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Effects of COVID-19 on Variations of Taxpayers in Tourism-Reliant Regions: The Case of the Mexican Caribbean

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Abstract: Given the tourism industry's risk and vulnerability to pandemics and the need to better understand the impacts on tourism destinations, this research assesses the effect of the COVID-19 outbreak on the variation of taxpayer units in the Mexican Caribbean region, which includes some of the major sun-and-sand beach destinations in Latin America. Using monthly data of registered taxpayer entities at the state and national levels as the analysis variable, probability distributions and definite integrals are employed to determine variations of the year following the lockdown, compared with previous years' data. Results indicate that despite the government's measures to restrict businesses' operations and a reduction in tourism activities, registered taxpayers at the regional level did not decrease for most of 2020. Further, as business activities and tourism recovered, taxpayer units increased at the end of 2020 and beginning of 2021. Surprisingly, such a pattern was not observed at the national level, which yielded no statistically significant variations. A discussion of factors influencing the resilience of the tourism region in the study (e.g., outbound markets' geographic proximity, absence of travel restrictions, closure of competing destinations) and implications for public finances are presented.

Keywords: COVID-19; taxpayer entities; economic risk; tourism recovery; fiscal revenues; crisis; resilience; tourism destinations; Mexico; Quintana Roo; Mexican Caribbean



Citation: Cruz-Milan, Oliver, and Sergio Lagunas-Puls. 2021. Effects of COVID-19 on Variations of Taxpayers in Tourism-Reliant Regions: The Case of the Mexican Caribbean. *Journal of Risk and Financial Management* 14: 578. <https://doi.org/10.3390/jrfm14120578>

Academic Editor: Junwook Chi

Received: 27 October 2021

Accepted: 29 November 2021

Published: 2 December 2021

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1. Introduction

The health pandemic caused by the novel coronavirus designated as COVID-19 has suddenly generated a profound crisis in the global economy, devastating the travel and tourism industry as one of the most affected, hardest-hit productive sectors worldwide (World Tourism Organization 2020; World Travel and Tourism Council 2021). Since early 2020, a myriad of business segments in tourism destinations suffered a drastic drop in sales and revenues due to the suspension and/or reduction of operations resulting from sanitary measures imposed by national and local authorities (Sigala 2020). The damage has been also reflected on the closure of enterprises worldwide (Gössling et al. 2021), particularly in tourism-reliant countries and regions where travelers' visitation dramatically dropped (Fotiadis et al. 2021). Such unexpected events impact the usual sources of government's revenues through direct and indirect taxation (Manente and Zanette 2010), with further negative consequences on future tax collection, public finances, and tourism planning in general (Blake 2016; Zhang and Lin 2017).

Research on tax-related topics has not received attention in the travel and tourism literature during the pandemic, since the academic community has focused its efforts on studying the most immediate disruptions of the sanitary crisis on topics as varied as the perception and behavior of travelers, the operative changes adopted by tourism services firms, or the communication and news dissemination about the coronavirus for tourists

([Travel and Tourism Transformed 2021](#)). However, considering the importance of tax revenues for tourism regions ([Bird 1992](#); [Gooroochurn and Milner 2008](#)), analyzing the effects of the pandemic on taxation and the public finances of tourism destinations remains a critical issue to address as these emerge from the COVID-19 crisis and require public funds generation ([Bausch et al. 2021](#)). The governments of tourism-reliant economies, especially those in developing countries, are traditionally considered to be risky entities by the financial community due to their unstable, volatile taxation levels and high risk of public deficits ([Bostan et al. 2018](#); [Hoti et al. 2005](#); [Lee and Chen 2021](#); [Shareef and Hoti 2005](#)). Further, this propensity is often reflected negatively on the credit risk ratings of sub-national, local authorities which are particularly vulnerable to economic disruptions such as those derived from the pandemic ([Ashta 2021](#); [Fitch Ratings 2020](#); [Hernández Trillo and Vargas 2012](#); [Standard and Poor's 2020](#)). Thus, examining how economic shocks impact the number of taxpayers on which taxes are levied is crucial to estimate governments' revenues and the economic contribution of tourism to the communities ([Blake et al. 2000](#); [Dwyer et al. 2004](#); [Hara 2008](#)).

Hitherto, there is scant research on how the economic crisis induced by COVID-19 manifested on changes in the aggregate number of established economic units that contribute to fiscal revenues with a specific focus on tourism regions. In light of the pandemic, studying consequences on the existing economic system in which tourism operates, including those on the overall volume of taxpayers at destinations, is a necessary step to better understand the broad transformations in the industry ([Zenker and Kock 2020](#)). Taxation provides the resources that can be directed to investments on infrastructure and programs that ultimately benefit the residents of destinations, enhancing their welfare and sustainable tourism development ([Mak 2006](#); [Sheng and Tsui 2009](#)). Thus, research on this stream can help stakeholders to inform taxation management and risk-reduction strategies to develop future tourism policies in a timely manner ([Chaperon 2017](#)). In this respect, one way to assess the impact of exogenous events on tourism-reliant regions is by measuring the volume and operation of legally, formally established economic agents ([Hara 2008](#)). This can be done through quantitative data analysis techniques that reveal the true effects of crises in industries like travel and tourism ([Eugenio-Martin et al. 2005](#)), evaluating the survival of taxpayer entities in economic sectors (see [Cefis et al. 2019](#); [Clarke et al. 2012](#)).

Therefore, the objective of this investigation is to study changes in the active status of taxpayer entities registered in a tourism region during the first year of the COVID-19 pandemic, comparing fiscal data of pre-pandemic years. To accomplish that, this work follows a case study approach in line with studies in the tourism literature aiming to understand impacts of crisis events ([Xiao 2010](#)). The context of study is the tourism region along the Mexican Caribbean, which hosts some of the principal sun-and-sand beach destinations in Latin America ([Camargo et al. 2020](#); [Güemes-Ricalde and Correa-Ruiz 2009](#)). This will permit observation of the magnitude of changes in taxpaying units established in the tourism destinations as a result of the sanitary crisis, as a way to better understand the region's resilience and business closure in major adverse situations ([Landini et al. 2018](#); [Sabatino 2016](#)). The research is in line with the growing interest in academia and practitioners to inductively examine neglected topics in tourism industry crises ([Pennington-Gray 2018](#)), such as taxation-related consequences of economic crises in tourism ([Jiang et al. 2019](#)) and the impacts produced by structural changes in understudied geographical regions, such as Latin American countries ([Kumar et al. 2020](#)). The methodology employs probability distributions and definite integrals analysis, which constitute classical mathematical techniques with multiple applications in a wide range of fields but are innovative for evaluating the economic impact of a crisis in tourism industry contexts. According to [Ladik and Stewart \(2008\)](#), introducing these type of methodological applications represents a valuable contribution to the field, by analyzing phenomena through empirical approaches that add to the management, economics, and tourism-related literature ([Corley and Gioia 2011](#); [Cruz-Milan 2014](#); [Pennington-Gray 2018](#); [Whetten 1989](#)) in a particularly salient, unprecedented context such as the COVID-19 pandemic ([Yang et al. 2021b](#)).

