of Shapiro-Wilks and Jarque-Bera) and the homogeneity (tests of Breusch-Pagan and White) of the residuals. The tests of Grubbs and Dixon have been used for detecting potential outliers. The results are available upon request.

Table 5. The estimated linear models for the entire and reduced worldwide samples

Panel A. The whole sample LnCovid19_pc = -9.10559+0,90309*LnTourism_pc

Source	Value	Standard error	t	Pr > |t|	Lower bound (95%)	Upper bound (95%)
Constant	-9.106	0.146	-62.414	< 0.0001	-9.393	-8.818
LnTourism_pc	0.903	0.060	15.128	< 0.0001	0.786	1.021
R^2	0.570					
R^2 (adjusted)	0.528					
F (Fisher)	228.869					
Pr > F	< 0.0001					

Panel B. The reduced sample LnCovid19_pc = -9.22673+0.89714*LnTourism_pc

Source	Value	Standard error	t	Pr > |t|	Lower bound (95%)	Upper bound (95%)
Constant	-9.227	0.143	-64491	< 0.0001	-9.509	-8.945
LnTourism_pc	0.897	0.058	15.498	< 0.0001	0.783	1.011
R^2	0.555					
R^2 (adjusted)	0.552					
F (Fisher)	244.079					
Pr > F	< 0.0001					

Source: author's calculations.

First, surprisingly for a simple linear regression, the R^2 is clearly strong. This indicates that 52.8% for the Panel A and 55% for the Panel B of the variability of the COVID-19 prevalence is explained by the international tourism attractiveness[11]. Furthermore, the F test of Fisher emphasizes that the variable of inbound tourism arrivals alone provides a significant proportion of information. The probability associated to the F-stat is lower than 0.0001, supporting that we cannot reject the null of a well-suited specification.

Second, looking at the estimated equations, a positive and significant trend characterises the nexus between COVID-19 infections per capita and annual inbound tourism arrivals per capita. Note that the intervals of confidence relative to both the constant and the coefficient of interest are very tight given some robustness to the estimates. Moreover, regardless the sample considered, the coefficient approximately equals 0.9, underlining the presence of a quasi-proportional relation between the two variables. Insofar as these latter are used in logs, the estimated coefficient must be interpreted as an elasticity so that an increase of 10% in international tourism attractiveness results in an increase of around 9% in the expected number of COVID-19 infections per capita. Accordingly, this preliminary study concludes

[11] Of course, this result also indicates that taking into account additional determinants would improve significantly the explanatory power of the model. This will be done in a future investigation. In addition, a first investigation including other controls supports the fact that the omitted variable issue is not a problem (Hoarau, 2020). More generally, the statistical cost resulting from the omitted variable bias depends on the goal of modelling. What matters here is to make a prediction for the Covid-19 prevalence conditional on international tourist arrivals. Therefore, in this special case, this bias is not strongly detrimental.

that international tourism may be considered as both responsible for and victim of the outbreak and the spread of the COVID-19 crisis across the world in the first stage of the pandemic.

Implications for the small island economies

This finding is particularly disturbing and dramatic for small island territories. Most of them are largely dependent on international tourism both in terms of GDP and of exports (see Table 6). Because of international tourism is found to be a main factor of COVID-19 outbreak, we guess that tourism development contains the seeds of its own destruction. Thus, tourism specialization, that is the model adopted by many small islands, is too much vulnerable to be considered as a sustainable strategy in the medium and long-run due to a very high exposure to health epidemics as the recent COVID-19 one.

Table 6. International tourism indicators for a selected set of small island economies

