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Abstract
The tourism industry is Barbados' main source of foreign exchange and provides the basis for steady economic growth in the economy. Consequently, the permanence or transience of shocks can have a direct impact on the welfare of all Barbadian residents. Against this background, our study applied univariate and panel unit root tests to determine whether shocks to visitor arrivals to Barbados are permanent or temporary. Our empirical findings imply that exogenous shocks will have permanent effects on visitor arrivals to Barbados. Our recommendation is for tourism authorities to handle negative external shocks according to each particular market differently, since tourists, even with countries, are not a homogenous group.

Keywords: shocks; Barbados; visitor arrivals; unit roots; panel; seasonality

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1. Introduction

Undoubtedly, tourism is one of the fastest growing industries in the world, with individuals from various countries expending billions of dollars in travel each year. Caribbean countries benefit from the fast pace of expansion of world tourism. For example, in 2001, the Caribbean accounted for 4.2% of world tourism receipts worth US$19.4 billion, out of a grand total of US$462.2 billion.[1]

Barbados has consistently ranked among the top seven tourist destinations in the Caribbean. A total of 1.27 million visitors (43 percent were long-stay arrivals) were recorded for the year 2004, with estimated tourism receipts totalling US$0.76 billion, or 3.5 percent of the total US$21.6 billion for the Caribbean. This was the second successive year of expansion in receipts, following two successive years of decline in 2001 and 2002.

The tourism industry is Barbados' main source of foreign exchange and provides the basis for steady economic growth in the economy. In 2005, tourism contributed 9.3 percent to overall gross domestic product (GDP), and an average of 9.7 percent from 1996-2005. The industry also employed 9.7 percent of the labour force in 2005 and an average of 10.6 percent over 1996-2005. Average earnings from tourism as a proportion of gross export earnings were 51 percent over the period 1980-2000. To this end, the Government of Barbados has invested significantly in the tourism industry through marketing, investment in tourism infrastructure and policy initiatives which have allowed investors to reduce the costs of inputs into the industry (see Table 1).

The tourism industry worldwide is very vulnerable to shocks such as global recession, natural disasters, acts of terrorism, and health-related outbreaks such as SARS and bird flu. To date, the industry continues to be challenged by major international events such as terrorism, which has had an effect on the industry worldwide.

Previous studies have sought to determine the impact of exogenous shocks on the tourism sector. Enders et al. (1992) investigate the impact of terrorist incidents on the revenue streams from tourism for Austria, Greece, Italy, and continental Europe. Their findings show that such incidents deterred tourism in these countries and that there was a negative externality: a terrorist incident in one country deterred tourism in neighbouring countries. Additionally, Enders et al. estimate that Austria, Greece and Italy lost 2.58 billion special drawing rights (SDRs), 427 million SDRs and 615 million SDRs respectively, while continental Europe lost over 21.6 billion SDRs in revenues between 1974 and 1988 as a result of terrorism. As a percentage of 1988 tourist revenues, these losses ranged from 6 percent for Italy to as high as 40.7 percent for Austria.

Among studies that examined whether shocks to tourism are permanent are those by Narayan (2005), and Bhattacharya and Narayan (2005). Narayan investigated whether military coups in Fiji resulted in a permanent or temporary shock to tourist expenditure. The key finding was that

[1] The Caribbean refers to: Anguilla, Antigua & Barbuda, Aruba, the Bahamas, Barbados, Belize, Bermuda, Bonaire, British Virgin Islands, Cancun (Mexico), Cayman Islands, Cozumel (Mexico), Cuba, Curacao, Dominica, Dominican Republic, Grenada, Guyana, Haiti, Jamaica, Martinique, Montserrat, Puerto Rico, Saba, St. Eustatius, St. Lucia, St. Maarten, St. Vincent and the Grenadines, Suriname, Trinidad and Tobago, and the US Virgin Islands.

the effect of coups was only temporary. Bhattacharya and Narayan (2005) test the random walk hypothesis for visitor arrivals to India. Similar to Narayan (2005), they find that shocks to India's ten major source markets have a temporary effect on visitor arrivals.

