



# The role of the tourism sector in creating direct employment in Mexico: evidence from linear and nonlinear ARDL frameworks

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Received: 14 June 2023 / Accepted: 19 October 2023 / Published online: 23 November 2023  
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## Abstract

This paper analyzes the role of the tourism sector in creating direct employment in Mexico by measuring the output elasticity of tourism employment from both linear and nonlinear perspectives. Although using such elasticity is a common practice for calculating the impact of economic growth on employment, it has been neglected in the context of the tourism labor market. Using Autoregressive Distributed Lag (ARDL) and Nonlinear Autoregressive Distributed Lag (NARDL) models, this study analyzes the impact of both the quarterly indicator of tourism gross domestic product (GDP) and the multilateral real exchange rate on tourism employment from the first quarter of 2006 to the first quarter of 2021. The results of the linear models show that tourism employment is elastic to variations in tourism GDP. Conversely, the NARDL model illustrates that tourism employment is inelastic to both positive and negative changes in tourism GDP. However, the NARDL model also shows that tourism employment is resilient to the negative phases of growth in the sector, as it grows more during the expansive episodes than it is reduced during the contractive phases. Meanwhile, the models including the multilateral real exchange rate show that tourism employment positively responds to the depreciation of the Mexican peso.

**Keywords** Economic growth · Tourism GDP · Tourism employment · ARDL · NARDL

**JEL Classification** C22 · E24 · Z32 · Z39

## Abbreviations

Y Aggregate output

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AIC	Akaike information criterion
ARCH	Autoregressive conditional heteroskedasticity
ARDL	Autoregressive distributive lag
BG	Breusch–Godfrey
BPG	Breusch–Pagan–Godfrey
K	Capital
$EC_t$	Error correction mechanism
GDP	Gross domestic product
L	Labor
$\pi$	Multilateral real exchange rate
OLS	Ordinary least squares
RESET	Regression equation specification error test
$E^T$	Tourism employment
$Y^T$	Tourism GDP
WHO	World health organization

## Introduction

Creating adequate conditions to stimulate economic growth is a major objective of economic policies as economic growth is related to employment expansion; however, the intensity of this relationship varies across countries and periods (Herman 2011) as it depends on the following factors: law, preferences, technology, social customs, and demographics (Neely 2010). Moreover, the relationship between unemployment and economic growth, as studied by Okun (1962), is now considered a statistical connection, rather than a structural feature of an economy, as it changes not only over time but also over business cycles (Knotek 2007).

Tourism has become one of the main economic activities, particularly in developing nations, as it helps poor areas escape poverty by promoting regional development (Yang et al. 2021), generating additional livelihood options, and boosting economic growth (Hipsher 2017a). Additionally, tourism contributes to poverty alleviation by creating employment opportunities for people with low levels of skill and education (Hipsher 2017b; Weinz and Servoz 2011). Apart from collaborating through the creation of inclusive employment, it provides jobs for women, young people, and marginalized groups, such as tribal or indigenous people (Hartrich and Martínez 2020), while generating numerous indirect jobs (Dahdá 2003).

Traditionally, the tourism sector's capacity to create employment has been considered a direct function of the number of tourists (Walmsley 2017). However, Santos (2023) found that in the specific case of Northern Portugal, inbound tourists had a negative, although statistically insignificant, impact on employment creation.

The main objective of this study is to estimate the output elasticity of tourism employment from both linear and nonlinear perspectives. To achieve this objective, the quantitative analysis was performed using linear and nonlinear Autoregressive Distributed Lag models, abbreviated as ARDL and NARDL, respectively. This study was carried out under the hypothesis that tourism, besides boosting job creation, is resilient to negative changes in tourism GDP.

I believe that this study will be of interest for both tourism researchers and policymakers as, although estimating the output elasticity of employment is a common practice among economists, to the best of my knowledge, this is the first time that it has been calculated for the tourism sector, either in its linear or nonlinear form. Similarly, I have not found any study analyzing the impact of the real exchange rate on tourism employment.

The results of this study show that, when using the linear model, tourism employment is elastic to changes in tourism GDP, but inelastic to changes in the real exchange rate. Conversely, the NARDL model illustrates that tourism employment is inelastic for both positive and negative variations in tourism GDP; additionally, the effect of the real exchange rate becomes shorter. In this sense, this article contributes to the existing literature not only by providing evidence of tourism as an important generator of direct employment but also by showing that tourism employment is resilient to contractive episodes in tourism GDP. Additionally, it collaborates by exhibiting the inelastic positive effect of the real exchange rate on the creation of tourism employment.

The remainder of this paper is organized as follows. The second section is divided into two subsections, with the first subsection presenting a literature review related to the relationship between tourism and employment creation, and the second subsection presenting a review of the impact of tourism GDP and the real exchange rate on tourism employment. The third section is also divided into two subsections; the first presents the study materials and their sources and the second presents the ARDL and NARDL empirical designs. In the fourth section, I present the econometric results. Finally, the discussion and conclusions are presented.

## Literature review

### Tourism and employment

Services are considered to have a positive impact on job creation and are regarded as employment-intensive activities (Basnett and Sen 2013; Ghose 2015). Services have become the most important sector in terms of their contribution to GDP and employment creation (Gurrieri et al. 2014). While tourism is connected to a vast number of economic branches, it is especially associated with numerous activities in the service sector, sometimes called “tourism services” (Álvarez 1996). Several studies have documented the relationship between tourism and employment generation, pointing out that tourism is an employment-intensive sector (Bhattarai et al. 2021; Bote 1990) and a booster of inclusive growth (Prasad and Kulshrestha 2015).

