Tourist arrivals and overnight stays along the Croatian Adriatic Coast: Changes in persistence and seasonality from the COVID-19 disruption

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Abstract
This study examines the changes in the persistence and seasonality inherent in the Croatian tourism sector in light of the onset of the COVID-19 pandemic. First, we differentiate between the changes in the persistence and seasonal behavior with respect to domestic and foreign tourist arrivals and overnight stays. Second, with nearly 90% of the Croatian tourism sector tied to the seven counties along the Adriatic coast we investigate the differential regional impact on persistence and seasonal behavior. Our results indicate the disruption was much more prominent for foreign tourist arrivals and overnight stays relative to domestic tourist arrivals and overnight stays with respect to the increased persistence associated with the onset of the pandemic along with the seasonal autorregressive component reduced considerably.

Keywords
COVID-19 pandemic, tourist arrivals, tourist overnight stays, persistence, fractional integration, seasonality, Croatia

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Introduction

Croatia’s tourism sector serves a prominent role in the country’s overall economy in contributing nearly 40% to export revenues and 12% of overall GDP. More specifically, the Adriatic coast attracts 90% of tourist arrivals and overnight stays in Croatia. In light of the importance of the tourism sector to the Croatian economy, it is not surprising to find that the global COVID-19 pandemic adversely impacted both the tourism sector and the overall economy, as GDP fell 8.1% in 2020 (Payne et al., 2021, 2022). As noted by Payne et al. (2021), the question is whether the shock from the COVID-19 pandemic altered the persistence behavior inherent in key tourism indicators used by both policymakers and those in the tourism and hospitality industry to facilitate the modeling and forecasting necessary to inform tourism planning efforts.

Investigating the degree of persistence in relation to the transitory or permanent nature of shocks associated with tourism indicators is particularly relevant to understanding the appropriate policy response to restore tourism indicators to their original trend path. If a shock is considered transitory in nature then the shock will dissipate with the need for policy intervention less likely, whereas if a shock is deemed permanent than policy intervention may be required for restoration of the tourism indicator to its original trend path. Within this stream of the tourism literature, researchers have either used unit root/stationarity or fractional integration tests to infer the degree of persistence (i.e., integration) in tourism indicators.

Unit root/stationarity tests examine whether the differencing parameter, $d$, is either 0 (i.e., stationary) or 1 (i.e., first-difference stationary).¹ On the other hand, fractional integration models provide greater flexibility than standard unit root/stationarity tests by allowing the differencing parameter, $d$, to vary along a continuous range between 0 and 1, or even greater than 1 in magnitude.² There are several ranges of $d$ (i.e., degrees of persistence) for a time series within a fractional integration framework: (1) stationary and mean-reverting ($0 \leq d < 0.5$), whereby shocks will dissipate quickly as the time series returns to its original trend; (2) non-stationary, but mean-reverting ($0.5 \leq d < 1$), shocks will be transitory with the time series taking longer to return to its original trend; and (3) non-stationary and non-mean-reverting ($d \geq 1$), shocks will yield a permanent effect in establishing a new trend for the time series. The larger the differencing parameter, the greater the degree of persistence inherent in a time series, which measures the extent to which changes in current market conditions lead to permanent future changes.

Previous studies on the degree of persistence for Croatian tourism indicators in the pre–COVID-19 period include Gil-Alana et al. (2015; 2016) and Apergis et al. (2017). Using fractional integration techniques, Gil-Alana et al. (2015) examine foreign tourist arrivals and overnight stays for the coastal counties to show the degree of persistence is greater than zero but less than one. This suggests that shocks are largely transitory. Gil-Alana et al. (2016) investigate aggregate measures of domestic and foreign tourist arrivals and overnight stays to find shocks are transitory with mean reversion. Similar results are also found by Apergis et al. (2017). More recently, Payne et al. (2021) re-examine the degree of persistence for Croatia’s aggregate measures of foreign tourist arrivals and overnight stays to reveal that persistence has increased with the onset of the COVID-19 pandemic. This study extends the analysis of Payne et al. (2021) in the case of Croatia to include the seven counties along with the Adriatic coast in analyzing both domestic and foreign tourist arrivals as well as overnight stays to investigate the change in the persistence behavior and seasonality of the data.
This is important since the aggregated results can differ from those which are disaggregated at the county level, implying that the effect of a given chock may differ from one county to another.