Small island economies	**International tourism**		
	per 1000 inhabitants	**receipts % of GDP**	**receipts % of exports**
Turks and Caicos	11708.483	76.982	..
Macao	29277.939	73.266	88.730
Sint Maarten	4378.413	71.539	58.871
Aruba	10222.495	68.764	75.190
Antigua and Barbuda	2793.760	60.289	84.311
Maldives	2877.664	57.326	82.694
St. Lucia	2171.654	51.461	81.271
Grenada	1659.878	46.209	84.338
Palau	5919.473	42.959	86.262
Seychelles	3741.138	38.423	35.421
St. Kitts & Nevis	2383.631	36.307	60.639
Vanuatu	396.337	35.546	62.844
US Virgin Islands	3561.513	31.180	..
St. Vincent & the Grenadines	725.887	29.705	76.270
Bahamas	4234.519	27.228	77.247
Cabo Verde	1305.706	26.507	53.584
Belize	1276.526	26.026	45.206
Fiji	984.739	24.744	51.324
Samoa	836.180	23.315	62.574
Barbuda	2372.305	21.866	..
Dominica	879.581	20.149	68.538
Jamaica	842.631	19.721	53.376
Curacao	2702.551	19.342	31.568
Guam	9344.385	17.800	..
Sao Tome and Principe	158.273	17.026	73.194
Cayman Islands	7214.760	15.209	19.864
Mauritius	1105.664	15.197	38.881

Source: The World Development Indicators, The World Bank.

Our results are in line with the theoretical and empirical literature dealing with the so-called Tourism Area Life Cycle model [TALC hereafter] (Butler. 2011; Charles et al.. 2019). The TALC model argues that all tourism destinations are characterized by a common dynamic process reproducing a S-shaped curve and experiencing a series of stages from exploration to involvement, development, consolidation, stagnation, and post-stagnation (which can be a decline without convenient economic policies). Following the chaos approach (Russel and Faulkner. 2001; Russel. 2006), the transition from one stage to the next is not linear or deterministic because of tourism resorts, whatever its maturity, heavily depend on a set of unpredictable triggers whose impacts are also unpredictable with a magnitude out of proportion to the initial shock. Amongst these triggers, the literature emphasized particularly the role of exogenous shocks, such as health crises[12]. These one-off shocks are expected to damage the attractiveness of the destination sharply and instantly, but with the possibility of a persistent impact in accordance with the butterfly effect principle (Faulkner and Russel. 2001).

However, contrary to the previous works we question the exogenous property of health crises. We show that international tourism development due to its globalized dimension strongly increases the probability of health epidemic outbreaks. In short, the more a country attractive in terms of foreign tourism, the more this probability high, and thereafter the more it will be damaged by the necessary measures for limiting the spread of the disease such as air traffic restrictions and strict lockdowns. Thereafter, these health-care measures are likely to generate a dramatic and deep economic and social crisis, especially for the countries largely depending on tourism such as numbers of small islands. Thus, in the context of the insular world, this finding implies that relying on tourism is too dangerous, then suggesting that policymakers should opt for a strategy of diversification rather than tourism specialization[13] when possible.

4. Conclusion

Finally, this study showed that international tourism more than a victim appears mostly as a major factor of the COVID-19 pandemic outbreak. A quasi-proportional positive and significant relationship exists, suggesting that an increase of 10% in inbound tourist arrivals leads to an increase of 9% in the prevalence of COVID-19 infections. This finding supports the well-accepted result in epidemiological and medicine studies that international travel and tourism constitute strong forces in the emergence of diseases and will continue to shape the outbreak, frequency, and spread of infections in geographic areas and populations. This important conclusion is very disturbing for the small island economies. Most of them have adopted for a long time a model of development largely focused on international tourism. Taking into account the obvious impact of major extreme events such as health epidemics, we claim that tourism specialization is too vulnerable to be considered as sustainable in the medium and long-run. Therefore, we are in accordance with the mainstream literature (Briguglio, 1995; Guillaumont, 2010; Closset et al., 2018) arguing that small island economies, and in particular small island tourist economies, are highly structurally vulnerable and require a special attention from the international community.

Note that this preliminary work suffers from methodological limits associated with the use of the simple linear model. In a future study, we will test for the validity of our relationship of

[12] Other exogenous shocks are also discussed, namely international economic and financial crises, wars, terrorism, and natural disasters (Baker, 2005).

[13] Earlier works already put forward this finding in the context of climate change (Closset et al., 2018; Goujon and Hoarau, 2020).

interest by introducing into the econometric specification several variables of control coming from different fields (geography, demographics, climate, and socioeconomics).

References

Baker D.Mc.A. (2005) "Tourism and the health effects of infectious diseases: Are there potential risks for tourists?" *International Journal of Safety and Security in Tourism/Hospitality* **12**, 1–17.

