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Econometric analysis of the international demand for tourist services in Argentina, 2007-2019

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Abstract

This paper presents a study on the determinants of the demand for inbound tourism in the tourist regions of Argentina between 2007 and 2019. Using non-linear autoregressive distributed lag (NARDL) models, we report different effects of the various explanatory variables per region. The exchange rate has not had a significant effect on international inflows. We report significant effects from the lagged levels of the number of nights spent per tourist and -in certain regions- from the economic activity level in the countries of origin and the rates of robberies and thefts per person in the region.

Keywords: international tourism; linear and non-linear autoregressive distributed lag models; structural changes; Argentina
JEL Classifications: L83, C52, C32, O54

Resumen

Este trabajo presenta un estudio sobre los determinantes de la demanda de turismo internacional en las regiones turísticas de Argentina entre 2007 y 2019. Utilizando modelos autorregresivos no lineales de rezagos distribuidos (NARDL), se reportan diferentes efectos de las diversas variables explicativas por región. El tipo de cambio no ha tenido un efecto significativo en la demanda. Se han encontrado asociaciones significativas entre la demanda internacional de servicios turísticos y rezagos en el número de pernoctes por turista, y -en ciertas regiones solamente-, el nivel de actividad económica en los países de origen y el nivel de actividad delictiva por persona en la región.

Palabras clave: turismo internacional; modelos autorregresivos de rezagos distribuidos lineales y no lineales; cambios estructurales en series de tiempo; Argentina
Clasificaciones JEL: L83, C52, C32, O54

1.- Introduction

The tourism industry is one of the most dynamic economic sectors in Argentina. Its gross value added (GVA) represents 4.9 percent of total GVA and generates around 6 percent of all formal jobs in the country (INDEC, 2022a).
Inbound international tourism contributes with 6.8 percent of all exports and until before the onset of the COVID-19 pandemic showed a growing trend reaching 264,000 arrivals per month (INDEC, 2020).
This paper studies the inflow of international tourists in Argentina between January 2007 and December 2019. The objective is to analyse whether it is related to some of its main determinants as identified in the literature.
The structure of the article is as follows. Section 2 provides a review of the literature; Section 3 describes the data used in this paper. Section 4 presents the econometric techniques and Section 5 discusses the results. Section 6 brings together some final thoughts.

2.- Literature review

The academic literature on the determinants of the demand for tourist services was reviewed by Johnson and Ashworth (1990) and Crouch (1994), and more recently by Rosselló Nadal and Santana Gallego (2022); Dogru et al. (2022); Camara et al. (2022); and Song et al. (2023).
Several econometric methods have been applied to study the determinants of the demand for tourist services, from ordinary least squares (Tung, 2019) to generalised moments systems (De Vita, 2014) or least dynamic squares (Untong et al, 2014)- but in many cases the possible autocorrelation in the dependent variable was not controlled for. Some papers used panel models: fixed effects panel and Tobit models (Surugui et al, 2011); autoregressive distributed lag models (Yazdi and Khanalizadeh, 2017); and dynamic panel models (Lim and Zhu, 2017).

Other econometric approaches include:

- Versions of the generalised autoregressive conditionally heteroscedastic model: E-GARCH (Park and Jei, 2010); DCC-GARCH (Akar, 2012); HAM (Chang and McAleer, 2012); VARMA-GARCH (Yap, 2012); GARCH with normal distribution (Saayman and Saayman, 2013) and Copulas (Tang et al, 2016; Gouveia et al., 2022).
- Vector cointegration (Salman (2003; Azhar et al, 2018), Hidden cointegration analysis (Irandoust, 2019), Asymmetric VAR (Yalcin et al; 2021) and Threshold VAR (Gaberli et al, 2021).

Other techniques are mixed data sampling (Nguyen and Valadkhani, 2020); dynamic panel econometrics (Garín-Muñoz and Pérez Amaral, 2000; Garín-Mun, 2006); neural networks and genetic programming (Álvarez-Díaz et al, 2018); genetic programming and fuzzy clustering (Pai et al., 2014); spectral analysis (Hassani et al., 2015); ridge regression models (Caicedo-Torres and Payare, 2016); survival analysis (Gokovali et al., 2007; Peypoch et al., 2012); deep learning (Zhang et al., 2021); ARMA-X models (Lim et al, 2009); count data regression models (Salmasi et al., 2012; Boto-García et al, 2019).

Following Song et al (2023), we apply the autoregressive distributed lag (ARDL) model by Pesaran et al. (2001) and its non-linear version (NARDL) developed by Shin et al (2014), as they control for the presence of long-term relationships between the demand for international tourist services and its covariates.

The ARDL model has been applied by Vanegas and Croes (2000); Narayan (2004); Halicioglu (2004); Toh et al (2006); Salleh et al (2007); Wang (2009); Song et al (2010); Lee (2011); Agiomirgianakis et al (2015); Vanegas (2017); Sharma et al (2019); Beh and Lee (2020); and Nor et al (2022). The NARDL, by Ongan et al (2018); Meo et al (2018); Işık et al (2019); Kara (2020); Iftikhar (2021); Borrego-Domínguez et al (2022); Kisswani et al. (2022); and Shi et al (2022).

Different variables of interest have been used across the literature: tourism expenditures or receipts; hotel occupancy rates; number of tourists; length of stay. The choice is crucial as the estimates of the elasticity values may not be comparable across studies, so conflicting conclusions may stem from the findings on the partial effects of the same independent variables (Rosselló-Nadal, 2022).

The main determinants identified in the literature are:

- income level of the country of origin (Camara et al, op. cit.).
- relative price of tourist services between the host and origin countries (Obi et al, 2015).
- internal security (Korstanje and Clayton, 2012; Ghaderi et al., 2017; Demir et al., 2019; Santana-Gallego and Fourie, 2022; Levantis and Gani, 2000; Gamage et al., 2020; Krajňák, 2021).
- economic activity (Peng et al 2014; Waqas-Awan et al, 2021).
- geographical distance (McKercher and Mak, 2019; Lin et al, 2002; Yang et al., 2022);
- climate (Goh, 2012; Bujosa and Rosselló, 2013; Rosselló and Waqas, 2015; Li et al., 2017; Muñoz et al, 2020);
- ICT (Kumar and Kumar, 2020; Nguyen and Nguyen, 2022);
- migration (Leitão and Shahbaz, 2012; Balli et al., 2016; Provenzano, 2020; Okafor et al, 2022);
- trade (Leitão, 2010; Santana-Gallego et al., 2011 and 2016; Khalid et al, 2022; Chen et al., 2022).

While the review is undoubtedly comprehensive, ensuring that it directly ties to the specific objectives of your study can make it more impactful. Highlighting gaps in the existing literature that your research addresses can strengthen the narrative of originality and necessity for your study

For Argentina, Gardella et al (2005) applied ordinary least squares to data on number of international tourist arrivals between 1985 and 2001 controlling for gross domestic product of countries of origin, the local aggregate price index, and dummy variables that accounted for the economic crises Argentina went through in 1989 and 2001 and the terrorist attacks in the United States on 11 September 2001. Yoma et al (op. cit.) used ordinary least squares regression models to investigate inflows of international tourists 1995 and 2008. These authors included as explanatory variables an index of the multilateral exchange rate, an aggregate measure of the GDP of the main countries of origin, the index published by

Transparency International[1] as a proxy for the overseas image of Argentina as a destination, and public spending by the national government department responsible for tourism, in addition to seasonal dummy variables. Descalzi and Molina (2019) used a linear regression model in a study on tourists from Brazil between 2004 and 2018 using the exchange rate between the Argentine and Brazilian currencies and Brazil's GDP as covariates on top of seasonal dummy variables. Finally, Tanana and Murello (2022) applied graphic analysis to study the relationship between multilateral exchange rates and receptive tourism between 2008 and 2018 and Cisneros-Martínez and Fernández-Morales (2016) decomposed the Gini index to study seasonality of tourism demand. Though insightful, these works are not closely related, respectively, to the econometric approach and the objective of this paper.

This paper adds to the literature on the Argentine case in many ways. First, it offers an analysis across the different tourist regions within the country, with the aim of contributing to better targeted tourism promotion and localised market development. Second, we controlled for internal criminality levels in addition to a weighted multilateral exchange rate and a weighted construct of GDP in origin. Thirdly, the paper applies state-of-the-art econometric models such as non-linear autoregressive distributed lag models and unit root tests with structural breaks.

3.- Data

The average length of stay provides an accurate reflection of the level of international demand of tourist services in a destination (Barros and Machado, 2010; Steen-Jacobsen et al, 2018; Gössling et al., 2018). It is also a key indicator for tourism management and policy design: a larger flow of tourists but with shorter average length of stay may not increase the total income of the establishments directly and indirectly related with tourist activities, nor the net inflow of foreign currency (Thompson and Thompson, 2010). Besides, shorter average lengths of stay may lead to a greater concentration of visits in the main tourist attractions of a host country, which may introduce long-term sustainability challenges in other destinations (Martínez-Roget et al, 2020; Qiang et al, 2020). On a methodological note, it helps eliminate the duality between visitor and tourist -the official definition of a tourist in Argentina is "any visitor who stays at least overnight in the place of visit" (INDEC, 2022d, p. 8).

We used monthly records non-resident travellers and their average stays between January 2007 and December 2019 (MTD, 2022). Stay is the number of nights non-resident travellers spent in hotels and para-hotel establishments, which include union-run hotels, cabins, bungalows, bed and breakfasts, hostels, etc. Non-resident travellers are people who do not reside in Argentina and spent one or more nights in one same establishment and pays for the service.

There are seven tourist regions in Argentina: Buenos Aires, CABA, Córdoba, Cuyo, Litoral, Norte and Patagonia[2]. Patagonia and Buenos Aires/CABA have recorded the highest number of average lengths of stay over the period (Figure 1).

