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Research note

Structural breaks in Brazilian tourism revenues: Unveiling the impact of exchange rates and sports mega-events

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ABSTRACT

This paper analyzes the structural pattern of Brazilian monthly tourism revenue over the course of 20 years. This research contributes to the literature on the benefits of sports mega-events by showing that in developing countries the benefits derived from them may be jeopardized by economic structural problems reflected in currency fluctuation. Policy implications in terms of a specific tourism exchange rate for developing countries that host mega sport events are derived.

1. Introduction

Over the last 15 years, Brazil has again joined the group of countries which host sports mega-events. In 2002, Brazil was elected the host country of the 2007 Pan American Games. In 2003, after more than 50 years, Brazil was chosen once again to host a World Cup, specifically, the 2014 World Cup. In addition, Brazil hosted the 2013 Confederations Cup. Also, in 2009 the city of Rio de Janeiro was chosen to host the 2016 Olympic Games. In addition to mega sport events another factor that can influence the success of a country's tourism activities is the exchange rate variation. Indeed, tourism spending is one of the most sensitive sectors to the influence of foreign exchange and exchange rate variations in a country (Henry, Hyeongwoo, & Ka, 2013).

This paper explores the issue of sports mega-events, as well as their relationship with exchange rates as possible modifiers in the pattern of tourism spending and revenues in Brazil. We want to verify if the 2014 World Cup and the 2016 Olympic Games affected the pattern of tourism receipts and expenses in Brazil, and also to verify if the restrictions in exchange rates affected the pattern of revenues and expenses for tourism in Brazil. We will examine the order of integration of the tourism exchange revenues and expenditures, in logs, as well its differences from a fractional point of view using I(d) models. In doing so, we can gain some knowledge about the nature of the shocks affecting series. A structural breaks test will be also performed. This paper is organized as follows: Section 2 presents a contextual setting of the Brazilian tourism industry. In Section 3 the data is presented and the methodology is detailed. In Section 4 the results are presented and analysed. Conclusions follow in Section 5.

2. Background

In 2009, the city of Rio de Janeiro was chosen to host the 2016 Olympic Games. Previous to the games, the first major event took place in 2013 with the Confederations Cup. This was followed by the 2014 World Cup and the Olympic Games two years later. In order to carry out these major events in Brazil, significant resources had to be invested by the Brazilian government, mainly in infrastructure. According to the EBC,[1] in December 2014 the Court of Audit of the Union, often referred to as the TCU, issued a report consolidating inspections related to the preparatory works for the 2014 World Cup and the final bill was around US$ 9.6 billion. Data from August 2015 of the Clean Games[2] site indicated an expense of US$ 11.3 billion corresponding to the total level of investment for the holding of the Olympic Games and the Paralympics Rio 2016. With so many resources being involved, a strong increase in international tourism was expected.

In addition to sports mega-events, another important point to consider is the exchange rate. The instability caused by the revelation of various corruption scandals led to a major crisis in the country. This

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[1] http://agenciabrasil.ebc.com.br/geral/noticia/2014-12/tcu-contabiliza-r-255-bilhoes-de-gastos-com-copa-do-mundo.
[2] http://www.jogoslimpos.org.br/destaques/custo-da-olimpiada-rio-2016-e-atualizado-para-r-3826-bilhoes/.

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political and economic instability provoked numerous fluctuations in the Brazilian exchange market. According to Daniel Gallas from the BBC "*Tourists who came to Brazil for last year's World Cup are probably lamenting the fact that the tournament wasn't held in 2015 instead. Since the beginning of the year, Brazil's real has been one of the fastest-falling currencies among major economies*".[3]

To the best of our knowledge, papers that relate sports mega-events, exchange rate and structural breaks are scarce. The current research also departs from previous ones about exchange rates or about mega sport events by using fractional integration models that are still an emerging technique in the field of tourism economics.

2.1. Literature review

Sports mega-events are a destination marketing tool for host countries (Nishio, 2013). Accordingly, they spread a positive image of the destination country and bring about an increase in tourism arrivals to the host country (Lyu & Han, 2017). According toFerrari and Guala (2017), hosting or organizing a sports mega-event is a way of strengthening the brand of the destination country and also a way of providing leverage for the event itself and to promote the image of the host country. On the other hand, Mules and Faulkner (1996) point out that hosting sports mega-events is not always unequivocally economically beneficial to the cities that host them. They emphasize that staging sports mega-events could result in the city authorities losing money even though the city itself benefits greatly in terms of additional spending in the city.