Brigulio L. (1995) "Small island developing states and their economic vulnerabilities" *World Development* **23(9)**, 1615-1632.

Butler R.W. (2011) *Tourism Area Life Cycle: Contemporary Tourism Reviews*, 1–33, Oxford: Goodfellow Publishers.

Cannonier C, Gallowey Burke M. (2018) "The economic growth impact of tourism in Small Island Developing States-evidence from the Caribbean" *Tourism Research* **25(1)**, 85-108.

Charles A., Darne O., Hoarau J.F. (2019) "How resilient is La Réunion in terms of international tourism attractiveness: an assessment from unit root tests with structural breaks from 1981-2015" *Applied Economics* **51(24)**, 2639–2653.

Closset M., Feindouno S., Guillaumont P., Simonet C., (2018) "A Physical Vulnerability to Climate Change Index: Which are the most vulnerable developing countries?" *Ferdi Working paper*, P213, october.

Faulkner B., Russell R. (2001) "Turbulence, Chaos, and Complexity in Tourism Systems: A Research Direction for the New Millennium", in *Tourism and the 21st Century: Reflections on Experience*, edited by B. Faulkner, G. Moscardo, and E. Laws, 328–349. London: Continuum Books.

Goujon M., Hoarau J.F. (2020) "Le tourisme insulaire à la merci du changement climatique : une évaluation par un indice synthétique de vulnérabilité physique" *Etudes et Documents*, CERDI, Forthcoming.

Guillaumont P. (2010) "Assessing the economic vulnerability of small island developing states and the least developed countries" *Journal of Development Studies* **46(5)**, 828-854.

Hoarau J.F. (2020) "Is international tourism responsible for the pandemic of COVID19? A preliminary cross-country analysis with a special focus on small islands" *TEPP Working Papers*, n°2020-04, 1-25.

Hufnagel L., Brockmann D., Geisel T. (2004) "Forecast and control of epidemics in a globalized world" *Proceedings: National Academy of Sciences* **101(42)**, USA, 15124-15129, October.

Leder K., Newman D. (2005) "Respiratory infections during air travel" *International Medicine Journal* **35**, 50-55.

Mangili A., Gendreau M.A. (2005) "Transmission of infectious diseases during commercial air travel" *Lancet* **365**, 989-996.

Novelli M., Gursing Burgess L., Jones A., Ritchie B.W. (2018) "No Ebola … still doomed – The Ebola-induced tourism crisis" *Annals of Tourism Research* **70**, 76-87.

Observatoire Français de Conjoncture Economique [OFCE] (2020) "Évaluation au 30 mars 2020 de l'impact économique de la pandémie de COVID-19 et des mesures de confinement en France" *OFCE Policy brief*, **65**, 30 mars https://www.ofce.sciences-po.fr/pdf/pbrief/2020/OFCEpbrief65.pdf.

Organization for Economic Cooperation and Development [OECD] (2020) "Evaluating the initial impact of COVID-19 containment measures on economic activity" *OECD note* http://www.cica.net/wp-content/uploads/2020/04/200331_OECD_evaluating-initial-impact-of-Covid-19.pdf.

Peeri N.C., Shrestha N, Rahman M.S., Zaki R., Tan Z., Bibi S., …, Haque U (2020) "The SARS, MERS, and novel coronavirus (COVID-19) epidemics, the newest and biggest global health threats: What lessons have we learned? *International Journal of Epidemiology*, Forthcoming, https://doi.org/10.1093/ije/dyaa033.

Pratt S. (2015) "The economic impact of tourism in SIDS" *Annals of Tourism Research* **52**, 148-160, May.

Russell R. (2006) "Chaos Theory and Its Applications to the Tourism Area Life Cycle Model", in *The Tourism Area Life Cycle: Conceptual and Theoretical Issues*, edited by R. W. Butler, 164–179, Clevedon: Channelview Publications.

Russell R., Faulkner B. (2004) "Entrepreneurship, Chaos, and the Tourism Area Life Cycle" *Annals of Tourism Research* **31(3)**, 556–579.

Siu A., Wong Y.C.R. (2004) "Economic Impact of SARS: The Case of Hong Kong" *Asian Economic Paper* **3(1)**, 62-83.

