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Measuring the Impact of Epidemic Outbreaks on Financial Results.

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Abstract

The aim of the study is to analyze the impact of epidemic outbreaks on financial results on the example of the tourism industry in the world and therefore to emphasize decision-making process under uncertainty in economics. To measure the impact of epidemic outbreaks on financial results on the example of the Tourism Industry we use Hodrick & Prescott (1997), Stock & Watson (1999) and Hamilton (2018) approach on data from 1995 to 2019 (185 countries). The study results indicate that total (registered) direct costs of the epidemic outbreaks from 1980 to 2019 on the world level amounts to -95 billions US\$ less in tourism spending and 56 million tourist arrivals drop. Total (potential) opportunity costs of epidemic crisis from 1980 to 2019 measured by the one-side HP filter worldwide equals -83 millions tourist arrivals and -126.7 US\$ billions of tourist spending. Summary of our findings on estimates from the one-side (HP) (2009) and Hamilton's filter (2018) declare opportunity costs have an important role in managing tourism demand. In case of practical implications, the effective decision making process in time of COVID-19 demands flexible and innovative growth models, long-term macroeconomic stability, effective epidemic measures, and state subsidies.

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1. Introduction

Crises are an inherent feature of the functioning of the economy and have been present in the history for years. History of economy is rich in examples of financial crises, but is also familiar with many epidemics, which consequently trigger financial crises. The scale of these crises is different as the scale of consequences varies from country to country or region to region.

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What we know for sure is that crises as well as epidemics and pandemics will be even more frequent. What is the main reasons for that? Without any doubt one of the major reason is consequence of globalization process. Gossling et al. indicate increasing availability of air transport, from luxurious options to cheap and massive for both leisure and business travel [1]. Pongsiri et al. highlight that the causes are to be found in greater mobility and trends in urbanization as well as social and global environmental changes, such as climate change, migration, and population growth [2]. Devaux et al. point out that increased meat consumption and loss of biodiversity increase the risk of transmission of diseases [3].

Without any doubts state financial COVID-19 support play a crucial role in mitigating pandemic adverse effects using effective decision-making process.

Burkle stated that not only big also small-scale disasters should be supported by cohesive sociopolitical and economic interventions define a country's public health capacity. A number of factors can contribute to future complex emergencies: urbanization of global populations; the demographic prevalence of the world's poor in urban settings; failing public health infrastructure; lack of moral integrity of governments; availability of and access to weapons, including weapons of mass destruction; economic inequities and corruption; undisciplined military, paramilitary and police; suspension of the rule of law; wanton violations of protective treaties; failures in environmental and ecological security; food and water insecurity; and transmigration of populations due to conflict or political, economic and environmental issues [4].

Between 1900 and 2020, there were at least 5 major crises worldwide caused by an external disorder coming from outside the economic system, in this case medical-epidemiological:

- encephalitis (1915), influenza (Spain, 1918), flu (Asia, 1957), flu (Hong Kong, 1968), AH1N1 pandemic (2009).

In November 2019, the SARS-CoV-2 virus was identified in China among bats, which, as a result of the infection, has spread around the world causing a crisis whose final outcome is still unknown, but according to economists from all over the world, the scale of the crisis and its consequences will be much greater than in the years of the great crisis of 1929-1933 as well as the financial crisis 2008-2011.

The tourism industry is very much a reality in many countries and in some of them is the engine of the economy, there is little research on the impact of the epidemic on the industry's financial performance. Epidemics/pandemics and the tourism industry are closely linked to each other due to the potential for infectious and transmission effects. Therefore, the tourism industry is particularly sensitive to function in crisis conditions, both caused by financial crises and epidemics, which consequently lead to financial crisis. However, this sensitivity is different depending on the crisis and the region.

As far as we notice until now (July 2020) the impact of COVID19 pandemic shock on the travel tourism industry is significantly underestimated. The financial consequences for this industry are likely to be much more pessimistic than assumed. What is more, the current situation as well as the planned second round of epidemics force not only a number of aid measures for the industry but also a long-term change of business models of companies. Empirical studies on pandemic outbreaks' impact on the tourism industry are widely missing in the literature.