According to Walmsley (2017), the total demand for tourism employment can theoretically be regarded as a function, although not necessarily linear, of the number of tourists under the assumption that there is a positive relationship between these two variables. In other words, if the number of tourists increases, so does the total demand for tourism employment. According to the same author, there are three possible ways in which employers can increase their tourism workforce, namely,

recruiting more staff, increasing the productivity of current staff, or a combination of both.

According to Tribe (2011), employment in the tourism and leisure sector is determined by the demand for tourism goods and services, meaning that this type of employment is directly related to tourist expenditure. However, tourists also spend money on imported goods and services, thus creating employment abroad. Additionally, as noted by Stabler et al. (2009), the consumption of both international and domestic tourists can include products or services that are not specifically designed for tourists. As per Tribe (2011), the number of jobs created by the tourism sector also depends on the relative price of labor and the technical mix of factors influencing the provision of goods or services. Effectively, following Varian (1992), the technical mix of factors would indicate, according to the technique utilized by a company, the number of labor units required to produce one unit of a certain good.

However, a company's main objective is to maximize its benefits, and the maximum benefit is attained when costs are minimized (Varian 1999). By this logic, employees are perceived as a cost to be minimized (Walmsley 2017), implying that firms are unlikely to fulfill their need to adapt their production capacity by merely hiring more people as this is an expensive and time-consuming process (Burggraeve et al. 2015; Walmsley 2017). Instead, when responding to a variation in the level of production activity, companies usually first modify their intensive production margin, and recruit more employees only when all the tools that make employment more flexible have already been used and increases in demand have been made certain (Burggraeve et al. 2015).

As tourism demand is influenced by seasonality, this phenomenon also affects tourism employment. During the negative phase of the tourism seasonal cycle, which is characterized by medium and low seasons, tourism companies seek strategies that allow them a certain margin of operability and profitability (Ramírez 1994). Consequently, tourism companies tend to have permanent staff and hire temporary employees as needed to achieve an adequate level of efficiency and quality of service provision (Caballero 2011). Young workers occupy a considerable number of temporary positions in the tourism sector, and temporary contracts are usually terminated once the seasonal peak ends (Jolliffe and Farnsworth 2003). However, seasonality does not have the same impact on all tourism subsectors; for example, seasonality is stronger in lodging than in restaurant services (Bote 1990).

It is important, however, to consider that tourism has been extensively criticized for creating precarious employment as most tourism workers are paid less than the "all-industry average" (Robinson et al. 2019). Additionally, most of the precarious positions are occupied by young people, women, and migrant workers (Ioannides et al. 2021). In fact, a large part of tourism activities is carried out by women who are usually employed in vulnerable and low-paid positions; besides that, an important part of the tourism workforce is made up of minors and students (Domínguez et al. 2021).

Finally, other significant factors affecting tourism demand include artificial and natural disasters, publicity, income level, local prices, and competitors' prices (Panosso and Lohmann 2012). The COVID-19 outbreak, which was officially declared a pandemic on March 11, 2020, by the World Health Organization (WHO 2020), had

a profoundly negative impact on the number of tourist arrivals internationally as a result of the contingency strategies adopted by different nations, such as quarantines and community lockdowns (Sigala 2020).

### Economic growth, exchange rate, and tourism employment

As previously mentioned, tourism employment has traditionally been regarded as being determined by the number of tourists or by tourist spending, which ultimately represents the demand for tourism goods and services. Unlike such approaches, this study considers tourism employment to be a function of tourism GDP and the multilateral real exchange rate. In this section, I present the aspects that relate tourism employment to economic growth and the exchange rate.

The connecting link between economic growth and employment is among the most debated issues in the economic literature (Herman 2011). However, boosting economic growth is considered a key strategy in employment creation (Herman 2011; Wolnicki et al. 2006). In fact, the empirical literature has highlighted the existence of a positive relationship between employment and economic growth, although the quality of jobs created depends on a country's situation, which is influenced by both the factors transmitting the effect of economic growth and complementary policies (Basnett and Sen 2013). Current evidence has also shown that employment expansion in any sector needs to be accompanied by both sectoral and economic changes; otherwise, it "is likely to hit a barrier" (Melamed et al. 2011).

Economic theory points out that employment and economic activity usually move in the same direction during periods of expansion as more production implies hiring more workers; accordingly, employment rises and unemployment falls (Burggraeve et al. 2015; Tangarife 2013). The relationship between employment and economic growth is established based on the aggregate production function, which can be expressed as  $Y = f(K, L)$ . This function states that the aggregate output ( $Y$ ) is a function of both capital ( $K$ ) and labor ( $L$ ) (Mankiw 2000; Sudrajat 2008). To analyze the relationship between economic growth and employment, the aggregate production function can be simplified as  $Y = f(L)$ , and this equation represents the supply side, implying that the aggregate output is a function of employment; meanwhile, the demand side can be expressed as  $L = f(Y)$ , which states that employment is a function of the aggregate output (Sudrajat 2008).

However, unemployment does not necessarily fall at the same rate as employment increases, as both demographic factors and labor force participation influence the dynamics of the labor market (Burggraeve et al. 2015). Nonetheless, in Algeria, it was found that demographic and institutional factors only partially explained the level of unemployment (Boukli-Hassane and Talahite 2008).

In addition, changes in unemployment are usually stronger during crises than during periods of economic expansion (Liquitaya and Lizarazu 2003). Furthermore, employment does not always grow as expected during expansion periods, an economic phenomenon known as "jobless growth" (Herman 2011). Examples of nations that have experienced jobless growth include Colombia (Tangarife 2013), India (Tejani 2016), Poland (Wolnicki et al. 2006), and South Africa

(Temitope 2013), among others. Additionally, economies with high levels of labor market regulations tend to have higher unemployment rates than those with lower levels as these conditions make firms more reluctant to hire new employees (Neely 2010).