Research considering the relationship between 2014 World Cup and tourism was conducted by Meurer and Lins (2016). The authors believe that the increase in the number of tourists is not restricted to the period of the competition. According to the authors, this period is prolonged possibly due to the greater visibility acquired during the events. The analysis of the relationship between the occurrence of the 2014 World Cup and the movement of tourists, reflected in the behaviour of the revenues generated from foreign visitors to Brazil, showed that the period of accomplishment of this competition really registered a significant jump in ticket sales. The role of the exchange rate in determining the level of revenues was also evidenced, with a time lag in the effects that unfolded in intervals from three to five months, a period which is plausibly compatible with the time necessary to plan and purchase the trip to Brazil.

The relationship between tourism and the exchange rate has been explored in a number of papers (Belloumi, 2010; Meurer, 2010; Meurer and Lins, 2016; Santana-Gallego, Ledesma-Rodríguez, & Pérez Rodríguez, 2010; Seul & Soocheong, 2011; Valencia, Melo, Sobral, & Xavier, 2015). Meurer (2010), p. 1065, argue that "*the real exchange rate is taken as a proxy of the relative price of the trip to a country*". The results of these authors' papers showed a direct influence of world GDP and exchange rates related to the number of foreign tourists arriving in Brazil. Under the assumption of tourism as a particular class of trade, Santana-Gallego et al. (2010) have applied gravity equations to explain international tourism flows. The main objective of their work was to analyse the effect of exchange rate arrangements on international tourism. The authors' findings indicated that this is a major factor in the determination of tourist arrivals. They also analyse the impact of several *de facto* exchange rate arrangements on tourism, finding that less flexible exchange rates promote tourism.

Sometimes the exchange rate is used by companies in the investment decision-making process in the area of tourism (Seul & Soocheong, 2011). According to these authors the tourism sector is sensitive to exchange rates between travellers' home countries and their destinations. The authors found that several tourism-related firms are passive regarding their exposure and may face financial burdens caused by demand fluctuations. According to Valencia, Melo, Sobral, & Xavier, 2015, the exchange rate is the monetary expression of the relation between two monetary units, indicating in the national currency the equivalent amount in a foreign currency. Thus, according to the authors, the exchange rate influences the most diverse sectors, especially those dealing with imports, exports, entry and exit of foreign exchange. The authors' results showed a causal relationship between exchange rate and foreign exchange expenditure and also an influence in foreign exchange revenue. They concluded that Brazilian tourists reveal more sensitivity to exchange rates than foreign tourists. In this article, we depart from these previous works in the sense that we mainly focus on the statistical properties of tourism spending and revenues in Brazil. By using fractionally integrated techniques, our methodology provides us with information about the nature of the shocks and, by testing for structural breaks, we can relate them to specific facts dealing with mega-events and exchange rate determination.

3. Data and methodology

The variables employed are Brazilian monthly tourism exchange revenue (log), expenditure (log) and their differences from December 1995 to September 2016, collected from Brazilian Central Bank website. The series are displayed in Fig. 1. We can see that, while revenues present a steady, albeit slow, growth over the course of time, expenditures are severely impacted by exogenous events, possibly related to devaluations in national currency. The difference between both time series, as expected, is a mixture of both patterns.

As argued earlier the methodology employed in this paper will be based on the concept of fractional integration. By this we understand that our series of interest requires d-differences to render stationarity I (0) where d can be any real value. This latter concept of stationarity I(0) (also named "short memory") is defined as a process that is covariance stationary and where the infinite sum of the autocovariances is finite. Examples of I(0) processes are, among others, the white noise case, but it also allows for some type of "weak" autocorrelation such as the one produced by the AutoRegressive Moving Average, ARMA-class of models. The I(0) processes are also called "short memory" because of the short degree of dependence between the observations, as opposed to the "long memory" case that takes places, for example, in the I(d) processes with $d > 0$. In other words, we say that x_t is integrated of order d, and denoted by $x_t \approx I(d)$, if it can be expressed as:

$$(1 - B)^d x_t = u_t,\ t = 1,2,\ ..., \tag{1}$$

where B refers to the backshift operator ($Bx_t = x_{t-1}$); u_t is an I(0) process (and thus, it may incorporate weak autocorrelation of the AR(MA) form) and, to allow for some degree of generality, x_t can be assumed to be the errors in a regression model that may incorporate deterministic terms such as an intercept or a linear time trend, i.e.,

$$y_t = \beta_0 + \beta_1 t + x_t;\ t = 1,2,\ ..., \tag{2}$$

where y_t refers then to the series under examination. In this context of fractional models, the estimation of the differencing parameter d is crucial from different perspectives. Thus, for example, if $d = 0$ in (1), clearly $x_t = u_t$, and x_t is said to be "*short memory*" (e.g., ARMA); however, if $d > 0$, x_t is said to be "*long memory*", so-named because of the strong association between observations which are far distant in time and, the higher the value of d is, the higher the degree of dependence (persistence) between the observations is. Also, if $d < 0.5$ the series is still covariance stationary, while $d \geq 0.5$ implies nonstationarity in the sense that the variance of the partial sums increase in magnitude with d. Finally, from a policy perspective, the value of $d = 1$ is important since $d < 1$ implies mean reversion, with shocks disappearing in the long run, contrary to the case of $d \geq 1$ where no mean reversion takes place.[4]

[3] Gallas, D. (2015, October 7). "Real worries: Why is Brazil's currency now so weak?" BBC News, retrieved from http://www.bbc.com/news/business-34455980.