The second section discusses the data, methodology, and empirical results. The third section presents concluding remarks.

**Data, methodology, and empirical results**

The monthly data from 1998:1 to 2021:9 for domestic and foreign tourist arrivals and overnight stays, respectively, was obtained from the Croatian Bureau of Statistics. As evident from Figure 1, the onset of the COVID-19 pandemic created some disruption in domestic tourist arrivals, but has weathered the storm to even show an increase. This may be attributed to the prevalence of international travel restrictions whereby Croatian citizens substituted away from international travel toward domestic tourism. On the other hand, Figure 2 illustrates that foreign tourist arrivals experienced a more prominent shock. A similar scenario emerges when evaluating domestic and foreign overnight stays as shown in Figures 3 and 4, respectively.

We utilize the following fractional integration modeling framework to assess the degree of persistence and seasonality in the tourism data as follows

\[
y_t = \alpha + \beta t + \epsilon_t; \quad (1 - B)^d x_t = u_t; \quad u_t = \rho u_{t-12} + \epsilon_t, \quad (1)
\]

where \(y_t\) refers to the observed data (in logs); \(\alpha\) and \(\beta\) are unknown coefficients referring, respectively, to a constant and a (linear) time trend; \(B\) is the backshift operator, that is, \(B^k x_t = x_{t-k}\); and \(d\) indicates the order of integration. Given the monthly nature of the data, \(u_t\) follows a seasonal (monthly) AR(1) process in which \(\epsilon_t\) is an uncorrelated zero-mean process with constant variance. The model is estimated by using the Whittle function in the frequency domain with tests to determine the confidence band of the non-rejection values of the differencing parameter \(d\) based on a simple version of the test by Robinson (1994).

The analysis begins with an examination of the domestic and foreign tourist arrivals for the pre–COVID-19 pandemic covering the period 1998:1 to 2020:2. Table 1 displays the estimates of \(d\) for the selected model based on either one of the three classical assumptions: i) no terms, ii) with an intercept, and iii) with an intercept and a linear time trend. The selection of the appropriate specification is based on the statistical significance of the t-statistics at the 5% level for the intercept term and time trend of the respective models. As shown in Table 1, the selected models do not include time trends, but just an intercept term. In fact, the time trend is only found to be significant alongside the intercept term in the cases of Istria and Lika-Senj for the foreign tourist arrivals and Zadar and Sibenik-Knin for domestic tourist arrivals. The difference parameter, \(d\), measuring the degree of persistence in the case of domestic tourist arrivals ranges from 0.19 in Sibenik-Knin to 0.40 in Istria. The point estimates of the differencing parameter, \(d\), suggest domestic tourist arrivals are stationary with mean reversion. The seasonal autoregressive coefficient estimates range from 0.898 in Lika-Senj to 0.974 in Zadar, indicative of a strong seasonal component in the data. With respect to foreign tourist arrivals over this same period, the differencing parameter, \(d\), ranges from 0.17 in Istria to 0.69 in Split-Dalmatia. With the exception of Zadar, Split-Dalmatia, and Dubrovnik-Neretva, the point estimates of the differencing parameter, \(d\), indicate foreign tourist arrivals are stationary with mean reversion. The seasonal autoregressive coefficient estimates for foreign tourist arrivals are larger than domestic tourist arrivals and range from 0.968 in Sibenik-Knin to 0.988 in Primorje-Gorski kotar.
Figure 1. Domestic tourist arrivals.
Figure 2. Foreign tourist arrivals.
Figure 3. Domestic tourist overnight stays.
Figure 4. Foreign tourist overnight stays.
When we extend the estimation period to include the period of the COVID-19 pandemic (1998:1 to 2021:9), we observe in Table 2 the intercept terms are statistically significant with the trend insignificant, as well as changes in the degree of persistence and seasonal behavior with respect to tourist arrivals.\(^5\) In terms of domestic tourist arrivals, the difference parameter, d, ranges from 0.41 in Lika-Senj to 0.66 in Istria and Split-Dalmatia, an increase relative to the pre–COVID-19 period. With the exception of Lika-Senj, the point estimates of the differencing parameter, d, indicate domestic tourist arrivals are non-stationary, but mean-reverting. Hence, shocks will be transitory with domestic tourist arrivals taking longer to return to its original trend. The seasonal autoregressive coefficient estimates are much lower, ranging from 0.464 in Istria to 0.853 in Zadar.