The next section provides an overview of the literature on COVID-19 in the tourism field, highlighting the lack of research on tax-related issues and identifying the appropriateness of probability distributions and definite integrals for this investigation. Then in the methodology section, the research context and data are described, followed by the empirical analysis and study results. Finally, a discussion of the findings along with implications, conclusions, limitations, and avenues for further research are presented.

2. Tourism Research on COVID-19 and Tax-Related Issues

Given the abrupt, unprecedented magnitude of the infectious disease COVID-19, there was a rapid, growing interest in the academic community to investigate and understand the unusual phenomenon (Bausch et al. 2021; Zenker and Kock 2020). According to the literature review by Yang et al. (2021b) about COVID-19 research in tourism journals, studies related to the pandemic and its consequences on travel and tourism have been approached from various perspectives and themes such as: perceptions, motivations, behavioral intentions, and other psychological effects on tourists, consumer well-being, emotions and mental health, businesses' responses and strategies addressing the coronavirus propagation, sustainability and inclusivity issues, or technology adoption and service delivery/innovations. Although several scholars have addressed economic topics in the context of the pandemic, specific research about taxation, public finances, fiscal- or tax-related issues is not reported in the academic literature. Indeed, Yang et al. (2021b) note that empirical investigations of the impacts on the governmental sector are needed in relation to policy implications to better manage future disasters and crises, given the increasing importance for risk management in the public sector (Bracci et al. 2021).

Several works have analyzed and monitored the economic effects on tourism as a result of the COVID-19 crisis. For instance, Yang et al. (2020) performed a simulation using dynamic stochastic general equilibrium modeling estimating the impact of the coronavirus outbreak in tourism, which they propose to be used for studying future disease surges and pandemics. In turn, Tsionas (forthcoming) examined forecast models using various scenarios for gradually reopening the hotel industry with different levels of capacity and expected profitability, concluding that reopening the sector at low demand levels would require important economic subsidies from governments. Kaczmarek et al. (2021) assessed the resiliency of the tourism industry to the pandemic analyzing data on over 1200 travel and leisure companies in 52 countries, identifying factors that contribute to their resilience. Farzanegan et al. (2021) examined the relationship between international tourism and COVID-19 cases and associated deaths in more than 90 countries, concluding that those nations exposed to high flows of international tourists are more prone to cases and deaths caused by the disease. Other studies were conducted to describe and/or forecast the impacts of COVID-19 on specific destinations and business sectors (e.g., lodging, commercial airlines, or casinos) using data from such varied sources as tourist arrivals, hotel reservations, employment, Google searches, and gross domestic product (GDP), among others. These investigations were conducted by Arbulú et al. (2021) on the Balearic Islands in Spain, by Huang et al. (2020) and Khan et al. (2021) in the United States, by Kido-Cruz and Kido-Cruz (2021) in Mexico, by Lim and To (forthcoming) and McCartney (2021) on the Special Administrative Region (SAR) of Macao in China, by Wickramasinghe and Ratnasiri (2021) on the case of Sri Lanka, by Pham et al. (2021b) on Australia, and by Foo et al. (forthcoming) on the case of Malaysia.

However, to the best of the authors' knowledge, no published research approached the measurement of economic and financial impacts by analyzing the statistical variations in the number of taxpayers at destinations using government's fiscal records. In fact, based on a recent review of financial-related research published in travel, tourism and hospitality journals, studies related to corporate finances, financial markets, and firms' financial management and returns have received the most attention by scholars, while topics such as public finance, fiscal and taxation issues have been neglected in the tourism literature (Jiménez-Caballero and Polo Molina 2017). According to Seetaram and Adedoyin

([forthcoming](#)), tax-related research in tourism has often been conducted from the perspective of the effects of levying taxes on travel demand, but taxation-related issues from the perspective of other stakeholders is still absent and requires further exploration and research in the travel and tourism literature. This is particularly important in a time that pandemic-driven developments from outside the tourism system will continue to pose challenges to tourism regions in various domains, one of which corresponds to taxation issues and fiscal-related difficulties faced by governments ([Laesser et al. 2021](#)).

2.1. Quantitative Analysis and Measurement in Tourism

Tourism research using quantitative analysis generally employs methodologies and techniques that can be classified in two types: stochastic and deterministic. According to [Hara \(2008\)](#), while the former is based on statistical probabilities, randomness, and assumes some error margin in measures (e.g., regression models, econometrics, or time series), the latter is more accurate, non-probabilistic, and refers to models that study flows and equilibrium structures (e.g., input-output and social accounting matrices, tourism satellite accounts, gravity models for trade/commerce, or computable general equilibrium models). Due to the lack of complete, updated national sector data to estimate deterministic models, probabilistic analyses following a longitudinal approach are useful to study possible changes in the stationarity of observed data. In the case of the tourism industry, those changes can be produced by “structural breaks” such as wars, terrorist attacks, natural disasters, or crises caused by epidemic outbreaks ([Cang and Seetaram 2014](#), p. 53) like the recent COVID-19 pandemic.

A multitude and variety of techniques exist for the study and analysis of time series and longitudinal data. According to [Baggio and Klobas \(2011\)](#), a review of the literature published in the tourism research field identified the application of more than 50 different techniques. Considering that time series analysis constitutes stochastic processes based on probabilistic distributions ([Arnau Gras 2001](#)), this work proposes the use of probability distributions and definite integrals tests to examine differences in longitudinal observations. In this way, it is possible to identify potential variations or changes in the aggregate number of taxpayer units located at tourism destinations resulting from an external shock like the COVID-19 pandemic, characterized as a structural break with a profound impact on economic systems ([Cang and Seetaram 2014](#)). The use of probability distributions and definite integrals is not new in economics and finance studies (e.g., [Kundu et al. 2019](#); [Parvez 2006](#)) but their application for research in a tourism industry context is still incipient, representing a practical, adequate technique to accomplish the objective of this investigation as explained next.

2.2. Probability Distributions and Definite Integrals

While the early interest to explain and predict the movement and trajectory of objects can be traced back to Isaac Newton and Pierre-Simon Laplace, it was until the 20th century that John M. Keynes specifically proposed using probabilities as an essential method to analyze uncertainty-related phenomena in economics, business, and industries ([García Molina 2016](#)). Probability distributions are among the most well-known mathematical methods to judge the probability of empirical observed events occurring by chance ([Vogt and Johnson 2016](#)) and have been applied in a wide variety of areas and solutions in different fields, including economics ([García Molina 2016](#)). For this reason, probability distributions can serve as a basis for understanding complex, multivariate systems using data sets to study large-scale phenomena ([Bolancé 2020](#); [Ramberg et al. 1979](#)). The utility of probability distributions was initially identified by Keynes, and up to the present time, have been applied to economic analysis in areas such as risk assessment in the oil industry (e.g., [Serrano Bautista and Mora 2020](#)), probabilistic analysis for estimating business closure and bankruptcy (e.g., [García et al. 2017](#)), and economic elasticity measured through probability distributions (e.g., [Ferrer and Miralles 2012](#)).