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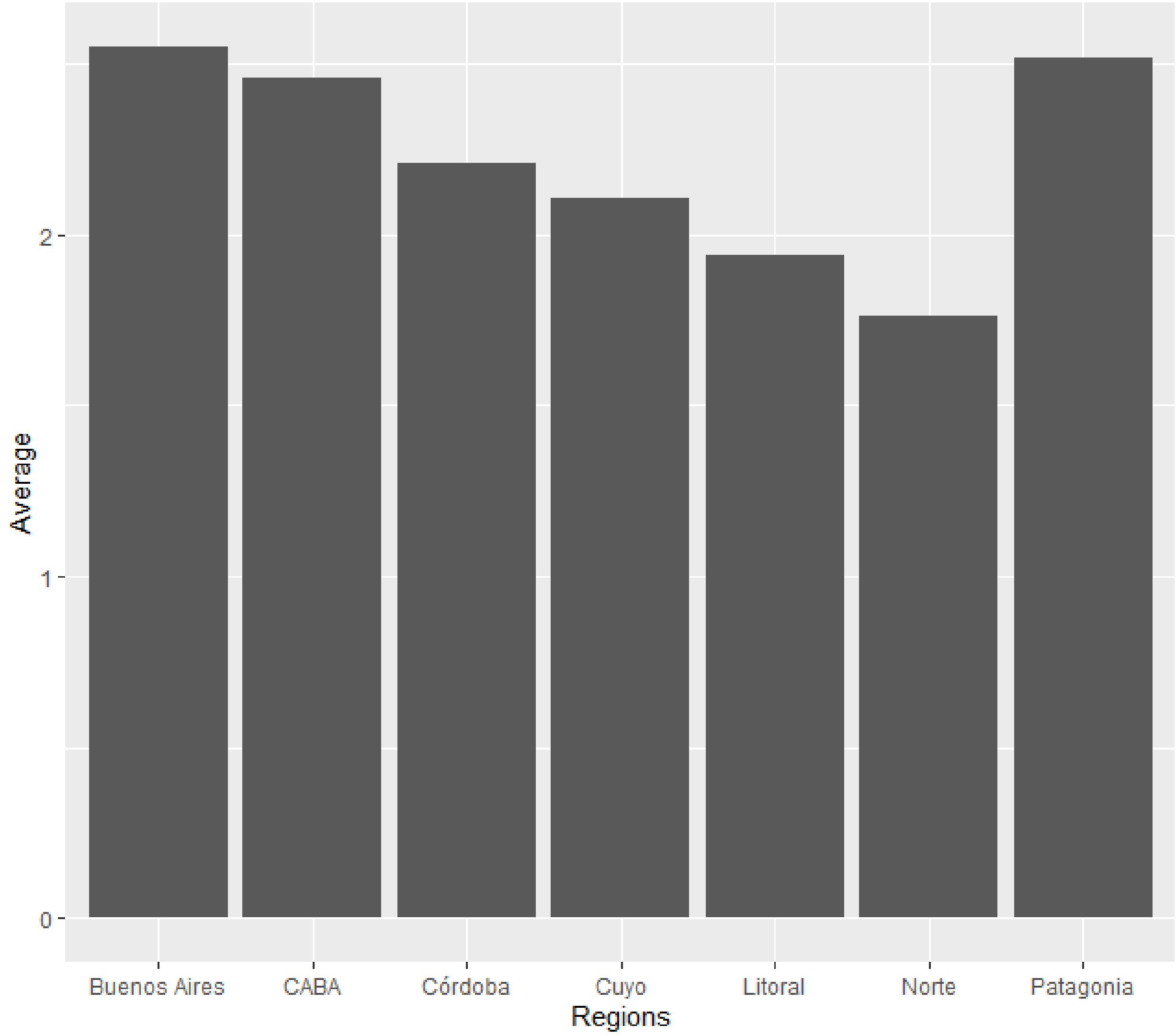
[1] http://www.transparency.org

[2] Buenos Aires include the provinces of La Pampa and Buenos Aires. CABA: the Autonomous City of Buenos Aires. Córdoba: Córdoba. Cuyo: San Juan, Mendoza and San Luis. Litoral: Formosa, Chaco, Misiones, Corrientes, Santa Fe and Entre Ríos. Norte: Jujuy, Salta, Catamarca, La Rioja,

Figure 1: Average length of stay by tourist region, 2007-2019



Recorded lengths of stay exhibit a strong seasonal component and a sizeable cross-regional variation (Figure 2):

Tucumán and Santiago del Estero. Patagonia: Neuquén, Río Negro, Chubut and Santa Cruz. (Source: Secretaría de Turismo de la Nación)

Figure 2: Stays by Tourist Region (in thousands) - January 2007 – December 2019

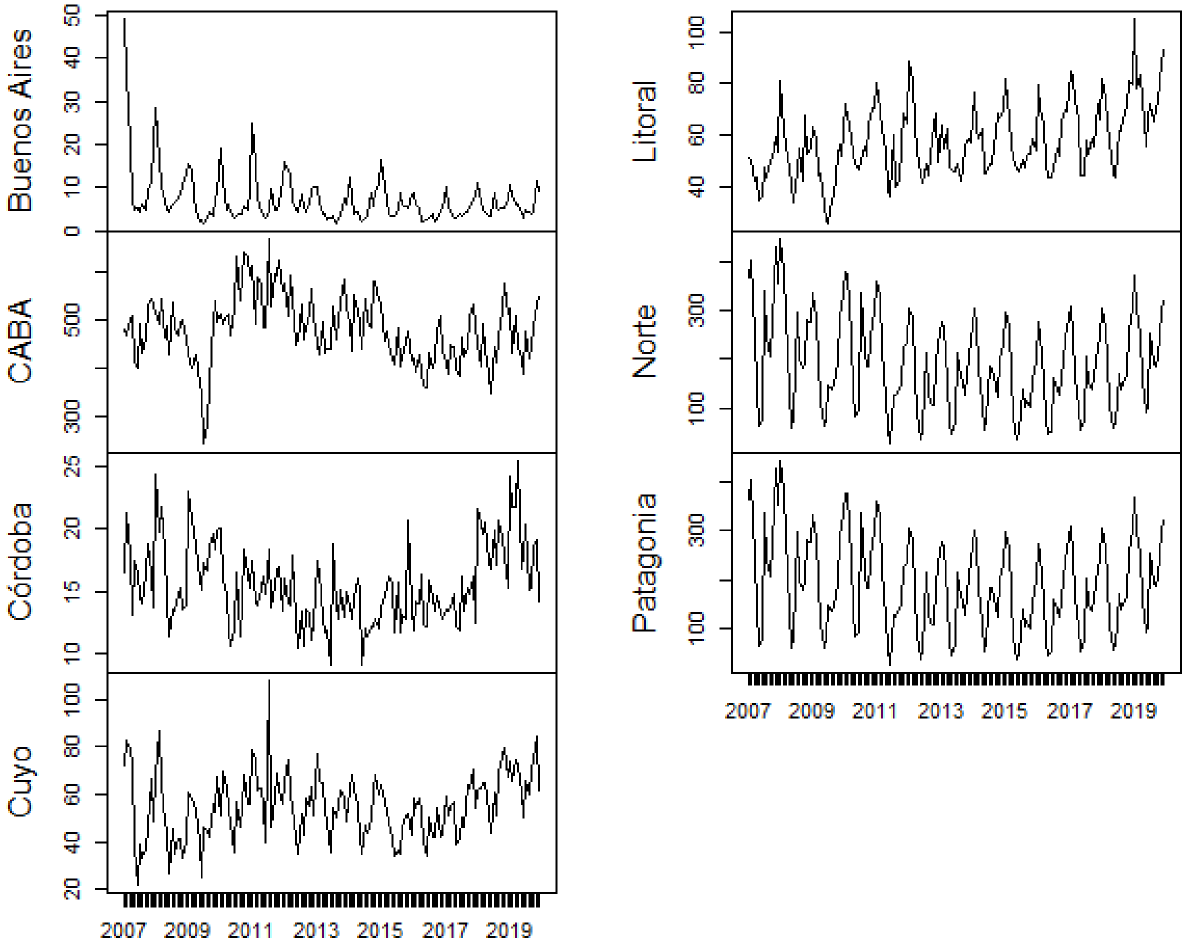
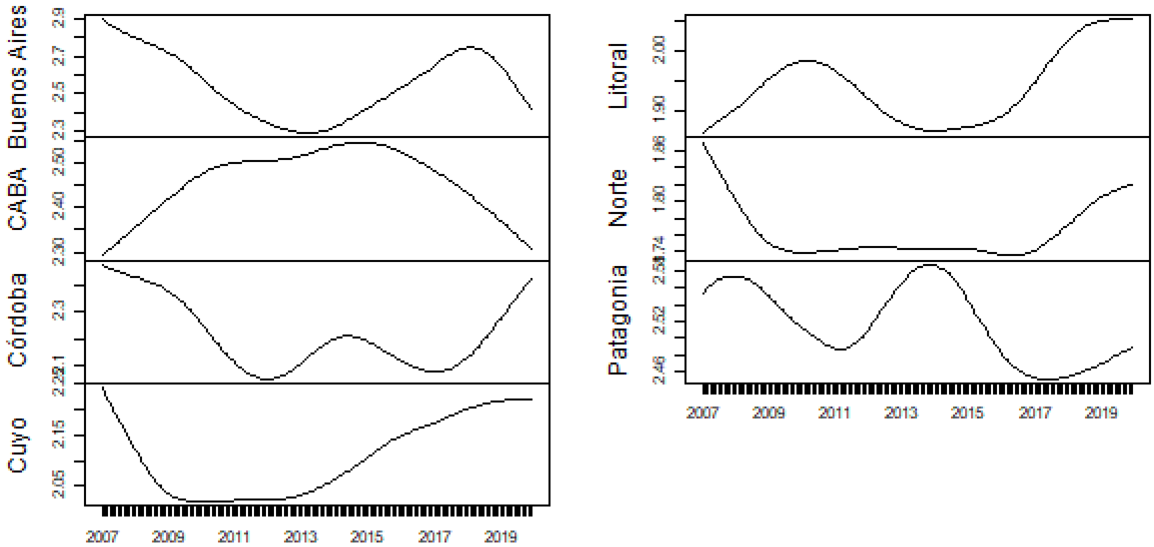


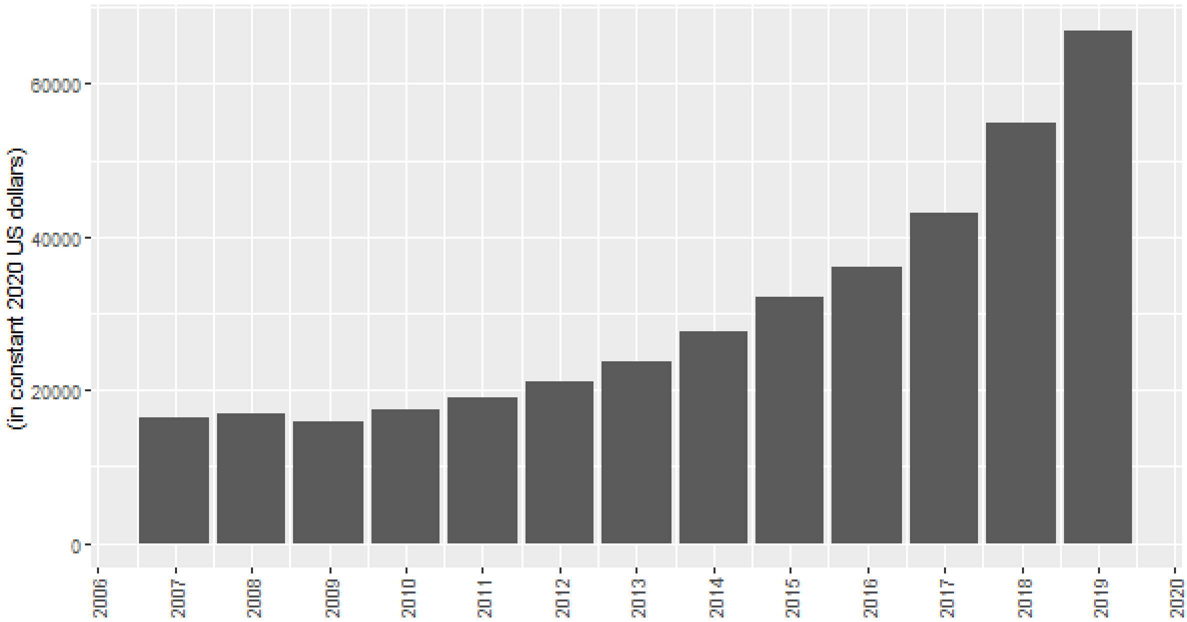
Figure 3 presents the trends in stays extracted from the time series by means of a Hodrick-Prescott filter. The trends vary substantially across tourist regions and there has been a strong substitution between some regions (e.g. Buenos Aires and CABA; Litoral and Patagonia).