### Table 1. Coefficients from estimated models for arrivals. Pre-COVID period, 1998:1–2020:2.

| Coastal county | Type       | d (95% band) | Intercept (t-value) | Time trend (t-value) | Seasonal AR |
|----------------|------------|--------------|---------------------|----------------------|-------------|
| Istria         | Domestic   | 0.40 (0.32, 0.51) | 9.455 (50.64)       | —                    | 0.939       |
|                | Foreign    | 0.17 (0.07, 0.30) | 10.623 (29.39)      | 0.0045 (2.01)       | 0.985       |
| Primorje-Gorski| Domestic   | 0.35 (0.25, 0.46) | 10.040 (67.83)      | —                    | 0.959       |
| kotar          | Foreign    | 0.42 (0.35, 0.49) | 10.479 (20.19)      | —                    | 0.988       |
| Lika-Senj      | Domestic   | 0.32 (0.24, 0.41) | 7.652 (43.79)       | —                    | 0.898       |
|                | Foreign    | 0.35 (0.24, 0.50) | 7.362 (11.59)       | 0.0112 (2.68)       | 0.979       |
| Zadar          | Domestic   | 0.22 (0.12, 0.35) | 8.468 (33.14)       | 0.0033 (2.06)       | 0.974       |
|                | Foreign    | 0.55 (0.48, 0.88) | 7.495 (8.35)        | —                    | 0.980       |
| Sibenik-Knin   | Domestic   | 0.19 (0.08, 0.33) | 7.953 (31.56)       | 0.0040 (2.57)       | 0.961       |
|                | Foreign    | 0.48 (0.41, 0.59) | 7.633 (8.61)        | —                    | 0.968       |
| Split-Dalmatia | Domestic   | 0.35 (0.27, 0.43) | 9.456 (53.73)       | —                    | 0.971       |
|                | Foreign    | 0.69 (0.59, 0.81) | 8.633 (8.98)        | —                    | 0.983       |
| Dubrovnik-Neretva | Domestic | 0.29 (0.20, 0.41) | 8.855 (74.98)       | —                    | 0.935       |
|                | Foreign    | 0.64 (0.57, 0.75) | 8.522 (10.93)       | —                    | 0.978       |

Notes: Selected models include intercept only and intercept with time trend.