In the area of fiscal-, tax-related research examining economic variables similar to this study, one of the works that used probability distributions was the analysis conducted by [Puls and Ramírez Pacheco \(2016\)](#) which employed probability curves and meta-analysis to evaluate the changes derived from the tax reforms implemented by four federal government administrations in Mexico. Along the same line of research, another investigation evaluated the effects of a value added tax (VAT) rate increase from 11% to 16% on consumption and on the overall fiscal revenues ([Lagunas Puls and Almeida Baeza 2019](#)). Contrary to the expectation of reduced tax revenues due to the potential elasticity of demand, the study concluded that the VAT increase did not have a negative impact on the aggregate level of tax collection. Another research in the branch of actuarial sciences and financial mathematics conducted by [Hao and Tang \(2009\)](#) used probabilistic and calculation methods to estimate and explain the fiscal impact of fixed tax rates imposed on net income, comparing proposed rates scenario variations when exceeding preestablished profits thresholds and maximum taxable income levels.

In the tourism industry, Gamma probability distributions were used to analyze the hotel room supply and estimate its fiscal impact in the event of an allowance to increase the number of rooms in a destination like Cancun that exceeded its originally planned hotel infrastructure ([Lagunas Puls et al. 2016](#)). The study findings indicated that the probability of growth in the destination's aggregate hotel room supply did not necessarily increase the probability of higher public tax revenues through the state hotel occupancy tax. Additionally, in the context of the hotel industry, [Csikosova et al. \(2021\)](#) recently employed probabilistic distributions to evaluate the risk of investments in accommodation businesses for selected regions in Slovakia, proposing a model that provides information for potential and profitable investments in lodging and real estate sectors. Therefore, in line with the objective of this research, a probabilistic method such as the one described here is deemed appropriate to ascertain significant changes in the number of taxpayers. Through the use of definite integrals to assess statistical differences ([Ďuriš 2020](#)), potential changes in the number of economic units can be examined beyond the ordinary, random variations attributed to competitive-based fluctuations (entry or exit of businesses) or seasonality that typically occurs in tourism destinations ([Goeldner and Ritchie 2012](#)).

3. Methodology and Data Used

The method described in this section aims to answer the research question: How has the pandemic affected the volume of taxpayers in the tourism-reliant region of Quintana Roo, Mexico in the first year since the COVID-19 outbreak? The state of Quintana Roo, located on the eastern coast of the Yucatan Peninsula in what is called the Mexican Caribbean region (see [Figure 1](#)), is home to some of the most important beach and cruise tourism destinations in Latin America: Cancun, the Mayan Riviera corridor, Cozumel, among others ([Cruz-Milan 2017](#); [CPTQ 2021](#); [Euromonitor International 2018](#)). Travel to sun-and-sand resort destinations of these types has been popular worldwide since the 1950s ([Prebensen et al. 2010](#)), representing one of the largest, fastest growing, and most lucrative sectors of the world's tourism industry ([Honey and Durham 2013](#)).



Figure 1. Map of the Mexican Caribbean region in the case study.

The economic importance of the Quintana Roo region and its contribution to the national tourism industry have been crucial to place Mexico among the top ten countries in terms of international tourist arrivals worldwide ([World Tourism Organization 2019](#)). In 2019, Quintana Roo received 22.8 million visitors, with a hotel infrastructure of 107,128 rooms, and tourism receipts of more than USD\$15,000 million ([SEDETUR 2020](#)). Over 70% of the state's gross domestic product corresponded to tourism activities, employing at least 450,000 people in the industry ([Vanegas 2021](#)). As the news of the first COVID-19 outbreak in Asia alarmed the national tourism sector for the coronavirus' imminent expansion to the entire American continent ([SECTUR 2020](#)), its repercussion on international travel became a reality at the end of the first quarter of 2020, drastically affecting Mexico's most important region for foreign-tourism revenue generation in the following months. Thus, based on the region's heavy reliance on tourism industry and the economic disruption as an outcome of the COVID-19 crisis ([Euromonitor International 2021](#); [Statista 2020](#)), the scarcity of research on Latin American contexts in general ([Aguinis et al. 2020](#)) and in coronavirus-related studies in tourism in particular ([Yang et al. 2021b](#)), this geographical area represents an appropriate, suitable context of research to examine the extent of the pandemic effects on the speed of closure or the permanence of its established economic units.

In order to accomplish that purpose, the variable of interest corresponds to the number of taxpayer units (micro, small, medium-sized, and large business, organizations, individuals, professionals, and other entities) officially recorded in the Mexican federal government's Active Taxpayer Registry ([Secretaría de Hacienda y Crédito Público 2021](#)), breaking down the data in two categories: the first comprises the record of taxpayers located in the state of Quintana Roo, and the second is the record of taxpayers at the national level (Mexico as a country) which serves as reference data to compare and evaluate the state-level results. The time series of monthly data spans from 2017 to 2020 and also includes the first quarter (three months) of 2021 (the most recent available data), totaling 51 observations for each variable in the analysis. The software GeoGebra ([Tatar and Zengin 2016](#)) was employed for calculations, and Minitab 17 was used to perform normal ([Aprausheva et al. 2015](#)), logistic ([Guia et al. 2013](#)), Weibull ([Krylov et al. 2009](#)), and Gamma ([Bagui and Mehra 2017](#)) probability distribution fitting tests.

$$f_{normal}(x, \mu, \sigma) = \frac{1}{\sqrt{2\pi} \sigma} e^{\left[\frac{-(x-\mu)^2}{2\sigma^2}\right]}, \quad x > 0 \quad (1)$$

$$f_{\text{logistic}}(x, \phi, \omega) = \frac{e^{-\left(\frac{x-\phi}{\omega}\right)}}{\left(e^{-\left(\frac{x-\phi}{\omega}\right)} + 1\right)^2 |\omega|}, \quad x > 0 \quad (2)$$

$$f_{\text{Weibull}}(x, \beta, \omega) = \frac{\beta}{\omega^\beta} (x)^\beta e^{-\left(\frac{x}{\omega}\right)^\beta}, \quad x > 0 \quad (3)$$

$$f_{\text{gamma}}(x; \beta; \omega) = \frac{1}{\Gamma(\beta)\omega^\beta} x^{\beta-1} e^{-\left(\frac{x}{\omega}\right)}, \quad x > 0 \quad (4)$$

where: μ = mean, σ = standard deviation, ϕ = location, ω = scale, β = shape.

According to the method and technique adopted in this research, the Anderson-Darling test (Jäntschi and Bolboacă 2018; Feuerverger 2016; Hasumi et al. 2009) was used to identify the optimal fitting, which is represented as A^2 , adopting a critical value of 0.751 to select the distribution with the smallest value result.

$$A^2 = -n - \left(\frac{1}{n}\right) \sum (2i - 1) \{ \ln F(Y_i) + \ln(1 - F(Y_{n+1-i})) \} \quad (5)$$

Once the optimal distribution was identified, the next step was to establish the curve with a density function through definite integrals to indicate the variables' usual pattern representation in an area equivalent to 95% of probability.

$$\int_a^b f(x) dx \quad (6)$$

where: a = lowest number of taxpayers in a period, b = highest number of taxpayers in a period.