Figure 3: Trends in stays per tourist region (in thousands)



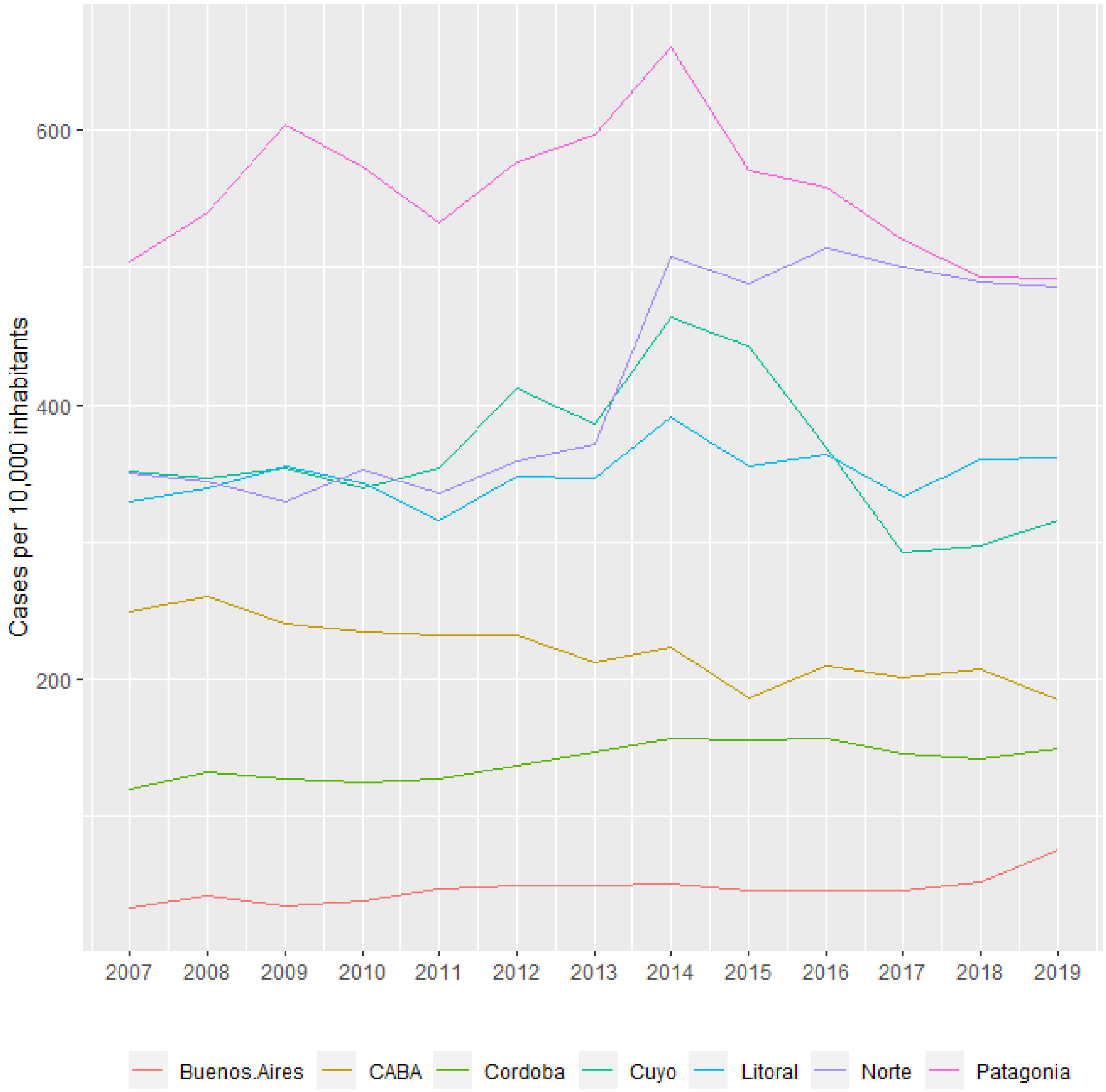
Yoma et al (op. cit.) produced a multilateral exchange rate of tourist activities by means of a weighted average of bilateral exchange rates between the Argentine local currency and the currencies from the main origin countries, with the number of tourists from each country as the weighting factor. Following this methodology, DNME (2021) produced an index of multilateral and bilateral tourism competitiveness using the currencies from the following countries: Chile, Brazil, Uruguay, Paraguay, Mexico, United Kingdom, Israel, and the EURO zone, which we use in this paper.
There are no data of number of visitors and their number of nights of stay by their country of origin, so we could not factor in the GDP of each country separately. Instead, we produced an aggregate indicator of income level using their relative GDP in real 2020 US dollars as weights -OECD (2022); CCSU (2022) for Uruguay; BCP (2022) for Paraguay.
As the periodicity of the available data for gross domestic product is quarterly, we converted them into monthly with disaggregation methods (Chamberlin, 2010; Sax and Steiner, 2013; Bannert and Thoeni, 2022). Figure 4 presents the evolution of the weighted GDP from the source countries.

Figure 4: Aggregate Gross Domestic Product, source countries, 2007 - 2019 (in constant 2020 US dollars)



Regarding criminality rates, terrorist activity remained low over the period: 29 cases were classified as terror-related, with 9 casualties and 2 fatalities (GTD, 2022). Therefore, we used the number of thefts and robberies (including attempts) per 10,000 inhabitants per province (Source: SNIC, 2022). Figure 5 presents their evolution.

Figure 5: Thefts and Robberies Rates by Tourist Region, 2007 - 2019



The international demand for places to stay overnight is concentrated in 4- and 5-star hotels, Apart Hotels and Boutique Hotels[3]. Figure 6 shows that hotel occupancy rates never reached saturation levels throughout the period.

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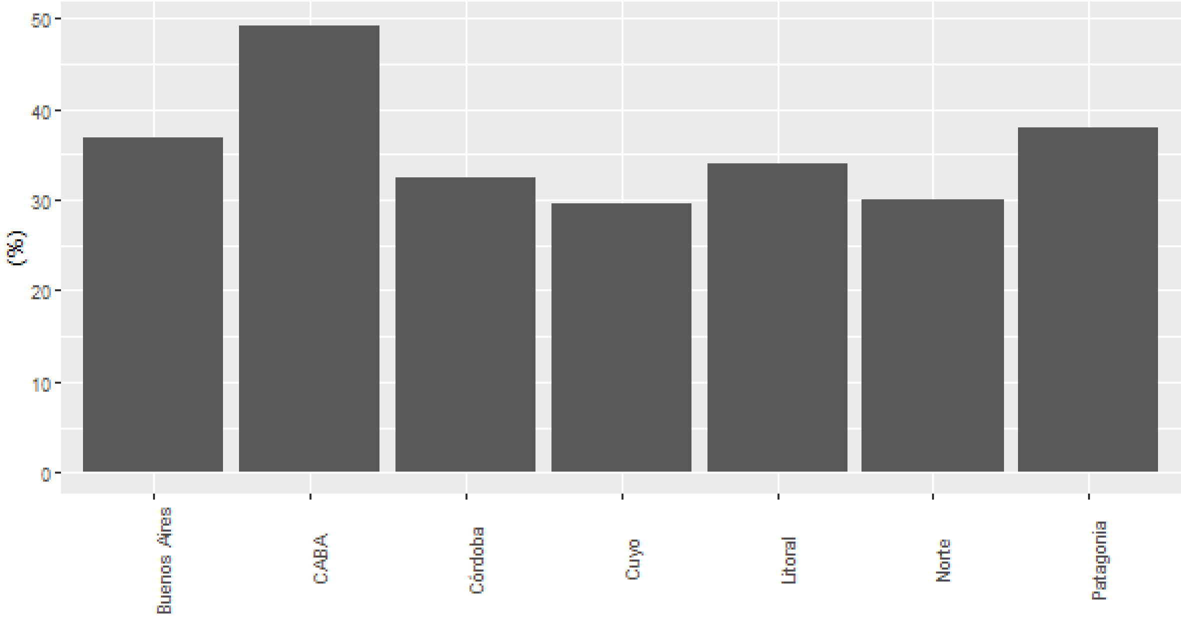
3 Source: https://turismo.buenosaires.gob.ar/es/observatorio/turistas-internacionales?dsd=SitL. Accessed on 4 January 2023.

Figure 6: Hotel Occupancy Rates by Tourist Region, 2007-2019 (4- and 5-star hotels, Apart Hotels, and Boutique Hotels)



We have not included any indicators for distance, climate, cost of travel, migration, and public spending. Distance is an important covariate in studies focused on the relative competitiveness between two or more destinations. However, it is less informative to analyse or forecast the demand towards one particular destination. Similarly, climate or weather indicators are relevant for studies of stationarity of demand of tourist services. However, Argentina has a wide variety of climates, so we decided not to include any weather- or climate-related indicators.

The fares of air tickets from the main countries of origin are the usual indicators for travelling costs. However, a sizeable proportion of international tourists arrive in Argentina by land (INPROTUR, 2020). Hence, we did not include any indicators of travel costs.

The relevant indicator of immigration as a pull factor of international tourism demand is the stock of immigrants, not the flow. By 2019 there were 2.2 million immigrants living in Argentina[4], around 4.5 percent of the total. Immigrants from the main tourist demand origin countries stood at 62 percent of all immigration stock in 2019. There are no annual data on numbers of permanent immigrants by country of origin. Consequently, we were not able to include this indicator in our quantitative analysis. Finally, there are no published data on public expenditure on tourism promotion, neither nation-wide nor by region, over the period.

[4] Source: Workbook *UN_MigrantStockByOriginAndDestination_2019.xlsx* Department of Economic and Social Affairs, Population Division. World Bank. 2019

4.- Econometric methods

Imagine that we are interested in modelling the relationship between two time series - y_t and x_t- such that:

$y_t = \beta_0 + \alpha_0 x_t + \varepsilon_t$ (1)

Imagine now that there is, in theory, a long-run relationship such that each variable depends on the other. F-tests can be used to test whether these long-run relationships are confirmed by the data or not. Pesaran and Shin (1999; 2001) reported that an ARDL model estimated under least squares renders the valid short-run and long-run parameters to explain the data generating processes behind this system of equations. The ARDL model allows to obtain short and long run elasticity estimates. A bivariate ARDL regression model of the stochastic process y_t over *t* periods in (1) can be represented thus:

$y_t = \beta_0 + \beta_1 y_{t-1} + ... + \beta_p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \alpha_2 x_{t-2} + ... + a_q x_{t-q} + \varepsilon_t$ (2)

where y is described by its *p* lagged values and *q* lagged values of an independent variable *x* plus a long-run stochastic perturbation term ε. It can be generalised to many independent variables. The model is autoregressive as y_t is explained, partially, by its lagged values.