The goal of this paper is to measure the impact of epidemic outbreaks on financial results on the example of the tourism industry in the world and therefore to emphasize decision-making process under uncertainty in economics. To measure the impact of epidemic outbreaks on financial results on the tourism industry we use Hodrick & Prescott [5], Stock & Watson [6] and Hamilton [7] approach on data from 1995 to 2019 (185 countries).

This paper is contains a continuation of the research published “Impact of COVID19 on Travel & Tourism Industry” (2021) Technological Forecasting and Social Change, Skare, Riberio Soriano, Porada – Rochoń [8]

The paper has four parts. First, summary of epidemic outbreaks worldwide since 1980 in section 2. The research methods with a summary of the results in section three. The conclusion (section 4) discusses theoretical, empirical and practical implications of the paper.

2. Pandemic outbreaks and tourism industry – research results

Empirical studies on pandemic outbreaks' impact on the tourism industry are widely missing in the literature. This may be due to the fact that the research topic is very complex. Many factors, both direct and indirect, influence the condition of the tourism industry during the pandemic. It's not just the number of infected number of deaths and region of occurrence of the disease (including region zero) but also the intensity and speed of spread to other regions, time of year, duration, media impact (information noise and negative messages) and last but not least government's reactions (restrictions as well as the financial stimulus).

It is also impossible not to notice that a global crisis such as the one in 2007 has had a significant impact on the tourism industry. According to The World Tourism Organization [9] estimation, due to the worldwide financial crisis

international tourist arrivals declined by 4.2% in 2009 to 880 million. International tourism receipts reached US\$ 852 billion (611 billion euros) in 2009, corresponding to a decrease in real terms of 5.7% on 2008.

Nowadays, the reverse is true that it is a pandemic that is making the global crisis happen. In case of tourism industry large but in the real short term had the effect of the September 11 terrorist attacks (2001). Research findings done by Zeng et.al. confirm that in China they registered 32.56% decline in non-resident arrivals as a result of terrorist attack [10].

This, in turn, results in a lack of emergency scenarios and recommendations for the redefinition of business models of tourism companies. The lack of the above is particularly evident during the Covid - 19 pandemic, when managers have to redefine their business models, often without knowing how to do it. We are sure that the behaviour of tourists and their preferences will be significantly changed.

A comparative analysis of the number of infections during equal epidemics in the last 50 years shows that the highest number of infections occurred during H1N1 (2009) and amounted to 762 630 000 prohibited infections. Together with the number of infected people during, the effect on lost arrivals and lost spending was more visible. Given the epidemic H1N1 (2009), the tourism industry has been most affected in Europe with a loss of 26 million of arrivals and loss of 61 bln \$ in tourism spending. The second most affected region was America with loss of 7 million of arrivals and loss of 21 bln \$ in tourism spending. The second pandemic that had an impact on losses in the tourism industry was the epidemic SARS (2002). The most affected region was Asia and Pacific with loss of 12 million of arrivals and loss of 2 bln \$ in tourism spending. In the case of the other epidemics under consideration, their impact on the financial results was much less significant or no impact at all [8].

Page et al. analysed the impact of two events: the global crisis and the swine flu pandemic on the tourism industry in the United Kingdom and proved that GBP 4,7 billion of revenue was lost between Q1 2008 and Q2 2009, of which GBP 3,7 billion was for the economic crisis and GBP 940 million for the swine flu epidemic. Moreover, this represents an accumulated loss of tourism revenue in the United Kingdom of approximately 19,6% in relation to the year 2007 expenditure figures. In addition, the study showed that during the three-month period in which it was examined in this study, the swine flu pandemic caused 20% of the total direct income losses between Q1 2008 and Q2 2009 [11].

Kou et al. [12] found Asian tourism demand has been significantly damaged by SARS, unlike Avian Flu. These results were confirm also by McAleer et al [13]. Blake et al.[14] checked the outbreak of foot and mouth disease (FMD) in the UK in 2001 and confirm its a negative impact on tourism industry. In 2001 they found reduction in tourism expenditure by 7.7 £ bilion as well as fall in GDP due to the reduction in tourism expenditure by 2 £ billion.