In this way, the amounts of active taxpayers from the first quarter of 2020 to the first quarter of 2021 (which comprises the outbreak and the most severe economic impacts of the pandemic on the Western Hemisphere) were assessed by graphically representing their location using definite integrals, in which the limits were set as the lowest and highest number of taxpayers throughout the three-month periods. This allowed to determine whether the area corresponding to each quarter was located within (or outside) the usual limits.

4. Results

The graphical display and estimates for A^2 are represented in Figure 2, which are necessary for the assessment in order to adopt the optimal fitting distribution.

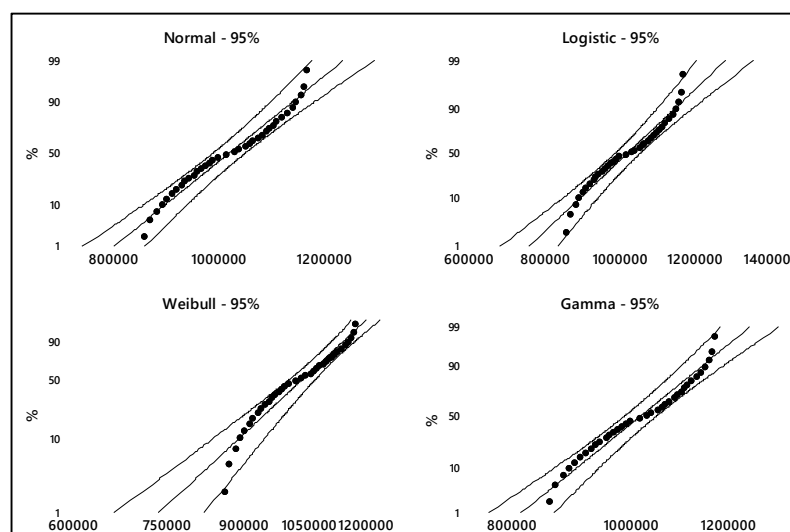


Figure 2. Fitting graphs of taxpayer entities in Quintana Roo (state level).

The results for A^2 were 0.496 for normal distribution, 0.572 for logistic distribution, 0.558 for Weibull distribution, and 0.537 for Gamma distribution. Based this output, the smallest distribution (normal) was adopted to analyze possible changes on registered taxpayer units in the state of Quintana Roo according to Table 1, which shows the statistical parameters necessary to establish the normal distribution curve of each variable and to locate the recorded values for the four quarters of 2020 and the first quarter of 2021.

Table 1. Statistical parameters for optimal fitting distribution.

Variable	μ	σ
Registered taxpayer entities in Quintana Roo (state).	1,016,905	93,916
Registered taxpayer entities in Mexico (national).	69,332,815	6,302,380

Figure 3 shows the results obtained for optimal fitting with respect to the number of registered taxpayers in Mexico (as a country), serving as a comparison variable to evaluate whether the directionality and magnitude of changes are analogous at both the state and national levels.

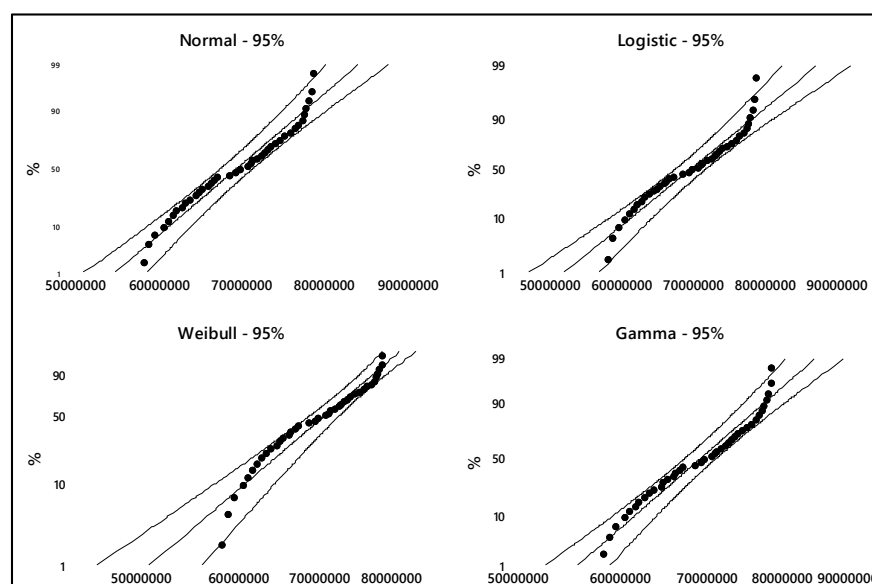


Figure 3. Fitting graphs of taxpayer entities in Mexico (national level).

The results of A^2 for active taxpayer business entities in Mexico were 0.622 for normal distribution, 0.686 for logistic distribution, 0.645 for Weibull distribution, and 0.683 for Gamma distribution, yielding the normal distribution and its parameters (Table 1) as the preferred option.

Then, using the curve's density function for the taxpayer entities in Quintana Roo:

$$f(x) = \frac{1}{\sqrt{2\pi} * 93916} e^{\left[\frac{-(x-1016905)^2}{2 * 93916^2}\right]} \quad (7)$$

Under the curve in Figure 4, the area representing the usual pattern corresponding to the number of taxpayer entities was identified according to the definite integral expressed as follows:

$$\int_{832833}^{1200977} \frac{1}{\sqrt{2\pi} * 93916} e^{\left[\frac{-(x-1016905)^2}{2 * 93916^2}\right]} dx \quad (8)$$

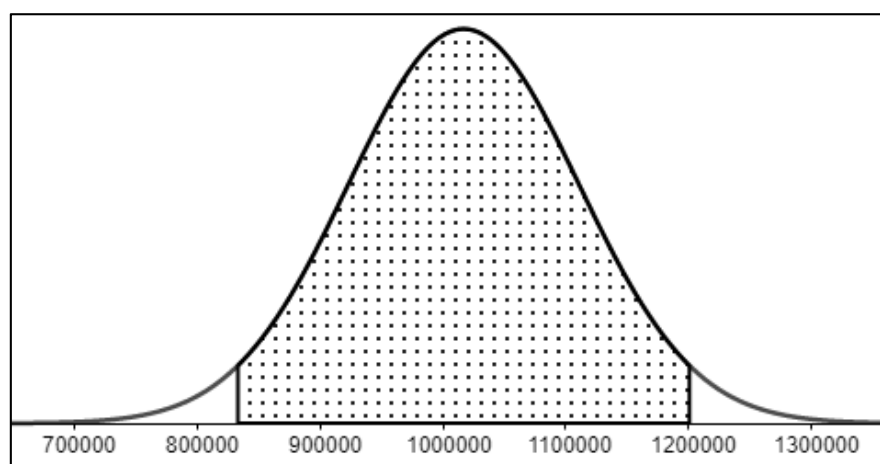


Figure 4. Distribution and definite integral area (interval) for Quintana Roo (monthly 2017–2019).