Regarding the output elasticity of employment, Basnett and Sen (2013) mentioned that this parameter indicates the level of job creation, although there may be a trade-off between the number of jobs generated and the value added per job. According to the same authors, employment elasticity analyses do not provide information on the quality of jobs created; therefore, special attention should be paid to the types of policies based on such studies.

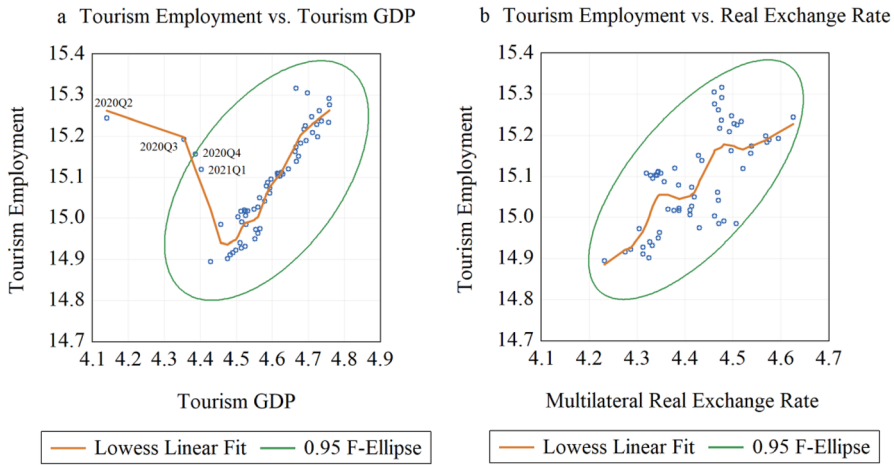
However, employment also impacts economic growth as labor is an input of production, which can be calculated as the sum of jobs or employees. Nevertheless, according to Pilat and Schreyer (2003), this type of measure, despite its simplicity, presents different flaws; for example, it does not adequately measure changes in the quality of labor or the average work time per employee.

Concerning the exchange rate, a depreciation of the national currency implies that foreign products will become more expensive than domestic products and, thus, domestic consumers will demand fewer imported products, while foreign consumers will respond by demanding more exports from the nation whose currency has depreciated (Krugman et al. 2023). Effectively, an increase in the price level, when income remains constant, implies a contraction of the budget set, in the sense that there are fewer feasible consumption baskets (Varian 1999). As most consumption baskets contain imported goods, an increase in the price of imports negatively impacts domestic consumers (Krugman et al. 2023).

In tourism, as per Álvarez (1996), a depreciation of the national currency, on the one hand, boosts the reception of international tourists, but, on the other hand, diminishes domestic tourists' spending. As tourism is a luxury good, according to the same author, a reduction in the purchasing power of domestic consumers more than proportionally reduces their spending on tourism goods and services. Meanwhile, according to Boullón (2009), inbound tourists' spending, from an accounting perspective, represents a type of export. Nevertheless, Álvarez (1996) mentioned that a depreciation of the national currency does not necessarily increase the foreign currencies generated by tourism as it reduces international tourists' average spending.

It is important to consider that tourism demand is more likely to be affected by the nominal values of exchange rates and prices than by real values. Moreover, in the short term, tourists may be unaware of the value of their national currency, which may cause them to be subject to money illusion (Stabler et al. 2009). Empirical evidence confirming the positive effect of the nominal exchange rate on international tourist arrivals has been reported in countries such as France (Chevillon and Timbeau 2006) and Mexico (Sánchez and Cruz 2016).

To exemplify the effect of both the multilateral real exchange rate and tourism GDP on direct tourism employment, I used multivariate analysis techniques consisting of control charts displaying scatter plots with nearest-neighbor fit. This analysis was complemented using confidence ellipses, as this technique permits detecting



**Fig. 1** Scatter plots with nearest-neighbor fit and confidence ellipses, 2006Q1–2021Q1

atypical data (Johnson and Wichern 2007). The series used in the control charts were transformed by applying seasonal adjustments and natural logarithms (Fig. 1).

The atypical data shown in Fig. 1a correspond to 2020Q2 and 2020Q3. During 2020Q2, the Mexican economy experienced the worst fall in history due to the COVID-19 pandemic (Cota 2020). Consequently, it brought about an increase in indicators related to poverty, social inequality, and disrupted labor markets, causing many residents to lose their jobs (Chiatchoua et al. 2020). However, direct tourism employment showed relatively high levels in 2020, although tourism GDP underwent important contractions, causing a change in the data trend (Fig. 1a) and suggesting the existence of asymmetries.

This trend in tourism employment could be due to Mexico’s internal control of the pandemic because, as reported by Weiss (2021), the country did not close its borders and was among the few nations that did not require a negative COVID-19 test to enter its territory. Mexico occupied the third place in the list of the most visited countries in 2020, behind Italy and France (De la Rosa 2022; Weiss 2021). Moreover, in 2021, Mexico received 31.9 million tourists, which made it the second most visited nation that year, behind France (De la Rosa 2022; León 2022). Consequently, the entry of tourists allowed tourism companies to maintain a considerable number of jobs.

Finally, Fig. 1b presents no atypical data in terms of confidence ellipses and shows that the depreciation of the Mexican peso stimulates jobs that are directly created by the tourism sector. The results presented in Fig. 1b suggest the existence of a symmetric relationship between the multilateral real exchange rate and tourism employment.