It's not clear how the final number of infected people will be in the case of Covid -19. We can expect that, the economic and social consequences can be enormous and unprecedented.

The study with the widest coverage in the literature testing the impact of COVID-19 on the travel tourism industry worldwide was done by Skare et al. [8] The study results indicate that the travel and tourism industry contribution to the GDP will decline from - 4.1 US\$ trillions to -12.8 US\$ trillions. The total tourism industry contribution to employment will fall from -164506 million to -514080 million jobs. Lost inbound tourist spending will plunge from -604.8 US\$ billion to -1.9 US\$ trillions with a fall in capital investments of -362.9 US\$ billion to -1.1 US\$ trillions.

3. Methods and results

To study the total impact (direct + indirect) on tourism supply and demand during epidemic crisis we follow two separate procedures (for results robustness). We measure direct impact as total loss in tourist arrivals and tourism spending in time of epidemic crisis (from UNWTO data). To measure the indirect impact due to travel restrictions, terrorism, decline in spending on the outbound market and change in socioeconomic, environmental conditions worldwide we use Hodrick & Prescott [5], Stock & Watson [6] and Hamilton [7] approach.

Because of the drawback in Hodrick & Prescott [5] (HP) filter - spurious dynamic relations of the data-generating process, end of the sample issue, smoothing parameter selection, values selection to use in the detrending operation. One-sided (HP) filter in Stock & Watson [6] eliminates some of the issues in the two-sided (HP) filter taking the form

$$H y_t = \tau_t + \varepsilon_t, \tag{1}$$

$$(1 - L)^2 \tau_t = \eta_t \tag{2}$$

with y_t = data series in the logarithm form, τ_t = unobserved trend component with ε_t, η_t as white noise sequences (uncorrelated).

We display the results of applying the one-sided (HP) filter on the data from the UNWTO from 1980 to 2019 in the table 1. We use one-side(HP) filter to extract tourist arrivals (demand) if the number of arrivals were to follow the long-run path (long-term trend). Extracted trend values represents the (potential) number of tourist arrivals that would be registered in a no-epidemic crisis scenario. Deviations in the registered number of tourist arrivals from the long-run trend (arrivals long-run path) represent (direct+indirect) arrivals in time of epidemic crisis.

We can see, as expected, that direct + indirect tourism (potential) losses in time of epidemic outbreaks are significantly higher when compared to the actual (registered) data. Comparing the potential losses we calculated using the one-side HP filter we can see that during the H1N1 (2009) crisis Africa region lost -1.69 bln US\$.

In this case potential losses almost equals actual losses. In all other epidemic outbreaks episodes in Africa from 1980 to 2019, looking at the actual data in the table 2 we can see that there was no decline in tourist arrivals or tourism spending. However, when looking to the potential losses measured by the one-sided HP filter we can see that Africa did experience potential losses in tourism demand for other epidemic outbreaks' crisis as well (see table 1). We can see that during the Bird flu (1997) Africa did not register any decline in the tourist arrivals or tourism spending according to the data from the UNWTO. Still, Africa during the Bird flu episode register a decline of -0.1 mln tourist arrivals and -0.2 bln US\$ loss in tourism spending. Hendra (1994) crisis had an impact of 2.5% on tourism with loss arrivals -0.5 bln US\$. Comparing the calculated impact factor and measured potential losses in tourist arrivals and spending we can observe few interesting facts. First fact is that actual (registered) data from UNWTO do not reflect the true impact on the tourism demand in time of epidemic outbreaks. Although actual data show an increase in the tourist arrivals and no losses in tourism demand for several outbreaks' episode, we can see that the majority of the epidemic outbreaks episodes were followed by a decline in the potential tourist arrivals and loss tourist spending.