ARDL models do not allow for asymmetric relationships between variables, in the sense that reductions in the values of an independent variable may have different effects over the dependent variable compared to increases in the independent variable of the same magnitude, but the non-linear NARDL model does.

The NARDL can be described thus. We start from an equation that includes an asymmetric relationship:

$y_t = \beta^+ . x^+_t + \beta^- . x^-_t + \varepsilon_t$ (3)

where $x_t = x_0 + x^+_t + x^-_t$

with

$x_t^+ = \sum_{j=1}^{j=t} \Delta x_j^+ = \sum_{j=1}^{j=t} \max(\Delta x_j, 0),$

$x_t^- = \sum_{j=1}^{j=t} \Delta x_j^- = \sum_{j=1}^{j=t} \min(\Delta x_j, 0),$

The NARDL model can be represented as:

$$y_t = \sum_{j=1}^{j=p} \phi_j y_{t-j} + \sum_{j=0}^{j=q} \left(\theta_j^{+\prime} x_{t-j}^+ + \theta_j^{-\prime} x_{t-j}^-\right) + \varepsilon_t \quad (4)$$

where ϕ_j is the autoregressive parameter; $\theta_j^{+\prime}$, $\theta_j^{-\prime}$ are the parameters of the asymmetric lagged values; ε_t is an independent iid stochastic process, with mean equal to zero and constant variance.

Given the possibility of a non-contemporaneous correlation between the dependent variable and the residuals in (4), y_t can be represented in this reduced form:

$$\Delta x_t = \sum_{j=1}^{q=1} \Lambda_j \Delta x_{t-j} + \upsilon_t \quad (5)$$

where υ_t is an iid stochastic process with mean equal to zero and variance equal to the positive definite covariance matrix, $\sum \upsilon$.

Using (5), the error term in (4) can be expressed thus:

$$\varepsilon_t = \omega' \upsilon_t + e_t = \omega'\left(\Delta x_t - \sum_{j=1}^{j=q-1} \Lambda_j \Delta x_{t-j}\right) + e_t \quad (6)$$

where e_t is a perturbation with null correlation.

After substituting (6) in (4) and arranging we obtain:

$$\Delta y_t = \rho \xi_{t-1} + \sum_{j=1}^{j=p-1} \gamma_j \Delta y_{t-j} + \sum_{j=0}^{j=q-1} \left(\pi_j^{+\prime} \Delta x_{t-j}^+ + \pi_j^{-\prime} \Delta x_{t-j}^-\right) + \varepsilon_t \quad (7)$$

where, for *j=1, …, q-1,*

$\pi_0^+ = \theta_0^+ + \omega,$

$\pi_0^- = \theta_0^- + \omega,$

$\pi_j^+ = \varphi_j^+ - \omega'\Lambda_j,$ y

$\pi_j^- = \varphi_j^- - \omega'\Lambda_j$

The model expressed in (7) corrects for possible weak endogeneity of any non-stationary explanatory variable. An adequate number of lags can lead to results free from serial correlation (Shin et al, op. cit.). Moreover, although non-linear, the model is linear insofar as its parameters, so it can be estimated by ordinary least squares.

The ARDL/NARDL models cannot be run with variables integrated of order 2 or above. Therefore, it is necessary to run unit root tests of each variable before running the ARDL and NARDL models.

The most commonly used unit root tests are the augmented Dickey-Fuller (ADF) test (Dickey-Fuller, 1979); the Phillips-Perron test (PP) (Phillips and Perron, 1988); and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test (Kwiatkowski et al, 1992). However, none of these tests are useful in the presence of structural breaks (Perron, 1989; Nunes et al, 1997). Lee and Strazicich (2003) developed a unit root test that allows for up to two structural breaks in a time series -either in the intercept or the trend. Kapetanios (2005) presented a test that extends the number of breaks to an a-priori non-determined number.

The Lee-Strazicich test is obtained from:

$$\Delta y_t = d'\Delta Z_t + \theta \tilde{S}_{t-1} + \sum \gamma_i \Delta \tilde{S}_{t-i} + \varepsilon_t \qquad (8)$$

where

$\tilde{S}_t$ is a detrended time series so that $\tilde{S}_t = y_t - \tilde{\psi}_x - Z_t\tilde{\delta}$ where $\tilde{\delta}$ is the vector of coefficients that results from regressing Δy_t over ΔZ_t, that is, over a vector of exogenous variables defined by the same data generation process. The $\Delta\tilde{S}_{t-i}$ term corrects for a possible presence of serial correlation. The null hypothesis is that the series is stationary and does not have a unit root. The number of lags is determined by a general-to-specific selection algorithm.

The Kapetanios test dates the structural breaks endogenously out of the minimization of the sum of the squared residuals. The test can be expressed thus:

$$y_t = \alpha_0 + \alpha_1 t + \rho y_{t-1} + \sum_{i=1}^{k} \lambda_i \Delta y_{t-i} + \sum_{i=1}^{m} \varphi_i DU_{i,t} + \sum_{i=1}^{m} \gamma_i DT_{i,t} + \varepsilon_t \qquad (9)$$

where α_0 is the intercept; α_1 is the time trend; ρ is the parameter of the autoregressive term of order 1; and DU and DT refer to dummy variables for the breaks in the intercept and trend, respectively, with m=1, …, 5.

With $T_{i,b}$ as a structural break, we have:

$$DU_{i,t} = \begin{cases} 1\ si\ \mathrm{t} < T_{i,b} \\ 0 \end{cases}$$

$$DT_{i,t} = \begin{cases} (t - T_{i,b})\ si\ \mathrm{t} < T_{i,b} \\ 0 \end{cases}$$

The null is that the series has a unit root with m structural breaks; in other words, that ⍰=1. We have applied the Lee-Strazicich and Kapetanios tests before running the ARDL and NARDL models, on levels and first differences of each of the variables. (Supplementary tables present the results from the ADF, PP and KPSS tests).

Regarding the Lee-Strazicich test, the recommended procedure is to run the 2-break version of the test on each time series, and if it is not significant, to proceed to run the 1-break version introduced in Lee and Strazicich (1999). With respect to the Kapetanios test, the greater the number of structural breaks conjectured, the longer the time series needs to be. In this study, each time series is of length n=156, so we assumed the presence of at most two structural breaks in each series -more breaks could risk rendering unstable results.

In our case, the cointegration equation can be represented thus:

$$\Delta Y_t = C + \alpha . Y_{t-1} + \sum_{j=1}^{j=p-1} \beta_j . \Delta Y_{t-j} + u_t \qquad (10)$$

Where Y_t represents the matrix of dependent and independent variables in the models - that is $Y_t = [stays_t \;\; crime_t \;\; xr_t \;\; gdp_t \;]$, where stays represent the overnight stays, crime the number of thefts and robberies per 100,000 population; xr, the multilateral exchange rate and gdp, the aggregate GDP of origin countries.

Finally, the ARDL model in our study is specified in Equation 11:

$$\Delta OS_t = \beta_0 + \beta_1 . OS_{t-1} + \beta_2 . CR_{t-1} + \beta_3 . XR_{t-1} + \beta_4 . GDP_{t-1} + \sum_{j=1}^{j=p-1} \tau_{1j} . \Delta OS_{t-j} + \sum_{j=1}^{j=p-1} \tau_{2j} . \Delta C + \sum_{j=1}^{j=p-1} \tau_{3j} . \Delta XR_{t-j} + \sum_{j=1}^{j=p-1} \tau_{4j} . \Delta GDP_{t-j} + \sum_{j=1}^{j=p-1} \tau_{5j} . \Delta OCUP_{t-j} + u_t \qquad (11)$$

where OS represents the overnight stays; CR stands for crime rates; XR is the exchange rate; GDP is the logarithm of the aggregate GDP of origin countries; and OCUP refers to the rate of hotel occupancy.

5.- Results

Tables 1a and 1b present the results from the Lee-Strazicich unit root tests on the series in levels and first differences, respectively. There are two statistically significant breaks in each series.

Table 1a: Lee-Strazicich Unit Root Tests on Levels

Variable	Break in intercept			Breaks in intercept and trend			
	Lags	Statistics	Date	Lags	Statistics	Date – 1st break	Date - 2nd break
Overnight stays							
Buenos Aires	13	-2.074	Jun-09	13	-6.153	Jun-09	Apr-18
CABA	13	-3.038	Jan-18	13	-5.751	Oct-09	Dec-14
Córdoba	12	-3.393	Oct-08	1	-5.669	Feb-10	Nov-15
Cuyo	1	-4.693	Dic-12	0	-9.135	May-08	Dic-14
Litoral	2	-2.917	Jul-08	0	-8.227	Dic-08	Apr-17
Norte	13	-3.424	Jul-09	0	-8.508	Jan-09	Nov-17
Patagonia	13	-2.889	May-08	12	-5.725	Mar-11	Sep-12
Crime							
Buenos Aires	13	-3.296	Mar-17	13	-4.576	Sep-13	Dic-17
CABA	13	-3.923	Jul-13	13	-6.598	Mar-15	Oct-17

Córdoba	12	-3.770	Apr-16	1	-4.993	Oct-08	Apr-13
Cuyo	1	-2.902	Apr-15	0	-6.495	Nov-13	Jan-17
Litoral	2	-3.280	Sep-15	0	-4.911	Oct-10	Feb-14
Norte	13	-2.366	Dic-13	0	-6.429	Nov-13	Jan-18
Patagonia	13	-2.689	Dic-14	12	-4.945	Nov-09	Apr-13
Exchange rate	13	-1.968	Jun-17	12	-5.758	Oct-14	Apr-18
Aggregate GDP of origin countries	9	-1.451	Mar-15	8	-10.044	Feb-14	Dic-17
Note: Critical values for one-break test at 1%, 5% and 10% respectively: -4.239 -3.566 -3.211 Critical values for two-break test at 1%, 5% and 10% respectively: –6.16, –5.59, y –5.28 for λ = (.2,.4); –6.40, –5.74, and –5.32 for λ = (.2,.6); –6.33, –5.71, and –5.33 for λ = (.2,.8); –6.46, –5.67, y –5.31 for λ = (.4,.6); –6.42, –5.65, and –5.32 for λ = (.4,.8); –6.32, –5.73, and –5.32 for λ = (.6,.8), where λ denotes the relative date of the breaks.							