## Materials and methods

### Data and sources

To conduct this study, quarterly time-series data from the first quarter of 2006 to the first quarter of 2021 ( $N = 61$ ) were obtained from the following sources: tourism employment ( $E^T$ ) from Datatur (n.d.); the multilateral real exchange rate index with respect to 111 countries ( $\pi$ ) from Banco de México (2021); and the quarterly indicator of tourism GDP (volume index, 2013 = 100), ( $Y^T$ ), from the National Institute of Statistics and Geography (INEGI 2021). As the multilateral real exchange rate index is provided on a monthly frequency basis, it was averaged into quarterly data.

The time-series data of tourism employment utilized in this study as an indicator of direct tourism employment, according to Datatur (n.d.), exclude induced and indirect employment. This series considers remunerated and subordinated workers, as well as self-employed workers, in tourism activities.

The Census X12 filter was applied to seasonally adjust the quarterly indicator of tourism GDP and the multilateral real exchange rate index. Applying this technique facilitates the detection of outliers, including the modeling of trading day and holiday effects (Hylleberg 2010). Meanwhile, the tourism employment series had already been seasonally adjusted by Datatur (n.d.). To avoid generating spurious results while computing the models, I tested the integration order of the series using breakpoint unit root tests (Table 1).

The results illustrate that  $\ln\pi_t$  is an  $I(1)$  series, whereas the tests provided mixed results for  $\ln E_t^T$  and  $\ln Y_t^T$  as these two series can be considered  $I(0)$  or  $I(1)$  in levels, depending on the test specifications. Therefore, I considered the ARDL and NARDL models to be adequate procedures for the purposes of this study.

### Empirical design

To elaborate on the design of this study, unlike the previously mentioned classical approach, tourism employment was considered a function of the quarterly indicator of

**Table 1** Breakpoint unit root tests, 2006Q1–2021Q1

Series	Innovation Outlier				Additive Outlier			
	A	B	C	D	A	B	C	D
$\ln E_t^T$	- 2.290	- 4.809*	- 5.272**	- 5.870***	- 2.299	- 14.94***	- 4.025	- 4.001
$\ln \pi_t$	- 3.901	- 3.587	- 3.895	- 3.112	- 3.943	- 3.669	- 3.684	- 3.139
$\ln Y_t^T$	- 3.689	- 14.59***	- 15.03***	- 7.172***	- 2.962	- 5.367***	- 5.225**	- 6.485***
$\Delta \ln E_t^T$	- 13.68***	- 14.25***	- 6.709***	- 7.259***	- 16.46***	- 10.19***	- 5.484**	- 6.557***
$\Delta \ln \pi_t$	- 8.696***	- 8.593***	- 8.495***	- 7.761***	- 8.595***	- 8.554***	- 8.215***	- 7.914***
$\Delta \ln Y_t^T$	- 12.76***	- 12.68***	- 24.17***	- 10.09***	- 10.03***	- 10.18***	- 14.81***	- 10.29***

A: intercept only; B: trend and intercept (intercept); C: trend and intercept (trend and intercept); D: trend and intercept (trend); lag length: Schwarz criterion; breakpoint selection: Dickey–Fuller min-t; \*, \*\*, and \*\*\* denote  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively



tourism GDP and the multilateral real exchange rate index as specified in Eqs. (1), (2), and (3):

$$E^T = f(Y^T) \quad (1)$$

$$E^T = f(\pi, Y^T) \quad (2)$$

$$E^T = f(\pi, Y^{T(+)}, Y^{T(-)}) \quad (3)$$

Equation (1) represents the basic bivariate function. Meanwhile, Eqs. (2) and (3) are augmented by introducing the multilateral real exchange rate. Equation (3) allows for asymmetries in  $Y^T$ , while Eq. (2) does not.

As mentioned by Sudrajat (2008), an important way of analyzing the relationship between economic growth and employment is based on Okun's work. Particularly, Okun's (1962) "fitted trend and elasticity" model provides a method to estimate the output elasticity of the employment rate. This study estimated the output elasticity of tourism employment using tourism employment and tourism GDP. Additionally, Eqs. (2) and (3) include the multilateral real exchange rate.

The ARDL methodology was selected to conduct the empirical estimation of Eqs. (1) and (2) as such an approach can function adequately regardless of whether the series are  $I(0)$ ,  $I(1)$ , or a combination of both (Nkoro and Uko 2016; Phong et al. 2019). Meanwhile, Eq. (3) was approximated using a NARDL model, as NARDL models are based on the beneficial properties of ARDL models and are used to study the asymmetric impacts of the independent variables on the dependent variable (Phong et al. 2019). In addition, such models enable the discrimination of different forms and combinations of asymmetries as well as provide an easy estimation based on ordinary least squares (OLS) (Shin et al. 2014). Furthermore, once cointegration has been identified, NARDL models can be computed as regular ARDL models (Phong et al. 2019).

However, according to Sam et al. (2019), a prerequisite for applying the traditional F-bounds test proposed by Pesaran et al. (2001) is that the dependent variable should be an  $I(1)$  series.  $\ln E^T$  does not fully satisfy this condition because the breakpoint unit root tests show that such a series could be  $I(0)$  or  $I(1)$  in levels, depending on the test specifications (Table 1). To avoid generating spurious results derived from the cointegration methodology, the so-called "augmented ARDL bounds test for cointegration" developed by Sam et al. (2019) was applied. This allows testing for the existence of a levels relationship in the presence of an  $I(0)$  dependent variable.