Table 1: Tourist arrivals and spending (direct + indirect effects) in time of epidemic outbreaks by world regions (estimated by one-sided HP filter)

Region	Epidemic Outbreak	Impact depth (in%)	Recovery time (years)	Lost arrivals (in mln)	Lost spending (US \$bln)
Africa	Hendra (1994)	2.6	1	-0.5	-
	H5N1 Bird Flu (1997)	0.5	0	-0.1	-0.04
	Nipah (1998)	0	0	-	-
	SARS (2002)	0.8	0	-0.2	-
	H1N1** (2009)	0	1	-	-1.69
	MERS*** (2012)	1.6	0	-0.9	-1.12
	H7N9 Bird Flu (2013)	0.3	0	-0.2	-1.66
Americas	Hendra (1994)	1.4	1	-1.5	-1.71
	H5N1 Bird Flu (1997)	1	1	-1.2	-
	Nipah (1998)	1.1	1	-1.3	-
	SARS (2002)	8.4	1	-8.9	-11.1
	H1N1** (2009)	2.4	1	-3.4	-7.78
	MERS*** (2012)	0	0	-	-
	H7N9 Bird Flu (2013)	0	0	-	-
Asia &	Hendra (1994)	0	0	-	-
	H5N1 Bird Flu (1997)	2.3	2	-2	-0.76
Pacific	Nipah (1998)	5.9	1	-5.3	-11.6
	SARS (2002)	7.5	1	-8.5	-2.04
	H1N1** (2009)	3.5	1	-6.5	-
	MERS*** (2012)	0	0	-	-
	H7N9 Bird Flu (2013)	0	0	-	-

Europe	Hendra (1994)	0	0	-	-4.72
	H5N1 Bird Flu (1997)	0	0	-	-3.27
	Nipah (1998)	0	0	-	-
	SARS (2002)	1.2	1	-4.9	-
	H1N1** (2009)	5.9	2	-28	-26.5
	MERS*** (2012)	0	0	-	-19.4
	H7N9 Bird Flu (2013)	0	0	-	-
Middle	Hendra (1994)	0	0	-	-3.37
East	H5N1 Bird Flu (1997)	0	0	-	-
	Nipah (1998)	0	0	-	-21.7
	SARS (2002)	0	0	-	-
	H1N1** (2009)	0.9	1	-0.4	-
	MERS*** (2012)	8	2	-4.2	-
	H7N9 Bird Flu (2013)	9.8	1	-5	-8.27

Notes: Impact is calculated as 1-(potential/actual tourist arrivals)

This means that although no direct costs were registered in time of a particular epidemic crisis (looking at official data), countries and regions still do experience opportunity costs in the number of tourist arrivals that could be achieved if the case of no epidemic crisis. That fact holds also for other regions in the sample during different epidemic crisis. We present the data in the table 1 available for discussion which is not presented here due to the space constraints to discuss all the data from the table 1. Figure 2 support the results of the one-side HP filtering in the table 1 showing lost tourist arrivals (opportunity cost) by the world regions from 1980 to 2019. Opportunity costs of tourism demand are much higher in relation to the registered (accounting cost) in the official statistical databases.

We can see from the table 1 that Europe during the SARS (2002) crisis experience impact on tourism demand of 1.2% with a decline in -4.9 mln potential tourist arrivals but with no decline in the potential tourism spending. Why was not a decline in the potential tourist arrivals of -4.9 mln reflected in the decrease in the potential tourism spending? The answer is increased quality of the tourism supply and higher potential spending per tourist arrival. In Europe, during the SARS (2002/2003) episode tourist spending per arrival increased from 610 US\$ to 700 US\$. Europe facing a decline in the potential number of tourist arrivals offset the decline in the potential tourism spending through increased potential spending per arrival. Opportunity costs of tourism spending reveal to the policymakers and practitioners that managing tourism demand should be always focused on spending and not arrivals. The total tourism demand is more vulnerable to the impact of external shocks to the tourism spending per person than number of tourist arrivals. Tourist arrivals are necessary but not sufficient condition to maximize economic impact of a tourist season in different external (exogenous) conditions.

Total (registered) direct costs of the epidemic outbreaks from 1980 to 2019 on the world level amounts to 95 bln US\$ less in tourism spending and 56 million tourist arrivals drop. Total (potential) opportunity costs of epidemic crisis from 1980 to 2019 measured by the one-side HP filter worldwide equals -83 mln tourist arrivals and -126.7 US\$ bln of tourist spending.