Smolinski M.S., Hamburg M.A., Lederberg J. (2003) *Microbial Threats to Health: Emergence, Detection, and Response*, Committee on Emerging Microbial Threats to Health in the 21st Century, 398p. http://www.nap.edu/catalog/10636.html.

World Health Organization [WHO] (2020) *Coronavirus disease (COVID-2019) situation reports* https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports/.

World Tourism Organization [WTO] (2020) *World tourism barometer*, **18(1)**, January, 1-5. https://webunwto.s3.eu-west-1.amazonaws.com/s3fs-public/2020-01/UNWTO_Barom20_01_January_excerpt.pdf.

Yang Y., Zhang H., Chen X. (2020) "Coronavirus pandemic and tourism: Dynamic stochastic general equilibrium modelling of infection disease outbreak" *Annals of Tourism Research*, Forthcoming.

Appendix

Table A.1. The worldwide sample

South Africa	Congo	**Cayman Isl.**	Mexico	San Marino
Albania	South Korea	**Solomon Isl.**	Moldavia	**St Vincent & the Gren.**
Algeria	Costa Rica	**UK Virgin Isl.**	**Monaco**	**Samoa**
Germany	Côte d'Ivoire	**US Virgin Isl.**	Mongolia	**Sao Tome & Principe**
Andorra	Croatia	India	Montenegro	Senegal
Angola	**Cuba**	Indonesia	Mozambique	Serbia
Antigua & Barbuda	**Curacao**	Iraq	Myanmar	**Seychelles**
Saudi Arabia	Danemark	Iran	Namibia	Sierra Leone
Argentina	Djibouti	Ireland	Nepal	**Sin Maarten**
Armenia	**Dominica**	**Iceland**	Nicaragua	**Singapore**
Aruba	Egypt	Israel	Niger	Slovakia
Australia	El Salvador	Italy	Nigeria	Slovenia
Austria	Unit. Arab Emirates	**Jamaica**	Norway	Sudan
Azerbaijan	Ecuador	Japan	**New Caledonia**	Sri Lanka
Bahamas	Eritrea	Jordan	New Zeland	Sweden
Bahrain	Spain	Kazakhstan	Oman	Switzerland
Bangladesh	Estonia	Kenya	Uganda	**Suriname**
Barbuda	Eswatini	**Kiribati**	Uzbekistan	Syria
Belgium	USA	Kuwait	Pakistan	Tajikistan
Belize	Ethiopia	Kyrgyzstan	**Palau**	Taiwan
Benin	**Fiji**	Lao PDR	Panama	Tanzania
Bermuda	Finland	Lesotho	**Papua New Guinea**	Chad
Bhutan	France	Latvia	Paraguay	Czech Rep.
Belarus	Gabon	Lebanon	Netherlands	Thailand
Bolivia	Gambia	Libya	Perou	**Timor-Leste**
Bosnia & Herzegovina	Georgia	Liechtenstein	Philippines	Togo
Botswana	Ghana	Lithuania	Poland	**Tonga**
Brazil	Greece	Luxembourg	**French Polynesia**	**Trinitad & Tobago**
Brunei	**Grenada**	**Macao**	**Puerto Rico**	Tunisia
Bulgaria	**Guadeloupe**	North Macedonia	Portugal	Turkmenistan
Burkina Faso	**Guam**	Madagascar	Qatar	**Turks & Caicos**
Burundi	Guatemala	Malaysia	Central African Rep.	Turkey
Cambodia	Guinea	Malawi	D.R. Congo	**Tuvalu**
Cameroun	**Guinea-Bissau**	**Maldives**	Dominican Rep.	Ukraine
Canada	**Guyana**	Mali	**Reunion**	Uruguay
Cabo Verde	**French Guyana**	**Malta**	Roumania	**Vanuatu**
Chile	**Haiti**	Morocco	United Kingdom	Venezuela
China	**Hawaii**	**Martinique**	Russia	Vietnam
Cyprus	Honduras	**Mauritius**	Rwanda	Yemen
Colombia	**Hong Kong**	Mauritania	**St Lucia**	Zambia
Comoros	Hungary	**Mayotte**	**Saint Kitts & Nevis**	Zimbabwe

Note: Small island economies are in bold.