All three models were computed using the restricted constant and no trend specification while utilizing series with natural logarithms to measure elasticities. Based on the conditional error correction regression, Eqs. (4) and (5) represent the ARDL models, whereas Eq. (6) represents the NARDL model:

$$\Delta \ln E_t^T = \alpha_A + \theta_0 \ln E_{t-1}^T + \theta_1 \ln Y_{t-1}^T + \sum_{i=1}^{p_0} \varphi_{0,i} \Delta \ln E_{t-i}^T + \sum_{i=0}^{p_1} \varphi_{1,i} \Delta \ln Y_{t-i}^T + \vartheta_A \delta_{A,t} + \varepsilon_{A,t} \tag{4}$$

$$\begin{aligned} \Delta \ln E_t^T &= \alpha_B + \beta_0 \ln E_{t-1}^T + \beta_1 \ln \pi_{t-1} + \beta_2 \ln Y_{t-1}^T + \sum_{i=1}^{n_0} \gamma_{0,i} \Delta \ln E_{t-i}^T \\ &+ \sum_{i=0}^{n_1} \gamma_{1,i} \Delta \ln \pi_{t-i} + \sum_{i=0}^{n_2} \gamma_{2,i} \Delta \ln Y_{t-i}^T + \vartheta_B \delta_{B,t} + \varepsilon_{B,t} \end{aligned} \tag{5}$$

$$\begin{aligned} \Delta \ln E_t^T &= \alpha_C + \lambda_0 \ln E_{t-1}^T + \lambda_1 \ln \pi_{t-1} + \lambda_2^+ \ln Y_{t-1}^{T(+)} + \lambda_2^- \ln Y_{t-1}^{T(-)} \\ &+ \sum_{i=1}^{s_0} \mu_{0,i} \Delta \ln E_{t-i}^T + \sum_{i=0}^{s_1} \mu_{1,i} \Delta \ln \pi_{t-i} + \sum_{i=0}^{s_2^+} \mu_{2,i}^+ \Delta \ln Y_{t-i}^{T(+)} \\ &+ \sum_{i=0}^{s_2^-} \mu_{2,i}^- \Delta \ln Y_{t-i}^{T(-)} + \vartheta_C \delta_{C,t} + \varepsilon_{C,t} \end{aligned} \tag{6}$$

where  $\varepsilon_{A,t}$ ,  $\varepsilon_{B,t}$ , and  $\varepsilon_{C,t}$  are the error terms. Meanwhile,  $\delta_{A,t}$ ,  $\delta_{B,t}$ , and  $\delta_{C,t}$  are variables designed to help the model correctly simulate the main breaks in the series, and are defined as shown in Eqs. (7), (8), and (9):

$$\delta_{A,t} = \begin{cases} 1 & t = 2020Q1 \\ -1 & t = 2008Q4 \\ 0 & \text{Otherwise} \end{cases} \tag{7}$$

$$\delta_{B,t} = \begin{cases} 1 & t = 2018Q4; 2019Q4; 2020Q1 \\ -1 & t = 2008Q4; 2017Q1; 2018Q2 \\ 0 & \text{Otherwise} \end{cases} \tag{8}$$

$$\delta_{C,t} = \begin{cases} 1 & t = 2014Q1; 2018Q4; 2019Q3; 2019Q4; 2020Q1 \\ -1 & t = 2008Q4; 2012Q1; 2018Q2 \\ 0 & \text{Otherwise} \end{cases} \tag{9}$$

In Eq. (6),  $\ln Y_t^{T(+)}$  and  $\ln Y_t^{T(-)}$  are partial sums, which, following Shin et al. (2014), are calculated as shown in Eqs. (10) and (11):

$$\ln Y_t^{T(+)} = \sum_{i=1}^t \max(\Delta \ln Y_i^T, 0) \tag{10}$$

$$\ln Y_t^{T(-)} = \sum_{i=1}^t \min(\Delta \ln Y_i^T, 0) \tag{11}$$

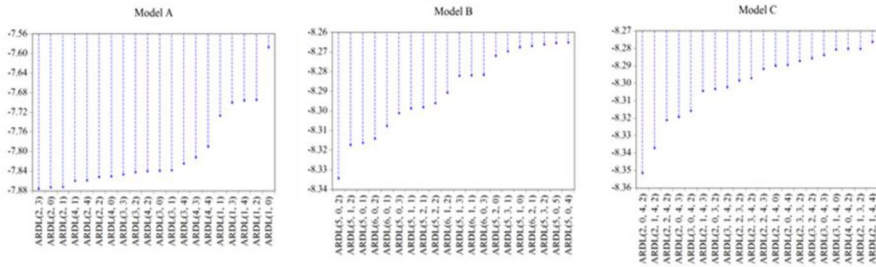


Fig. 2 Akaike information criteria (top 20 models)

To test the statistical significance of the asymmetries in Eq. (6), following Shin et al. (2014), the chi-square statistic of the Wald test was utilized. The null hypotheses of symmetry used to test long- and short-run relationships, following Olayeni’s (2019) examples, are shown in Eqs. (12) and (13), respectively, whereas Eq. (14) describes the joint test:

$$H_0 : \lambda_2^+ = \lambda_2^- \tag{12}$$

$$H_0 : \sum_{i=0}^{s_2^+} \mu_{2,i}^+ = \sum_{i=0}^{s_2^-} \mu_{2,i}^- \tag{13}$$

$$H_0 : \lambda_2^+ = \lambda_2^-, \sum_{i=0}^{s_2^+} \mu_{2,i}^+ = \sum_{i=0}^{s_2^-} \mu_{2,i}^- \tag{14}$$

To determine the optimal number of lags, the Akaike information criterion (AIC) was used (Fig. 2). In Models A and C, a maximum of four lags was allowed. In Model B, a maximum of six lags was allowed.