To check the robustness of the results of using one-sided HP filter presented in the table 4 we use Hamilton (2018)

$$y_{t+h} = \beta_0 + \beta_1 y_t + \beta_2 y_{t-1} + \beta_3 y_{t-2} + \beta_4 y_{t-3} + v_{t+h} \tag{3}$$

$$\hat{v}^{t+h} = y_{t+h} - \beta_0 - \beta_1 y_t - \beta_2 y_{t-1} - \beta_3 y_{t-2} - \beta_4 y_{t-3} \tag{4}$$

Hamilton [7] use non-stationary time series data (number of tourist arrivals and tourism spending) fitting the OLS regression using $y_t + h$ (our most recent data for tourist arrivals and spending) for annual data ($h=4$). From the derived stationary residuals (forecast errors stationary assumption) we isolate the stationary and cyclical component of the series.

Schuler [15] find Hamilton's filter do not exhibit same drawbacks as the (HP) filter but is affected by the regression bias. Hamilton's regression filter tends to exceed the actual cycle frequencies (longer extracted cyclical component).

Both filters' exhibit some drawbacks, however they are standard methods for isolating trend and cycles in time series data.

Table 2 show the results of applying the Hamilton's filter on the tourist arrivals and spending by the world regions from 1980 to 2019. We can see that the results validate the results of the (HP) filter in the table 1. Opportunity costs (lost tourist arrivals and spending) in the form of Hamilton's cycles are visible below.