### Table 2. Coefficients from estimated models for arrivals. Full period, 1998:1–2021:9.

| Coastal county | Type       | d (95% band) | Intercept (t-value) | Time trend (t-value) | Seasonal AR |
|----------------|------------|--------------|---------------------|----------------------|-------------|
| Istria         | Domestic   | 0.66 (0.48, 0.89) | 9.278 (21.13)       | —                    | 0.464       |
|                | Foreign    | 0.76 (0.55, 0.95) | 9.057 (8.16)        | —                    | 0.763       |
| Primorje-Gorski| Domestic   | 0.59 (0.40, 0.84) | 9.798 (26.22)       | —                    | 0.587       |
| kotar          | Foreign    | 0.93 (0.76, 1.12)| 8.489 (8.78)        | —                    | 0.787       |
| Lika-Senj      | Domestic   | 0.41 (0.29, 0.58) | 7.626 (27.96)       | —                    | 0.711       |
|                | Foreign    | 0.90 (0.71, 1.12)| 6.015 (5.37)        | —                    | 0.739       |
| Zadar          | Domestic   | 0.57 (0.28, 0.80) | 8.057 (13.88)       | —                    | 0.853       |
|                | Foreign    | 0.94 (0.78, 1.14)| 5.369 (4.77)        | —                    | 0.811       |
| Sibenik-Knin   | Domestic   | 0.60 (0.42, 0.80) | 7.424 (11.31)       | —                    | 0.797       |
|                | Foreign    | 0.94 (0.78, 1.12)| 5.037 (3.88)        | —                    | 0.835       |
| Split-Dalmatia | Domestic   | 0.66 (0.47, 0.88) | 9.050 (19.65)       | —                    | 0.678       |
|                | Foreign    | 1.08 (0.90, 1.32)| 7.993 (8.28)        | —                    | 0.810       |
| Dubrovnik-Neretva | Domestic | 0.56 (0.36, 0.79) | 8.529 (22.70)       | —                    | 0.536       |
|                | Foreign    | 0.97 (0.80, 1.18)| 7.733 (8.34)        | —                    | 0.711       |

Notes: Selected model with intercept only.
In regard to foreign tourist arrivals, the differencing parameter, $d$, is much higher, ranging from 0.76 in Istria to 1.08 in Split-Dalmatia. With the exception of Split-Dalmatia, the point estimates of the differencing parameter, $d$, suggest foreign tourist arrivals are non-stationary, but mean-reverting, whereas in the pre–COVID-19 period foreign tourist arrivals are stationary with mean reversion. Such behavior suggests that shocks will be transitory, but long-lasting. As in the case of domestic tourist arrivals, the foreign tourist arrivals also reveal elevated persistence levels and less prominent seasonality.

Next, we shift our analysis toward domestic and foreign overnight stays for the coastal counties during the pre–COVID-19 period as shown in Table 3. With the exception of foreign tourist overnight stays in Lika-Senj and domestic tourist overnight stays in Sibenik-Knin which include both intercept and trend terms, the model specifications for the rest of the counties only include an intercept term. The difference parameter, $d$, measuring the degree of persistence in the case of domestic tourist overnight stays ranges from 0.19 in Sibenik-Knin to 0.80 in Split-Dalmatia. With the exception of Lika-Senj, foreign tourist overnight stays over this same period, the differencing parameter, $d$, ranges from 0.31 in Istria to 0.65 in Dubrovnik-Neretva. With the exception of Zadar, Split-Dalmatia, and Dubrovnik-Neretva, the point estimates of the differencing parameter, $d$, indicate foreign tourist overnight stays are stationary with mean reversion. The seasonal autoregressive coefficient estimates range from 0.976 in Sibenik-Knin to 0.981 in Primorje-Gorski kotar.

By extending the estimation period to include the period of the COVID-19 pandemic (1998:1 to 2021:9), we observe in Table 4 the intercept terms are statistically significant with the time trend insignificant along with changes in the degree of persistence and seasonal behavior with respect to tourist overnight stays. In terms of domestic tourist overnight stays, the difference parameter, $d$, increases with a range of 0.46 in Lika-Senj to 0.80 in Split-Dalmatia. With the exception of Lika-Senj, the point estimates of the differencing parameter, $d$, indicate domestic tourist overnight stays...
are non-stationary, but mean-reverting. The seasonal autoregressive coefficient estimates decrease with a range of 0.632 in Istria to 0.913 in Zadar. In terms of foreign tourist overnight stays, the differencing parameter, \(d\), is much higher, ranging from 0.97 in Istria and Sibenik-Knin to 1.20 in Dubrovnik-Neretva. Other than Istria and Sibenik-Knin, the point estimates of the differencing parameter, \(d\), exceed one, indicative of non-stationary and non-mean-reverting behavior. Such behavior suggests that shocks will be permanent in altering the trend path of foreign overnight stays. In comparing the results across domestic and foreign tourist arrivals and overnight stays, it appears the shock associated with the COVID-19 pandemic is more pronounced with respect to foreign tourist overnight stays.