The AIC results show that the optimal specifications are ARDL (2, 3) for Model A; ARDL (5, 0, 2) for Model B; and NARDL (2, 0, 4, 2) for Model C (Fig. 2). These results imply that, in the empirical estimation of Eqs. (5) and (6), it is necessary to use the term  $\ln\pi_t$  in the long-run path, instead of its lagged form, whereas the values related to  $\Delta \ln\pi_{t-i}$  are omitted from the short-run path of both equations.

Finally, as ARDL and NARDL models can be computed using the OLS methodology, the Quandt–Andrews unknown breakpoint test was applied to test for structural changes in the models. To estimate the NARDL model and its dynamic multiplier, the EViews NARDL add-in was employed, as per the instructions provided by Olayeni (2019).

## Results and discussion

This study analyzed the effect of tourism GDP and the real exchange rate on the generation of tourism employment. To conduct the econometric analysis, correct specification tests were first applied to the ARDL and NARDL models (Table 2).

To complement the tests in Table 2, the Quandt–Andrews unknown breakpoint test was applied (Table A1, Appendix), and it was found that all three models strictly satisfied the condition of no structural change. The stability of the models was verified by applying CUSUM and CUSUM of Squares tests to each model (Figures A1, A2, and A3).

Once it was verified that the models satisfied the correct specification tests, the conditional error correction regressions were computed (Table 3). The estimations in Table 3 were performed according to the optimal number of lags provided by the AIC (Fig. 2).

To test for level relationships, the augmented ARDL bounds test for cointegration was applied. It was found that all three models successfully satisfied the conditions imposed by this test (Table 4).

However, as remarked upon in the note accompanying Table 3, the  $p$  value associated with  $\ln E_{t-1}^T$  is incompatible with t-bounds distribution. Nevertheless, as all three models were estimated using the restricted constant and no trend method (Case II), I used the critical values corresponding to the unrestricted constant and no trend method (Case III) to perform the test shown in Table 4; according to Sam et al. (2019), Case II is subsumed under Case III.

According to Shin et al. (2014), the F-bounds test depends on the number of variables entering the long-run relationship. However, when measuring asymmetries, it is not clear what the appropriate value of  $k$  should be as there is a dependency between partial sums. In this study, the partial sums were considered as different regressors, as shown in Table 4, with  $k = 3$  in Model C.

**Table 2** Correct specification tests

Test	Model A		Model B		Model C	
	Value	Probability	Value	Probability	Value	Probability
Jarque–Bera normality test	0.5105	0.7747	2.2497	0.3246	1.4697	0.4795
BG serial correlation LM test	18.247	0.1084	13.752	0.3168	16.037	0.1895
BPG Heteroskedasticity Test	3.2438	0.8616	4.4376	0.9255	8.0510	0.7811
ARCH LM test	13.878	0.3085	12.491	0.4070	5.0560	0.9561
Ramsey RESET test	0.3180	0.5753	0.2772	0.6012	1.4941	0.2284
$F$ -Statistic	5165.7	0.0000***	5358.6	0.0000***	4625.3	0.0000***
$R^2$	0.9986	–	0.9991	–	0.9992	–
Adjusted $R^2$	0.9984	–	0.9989	–	0.9990	–

BG and ARCH tests were performed using 12 lags

BG Breusch–Godfrey, BPG Breusch–Pagan–Godfrey

\*\*\*Denotes  $p < 0.01$

**Table 3** ARDL and NARDL conditional error correction regressions

Variable	Model A		Model B		Model C	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
Constant	0.5723	4.1845***	0.4913	4.2214***	3.2922	4.1605***
$\dagger \ln E_{t-1}^T$	- 0.0683	- 4.8200***	- 0.0649	- 4.9925***	- 0.2287	- 4.2515***
$\dagger \ln \pi_t$	-	-	0.0261	3.1749***	0.0250	2.8964***
$\ln Y_{t-1}^T$	0.1006	5.1410***	0.0823	4.9258***	-	-
$\ln Y_{t-1}^{T(+)}$	-	-	-	-	0.2079	4.6641***
$\ln Y_{t-1}^{T(-)}$	-	-	-	-	0.1199	5.6516***
$\Delta \ln E_{t-1}^T$	0.3910	3.3899***	0.3284	3.1807***	0.6184	6.0529***
$\Delta \ln E_{t-2}^T$	-	-	0.0820	0.7500	-	-
$\Delta \ln E_{t-3}^T$	-	-	0.1002	1.9520*	-	-
$\Delta \ln E_{t-4}^T$	-	-	- 0.3969	- 3.5594***	-	-
$\Delta \ln Y_t^T$	0.1298	14.9611***	0.1345	19.4487***	-	-
$\Delta \ln Y_{t-1}^T$	- 0.0020	- 0.1790	0.0275	1.6108	-	-
$\Delta \ln Y_{t-2}^T$	- 0.0170	- 1.7842*	-	-	-	-
$\Delta \ln Y_t^{T(+)}$	-	-	-	-	0.1059	2.2141**
$\Delta \ln Y_{t-1}^{T(+)}$	-	-	-	-	- 0.0040	- 0.1197
$\Delta \ln Y_{t-2}^{T(+)}$	-	-	-	-	- 0.1193	- 3.1777***
$\Delta \ln Y_{t-3}^{T(+)}$	-	-	-	-	0.0813	1.9398*
$\Delta \ln Y_t^{T(-)}$	-	-	-	-	0.1260	13.423***
$\Delta \ln Y_{t-1}^{T(-)}$	-	-	-	-	- 0.0581	- 2.3342**
$\delta_{At}$	0.0105	3.1761***	-	-	-	-
$\delta_{Bt}$	-	-	0.0096	6.1764***	-	-
$\delta_{Ct}$	-	-	-	-	0.0085	5.8761***

\*, \*\*, and \*\*\* denote  $p < 0.1$ ,  $p < 0.05$ , and  $p < 0.01$ , respectively

$\dagger$   $p$  value incompatible with t-bounds distribution.  $\dagger\dagger$  Variable interpreted as  $Z = Z(-1) + D(Z)$

After confirming that the models fulfilled the correct specification tests and that the variables were cointegrated, the long-term coefficients and error correction terms were obtained (Table 5).