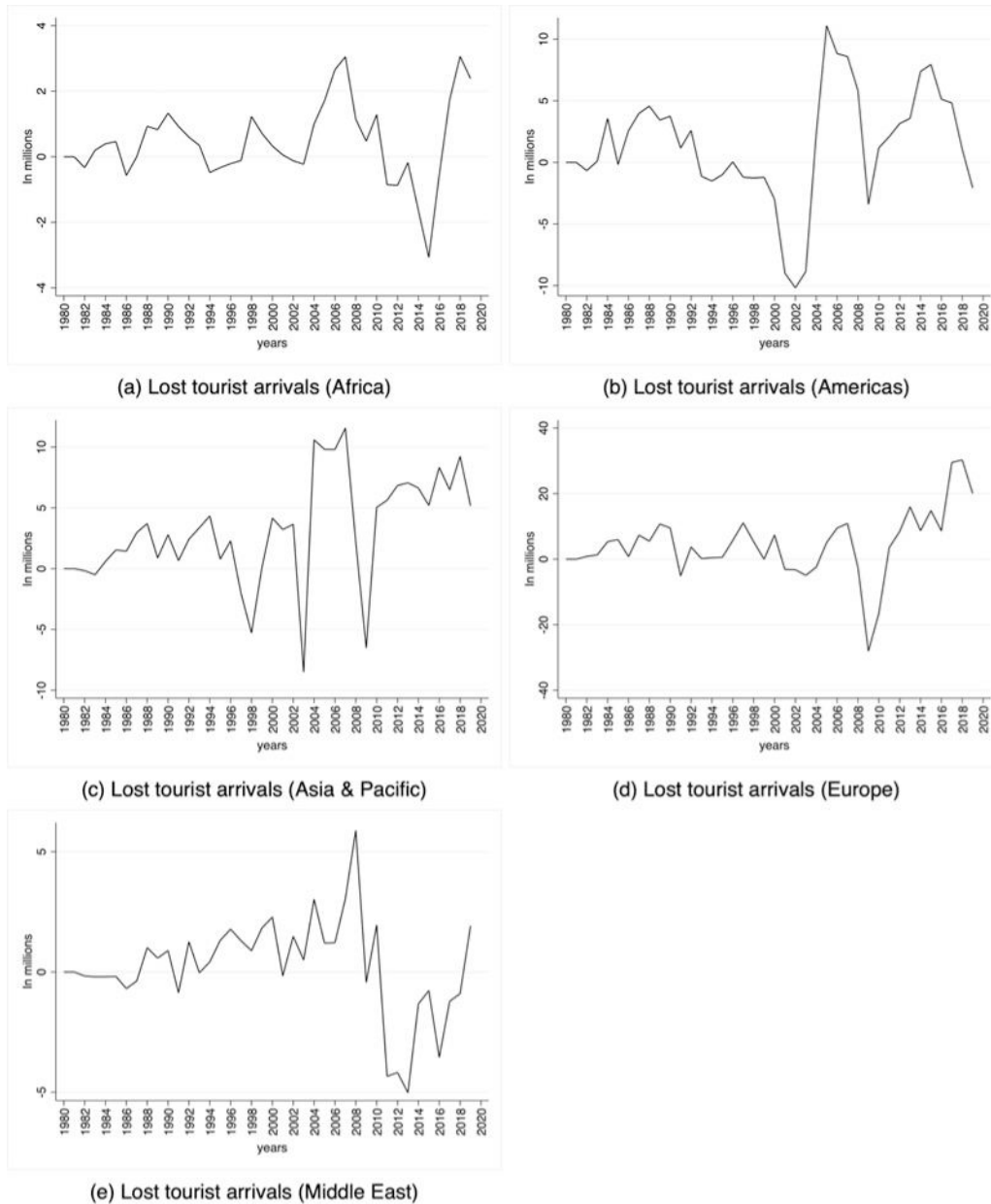


Fig. 1: Lost (potential) tourist arrivals by the world regions 1980-2019 (estimated by one-side HP filter)

Source: Authors' calculation

Table 2: Tourist arrivals and spending (direct + indirect effects) in time of epidemic outbreaks by world regions (estimated by Hamilton filter)

Regions	Epidemic outbreak	Impact depth (%)	Recovery time (years)	Lost arrivals (mln)	Lost spending (US \$bln)
Africa	Hendra (1994)	7.7	1	-1	-0.71
	H5N1 Bird Flu (1997)	2.6	1	-1	-0.52
	Nipah (1998)	0	0	-	-0.76
	SARS (2002)	4.2	1	-1	-
	H1N1** (2009)	3.3	1	-1	-3.86
	MERS*** (2012)	5.9	1	-3	-
	H7N9 Bird Flu (2013)	0.2	0	-	-1.72
Americas	Hendra (1994)	5.3	1	-6	-3.26
	H5N1 Bird Flu (1997)	0.8	1	-1	-
	Nipah (1998)	2.9	1	-4	-6.15
	SARS (2002)	11.8	2	-13	-24.6
	H1N1** (2009)	9.6	2	-14	-21.7
	MERS*** (2012)	0	0	-	-
	H7N9 Bird Flu (2013)	0	0	-	-
Asia & Pacific	Hendra (1994)	0	0	-	-
	H5N1 Bird Flu (1997)	6.7	2	-6	-11.8
	Nipah (1998)	15.2	2	-14	-31.3
	SARS (2002)	17.9	1	-20	-11.3
	H1N1** (2009)	12.1	1	-22	-17.3
	MERS*** (2012)	0	0	-	-
	H7N9 Bird Flu (2013)	0	0	-	-
Europe	Hendra (1994)	1.4	1	-4	-14.6
	H5N1 Bird Flu (1997)	0	0	-	-11.5
	Nipah (1998)	0	0	-	-14.5
	SARS (2002)	2.5	1	-10	-
	H1N1** (2009)	13.6	3	-64	-20.9
	MERS*** (2012)	0	0	-	-
	H7N9 Bird Flu (2013)	0	0	-	-
Middle East	Hendra (1994)	21.7	1	-2	-
	H5N1 Bird Flu (1997)	0	0	-	-
	Nipah (1998)	2.9	0	-	-1.26
	SARS (2002)	0	0	-	-
	H1N1** (2009)	0	0	-	-April 6, 2020
	MERS*** (2012)	15.7	3	-8	-10.6
	H7N9 Bird Flu (2013)	6.9	1	-4	-7.55