The taxpayer entities used within the definite integral are shown in Table 2. These are grouped according to each quarter period, identifying the lowest and the highest number of taxpayers a , b , respectively representing the limits of the integral for the periods reported.

Table 2. Registered taxpayer entities in Quintana Roo (from January 2020 to March 2021).

Quarter 1, 2020 ¹	January	a	1,168,936
	February		1,175,238
	March	b	1,179,424
Quarter 2, 2020 ¹	April	a	1,180,510
	May		1,181,799
	June	b	1,184,330
Quarter 3, 2020 ¹	July	a	1,186,782
	August		1,189,373
	September	b	1,196,169
Quarter 4, 2020 ¹	October	a	1,198,818
	November	b	1,202,214
	December		1,200,919
Quarter 1, 2021 ¹	January		1,203,422
	February	b	1,207,088
	March	a	1,192,804

¹ a = lowest number of taxpayers in the quarter; b = highest number of taxpayers in the quarter.

According to the results in Figure 5, the definite integral areas for registered taxpayer entities at the state level in the first, second, and third quarter of 2020 is found within the normality limit on the right tail of the curve. In other words, during the first months of the pandemic, there were no significant changes exceeding the critical interval point. However, in the fourth quarter of 2020 and first quarter of 2021, the number of taxpayer units yielded a statistically significant increment over the confidence interval (95%), reflecting a magnitude change that is sufficiently large to be classified as an unusual increase—particularly in the context of the pandemic and its effects on economic sectors.

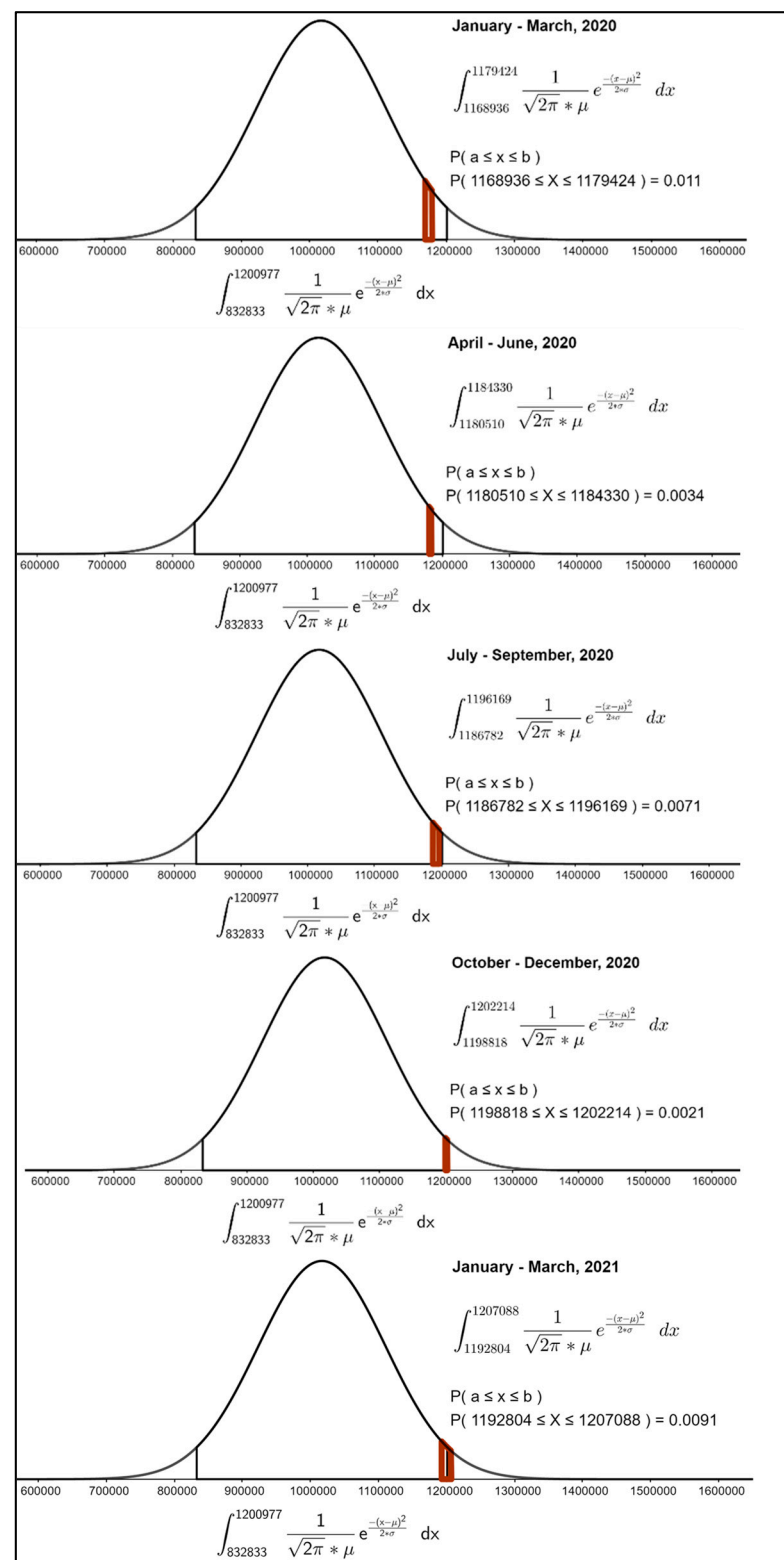


Figure 5. Quarterly variations of taxpayer entities in Quintana Roo (state level).

With respect to the taxpayer entities at the national level (Mexico as a country), considering the statistical parameters in Table 1, the corresponding density curve and its area representing definite integral with the usual pattern at 95% of probability is:

$$f(x) = \frac{1}{\sqrt{2\pi} * 6302380} e^{\left[\frac{-(x-69332815)^2}{2*6302380^2}\right]} \quad (9)$$

Under the curve in Figure 6, the area representing the usual pattern corresponding to the number of taxpayer entities was identified according to the definite integral expressed as follows:

$$\int_{56980377}^{81685253} \frac{1}{\sqrt{2\pi} * 6302380} e^{\left[\frac{-(x-69332815)^2}{2*6302380^2}\right]} dx \quad (10)$$

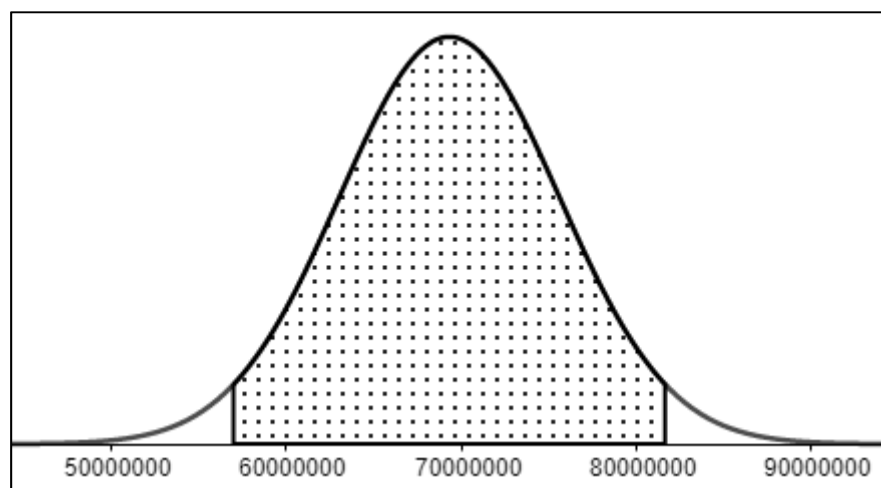


Figure 6. Distribution and definite integral area (interval) for Mexico (monthly 2017–2019).