Negative signs in the error correction terms indicate convergence to equilibrium, while positive signs indicate divergence (Nkoro and Uko 2016). In Models A, B, and C, the rates of equilibrium adjustment are 6.83%, 6.49%, and 22.87%, respectively (Table 5).

According to Model A, when the quarterly indicator of tourism GDP increases by 1%, direct tourism employment increases by 1.47%. Meanwhile, according to Model B, when the quarterly indicator of tourism GDP increases by 1%, tourism employment increases by 1.26%. In both cases, the linear specifications show that tourism employment is elastic to changes in tourism GDP (Table 5). Model B also illustrates that the depreciation of the Mexican peso has positive effects on tourism

**Table 4** Augmented ARDL-bounds test for cointegration

Model	Actual sample		Overall $F$ -bounds test		Exogenous $F$ -bounds test		$t$ -bounds test	
Model A	$n = 58$		13.247***		26.430***		- 4.820***	
Model B	$n = 56$		9.654***		14.481***		- 4.992***	
Model C	$n = 56$		9.893***		12.888***		- 4.251**	
Critical values								
Model	$k$	Finite sample	Overall $F$ -bounds test		Exogenous $F$ -bounds test		$t$ -bounds test	
			$I(0)$	$I(1)$	$I(0)$	$I(1)$	$I(0)$	$I(1)$
Model A	1	$n = 60$	7.4	8.51	7.03	11.84	- 3.43	- 3.82
		$n = 55$	7.435	8.46	7.04	12.09		
Model B	2	$n = 60$	5.697	6.987	5.03	8.10	- 3.43	- 4.1
		$n = 55$	5.707	6.977	5.05	8.31		
Model C	3	$n = 60$	4.748	6.188	4.24	6.83	- 3.13	- 4.05
		$n = 55$	4.828	6.195	4.18	6.89		

\*\*\* and \*\* denote tests at the 1% and 2.5% levels, respectively.  $k$  represents the number of independent dynamic regressors

employment: for each 1% increase in the multilateral real exchange rate index, tourism employment increases by 0.40% (Table 5). In the short term, both Models A and B show that tourism GDP growth stimulates the tourism sector’s capacity to create jobs. However, Model B shows that the real exchange rate has no effect on direct tourism employment (Table 3).

**Table 5** Long-term coefficients and error correction terms

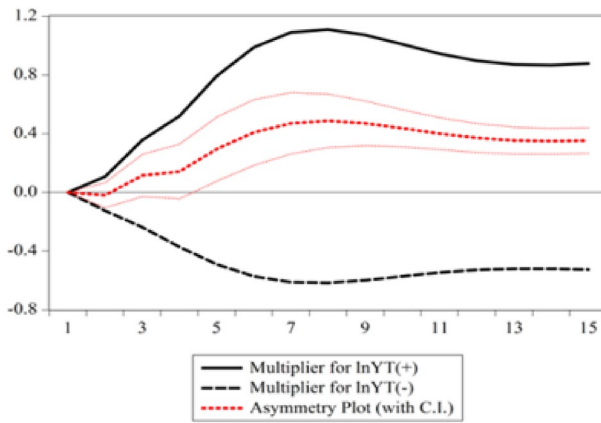
Variables	Model A		Model B		Model C	
	Coefficient	$t$ -Statistic	Coefficient	$t$ -Statistic	Coefficient	$t$ -Statistic
<i>Long-term coefficients</i>						
$\ln Y_t^T$	1.4719	12.1353***	1.2673	10.9550***	-	-
$\ln \pi_t$	-	-	0.4018	3.4788***	0.1094	2.7151***
$\ln Y_t^{T(+)}$	-	-	-	-	0.9091	19.6770***
$\ln Y_t^{T(-)}$	-	-	-	-	0.5244	6.3133***
Constant	8.3687	15.0867***	7.5649	13.6130***	14.3925	83.6523***
<i>Error correction terms</i>						
$EC_{At-1}$	- 0.0683	- 5.2569***	-	-	-	-
$EC_{Bt-1}$	-	-	- 0.0649	- 6.2608***	-	-
$EC_{Ct-1}$	-	-	-	-	- 0.2287	- 6.7105***

\*\*\*Denotes the rejection of the null hypothesis at the 1% significance level; EC: error correction term

**Table 6** Wald test for long- and short-term asymmetries

Test statistic	Value	df	Probability
<i>Long-run asymmetries</i>			
$\chi^2$	9.3192	1	0.0023***
<i>Short-run asymmetries</i>			
Test statistic	Value	df	Probability
$\chi^2$	0.0014	1	0.9700
<i>Joint test</i>			
Test statistic	Value	df	Probability
$\chi^2$	10.0516	2	0.0066***

\*\*\*Denotes the rejection of the null hypothesis at the 1% significance level. df: degrees of freedom



**Fig. 3** Tourism GDP dynamic multiplier

Before analyzing the results of Model C, it is important to corroborate the statistical existence of asymmetries by testing the null hypotheses in Eqs. (12), (13), and (14) using the Wald test (Table 6).