Table 1b: Lee-Strazicich Unit Root Tests on first differences

Variable	Breaks in intercept and trend			
	Lags	Statistics	Date – 1st break	Date - 2nd break
Overnight stays				
Buenos Aires	8	-4.51297	May-17	Oct-17
CABA	13	-4.18693	Ago-08	May-10
Córdoba	0	-18.6352	Jun-10	Mar-11
Cuyo	0	-16.5276	Ago-08	Jul-09
Litoral	0	-15.8156	Jun-08	Nov-08
Norte	0	-15.2404	Nov-11	Jun-12
Patagonia	11	-6.52103	Ago-13	Apr-18
Crime				
Buenos Aires	13	-3.64708	Dic-08	Dec-14
CABA	13	-4.14237	Mar-14	Dec-14
Córdoba	12	-4.02498	Jun-08	Jul-18
Cuyo	12	-3.61244	Jun-08	Mar-09
Litoral	12	-3.93971	Jun-08	Jan-09
Norte	12	-3.83117	Jan-13	Apr-13
Patagonia	12	-3.50324	Jun-08	Oct-11
Exchange rate	0	-13.0751	Nov-17	Feb-18
Aggregate GDP of origin countries	0	-2.64889	Jun-17	Jul-18
Note: see critical values in note to Table 3a				

Tables 2a and 2b present the results of the Kapetianos unit root test for one and two structural breaks, respectively. At least the statistics of all the series in first differences are significative.

Table 2a: Kapetanios Unit Root Test – One break

Series		Kapetanios statistics			
		Levels			1st differences
		Intercept	Trend	Intercept + Trend	
Overnight stays	Buenos Aires	-5.100	-4.465	-4.958	-9.784
	CABA	-4.012	-5.237	-5.257	-7.492
	Córdoba	-4.154	-3.773	-4.139	-9.363
	Cuyo	-7.907	-5.528	-9.402	-6.711
	Litoral	-3.753	-3.167	-3.482	-8.794
	Norte	-8.239	-8.239	-8.416	-7.745
	Patagonia	-8.771	-7.999	-8.754	-8.204
Crime	Buenos Aires	-2.336	-3.619	-3.933	-8.093
	CABA	-8.173	-7.594	-8.113	-8.792
	Córdoba	-5.442	-4.893	-5.927	-8.195
	Cuyo	-4.485	-2.811	-3.450	-7.523
	Litoral	-3.504	-4.405	-3.412	-8.646
	Norte	-8.763	-2.737	-9.017	-7.418
	Patagonia	-3.465	-4.017	-4.203	-11.280
Exchange rate		-4.182	-3.870	-4.280	-7.098
Aggregate GDP of origin countries		2.568	3.341	3.957	-5.021
Critical values (5%)		-4.938	-4.495	-5.081	-4.938

Table 2b: Kapetanios Unit Root Test – Two breaks

Series		Kapetanios statistics			
		Levels			1st differences
		Intercept	Trend	Intercept	
Overnight stays	Buenos Aires	-5.325	-4.890	-5.963	-9.954
	CABA	-5.656	-6.511	-7.396	-7.572
	Córdoba	-4.850	-4.017	-3.584	-9.761
	Cuyo	-8.137	-5.592	-6.771	-6.819
	Litoral	-4.304	-3.320	-4.244	-9.064
	Norte	-8.539	-5.846	-6.772	-7.940
	Patagonia	-9.109	-8.146	-9.090	-8.268
Crime	Buenos Aires	-2.874	-4.863	-5.492	-8.169
	CABA	-8.432	-7.959	-9.374	-8.886
	Córdoba	-7.081	-6.084	-6.940	-8.222
	Cuyo	-5.084	-2.747	-3.865	-7.679
	Litoral	-3.804	-5.048	-8.734	-9.111
	Norte	-9.463	-7.113	-8.953	-7.715

	Patagonia	-4.261	-4.315	-6.844	-7.059
Exchange rate		-5.371	-4.928	-4.035	-7.204
Aggregate GDP of origin countries		7.428	2.874	1.282	-6.358
Critical values (5%)		-5.685	-5.096	-6.113	-5.685

The unit root tests that allow for the existence of structural breaks in the series do not reject the hypothesis that the series are integrated of order 0 or 1. Consequently, we can run ARDL and NARDL models.

Table 3 presents the results from the ARDL models with unrestricted error correction (for comparison, Supplementary Table 3 presents the results from linear regression models). In each case, the best-fitting model was selected by means of the Akaike information criterion. The exchange rate is not statistically significant in any region, and the level of economic activity in the origin countries is significant only for the number of overnight stays of international tourists in Buenos Aires and CABA.

The table also shows various diagnostic tests. The coefficient of determination (R^2), which measures the proportion of the variance in the dependent variable that is explained by the model. The Durbin-Watson test, which measures whether there is a first-order autocorrelation in the models. The Ramsey RESET test, which measures the correctness of the form of the regression function. The Breusch-Godfrey serial correlation test, which measures if different lags of the residuals are correlated thus affecting the standard errors of the regression. In the supplement, we also provide the cumulative (CUSUM) and cumulative sum of squares (CUSUMSQ) stability tests.

Based on the R^2 statistics, the models range between 35.8 per cent for Litoral and 83.4 per cent for Patagonia in terms of overall explanatory power (although the latter is found to suffer from serial correlation). The Durbin-Watson tests suggest that there are no first-order autocorrelations in any of the regional models. The supplementary charts show that the CUSUM and CUSUMSQ stability tests remain within the critical bonds at 5% level of significance, so that the null hypothesis that the coefficients are stable cannot be rejected in any region. The Ramsey test suggests that only in Buenos Aires and Córdoba there might be some specification problem as we fail to reject the null hypothesis that including terms of a higher degree would improve the fit over a linear model. The Breusch-Godfrey tests fail to detect serial correlations except in Patagonia, which means that the null hypothesis of no serial correlation cannot be rejected in any other region.

Table 3: Results from ARDL models with unrestricted error correction

Coefficients	Regions						
	Buenos Aires	CABA	Córdoba	Cuyo	Litoral	Norte	Patagonia
Constant	2.141	0.716	0.114	1.238	0.409	1.011	1.594
	(6.24)	*(3.41)*	*(0.44)*	*(5.70)*	*(1.95)*	*(6.50)*	*(4.63)*
Overnight stays							
L(OS , 1)	-0.725	-0.202	-0.311	-0.616	-0.320	-0.554	-0.983
	(-8.68)	*(-3.38)*	*(-4.13)*	*(-7.07)*	*(-4.36)*	*(-7.52)*	*(-8.04)*
OS Break		0.024		0.036		-0.047	0.034
		(0.61)		*(0.41)*	*(0.23)*	*(-0.78)*	*(0.29)*

L(OS Break, 1)	1.594		0.072		2.923		
	(2.67)		*(0.40)*				
d(L(OS , 1))	0.137	-0.269	-0.412	-0.058	-0.250		0.367
	(1.86)	*(-3.16)*	*(-4.73)*	*(-0.72)*	*(-3.27)*		*(3.286)*
d(L(OS , 2))		-0.281	-0.223		0.000		0.185
		(-3.45)	*(-2.91)*		*(0.00)*		*(1.786)*
d(L(OS , 3))							0.352
							(3.789)
d(L(OS , 4))							0.306
							(4.317)
d(L(OS , 5))							0.297
							(4.231)
d(OS Break)	0.306		0.304		0.102		
	(1.06)		*(2.39)*		*(1.88)*		
d(L(OS Break, 1))	-1.777						
	(-4.27)						
d(L(OS Break), 2))	-1.377						
	(-4.71)						
Crime	-0.018			0.000			0.002
	(-3.18)			*(0.47)*			
L(Crime, 1)		-0.001	0.000		0.000	0.000	0.000
		(-2.03)	*(0.00)*		*(0.59)*	*(-0.95)*	
L(Crime, 2)							
L(Crime, 3)							
L(Crime, 4)							
L(Crime, 5)							
d(Crime)		0.000	0.000		-0.001	0.000	
		(-0.67)	*(0.00)*		*(-1.82)*	*(1.21)*	
d(L(Crime, 1)		0.001			0.000		
		(2.04)			*(0.00)*		
d(L(Crime, 2)		0.001			0.000		
		(2.07)			*(0.00)*		
d(L(Crime, 3)		0.001					
		(4.01)					
d(L(Crime, 4)							
d(L(Crime, 5)							
Exchange rate							
XR		0.000	0.001		0.000	0.000	
		(0.77)	*(1.87)*		*(1.36)*	*(0.27)*	

L(XR, 1)	0.001			0.000			
	(0.67)			*(-1.12)*			
d(XR)	0.000			0.000			
	(0.00)			*(0.06)*			
d(L(XR, 1))	0.000			0.001			
	(0.00)			*(1.64)*			
d(L(XR, 2))							
d(L(XR, 3))							
d(L(XR, 4))							
Aggregate GDP of origin countries							
GDP						0.000	
						(1.35)	
L(GDP)	0.000	0.000	0.000	0.000	0.000		
	(2.15)	*(3.20)*	*(0.52)*	*(-1.64)*	*(0.00)*		
d(GDP)	0.000	0.000	0.000	0.000	0.000		
	(1.68)	*(1.96)*	*(-1.03)*	*(2.23)*	*(0.00)*		
d(L(GDP,1))			0.000	0.000			
			(-1.58)	*(3.33)*			
d(L(GDP,2))			0.000	0.000			
			(-1.81)	*(3.70)*			
d(L(GDP,3))							
d(L(GDP,4))							
d(L(GDP,5))							
d(L(GDP,6))							
OCUP	0.107		0.320			0.469	
	(1.40)		*(2.17)*			*(2.49)*	
L(OCUP,1)					0.143	-1.120	0.055
					(0.93)	*(-0.79)*	*(0.12)*
d(OCUP)		0.388			0.462	-1.119	1.962
		(3.77)			*(3.30)*	*(-0.98)*	*(6.74)*
d(L(OCUP,1)		0.188				-0.150	-0.181
		(1.52)				*(-1.55)*	*(-0.42)*
d(L(OCUP,2)		0.390				0.233	-0.718
		(3.88)				*(1.96)*	*(-1.80)*
d(L(OCUP,3)		0.153					-1.413
		(1.57)					*(-3.54)*
d(L(OCUP,4)							-0.882

							(-2.62)
Note: L denotes lag; for example, (L, variable, 1) corresponds to the first lag; d denotes first differences. t-statistics between brackets.							
Diagnostic Tests							
R^2	0.483	0.521	0.447	0.404	0.358	0.388	*0.834*
Durbin-Watson	1.987	1.985	2.027	1.933	2.108	1.982	1.925
	(0.35)	*(0.35)*	*(0.47)*	*(0.24)*	*(0.66)*	*(0.35)*	*(0.21)*
Ramsey RESET	0.795	3.550	1.796	4.896	3.162	4.110	7.225
	(0.45)	*(0.03)*	*(0.17)*	*(0.01)*	*(0.05)*	*(0.01)*	*(0.00)*
Breusch-Godfrey serial correlation test	0.026	0.011	0.261	1.260	3.604	0.008	*0.548*
	(0.87)	*(0.92)*	*(0.61)*	*(0.26)*	*(0.06)*	*(0.93)*	*(0.46)*
Note: p-values between brackets.							