### Concluding remarks

Without question the global COVID-19 pandemic has had a tremendous impact on the global tourism and hospitality industry. This disruption has been particularly significant for small open economies like Croatia which rely heavily on the tourism sector as a major source for export revenues, and overall contribution to the country’s GDP. Through the use of fractional integration techniques, this empirical study differentiates between the transitory and permanent nature of the COVID-19 shock with respect to domestic and foreign tourist arrivals as well as overnight stays across Croatia’s seven coastal counties, which constitute almost 90% of the country’s tourist arrivals and overnight stays. Such analysis is relevant for the use of historical information in the construction of tourism demand models and the generation of forecasts to project future tourism trends.

The results indicate an increase in the degree of persistence with the emergence of the COVID-19 pandemic and a decrease in the seasonal autoregressive component of the respective data. Since the shock from the COVID-19 pandemic has elevated the degree of persistence associated with the shock in conjunction with the change in the seasonality observed, sustained marketing and promotion campaigns to restore tourism are warranted. Related to these marketing and promotion campaigns is the importance of updates on the assessment of the spread of the COVID-19 virus and the appropriate health measures to ensure tourists stay safe. Moreover, consideration should be

#### Table 4. Coefficients from estimated models for overnight stays. Full period, 1998:1–2021:9.

| Coastal county       | Type         | \(d\) (95% band) | Intercept (t-value) | Time trend (t-value) | Seasonal AR |
|----------------------|--------------|------------------|---------------------|----------------------|-------------|
| Istria               | Domestic     | 0.68 (0.50, 0.92)| 10.707 (20.26)     | —                    | 0.632       |
|                      | Foreign      | 0.97 (0.81, 1.14)| 9.774 (8.20)       | —                    | 0.856       |
| Primorje-Gorski      | Domestic     | 0.67 (0.49, 0.88)| 10.791 (19.00)     | —                    | 0.837       |
|                      | Foreign      | 1.16 (1.02, 1.34)| 9.818 (10.19)      | —                    | 0.888       |
| Lika-Senj            | Domestic     | 0.46 (0.33, 0.62)| 8.430 (18.61)      | —                    | 0.848       |
|                      | Foreign      | 1.06 (0.91, 1.24)| 6.191 (5.08)       | —                    | 0.860       |
| Zadar                | Domestic     | 0.77 (0.57, 0.95)| 8.742 (9.30)       | —                    | 0.913       |
|                      | Foreign      | 1.12 (0.98, 1.28)| 6.316 (5.40)       | —                    | 0.901       |
| Sibenik-Knin         | Domestic     | 0.70 (0.49, 0.89)| 7.828 (8.58)       | —                    | 0.868       |
|                      | Foreign      | 0.97 (0.83, 1.13)| 6.891 (4.94)       | —                    | 0.906       |
| Split-Dalmatia       | Domestic     | 0.80 (0.62, 1.01)| 10.184 (14.79)     | —                    | 0.877       |
|                      | Foreign      | 1.15 (1.00, 1.34)| 9.502 (9.03)       | —                    | 0.910       |
| Dubrovnik-Neretva    | Domestic     | 0.70 (0.50, 0.90)| 9.393 (16.47)      | —                    | 0.748       |
|                      | Foreign      | 1.20 (1.04, 1.40)| 9.041 (10.31)      | —                    | 0.853       |

Notes: Selected model with intercept only.
given to the investment required to enhance the sustainability of the tourism sector, both economi-
cally and environmentally, in order to mitigate future shocks and increase the resilience and
sustainability of the tourism sector through regional diversification and specialization.