The Wald test rejects the null hypothesis of long-term symmetric adjustment in Eq. (12); however, it does not reject the null hypothesis in Eq. (13); thus, there is no evidence of asymmetries in the short term (Table 6). Figure 3 shows the multiplier effect of tourism GDP on tourism employment with its shocks.

Given the results in Table 5, Model C demonstrates that tourism employment is inelastic to changes in the quarterly indicator of tourism GDP. If the quarterly indicator of tourism GDP increases by 1%, tourism employment increases by 0.90%. Conversely, if the quarterly indicator of tourism GDP decreases by 1%, tourism employment decreases by 0.52%. Model C also shows that tourism employment responds positively to the depreciation of the Mexican peso. However, a 1% increase in the multilateral real exchange rate index generates only a 0.10% increase in tourism employment (Table 5).

Overall, the results suggest that Model C is better equipped to model tourism employment than Models A and B, as Model C has a smaller AIC value (Fig. 2). Model C also converges faster to equilibrium than Models A and B; in terms of absolute values, it presents a larger error correction term (Table 5).

## Conclusions and policy implications

This study documents the impact of both the quarterly indicator of tourism GDP and the multilateral real exchange rate on direct tourism employment. The empirical approach employed consisted of applying the ARDL and NARDL methodologies to estimate the output elasticity of employment in the Mexican tourism sector.

The results indicate that both linear models are consistent with traditional approaches that claim tourism is an employment-intensive sector, as both models exhibit an output elasticity of tourism employment greater than unity. Meanwhile, the nonlinear model shows that tourism employment is inelastic to both positive and negative changes in tourism GDP. However, Model C indicates that tourism employment is more elastic to a positive change in tourism GDP than to a negative change. In other words, Model C shows that, in the long term, expansions in tourism GDP create more employment than is lost due to contractions. Thus, Models A and B could be overestimating the impact of tourism GDP on the creation of direct employment.

Meanwhile, the results in Models B and C show that, in the long term, real exchange rate variations exert a sufficiently strong impact on tourism demand to induce a statistically significant effect on the level of tourism employment, although such an effect is inelastic (Table 5). In addition, both models demonstrate that, in the short term, the multilateral real exchange rate has no effect on tourism employment (Table 3). This result is congruent with Stabler et al.'s (2009) observation that tourists may be unaware of their national currency value in the short term, implying that tourism demand is not sufficiently stimulated to produce a change in employment level.

All three models demonstrate that the Mexican tourism sector has a great capacity to generate direct employment during its expansion periods. Moreover, the results of Model C document the resilience of tourism employment during crises. In this sense, it is necessary to consider that the Mexican tourism sector demand was stimulated by the internal control of the COVID-19 pandemic, leading the country to achieve an unusually high position in the ranking of the most visited countries (Weiss 2021), while stimulating tourism companies to maintain an important level of occupation. Nevertheless, as mentioned by Paredes (2022), once travel conditions become normalized, Mexico will probably revert to the same place it had in the rankings before the pandemic.

The results in Fig. 1a show a negative trend in the relationship between direct tourism employment and tourism GDP from 2020Q2 to 2021Q1, whereas there is a positive and mostly linear relationship for the rest of the study period. This suggests that the asymmetric impact of tourism GDP on tourism employment could have



been introduced as an effect of the pandemic. However, it is necessary to conduct further research to confirm this observation.

Although the results of this study are congruent with the well-established notion that tourism contributes to national economies by creating employment, it is important to consider that elasticity analyses do not provide information on the quality of jobs generated. For example, according to Robinson et al. (2019), tourism also contributes to creating deep social cleavages, economic inequalities, and precarious employment conditions. Ferguson (2010) mentioned that the tourism sector creates a significant number of unpaid jobs as a result of numerous tourism micro-businesses; for example, it results in unpaid family members working in the hotel and restaurant trade. In the case of Mexico, Wilson (2008) noted that tourism has increased the number of workers employed in precarious occupational conditions, and made the country more dependent on foreign loans and patronage.

A final consideration of these results is that growth in the tourism sector can create a considerable number of jobs. However, the above-mentioned observations regarding the quality of tourism employment challenge the vision of tourism as a force for alleviating poverty. In this context, as Basnett and Sen (2013) noted, it is important to carefully consider employment output elasticity when designing economic policies. In this sense, such analyses should be complemented by studies on the effect of tourism on the complementary rates of occupation, such as the under-employment rate, the rate of informal employment, or the rate of critical occupancy conditions.

## Limitations

This study estimated the output elasticity of tourism employment; therefore, it is not possible to make conclusions on the quality of employment created by the tourism sector in Mexico. Additionally, the tourism employment time-series data exclude induced and indirect employment, and thus, the models do not consider all types of employment created by the tourism sector. In addition, according to Datatur (n.d.), due to the COVID-19 outbreak, there was a change in the computation methodology of tourism employment; therefore, the results of the second quarter of 2020 correspond to the Telephone Survey of Occupation and Employment (ETOE). Finally, as mentioned in this paper, tourism GDP corresponds to a volume index.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s43546-023-00584-4>.

**Acknowledgements** Fernando Sánchez López is a PhD Candidate from Programa de Posgrado en Economía, Universidad Nacional Autónoma de México (UNAM), and has received a fellowship from CONAHCYT.

**Author contributions** FSL is the only author.

**Funding** No funding was received.

**Availability of data and materials** The data that support the findings of this study are openly available at Mendeley Data at <https://doi.org/10.17632/vy6wyfr33k.1>

## Declarations

**Conflict of interest** The author declares no potential conflicts of interest.

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