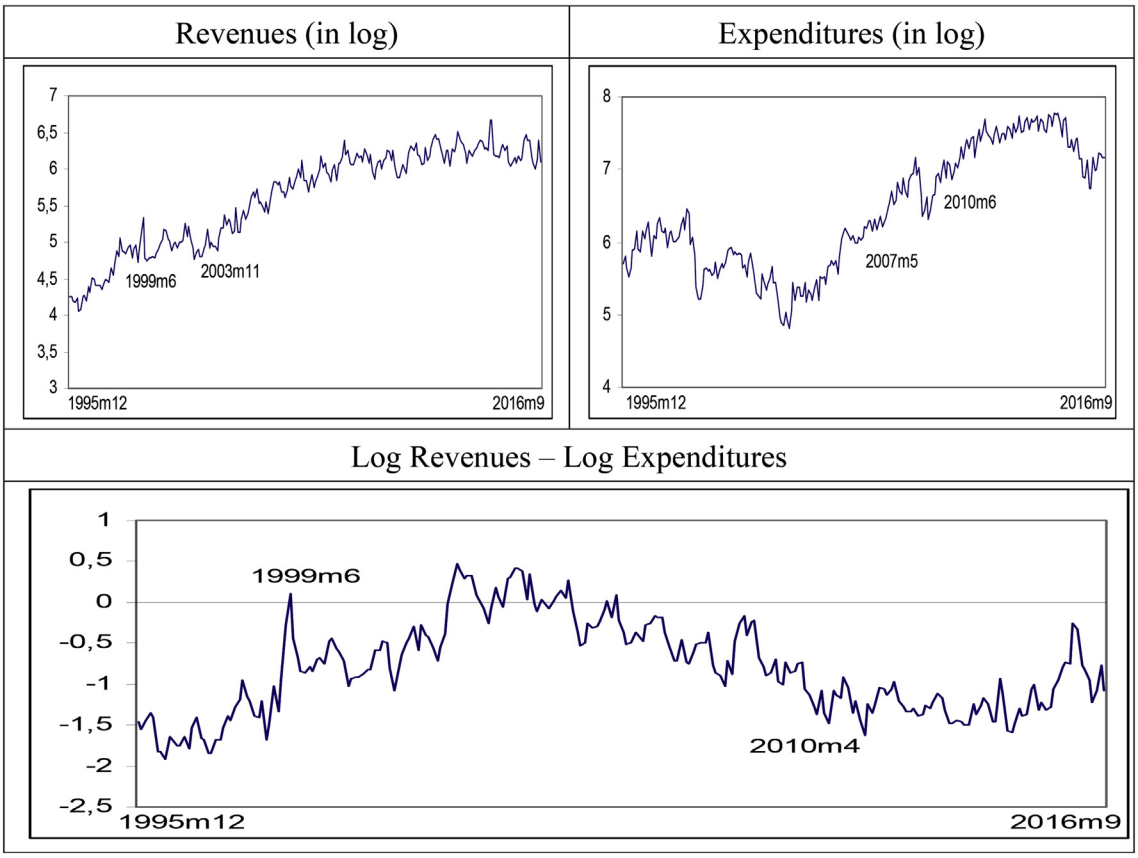

Fig. 1. Time series plots.

Table 1
Estimates of d and 95% bands under uncorrelated (white noise) errors.

Series	No det. Terms	An intercept	A linear time trend
REVENUES (log)	0.96 (0.88, 1.06)	0.80 (0.74, 0.88)	0.79 (0.73, 0.88)
EXPENDITURES (log)	0.91 (0.84, 1.00)	0.66 (0.60, 0.74)	0.65 (0.58, 0.75)
Log REV – Log EXP	0.90 (0.80, 1.02)	0.83 (0.74, 0.95)	0.83 (0.74, 0.95)

In bold, the selected model according to the deterministic terms.

4. Analysis and discussion of results

Across Table 1 – 4, we display the estimates of d (and their corresponding 95% intervals) using the Whittle function expressed in the frequency domain (Dahlhaus, 1989; Robinson, 1994) in the model given by:

$$y_t = \beta_0 + \beta_1 t + x_t;\ (1 - L)^d x_t = u_t;\ t = 1,2,\ ..., \quad (3)$$

where y_t refers to each of the individual series, β_0 and β_1 are unknown coefficients corresponding respectively to the intercept and a linear time trend, and x_t is assumed to be I(d) where d is an unknown (real)-value parameter that will be estimated for the data; finally, u_t is supposed to be I(0) and we consider the two cases of uncorrelated (white noise) and autocorrelated errors, in the latter case imposing the non-parametric approach of Bloomfield (1973).[5]

Tables 1 and 2 refer to the case of uncorrelated errors, while Tables 3 and 4 allow for autocorrelation. The second column in Tables 1 and 3 displays the estimates under the assumption that $\beta_0 = \beta_1 = 0$ in (3), i.e., with no deterministic terms; the third column incorporates an intercept, i.e. $\beta_1 = 0$; and the last column includes both the constant and the liner time trend.

The first thing we observe is that the time trend is required in the two-individual series (revenues and expenditures) but not in the differences. The orders of integration are respectively 0.79, 0.65 and 0.83 and the unit root null hypothesis, i.e., d = 1, is rejected in the three series in favour of $d < 1$, i.e., in favour of mean reversion. (Note that the intervals in the second column of Table 2 exclude the value of 1 in the three cases).

If we focus now on the case of autocorrelation (Tables 3 and 4) we observe that the time trend is only required for the expenditures but not for the revenues and the differences between them, and though the estimated values of d are smaller than 1 in the three series, in the case of the revenues the unit root null hypothesis cannot be statistically rejected. As a robustness method, we also employ a semiparametric approach where no functional form is imposed on the error term. We use here a "local" Whittle method, as initially proposed by Robinson (1995) and later extended and improved by Velasco (1999), Shimotsu and Phillips (2005), Abadir, Distaso, and Giraitis (2007) and others.

[4] Mean reversion means that in the event of a shock in the series, its effect disappears in the long run. In other words, shocks have only transitory effects.

[5] This is a non-parametric method that approximates the behaviour of highly parameterized ARMA models with a reduced number of parameters. The results using this approach were in fact very similar to those based on various seasonal and non-seasonal ARMA models. The use of seasonal dummy variables produces insignificant coefficients in practically all cases.

Table 2
Estimated coefficients with uncorrelated (white noise) errors.

Series	d	Intercept	Time trend
REVENUES (log)	0.79 (0.73, 0.88)	5.711 (38.36)	0.006 (1.88)
EXPENDITURES (log)	0.65 (0.58, 0.75)	4.267 (39.62)	0.008 (6.15)
Log REV – Log EXP	0.83 (0.74, 0.95)	−1.469 (−7.89)	–

In parenthesis in the third and fourth columns, t-values.