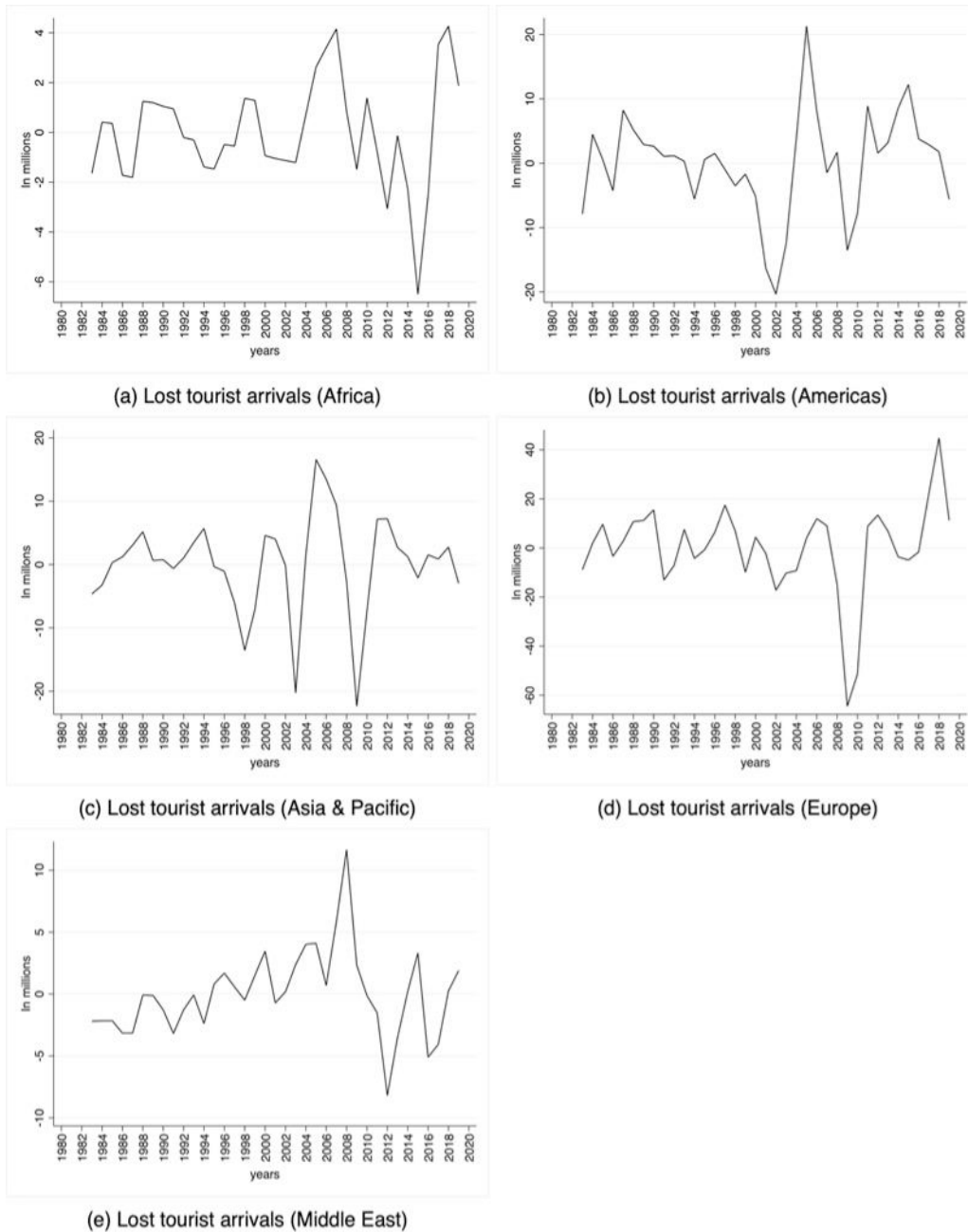


Fig. 2: Lost (potential) tourist arrivals by the world regions 1980-2019 (estimated by Hamilton filter)

Comparing the results of the Hamilton's filtering with the actual data from the UNWTO database, we can see again that opportunity costs (lost arrivals and spending) are significant. Therefore, former results from the (HP) filtering finding opportunity costs on average exceed actual costs in terms of lost tourist arrivals and spending are confirmed

by the Hamilton's filter results. Here we discuss the results for Americas and Asia and Pacific (results for other regions we do not discuss here due to space constraints, but interpretation from the table 2 is straightforward).