Table 3 shows the taxpayer entities used within the definite integral for the analysis at the national level. These are grouped according to the same periods of 2020 and 2021, identifying the lowest and the highest number of taxpayers a , b , respectively representing the limits of the integral for the periods reported.

Table 3. Registered taxpayer entities in Mexico (from January 2020 to March 2021).

Quarter 1, 2020 ¹	January	a	77,706,166
	February		78,099,153
	March	b	78,360,839
Quarter 2, 2020 ¹	April	a	78,470,475
	May		78,595,530
	June	b	78,764,187
Quarter 3, 2020 ¹	July	a	78,963,137
	August		79,163,535
	September	b	79,659,718
Quarter 4, 2020 ¹	October		79,855,872
	November	b	80,044,868
	December	a	79,756,507
Quarter 1, 2021 ¹	January		79,918,870
	February	b	80,136,246
	March	a	78,883,432

¹ a = lowest number of taxpayers in the quarter; b = highest number of taxpayers in the quarter.

As reflected in Figure 7, the definite integral areas for all quarters of 2020 and the first quarter of 2021 are found within the usual values at the national level. Although the values for Mexico show a tendency approximating to the right tail boundary, the cases do not reach the limits to be classified as atypical increases or changes. Thus, was a statistically significant variation of taxpayer units at the state level, but not the national level.

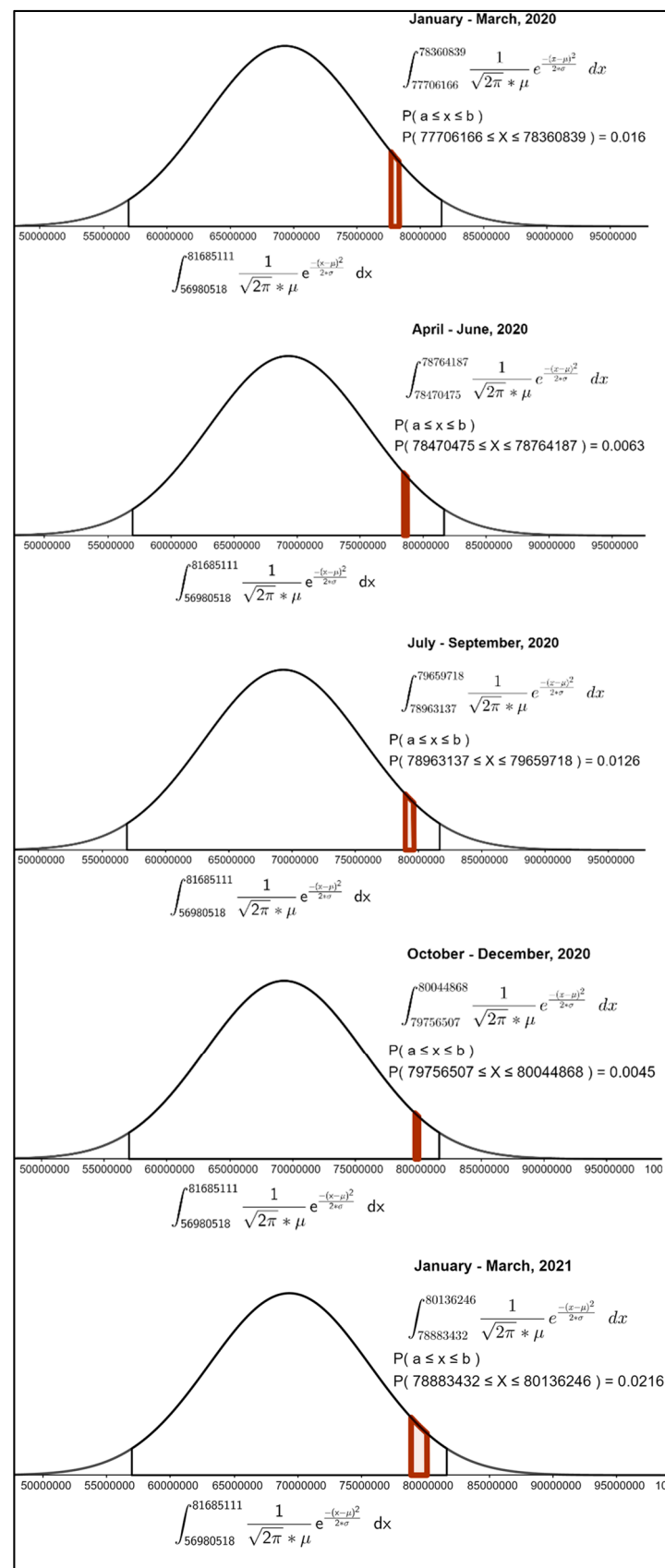


Figure 7. Quarterly variations of taxpayer entities in Mexico (national level).

5. Discussion

The results of the empirical analysis (as represented in Figures 5 and 7) show that the volume of taxpayer entities in the Mexican Caribbean remained stable during the first three quarters of 2020 and displayed a significant increase starting on the fourth quarter of 2020. In light of the study findings, a discussion of the contextual situation in the two periods and some fiscal implications are presented next.

5.1. Enduring the Initial Shock

Various reasons might help to understand why the number of taxpayer entities did not drop during the first months of the pandemic. For instance, considering the business cycles and that lead times for eventual closures do not occur immediately, it is possible that a substantial portion of the economic units delayed their decisions as to whether to stay in business or not, hoping for a rapid industry recovery. Particularly in crises for which a foreseeable time horizon is unknown and to the extent of their available resources and capabilities, businesses will normally make extra efforts to maintain the enterprise afloat (Walsh and Cunningham 2016), in many cases for weeks or months before deciding to close permanently. A definite, outright closure may be further postponed if business managers and/or owners harbor an expectation that operations could resume soon, trying to remain in business for some time longer in hopes of a reactivation. In this respect, according to a panel survey for tourism business executives in Mexico who were consulted in April of 2020 (CICOTUR 2020), there was an expectation that a recovery period would start in the summer of 2020, so it is not unlikely that taxpayers remained optimistic and perhaps made all efforts to resist for a few more months.