Table 3
Estimates of d and 95% bands under autocorrelated (Bloomfield) errors.

Series	No det. terms	An intercept	A linear time trend
REVENUES (log)	0.92 (0.80, 1.09)	0.84 (0.75, 1.00)	0.84 (0.74, 1.00)
EXPENDITURES (log)	0.95 (0.82, 1.13)	0.62 (0.56, 0.73)	0.62 (0.51, 0.75)
Log REV – Log EXP	0.70 (0.59, 0.86)	0.67 (0.58, 0.82)	0.68 (0.59, 0.82)

In bold, the selected model according to the deterministic terms.

Table 4
Estimated coefficients with autocorrelated (Bloomfield) errors.

Series	d	Intercept	Time trend
REVENUES (log)	0.84 (0.75, 1.00)	5.710 (37.60)	–
EXPENDITURES (log)	0.62 (0.51, 0.75)	4.276 (40.71)	0.008 (7.03)
Log REV – Log EXP	0.67 (0.58, 0.82)	−1.446 (−8.63)	–

In parenthesis in the third and fourth columns, t-values.

Table 5
Estimates of d using a semiparametric method.

M	Rev (log)	Exp (log)	Rev – Exp	Lower I(1)	Upper I(1)
10	1.093	1.099	1.143	0.739	1.260
11	1.072	1.064	1.089	0.752	1.247
12	1.118	1.121	1.144	0.762	1.237
13	0.993	1.005	1.072	0.771	1.228
14	0.865	1.044	1.041	0.780	1.219
15	0.879	1.042	1.067	0.787	1.212
16	0.915	1.048	1.058	0.794	1.205
17	0.910	0.972	0.980	0.800	1.199
18	0.837	0.993	0.937	0.806	1.193
19	0.819	0.956	0.923	0.811	1.188
20	0.748	0.967	0.866	0.816	1.1832

In bold, evidence of I(1) behaviour at the 5% level.

Table 5 displays the estimates of d for a selected group of bandwidth numbers, specifically from m = 10, 11, 12, …, 20. Note that the choice of m is important in this context since the estimates of d can be very sensitive to this number. It reflects the trade-off between bias and variance: the asymptotic variance is decreasing with m while the bias is growing with m. The results support the I(1) models in almost all cases for the three series, with the estimates of d being higher in all cases than those reported in the previous tables and based on a parametric approach.

The disparity in these results may be explained by the potential presence of structural breaks that have not been taken into account as yet. Due to this, the possibility of structural breaks is also examined and for this purpose we use Bai and Perron's (2003) method. The results for one and/or two breaks are reported in Table 6, showing that if a single break is allowed, it takes place at November 2003 for the revenues, at May 2007 for the expenditures, and at January 1999 for the difference between the two series. If two breaks are allowed, they occur at January 1999 and November 2003 (revenues); May 2007 and June (2010) (expenditures), and January 1999 and April 2010 for the differences between them.

In order to explain the structural breaks found in the analysis, readers should take into account that Brazil is a country which is heavily dependent on commodity exports and that this exchange inflow may sometimes favours the number of foreign visitors in Brazil. Besides, economic growth in Brazil over the last 20 years has resulted in multiple improvements in terms of physical infrastructure (such as airports and hotels) able to receive and accommodate a greater tourism inflow. Specifically, since 2008, Brazil has committed vast amounts of resources to improving its physical infrastructure in order to be able to better host the World Cup of 2014 and the Olympic Games of 2016. Economic growth also promotes the improvement of human resources. Brazilians are less illiterate and more open to speaking English now than they were 20 years ago.

The underlying rationale for the presence of breaks, as depicted in Table 6 follows the commodity boom derived from Chinese imports in Brazilian foreign accounts. In short, in January 1999 the Brazilian Central Bank changed the exchange rate from the currency board to a floating exchange rate with inflation targets. The severe devaluation of the Brazilian currency at that time may help to explain an increase in the number of foreign tourists visiting Brazil. November 2003, May 2007, and June 2010 may be related to the begin, peak, and end of the commodity boom cycle. During this period, Brazil experienced a strong influx of dollars, which helped to increase the value of the national currency. Also, during this period there was a substantial increase in the number of Brazilian tourists going abroad, and the Brazilian Central Bank accumulated more than 300 billion dollars in foreign reserves.