Opportunity cost (lost tourist arrivals) for Americas were highest during the SARS (2002) and H1N1 (2009) outbreaks. During SARS(2002) potential tourist arrivals declined by -13 mln with -24.6 US\$ billions lost tourist spending. Again, when we compare potential lost tourist spending of -24.6 US\$ bln with actual data from the UNWTO (no lost tourist spending during SARS) we get the real picture that the actual opportunity costs of epidemic outbreaks are significant. During H1N1 (2009) crisis actual UNWTO data show Americas register - 21 US\$ dollars while opportunity costs isolated by the Hamilton's filter -21.7 US\$ billions. Actual data from the UNWTO shows Americas did not register any actual decline in the tourist arrivals and spending during other epidemic outbreaks. Still, opportunity costs data show a different picture. From the table 4, we can see that opportunity costs in tourist arrivals in Americas during Hendra (1994) were -6 millions tourist arrival. In 1997 during Bird Flu crisis there was -1 mln tourist arrival, Nipah (1998) - 4 millions. MERS (2012) and H7N9 (2013) outbreaks show no associated opportunity costs in tourist arrivals or spending.

Actual UNWTO data for Asia and Pacific show the regions register three distinct out- breaks episodes Bird Flu (1997), SARS(2002), H1N1(2009). During Bird Flu (1997) there was -1 mln tourist arrival, (-2 US\$ billions spending), SARS (2002) - 12 mln arrivals (- 2 US\$ billions spending) and H1N1(2009) - 3 mln arrivals (-6 US\$ bln spending). Opportunity costs (from Hamilton's filter) show Asia and Pacific during Bird Flu (1997) were -6 millions tourist arrival (-11.8 US\$ billions spending), SARS(2002) - 20 mln arrivals (-11.3 US\$ billions spending), H1N1(2009) - 22 mln arrivals (-17.3 US\$ bln spending).

Figure 2 validate the well-known fact of cyclically and shock vulnerably tourism demand. Vulnerability of the tourism demand in the last 40 years is particularly high in Americas, Asia & Pacific and Europe. Epidemic outbreaks impact on tourism demand various significantly in level across regions.

Conclusions

Our study results confirm that total (registered) direct costs of the epidemic outbreaks from 1980 to 2019 on the world level amounts to -95 billions US\$ less in tourism spending and 56 million tourist arrivals drop. Total (potential) opportunity costs of epidemic crisis from 1980 to 2019 measured by the one-side HP filter worldwide equals -83 millions tourist arrivals and -126.7 US\$ billions of tourist spending.

Summary of our findings on estimates from the one-side (HP) (2009) and Hamilton's filter (2018) declare opportunity costs have an important role in managing tourism demand. Managers in the tourism industry due to industry volatility and external shock should rely on opportunity costs data in modeling tourism demand instead of using only actually (accounting) recorded data. Using opportunity costs data enable managers in the tourism industry to better forecast and manage adverse shocks in future tourism demand. Only by relying on opportunity costs data we can realize the real adverse shocks impact on the tourism demand (present and future). Epidemic outbreaks are associated to significant opportunity costs in the tourism demand and must be considered.

Skare et al.[8] stressed the important issue that pandemic cycles appearing on the peak of financial cycles, as this time, intensify the negative pandemic impacts limiting economic response of business and government.

The impact of COVID-19 on tourism industry turnover does not follow a unique pattern, factors like growth models, decision making, macroeconomic stability, epidemic measures, and state financial COVID-19 support play a crucial role in mitigating pandemic adverse effects using effective decision making process. We need future studies to explore the individual role of factors above in COVID-19 impact on the tourism industry.

The tourism industry in particular has been affected by the negative effects of the Covid -19 pandemic. In view of the above, Covid -19 has already shown how important it is to prepare for the crisis. Nowadays, we see the need for a major transformation of tourist services - different according to region and time. This will be the result of changes in consumer behavior and travel demand. The primary focus will be on local, national tourism, at least in the near future. Therefore there is a need for stronger national collaboration and coordination among tourism departments to develop effective responses for current demand

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