Table 4 presents the results from the NARDL models. The coefficients in NARDL models can be classified into short-run and long-run coefficients. They measure any asymmetry in, respectively, the contemporaneous and lagged impacts of independent variables. We fail to find any asymmetries in the short-and long-run between the exchange rate and the international demand of tourist services, except marginally in Norte. In other words, overvaluation and undervaluation of the Argentine currency vis-à-vis the currencies in the pool of origin countries on the international demand for tourist services would be the same. Therefore, the conclusions will be based on the ARDL models in Table 3.

Table 4: Results from NARDL models

Short-run Coefficients							
Coefficients	Regions						
	Buenos Aires	CABA	Córdoba	Cuyo	Litoral	Norte	Patagonia
Constant	2.31200	0.80870	0.67130	1.11700	0.56220	1.07200	0.24320
	(5.491)	*(3.799)*	*(2.837)*	*(6.035)*	*(2.671)*	*(7.179)*	*(0.571)*
Overnight stays							
OS 1	-0.60610	-0.58060	-0.68200	-0.57420	-0.56130	-0.61340	-0.18330
	-(7.429)	*-(7.007)*	*-(8.850)*	*-(7.560)*	*-(7.041)*	*-(7.966)*	*-(2.482)*
OS 2	-0.20050	0.16650	0.24710		0.22640		-0.44800
	-(2.522)	*(2.031)*	*(3.116)*		*(2.839)*		*-(5.861)*
OS Breaks	0.13210	0.02563	0.33880	0.00364	0.08475	-0.03532	0.14710
	(0.432)	*(0.611)*	*(2.586)*	*(0.039)*	*(1.499)*	*-(0.561)*	*(0.597)*
OS Breaks 1	-0.65270	0.01780			0.12720	-0.03932	
	-(2.170)	*(0.417)*			*(2.268)*	*-(0.637)*	
OS Breaks 2		0.05062					
		(1.186)					
Exchange rate							
XR_p	-0.00046	-0.00004	0.00016	-0.00053	0.00026	-0.00002	-0.00221
	-(0.265)	*-(0.184)*	*(0.209)*	*-(1.022)*	*(0.824)*	*-(0.056)*	*-(1.654)*

XR_n	0.00110	0.00050	0.00156	-0.00045	0.00021	-0.00010	0.00068
	(0.177)	*(1.535)*	*(1.605)*	*-(0.635)*	*(0.487)*	*-(0.212)*	*(0.370)*
XR_n_1	0.01675						
	(2.092)						
XR_n_2	-0.01213						
	-(1.952)						
Crime	-0.02302	0.00023	0.00110	0.00006	-0.00072	-0.00087	-0.00186
	-(2.574)	*(0.841)*	*(1.005)*	*(0.239)*	*-(1.898)*	*-(2.459)*	*-(2.827)*
Crime 1	-0.00404	0.00076			0.00092	-0.00087	
	-(0.435)	*(2.326)*			*(2.430)*	*-(2.377)*	
Crime 2		-0.00029					
		-(1.068)					
Aggregate GDP of origin countries							
GDP	0.00012	0.00001	0.00001	0.00000	0.00001	0.00001	0.00003
	(2.621)	*(2.066)*	*(1.951)*	*(0.961)*	*(1.734)*	*(0.750)*	*(2.112)*
GDP_1	-0.00007	-0.00003			-0.00001	0.00000	
	-(1.443)	*-(4.348)*			*-(1.552)*	*-(0.476)*	
GDP_2		0.00002					
		(2.124)					
Trend	0.00968	0.00304	0.00013	-0.00049	-0.00039	-0.00103	0.00212
	(1.421)	*(3.082)*	*(0.046)*	*-(0.249)*	*-(0.334)*	*-(0.811)*	*(0.419)*
Long-run Coefficients							
Coefficients	Regions						
	Buenos Aires	CABA	Córdoba	Cuyo	Litoral	Norte	Patagonia
Overnight stays							
OS 2	-0.33085	0.28686	0.36224		0.40330		-2.44468
	-(2.183)	*(2.267)*	*(3.412)*		*(3.341)*		*-(1.924)*
OS Breaks		0.04415	0.49677	0.00633	0.15097	-0.05757	0.80275
		(0.613)	*(2.433)*	*(0.039)*	*(1.492)*	*-(0.563)*	*(0.576)*
OS Breaks 1		0.03066			0.22655	-0.06411	
		(0.417)			*(2.209)*	*-(0.641)*	
OS Breaks 2		0.08718					
		(1.174)					
Exchange rate							
XR_p	-0.00076	-0.00008	0.00023	-0.00092	0.00047	-0.00003	-0.01208
	-(0.265)	*-(0.184)*	*(0.210)*	*-(1.031)*	*(0.829)*	*-(0.056)*	*-(1.385)*
XR_n	0.00181	0.00086	0.00229	-0.00078	0.00038	-0.00017	0.00373
	(0.177)	*(1.525)*	*(1.587)*	*-(0.636)*	*(0.489)*	*-(0.211)*	*(0.370)*
XR_n_1	0.02764						
	(2.016)						
XR_n_2	-0.02001						
	-(1.870)						
Crime	-0.03798	0.00040	0.00161	0.00010	-0.00129	-0.00142	0.01013
	-(2.530)	*(0.825)*	*(1.003)*	*(0.239)*	*-(1.882)*	*-(2.361)*	*(1.860)*

Crime 1	-0.00667	0.00131			0.00163	-0.00142	
	-(0.437)	*(2.275)*			*(2.299)*	*-(2.252)*	
Aggregate GDP of origin countries							
GDP	0.00020	0.00003	0.00002	0.00001	0.00003	0.00001	0.00015
	(2.476)	*(2.048)*	*(1.927)*	*(0.976)*	*(1.656)*	*(0.756)*	*(1.659)*
GDP_1	-0.00012	-0.00006			-0.00002	-0.00001	
	-(1.397)	*-(3.480)*			*-(1.487)*	*-(0.476)*	
GDP_2		0.00003					
		(1.876)					
Trend	0.01598	0.00523	0.00019	-0.00086	-0.00070	-0.00168	0.01158
	(1.424)	*(3.103)*	*(0.046)*	*-(0.250)*	*-(0.333)*	*-(0.808)*	*(0.417)*
Note: the subscripts p and n denote, respectively, a positive and a negative change in the variable. t-statistics between brackets.							
Diagnostic Tests							
R^2	0.440	0.421	0.187	0.284	0.320	0.335	0.336
Short-run asymmetry test	0.061	1.612	1.239	0.008	0.008	0.019	1.550
	(0.970)	*(0.447)*	*(0.538)*	*(0.996)*	*(0.996)*	*(0.991)*	*(0.461)*
Jarque–Bera normality test	0.917	0.991	0.983	0.872	0.989	0.967	0.794
	(0.000)	*(0.467)*	*(0.058)*	*(0.000)*	*(0.282)*	*(0.001)*	*(0.000)*
Engle's test of conditional heteroscedasticity	0.320	0.369	1.885	1.095	1.784	4.197	0.079
	(0.852)	*(0.832)*	*(0.390)*	*(0.295)*	*(0.410)*	*(0.040)*	*(0.961)*
Long-run asymmetry test	0.165	4.782	2.664	0.024	0.025	0.049	46.153
	(0.921)	*(0.092)*	*(0.264)*	*(0.988)*	*(0.987)*	*(0.976)*	*(0.000)*
Pesaran, Shin and Smith Cointegration test	*8.41*	*7.22*	*11.52*	*8.32*	*6.08*	*7.24*	*11.00*
	Critical values I(1): 1%: 6.36 5%: 4.85 10%: 4.14						
Note: p-values between brackets.							

6.- Conclusions

This is the first paper to apply ARDL and NARDL models to data on international tourism demand across the seven tourist regions in Argentina.

We can conclude that the exchange rate has not affected the number of overnight stays of international tourists between 2007 and 2019 in any region. Neither the ARDL models nor the NARDL models exhibit any statistically significant relationship between the exchange rate and the number of overnight stays. Moreover, the NARDL models found no asymmetric effects of overvaluation and undervaluation of the local currency on the number of overnight stays of international tourists. Therefore, the exchange rate policies and the periods of overvaluation and undervaluation of the local currency vis-à-vis those of the main countries of origin have had no impact on the international demand for tourist services over the period under study. Besides, the CUSUM and CUSUM of the squares tests show the regression coefficients are stable over time.

The level of economic activity in the countries of origin is only statistically significant in CABA and Buenos Aires. The positive signs obtained for these regions suggest that the income elasticity of demand is only relevant for the main tourist region (CABA) and its closest neighbouring region (Buenos Aires). Overnight stays of international tourists in the other tourist regions in Argentina would not be affected by the level of economic activity in the main countries of origin. This could be interpreted as a result of CABA being an international tourism hotspot and that international demand for regional tourist attractions in Argentina would be a spillover of the international demand to visit CABA - and that therefore the income elasticity of the regional spillover demand would equal to zero. We could also interpret this result using the distinction between extensive and intensive margins: the decision by a resident abroad to visit Argentina is a decision on the extensive margin dependent on the level of income in the country of origin and it almost certainly includes overnight stays in CABA. Instead, once the decision to visit Argentina is taken, visiting other regions such as Córdoba, Cuyo, Litoral or Norte, is an intensive margin decision independent from economic activity in the origin country. The literature on regional spillover effects of tourism demand has not focused on differentials in income elasticities of the demand for hotspots such as global cities and of regional spillover demand (Bassil et al, 2023). Our results suggest that this could be an important line of future research.

Hotel occupancy rates tend to be statistically insignificant or present a positive effect on overseas demand, depending on the region.

Finally, recorded criminality has had a negative impact in Buenos Aires, CABA, Norte and Patagonia, but not in any of the other three regions.

One of the limitations of this study is that the data source does not include overnight stays in privately rented accommodation. Therefore, we could not control or look into the impact of the technological disruption introduced by 'peer-to-peer' platforms embedded into the shared economy paradigm such as *Airbnb*. If there was a substitution effect between hotel accommodation and privately rented accommodation, the results presented in this paper would be biased for not comprising all overnight stays of international tourists. In this regard, Yang et al (2021) concluded that even though a moderate effect has been recorded upon performance indicators of the hotel industry, the greater adverse impact of private rentals is found on occupancy rates -see also Bravo Zúñiga and Canto Briceño (2021). Moreover, Granero (2019) in a study looking into the CABA region reported that there would be a low substitution effect given hotel occupancy rates have remained fairly stable before and after the irruption of the *Airbnb* platform -see also González Correa (2016). Therefore, despite the proviso that the data does not include information about privately rented accommodation, we do not expect this limitation severely to bias our results.