Table 7 displays the estimates of d for each series and each subsample. We observe that for the revenues there is a slight increase when moving from one subsample to another though the difference across the values of d is almost negligible. In the three subsamples we have evidence of mean reversion. The same evidence is found for the expenditures though the values are slightly higher in all three cases. Finally, for the difference between the two series the highest value of d is found during the second subsample where the unit root null cannot be rejected. Therefore, in this subsample shocks had a permanent nature though mean reversion takes place in the first and in the last subsamples.

5. Conclusions

This research explored the structural pattern of Brazilian monthly tourism revenue over the course of 20 years, using official data from the Brazilian Central Bank. A different set of methods based on long memory and fractional integration and allowing for structural breaks was applied. Results suggested that the impact of exchange rates, driven by the rise and fall of the commodities boom, tend to obfuscate the relevance of sports mega-events in nurturing a more sustainable growth of tourism activity in Brazil. This being the case, one possible policy implication maybe related to the fact that such countries should operate with a specific tourism exchange rate in the years previous to and following sports mega events, so that the memory of a favourable touristic inflow could be created and sustained for longer periods.

This research contributes to the literature on the benefits of sports mega-events by showing that their benefits in developing countries may be jeopardized by economic structural problems reflected in currency fluctuation. Further research should be conducted in other developing countries that have held mega sports events to assess whether or not

Table 6
Results and rationale allowing 1 and 2 breaks.

i) Allowing a single break		
Log Revenues	November 2003	Beginning of the commodity cycle, Brazil starts to be expensive for foreign tourists
Log Expenditures	May 2007	Massive flow of Brazilian tourists abroad, peak of the commodity boom where China drove price increases of iron ore, oil, soybeans etc
Differences	January 1999	Devaluation of national currency, bigger inflow of foreign tourists to Brazil in comparison to Brazilian tourists abroad
ii) Allowing for two breaks		
Log Revenues	January 1999	Devaluation of national currency, bigger inflow of foreign tourists to Brazil in comparison to Brazilian tourists abroad
	November 2003	Beginning of commodity cycle, Brazil starts to be expensive for foreign tourists
Log Expenditures	May 2007	Massive flow of Brazilian tourists abroad, peak of the commodity boom where China drove price increases of iron ore, oil, soybeans etc
	June 2010	End of commodity boom cycle, Brazil starts moving into its great economic depression 2014–2017
Differences	January 1999	Devaluation of national currency, bigger inflow of foreign tourists to Brazil in comparison to Brazilian tourists abroad
	April 2010	Close to the end of commodity boom cycle

Table 7
Estimates of d for each series and each subsample.

	First subsample	Second subsample	Third subsample
REVENUES (log)	0.42 (0.13, 0.73)	0.53 (0.34, 0.80)	0.57 (0.46, 0.74)
EXPENDITURES (log)	0.84 (0.74, 0.98)	0.60 (0.37, 0.93)	0.62 (0.52, 0.76)
Log REV – Log EXP	0.57 (0.39, 0.87)	0.83 (0.69, 1.04)[a]	0.62 (0.46, 0.88)

[a] Evidence of unit roots or I(1) behaviour at the 5% level.

major structural economic problems still obfuscate the impact of such events in the growth of tourism activities. In addition, seasonal dummy variables on time can be employed to capture the effects of exchange rate volatility and the realization of the megasports events, in the analysis. Additional information on the nature of the exchange regime in these countries (whether currency board or free fluctuation) should also be collected.

Authors contribution

Luis Alberiko Gil-Alana conducted the empirical analysis of the paper along with the interpretation of the results and conclusions. He also provided the motivation for the paper.

Otávio Henrique dos Santos Figueiredo got and examined the data; he also made part of the introduction and the literature review, along with the interpretation of the results.

Peter Wanke did the introduction, the background and part of the literature review. He also helped to the interpretation of the results and conclusions.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tourman.2019.03.006.

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