Additionally, since the majority of the international tourism arrivals to the Caribbean and Latin America correspond to visitors from the United States (Oyewole 2009), it is plausible that in the early months of the outbreak the tourism industry in the region was uncertain about soon-to-come, relevant decisions yet to be made by the United States as the major outbound market. These included, for example, determinations by the U.S. State Department (e.g., passports issuance, travel warnings) (USNews 2020) and the airlines' resuming of previously cancelled flight routes (The New York Times 2020). Moreover, despite the initial sanitary measures imposed by local governmental authorities, an unknown but substantial volume of economic activity and transactions continued to take place during the most difficult weeks of the pandemic, although at a lower scale. In this regard, it has been noted that travelers continued to arrive at several Mexican tourism destinations to stay at second homes, vacation properties, or with friends and relatives, rather than at regular hotels and other lodging commercial establishments with restricted operations (CICOTUR 2020). Therefore, not all business activities at the destinations remained completely closed during the COVID-19 outbreak and thus were able to earn sufficient revenues to survive.

5.2. Rebound and Recovery

With respect to the growth of taxpayer entities starting in the fourth quarter of 2020, a combination of factors may account for a quick recovery of tourism activities in the region, including little restrictions for international travelers, closure of competing destinations, short distance from major outbound markets, destination loyalty, and vaccines. The Mexican Caribbean did not impose any travel ban or strict measures to control the inflow of foreign visitors (World Tourism Organization 2021), and given the closure of other destinations worldwide, it represented an available, short-distance destination for travelers from the United States and Canada, the main international markets for the Mexican Caribbean. The rapid increase in international tourism was particularly noticeable at the end of 2020 and beginning of 2021, according to the 'COVID19tourism Index' (see Yang et al. 2021a). In fact, Mexico is to date the country that has reached the greatest travel and tourism recovery level in the Americas, second only to the Dominican Republic (COVID19tourism Index 2021). The rebound of the Mexican Caribbean region is

attested by the expansion of its flights' connectivity with 45 cities in the United States and Canada at the start of 2021, surpassing the number of connected cities before the pandemic (Vanegas 2021). Additionally, despite the government's decision not to impose restrictions for incoming international passengers at the airports (e.g., testing, quarantines), hotels and resorts in Quintana Roo implemented internal safety and sanitation protocols, in such a way that the Mexican Caribbean became the first destination in the Americas to receive the 'Safe Travels stamp' which helped to signal confidence to tourists (World Travel and Tourism Council 2020a).

Further, because of the high level of visitor loyalty for the Mexican Caribbean region at almost 50% (CPTQ 2020) and the lack of alternative international travel destinations, it is likely that tourists who were stressed or exhausted by the threat of the virus during the early lockdown period, felt confident to travel once the pandemic attenuated towards the end of 2020 and into the early months of 2021. This is especially feasible after vaccinations became available in the United States and Canada. Such a phenomenon manifested as a form of "revenge travel" is noted by recent research on the interaction of previous visitation, COVID-19 threat, and travel-related intentions (Kim et al. forthcoming), pointing out the importance of personality-based psychographic profiles (e.g., allocentrics-psychocentrics) as determinants of travel behavior (Litvin et al. forthcoming). Interestingly, although in the early months of 2021 foreign arrivals to Mexico had not reached pre-pandemic levels, the average expenditures of visitors exceeded those of 2019 (CICOTUR 2021; Euromonitor International 2021) suggesting that more affluent, 'allocentric' tourists with low risk aversion contributed to fuel a rebound of economic activity in the Mexican Caribbean. As anecdotal evidence in support of what seems a pattern of greater spending by tourists in the area, a sales manager in one of the major time-share resort chains in the Mexican Caribbean (who is a personal friend of the first author) asserted that in the second half of 2020 and the first months of 2021, the company reached record-breaking sales levels, in counterintuition to the expectations at the start of the pandemic (F. Haas-Rosa, personal communication, 12 June 2021).

The study findings for the state level (Quintana Roo) reveal a high degree of resilience amid the crisis in a tourism-based economy (Amore et al. 2018; Dahles and Susilowati 2015), in contrast with the results of the analysis for taxpayer entities at the national level (Mexico as a country) for which no statistically significant increases were found. The Mexican Caribbean destinations account for more than a third of Mexico's total international inbound tourism receipts (SEDETUR 2019), the highest volume of tourism-related economic units, and contributes to almost half of the tourism industry's gross value added nationwide (SECTUR 2016). Further, more than 50% of the state's GDP corresponds to tourism activities (Vanegas 2021) compared to less than 9% of the GDP for Mexico at the national level (Kido-Cruz and Kido-Cruz 2021) which is more diversified across sectors and industries in 31 other states (considering total travel and tourism contribution measures as per World Travel and Tourism Council 2020b; INEGI 2020).

However, the signs of resilience in the Mexican Caribbean did not mean an absence of adverse effects to the regions' economy, which experienced substantial declines in consumption indicators and thus, a rise in unemployment and worker layoffs during the COVID-19 hardest-hit months as in the rest of the country (Campos-Vazquez and Esquivel 2021; Huesca et al. 2021). A few probable circumstances may be argued to explicate that the pandemic's impact was not reflected in a significant reduction of registered taxpayer entities. First, perhaps most of the consequences of the crisis were suffered by entities in the informality sector that constitutes a high proportion of the Mexican economy (Bruhn 2013). Considering that informal businesses tend to have fewer resources, lack institutional supports, and are more vulnerable to the economic shock of the coronavirus (International Labour Organization 2020), probably the informal sector comprised most of the entities going out of businesses in 2020 (Moreno and Cuellar 2021), and thus such closures were not recorded in the government's Active Taxpayer Registry (Secretaría de Hacienda y Crédito Público 2021). Second, it could be assumed that bureaucracy, 'red tape'

obstacles, and slow processes in government agencies would make it difficult for business entities to formally liquidate a legally established firm, given the inflexible institutional environment of a country like Mexico (World Bank 2020). Nonetheless, entities that fail to officially liquidate or change to ‘inactive status’ in the government’s taxpayer registry are subject to penalties and fines, making it unlikely that their permanence was due to institutional, bureaucratic reasons, or neglect. Finally, a legislative initiative to modify the rules of business ‘outsourcing’ contracts was discussed and approved in the Mexico’s Congress in the spring of 2021, which may be seen as a potential influence on the increase in taxpayer units identified in the study. However, such grounds are not supported by the fact that the new law went into effect in September 2021, several months beyond the period analyzed in the study. Further, the ‘outsourcing’ regulation was also applicable at the national level, for which no statistically significant increase in taxpayer entities was revealed whatsoever.

5.3. Fiscal Implications

Based on the study results, it is a positive finding that economic agents in the Mexican Caribbean strived to remain active/in business and contribute to tax revenues for state and federal governments. However, by maintaining an “active” legal status albeit with reduced operations, regular tax collection levels were not achieved for a number of local tax concepts (e.g., hotel occupancy tax, payroll taxes, etc.) that are crucial for state and municipal governments (Hotel Management 2020; Seetaram and Adedoyin forthcoming). Moreover, the collection of federal income taxes is jeopardized in relation to the reduced volume of business profits derived from the downturn in tourism activity. Further, it is important to point out that business establishments in highly vulnerable industries like hospitality and tourism require their respective governments’ support in the form of tax breaks and other stimulus packages (Khalid et al. 2021; Loayza and Pennings 2020). Particularly in economies that tend to be more heavily dependent on tourism (Forbes 2020; Lee and Chang 2008; Quinn 2020), the lack of fiscal incentives and/or subsidies might represent the difference between survival or bankruptcy for businesses, especially during the most critical months of a structural break in the absence of sufficient liquidity to cover fixed costs and overhead expenses (Assaf and Scuderi 2020). In countries like Mexico—as in the case of others in Latin America and the Caribbean—the benefits of tourism to economic development have been demonstrated empirically for coastal regions like the one in this study (Faber and Gaubert 2019). This calls for the collaboration of governments, private sector, and society as a whole to maintain the economic vitality of taxpayer entities in the face of new challenges such as the COVID-19 pandemic (Pham et al. 2021a).