Another limitation is the omission of travel costs and public spending in tourism promotion. Divisekera (2012) recommends the estimation of cross-elasticities between transport and tourism demand, although this author also points out that this variable has been left out in almost all the literature. Regarding public spending, this is a covariate more relevant for the analysis of individual decision-making processes when it comes to choosing between alternative destinations (the 'conversion studies' approach) -Crouch (1995); Kim et al (2005). In addition, Vanegas (2021) mentions that very few published papers on international tourism demand have included public spending on tourism promotion among the explanatory variables, and Witt and Martin (1987) further highlight some of the

limitations of using marketing indicators in tourism demand models. Notwithstanding, Cruz-Milán and Avsar (2021) have reported significant effects of publicly funded tourism promotion on the international demand of tourist services in Mexico.
Future research -depending on data availability- could factor in a broader choice of accommodation type like private rented options, as well as travel costs (particularly within the country, given the radial setup of the road and air transport networks within Argentina, with Buenos Aires as the dominant hub) and public spending on tourism promotion. Another avenue for future research is to consider the impact of the COVID-19 pandemic and other major shocks to international markets not only on the international demand for tourist services in the country, but also the resilience of the sector in the face of these events. Finally, the recently announced changes in the regulatory framework of commercial aviation in Argentina favouring the introduction of an Open Skies policy could have direct implications for the international demand, which could also be worth investigating.

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Supplementary Table 1: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Unit Root Tests – Series in Levels

	ADF			PP		KPSS	
	tau3	phi2	phi3	Z rho	p-value	kpss	p-value
Overnight stays Buenos Aires	-3.912	5.130	7.659	-76.722	0.010	0.146	0.050
Overnight stays CABA	-2.498	2.659	3.988	-36.645	0.010	0.422	0.010
Overnight stays Córdoba	-3.307	3.869	5.775	-74.320	0.010	0.285	0.010
Overnight stays Cuyo	-5.671	10.735	16.088	-82.455	0.010	0.181	0.023
Overnight stays Litoral	-3.266	3.595	5.338	-60.187	0.010	0.282	0.010
Overnight stays Norte	-6.127	12.517	18.774	-86.423	0.010	0.127	0.086
Overnight stays Patagonia	-8.153	22.179	33.268	-58.654	0.010	0.013	0.100
Crime Buenos Aires	-3.274	3.847	5.502	-24.267	0.024	0.099	0.100
Crime CABA	-8.048	21.702	32.392	-61.298	0.010	0.027	0.100
Crime Córdoba	-3.058	3.237	4.718	-95.733	0.010	0.236	0.010
Crime Cuyo	-1.340	0.808	1.182	-16.359	0.160	0.315	0.010
Crime Litoral	-4.241	6.031	9.010	-60.503	0.010	0.089	0.100
Crime Norte	-3.356	3.843	5.630	-19.037	0.078	0.110	0.100
Crime Patagonia	-2.269	2.125	3.187	-33.087	0.010	0.237	0.010
Exchange rate	-2.466	2.217	3.127	-15.202	0.213	0.116	0.100
GDP	1.396	5.241	6.587	1.972	0.990	0.166	0.034

Note: For the ADF test, tau3 is the unit root test; phi2 and phi3 are the tests on the intercept and the linear trend, respectively.

Critical values:

	1pct	5pct	10pct
tau3	-3.99	-3.43	-3.13
phi2	6.22	4.75	4.07
phi3	8.43	6.49	5.47

In the KPSS, the null is that the series is non-stationary.

Supplementary Table 2: Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Unit Root Tests – Series in First Differences

	ADF	PP		KPSS	
	tau1	Z rho	p-value	kpss	p-value
Overnight stays Buenos Aires	-9.747	-134.170	0.010	0.146	0.050
Overnight stays CABA	-13.078	-183.629	0.010	0.422	0.010
Overnight stays Cordoba	-9.079	-197.172	0.010	0.285	0.010
Overnight stays Cuyo	-8.474	-182.078	0.010	0.181	0.023
Overnight stays Litoral	-8.631	-182.320	0.010	0.282	0.010
Overnight stays Norte	-13.111	-170.871	0.010	0.127	0.086
Overnight stays Patagonia	-9.290	-102.042	0.010	0.013	0.100
Crime Buenos Aires	-8.531	-174.910	0.010	0.099	0.100
Crime CABA	-8.153	-184.727	0.010	0.027	0.100
Crime Córdoba	-7.728	-184.138	0.010	0.236	0.010
Crime Cuyo	-6.135	-197.531	0.010	0.315	0.010
Crime Litoral	-7.450	-257.644	0.010	0.089	0.100
Crime Norte	-6.903	-202.409	0.010	0.110	0.100
Crime Patagonia	-7.175	-178.311	0.010	0.237	0.010
Exchange rate	-8.943	-158.295	0.010	0.116	0.100
GDP	-0.772	-200.258	0.010	0.166	0.034

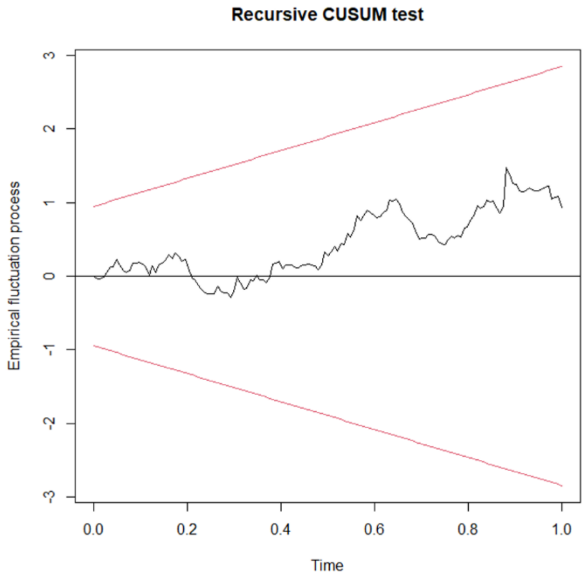
Note: Critical values del coeficiente tau1 de la prueba ADF:
1pct 5pct 10pct
tau1 -2.58 -1.95 -1.62

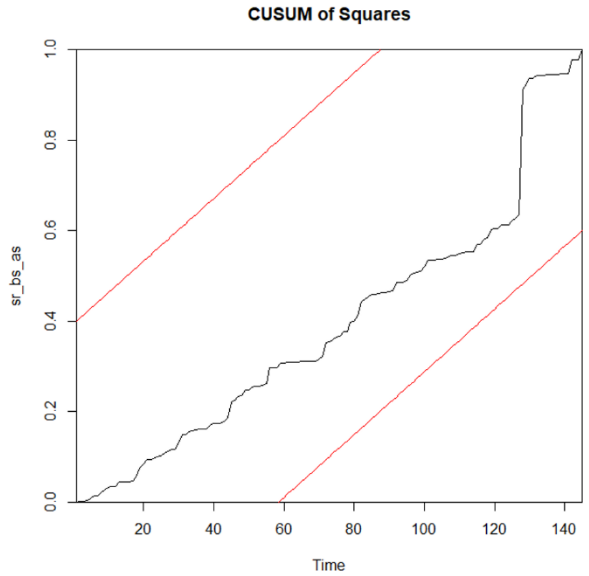
Supplementary Table 3: Results from Linear Regression Models

Region	Constant	Crime	Exchange rate	Break in series of Overnight stays	GDP	R^2
Buenos Aires	2.877	-0.032	0.003	0.305	0.000	0.203
	(8.750)	*-(5.473)*	*(1.736)*	*(0.915)*	*(3.982)*	
CABA	2.616	-0.001	0.000	0.037	0.000	0.079
	(22.599)	*-(1.666)*	*-(0.925)*	*(0.525)*	*-(2.332)*	
Córdoba	1.212	0.002	0.002	0.250	0.000	0.154
	(4.129)	*(1.690)*	*(3.337)*	*(1.533)*	*-(2.948)*	
Cuyo	1.980	0.000	0.000	-0.011	0.000	0.195
	(13.086)	*-(0.104)*	*-(0.994)*	*-(0.112)*	*(3.278)*	
Litoral	1.838	-0.001	0.001	0.068	0.000	0.239
	(11.580)	*-(2.206)*	*(2.750)*	*(0.998)*	*(2.700)*	
Norte	1.771	0.000	0.000	-0.094	0.000	0.037
	(16.976)	*-(0.988)*	*(0.450)*	*-(1.355)*	*(1.306)*	
Patagonia	0.434	0.003	0.000	0.029	0.000	0.149
	(0.792)	*(3.668)*	*-(0.039)*	*(0.094)*	*-(0.349)*	
Note: t-statistics between brackets						

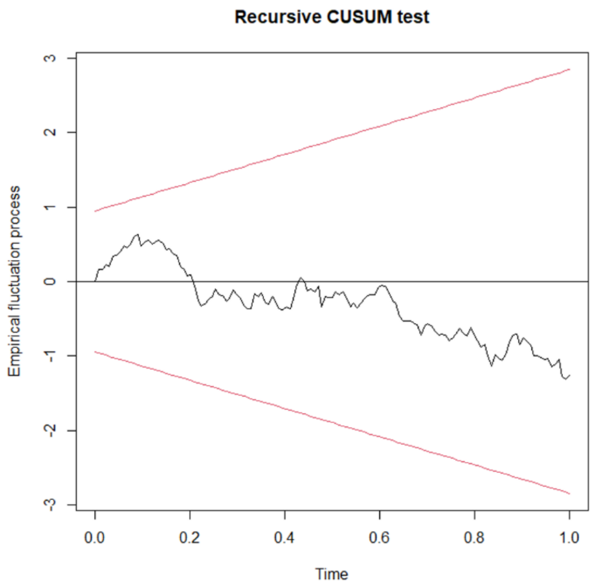
Supplementary Charts – CUSUM and CUSUM of Squares – ARDL models

