

COVID-19 AND PREDICTING SUSTAINABLE TOURISM RECOVERY: ADDITIVE MODEL

Tourism is a major driver of the world economy, accounting for 7 per cent of international trade. Globally, tourism generates directly or indirectly one in every ten jobs. The COVID-19 crisis has devastated the tourism economy, with unprecedented effects on jobs and businesses. Tourism was one of the first sectors to be deeply affected by the COVID-19 containment measures, and with the ongoing travel restrictions and the looming global recession, it also risks being among one of the last to recover. Around the world, in countries at all development levels, many millions of jobs and businesses are dependent on a strong and thriving tourism sector. Tourism has also been a driving force in protecting natural and cultural heritage, preserving them for future generations to enjoy [1].

Following the initial rebound in mid-2020, the global economic recovery has slowed (figure 1). Whereas activity and trade in the goods sector have improved, the services sector remains anemic, with international tourism, in particular, still depressed [2].

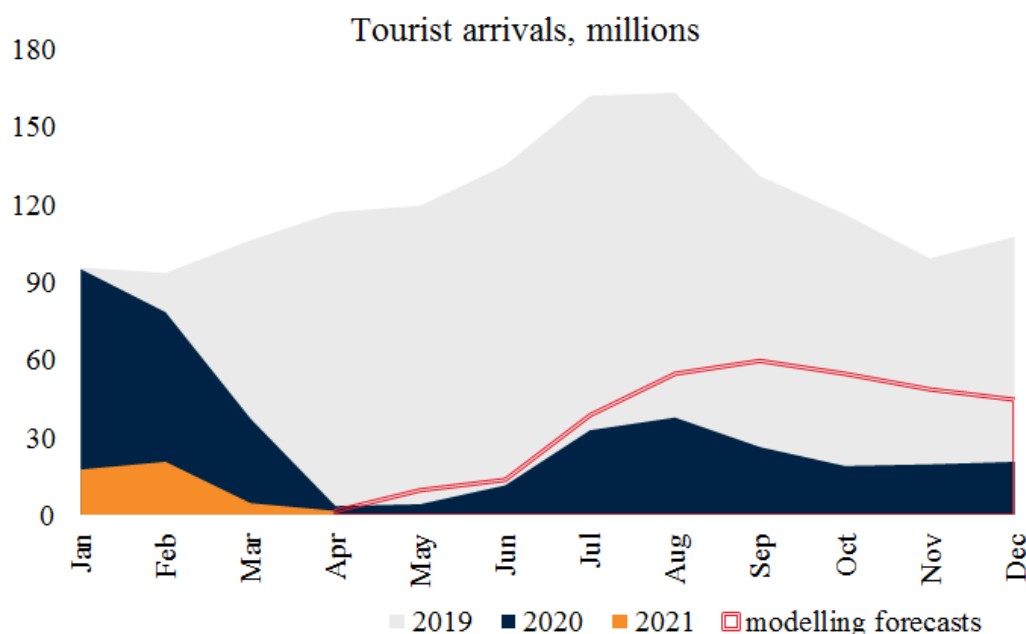


Figure 1. International tourist arrivals.

The study by Williams and Kayaoglu [3] illustrates the impact of an epidemic outbreak on the tourism industry and the supporting sectors to the tourism product and service delivery, as well as employment. On this basis, it is clear that the great lockdown and shutdown of the tourism-related businesses and supporting businesses

following the COVID-19 pandemic have resulted in an unprecedented socio-economic impact.

Consider the approach proposed by Polyzos et al. [4] to build a 12-month forecast of international tourist arrivals. In paper only used data from the SARS pandemic to train a single Long Short Term Memory (LSTM) network, in order to derive forecasts. In addition, they focused only on Chinese tourists, thus limiting the scope of the results. If use data for international tourist arrivals, then it can be expanding our approach to a more global framework. Based on these results, we can conclude that the tourism industry has been confronted with numerous crises in the past, but the present crisis resulting from the COVID-19 outbreak remains by far the most damaging one [5, 6, 7].

In article [8] Tsionas forecasts post-COVID-19 gradual adjustment in the tourism, hospitality, and related industries. The results show that reopening gradually that requires only nonnegative profits is quite feasible, whereas reopening that requires the same profit level as in the pre-COVID-19 period remains significantly more difficult and appears achievable by reopening at capacity neighboring 33%. Consider the methodology for constructing an additive model. It can be expanded the decomposable time series model of Harvey and Peters [9] and splits the model into three components, the trend, the seasonality, and the “irregular” component. The latter component is essentially the training set used. This model specification is essentially similar to the GAM methodology of Hastie and Tibshirani [10] and has been introduced by Taylor and Letham [11]. We will further expand this model [12], taking into account the complexities of the current crisis conditions. The general form of the model can be described as follows:

$$\varphi(t) = f(t) + s(t) + \eta(t) + \varepsilon(t)$$

where f is the general trend of the time series, s is the seasonal component and η represents the effect of the training set, to capture irregular effects on the time series.

Finally, the error term ε will capture the residual, idiosyncratic changes not accommodated by the model. The errors are assumed to be normally distributed [13]. But there is an alternative view of the linear model, which postulates that trend dynamics are responding to a retracement process. In this alternative view, the state of the tourism and the level of recovery are history dependent, what it is known as hysteresis. Consider the tourism sector during the crisis caused by the COVID-19 pandemic, and prospects after the crisis recovery. In studying the functioning of this system, we will discuss some limitations.

Let the problem consist in determining the reactions (outputs) to these external actions according to the given external influence on the system (by inputs). At the same time it is possible to be limited to inputs of the simplest structure: piecewise-linear, piecewise-smooth, special splines, etc.

Let W be a converter with scalar inputs $u(t)$ and outputs $x(t)$, the state of which is a pair $\{u, x\}$, ie an input-output pair. For the set of possible states of the converter W we can take the horizontal lines Φ_l and Φ_r . If the input $u(t)$ ($t \geq t_0$) is continuous and monotonic, then the output can be defined as

$$x(t) = W[t_0, x_0]u(t) \quad (t \geq t_0),$$

that the variable state $\{u(t), x(t)\}$ was a point of the polyline $M_0 = \{u(t_0), x_0\}$, which passes through the initial state of the segment with an angular coefficient 1 and the ends on the lines Φ_l and Φ_r . In other words, under the condition of a monotone input-output is determined by the equation.

$$x(t) = \begin{cases} \min\{h, u(t) - u(t_0) + x(t_0)\}, & \text{if } u(t) \text{ does not decrease,} \\ \max\{-h, u(t) - u(t_0) + x(t_0)\}, & \text{if } u(t) \text{ does not increase,} \end{cases}$$

Moreover, the input $u(t)$ is defined only if $t \geq t_0$ the equation is fair

$$\lim_{t \rightarrow \infty} |u(t) - v(t)| = 0,$$

where $v(t)$ is the exit curve from the crisis situation.

For the trend component of the model, we select the hysteresis, non-linear, saturating growth approach over the linear trend with breakpoints. This is justified since the tourism data series demonstrates non-linear patterns, without specific breakpoints that boost demand on a global level. The pandemic has revealed an opportunity for more diversified, ‘slower’, smaller, and more authentic experiences. We need to engage in a collective reflection on the future of tourism and on the sensitive links between tourism and the environment. We need more investment in technology, green infrastructure and value-added jobs. These will lead to a more sustainable, inclusive and resilient tourism sector.

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