6. Concluding Remarks

Given the lack of research on tax-related impacts in the tourism crisis literature, this research studied variations in the number of taxpayer entities during the COVID-19 pandemic in the state of Quintana Roo, a tourism region that comprises some of the most important beach resort destinations in Latin America and the Caribbean. The study results show that at the beginning of the coronavirus outbreak, the number of registered taxpayers did not vary significantly and remained constituted for at least the first three quarters of 2020. This finding indicates that firms and business established in the Mexican Caribbean tourism destinations were able to maintain an ‘active status’ during the most critical period of the crisis in which operations were restricted or under suspension. Although the harsh financial situation compelled companies to lay off and/or furlough thousands of employees and personnel (El Economista 2020), that was not reflected in the closure, dissolution, or a change to an ‘inactive status’ of the established economic and business units for legal and fiscal purposes, contrary to what typically is expected to occur in times of crisis (Barbera et al. 2016; Clemens and Veuger 2020; Brondolo 2009). Further, starting in the fourth quarter of 2020, the number of state taxpayer entities increased significantly in what seemed a trend of economic recovery for the region, expanding the volume of

the taxpayers (economic units) compared to the pre-pandemic period. Surprisingly, the volume of national taxpayers did not show the same pattern, and the number of registered entities remained stagnant during all of 2020 and the first quarter of 2021, manifesting different conditions and response to the pandemic repercussions.

The COVID-19 pandemic has represented a global disruption impacting industries, markets, and consumption at an unprecedented scale (Das et al. 2021). Though a transition toward normalcy can be glimpsed on the horizon, the pandemic is not yet over and its permanent, long-term consequences on public finance, budgetary institutions and fiscal governance will not be fully known until further assessment is done in the years to come (Grossi et al. 2020). Taxes play an important role in the health of a country's economy, but when the volume of taxpayers shrinks, governments make expenditure cuts and/or restructure their tax system in order to raise revenue and foster economic recovery (Bunn and Asen 2021; Buerger et al. 2021). In those situations, estimating changes in tax bases to forecast revenue declines is a key source of risk and uncertainty faced by state governments (Clemens and Veuger 2020). Thus, knowledge about past changes in taxpayer entities may facilitate decisions aimed to strengthen or rebuild the tax bases over the medium-term (Brondolo 2009). For tourism-reliant regions, such information is a central input for tax planning towards resuming normal operations after the initial economic shutdown shocks and the travel-flow disruptions have lessened. As noted by Grossi et al. (2020), investigations on the 2020–2021 experiences in public finances are needed to draw out lessons about fiscal-, tax-related, and financial management issues, as a way to be more equipped to handle the next unexpected crisis. Raki et al. (2021) argue that the COVID-19 crisis is a reminder that firms should focus their efforts on proactive, rather than reactive strategies to reduce negative outcomes on consumers (e.g., physical, emotional, financial well-being) and businesses (e.g., employees, profits). Similarly, for governments and stakeholders in tourism destinations it is vital to formulate proactive strategies, by developing scenario planning approaches that consider the increasing prevalence of disruptive episodes worldwide (e.g., pandemics, natural disasters, financial crises, political instability, security threats) that may affect their public finances.

Limitations and Future Directions

This work investigated the case of a specific geographical area with particular situational conditions (Xiao 2010) which may not necessarily be extrapolated easily to other tourism regions. The purpose of the research was to measure the change of taxpayer units during a delimited period at the national (Mexico) and sub-national (Quintana Roo) levels. Because this research did not assess the pandemic effects on the actual volume of taxes collected, future investigations might be conducted to estimate the impact of incorporating different types of taxes, such as the income tax, payroll taxes, property tax, or the VAT. In this regard, the VAT does not depend exclusively on the operation of international tourism-related economic units, but rather on the inelastic nature of other goods or services (e.g., sales in supermarkets and other essential products to the local population) and consumers' purchase patterns which have also been impacted by the pandemic (see Valaskova et al. 2021). A more detailed, granular dataset could be also used to determine the impact of the COVID-19 crisis on tourism from a broader economic perspective, analyzing other variables (e.g., tourist arrivals, employment, consumption) across specific business segments or according to the North American Industry Classification System (NAICS). Further research should also pay attention to the tax incidence on economic entities that have traditionally been undertaxed or untaxed in destinations such as those in the Mexican Caribbean (Ambrosie 2013). This may shed light on ways to increase fiscal revenues to invest in enhancing the destination's sustainability and quality of life (Mc Coy Cador et al. 2019), which are especially important for this area that was originally promoted to generate benefits and development opportunities for the region's population (Collins 1979). For instance, tax-derived funds could be applied to address the recent growth of crime-related problems in the region (de la Torre and Navarrete Escobedo 2018).

Mexico's GDP is highly dependent on its tourism industry (Gavurova et al. 2021), and during the pandemic, the federal government decided to maintain open borders for international travelers which allowed to keep some level of economic and business activity. Alternatively, a more protective policy could have been followed by implementing border closures, quarantines and/or screening of travelers in the way other countries did to contain or delay transmission rates (Bou-Karroum et al. 2021; Farzanegan et al. 2021; Grépin et al. 2021), together with other mitigation measures that could help to reduce the impact on communities (Grubaugh et al. 2021). Thus, it is uncertain the extent to which the lack of strict travel-related control measures contributed to spread the disease in Mexico, which is among the countries with most COVID-19 deaths and highest observed case-fatality ratios worldwide (John Hopkins University 2021; Ritchie et al. 2021). Future research should focus on studying governments' decision-making policies on how to effectively balance the need to protect both productive activities and the public's health.

Author Contributions: Conceptualization, O.C.-M. and S.L.-P.; methodology, O.C.-M. and S.L.-P.; software, S.L.-P.; validation, S.L.-P.; formal analysis, S.L.-P.; investigation, O.C.-M.; resources, O.C.-M. and S.L.-P.; data curation, S.L.-P.; writing—original draft preparation, O.C.-M.; writing—review and editing, O.C.-M.; visualization, O.C.-M. and S.L.-P.; supervision, O.C.-M.; project administration, O.C.-M. All authors have read and agreed to the published version of the manuscript.

Funding: TAMU-CC Open Access Publication Fund.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Publicly available datasets were analyzed in this study. This data can be found here <https://www.sat.gob.mx/home/> (accessed on 15 October 2021).

Conflicts of Interest: The authors declare no conflict of interest.

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