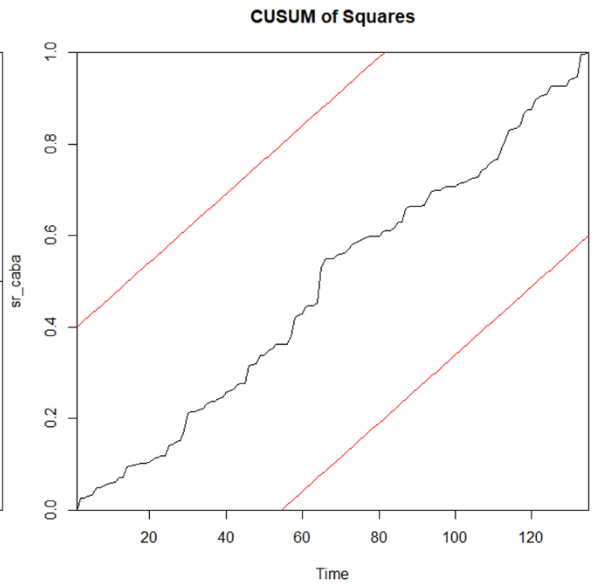
Buenos Aires



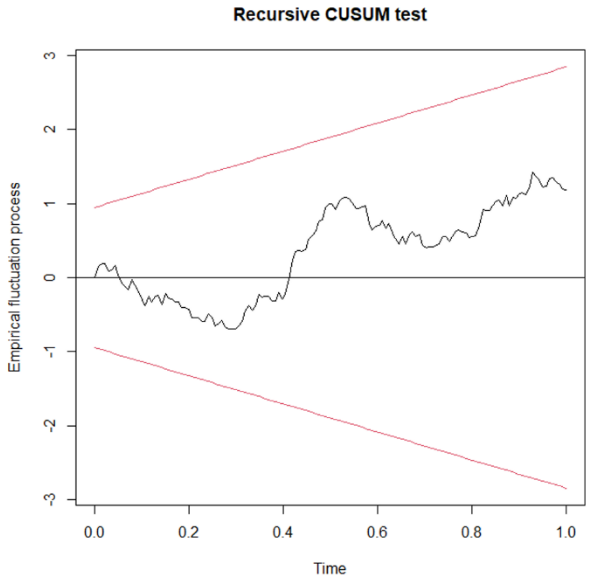


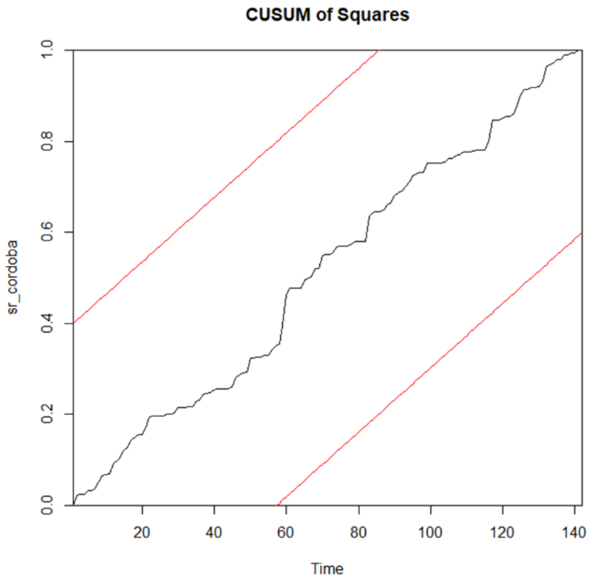
CABA



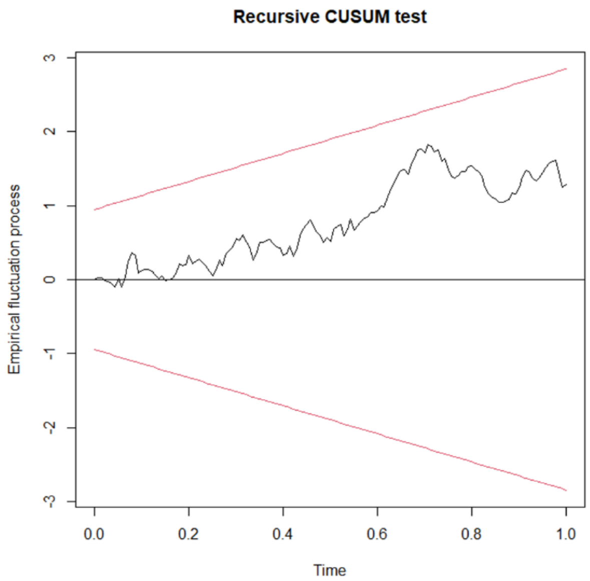


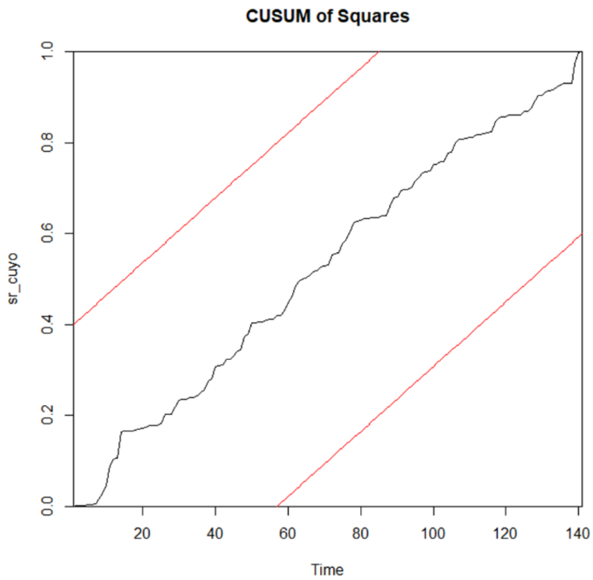
Cordoba



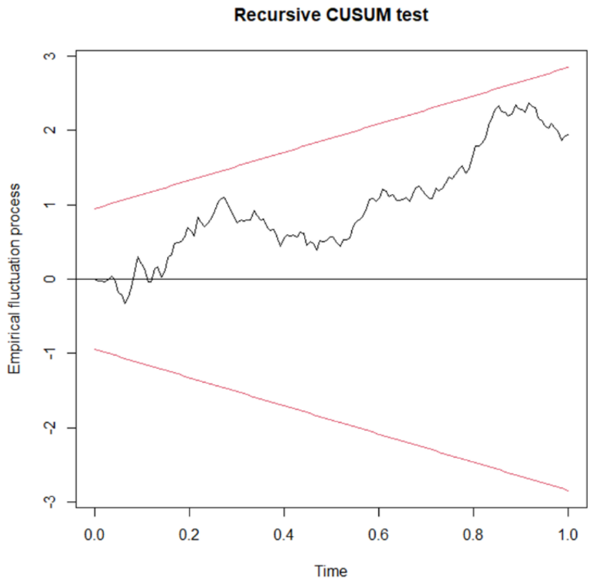


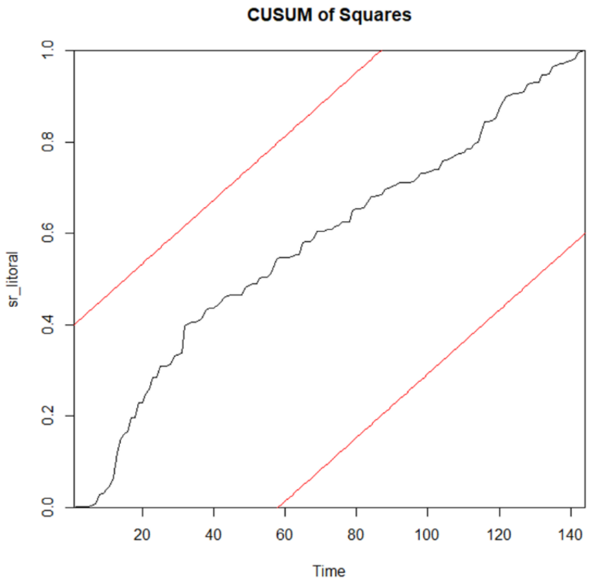
Cuyo



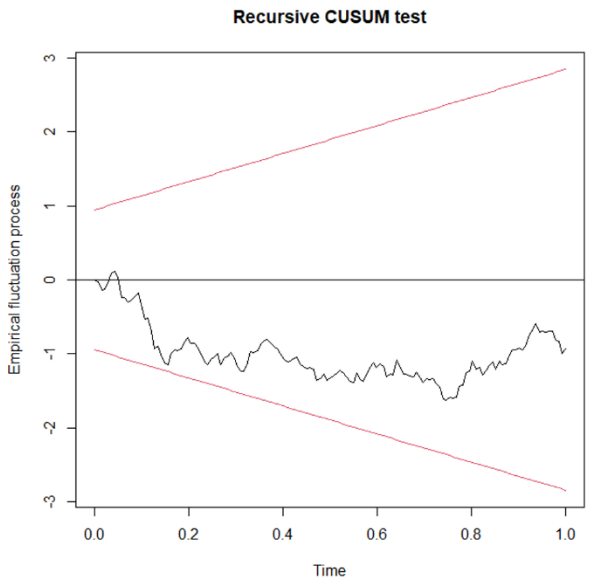


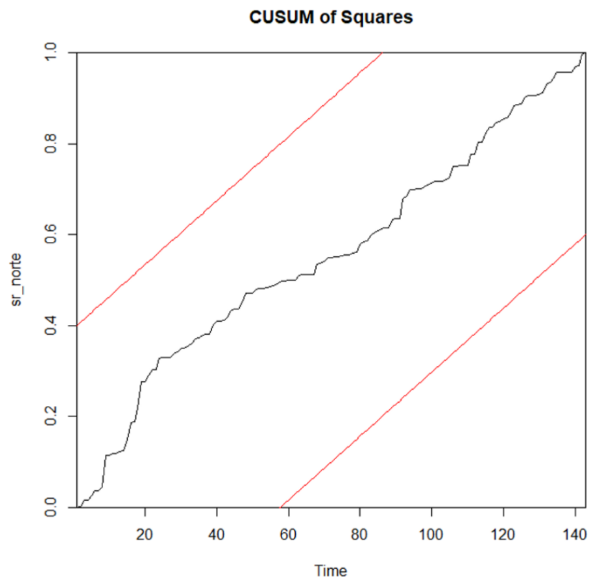
Litoral



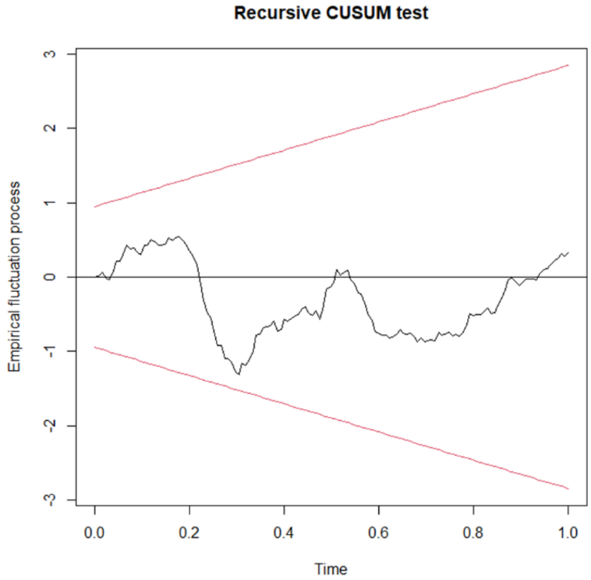


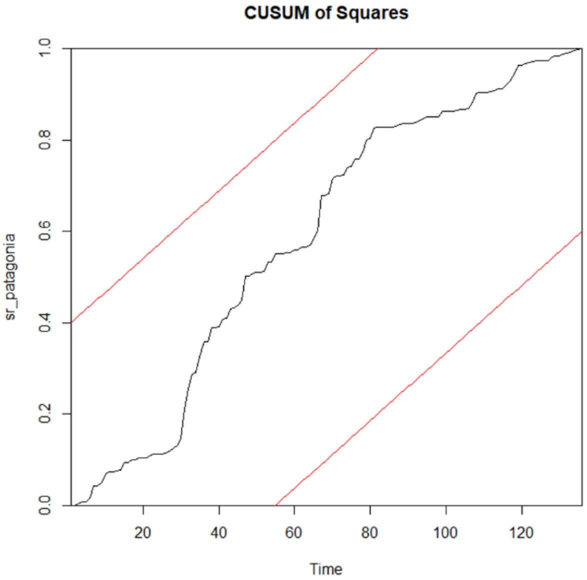
Norte





Patagonia


Recursive CUSUM test
Empirical fluctuation process
Time
3
2
1
0
-1
-2
-3
0.0
0.2
0.4
0.6
0.8
1.0


CUSUM of Squares
sr_patagonia
Time
1.0
0.8
0.6
0.4
0.2
0.0
20
40
60
80
100
120