The degrees of persistence observed in our results during the pre–COVID period are similar to
those reported by Gil-Alana et al. (2015, 2016) and Apergis et al. (2017) with the order of in-
tegration ranging from zero to less than one. Likewise, with the inclusion of the COVID period, our
results demonstrate some variation across coastal counties, but the observed increase in the degree
of persistence is similar to the studies by Payne et al. (2021) and Gil-Alana and Poza (2021) who
also find an increase in the degree of persistence with the inclusion of the COVID time period.
Moreover, our results are also similar to previous studies in which the effects of shocks on tourism-
related time series are generally transitory with long-lasting effects. However, the COVID-19
pandemic may have changed the nature of the persistence in the data with the long-range de-
pendence significantly increasing during this period.

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Notes

1. Au et al. (2005), Bhattacharya and Narayan (2005), Narayan (2005a, 2005b, 2005c, 2008), Chu et al.
   (2008), Narayan and Prasad (2008), Lean and Smyth (2009), Lee (2009, 2010), Smyth et al. (2009), Tang
   and Wong (2009), Saleh et al. (2011), Chu et al. (2014), Lee et al. (2014), Tan and Tan (2014), Yang et al.
   (2014), Solarin (2015), Tiwari et al. (2018), Xie et al. (2018), Valadkhani and O’Mahony (2018),
   Kyophilavong et al. (2019), and Baig and Hussain (2020) have utilized unit root/stationarity tests to
   primarily examine tourist arrivals for a number of countries within the Asia-Pacific Rim region. In addition,
   a number of other country studies outside the Asia-Pacific region include Lorde et al. (2009), Bassil et al.
   (2014), Dedeoglu (2016), Solarin (2016), Charles et al. (2019), Dash et al. (2017), and Yucel (2021).

2. Studies by Chu (2008, 2009), Assaf et al. (2011, 2012), and Al-Shboul and Anward (2017) examine a
   number of countries constituting the Asia-Pacific Rim region while Cunado et al. (2004, 2005, 2008a), Gil-
   Alana (2010), Gil-Alana et al. (2004, 2008, 2015, 2016, 2019, 2020), Gil-Alana and Fischer (2010),
   Nowman and van Dellen (2012), Apergis et al. (2017), Gil-Alana and Huijbens (2018), Caporale and Gil-
   Alana (2019), Perez-Rodriguez and Santana-Gallego (2020), Gil-Alana and Poza (2021), and Payne et al.
   (2021) investigate the degree of persistence in several tourism indicators in the case of European countries.
   Moreover, Gil-Alana (2011) and Gil-Alana et al. (2014) deploy fractional integration models to study the
   persistence behavior of several tourism indicators for South Africa and Kenya, respectively. In addition,
   studies by Gil-Alana (2005, 2009), Cunado et al. (2008b), Payne and Gil-Alana (2018), and Gil-Alana and
PAYNE (2020) explore the persistence in U.S. tourism indicators. Studies by CHEN and MALINDA (2014) and ANDRAZ et al. (2018) explore the degree of persistence inherent in travel and tourism equity indices.

3. It is interesting to note the Croatian tourism sector was more successful than competing tourist destinations during the pandemic due in large measure to Croatia’s closeness to source markets via ground transportation instead of air transportation.

4. The first COVID-19 case in Croatia was reported on February 25, 2020.

5. Alternatively, we could have examined the degree of persistence exclusively for the COVID period, but the sample size would then be too small to make reasonable and significant inferences from the results. In this respect, we report the results for the whole time period including both pre-COVID and COVID periods.

6. In fact, in 2021 the Ministry of Tourism and Sports introduced a promotion campaign, “Stay Safe in Croatia,” to all stakeholders in the tourism industry that were following strict prescribed health protocols.

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