Koo and Fu (2003) analyze the economic impact of SARS on major East Asian economies. They report that the two countries mainly affected were mainland China (predominantly in Beijing) and Hong Kong (which had been hardest hit by epidemic based on the rate of contracted cases as a percentage of the population). Taiwan was also affected but to a lesser extent; while South Korea's and Japan's economies were in the main unaffected by SARS. Overall, they predict that the influence of SARS was likely to be limited and temporary. Another study which considered the effects of SARS was conducted by Au et al. (2005) who assessed the effects on Hong Kong's tourism industry. Their analysis, which looked at tourist arrivals from 24 countries, revealed that exogenous shocks will have permanent effects on tourist arrivals from Japan, Taiwan, the USA and the UK, which make up 60 percent of total tourist arrivals to Hong Kong. Based on this finding, they recommend country-specific policies to reduce the negative impact of SARS on visitor arrivals from the aforementioned countries.

To the authors' knowledge no studies have attempted to determine the nature of exogenous shocks to the tourism industry in Barbados. Against this background, our study utilizes univariate unit root tests as well as recently developed panel unit root testing procedures to determine whether shocks to long-stay visitor arrivals to Barbados from 1956-2005 are permanent or temporary. If visitor arrivals have a unit root, then shocks to visitor arrivals have permanent effects. On the other hand, if visitor arrivals do not have a unit root, then this suggests that shocks to visitor arrivals are temporary in nature. We focus on the four major source markets for visitors to Barbados—the United States of America (USA), the United Kingdom (UK), Canada and CARICOM; the minor markets—OTHER; and total arrivals—TOTAL.

The findings from this study have significant policy implications for Barbados. The country is especially prone to the effects of shocks primarily as a result of its high degree of structural openness, and import dependence which amplifies any external shocks. Earnings from tourism have a direct impact on Barbados' balance of payments since tourism, as was mentioned earlier, is the country's main source of foreign exchange. Thus shocks to international tourist arrivals will affect the current account balance and financial reserves. The multiplier effect of external shocks would also impact other sectors of the economy, such as the agricultural sector which services the tourism industry. Other sectors which would be affected from shocks to tourism are: construction, transportation, communications, entertainment, food and beverage; and other sectors which need foreign exchange for the importation of raw materials. The levels of personal and government consumption would also be impacted. As a consequence therefore, the permanence or transience of shocks, both positive and negative, can have direct or indirect impact on the welfare of all Barbadian residents. It is critical, therefore, that policymakers in Barbados have an understanding of the degree to which external shocks affect the source markets for international tourist arrivals and by extension the tourism industry, given their strong relationship with the overall health of the economy.

The rest of the paper is structured as follows. Section 2 outlines the econometric methodology used in the study. Section 3 discusses the data and empirical findings. Concluding remarks are presented in Section 4.

2. Econometric Methodology

A series is described as stationary if its statistical properties remain constant along a time path. Under such circumstances, any type of external shock would have a temporary and diminishing effect on the series. This implies that the series would naturally return to its original statistical properties over time. On the other hand, a series is described as non-stationary if its statistical properties vary over a time path. Such a series is described by econometricians as a random walk. Any exogenous shocks to a random walk series will persist and the effect will be long-term in nature. In order to determine the stationarity properties of a series, one must employ unit root tests.

2.1 Univariate Unit Root Tests

A time series that requires a first differencing filter to remove the stochastic trend is a nonstationary series, and is integrated at the zero frequency, that is, of order *I*(1). The standard procedure used to test for integration is that by Dickey and Fuller (1979, 1981). The augmented Dickey-Fuller (ADF) test has several variants. The most general variant is based on the regression equation with the inclusion of a constant and a trend of the form:

$$\Delta x_t = \alpha_0 + \alpha_1 t + \rho x_{t-1} + \sum_{j=1}^{k} \beta_j \Delta x_{t-j} + \varepsilon_t \tag{1}$$

where x_t is the series under investigation; $\Delta x_t = x_t - x_{t-1}$; α_0 is a constant; t is a linear time trend; ε_t is the stochastic error term; and k is the number of lagged differences of the dependent variable which are included so as to control for serial correlation in the error term. The null hypothesis of a unit root process is rejected if the coefficient ρ is significantly less than zero. Failure to reject the null hypothesis implies that the time series has a unit root.

We also employ the Kwiatkowski, Phillips, Schmidt, and Shin (1992) test where the series x_t is assumed to be (trend) stationary under the null against the alternative of non-stationarity of the series (or a unit root). KPSS assume that a variable can be decomposed into a deterministic trend ($x(t)$), a random walk ($x(s)$) and a stationary error:

$$x_t = x(t) + x(s) + \varepsilon_t \tag{2}$$

where $x(s)_t = x(s)_{t-1} + u_t$. If the variable is stationary, then $\sigma_u^2 = 0$. This hypothesis can be tested by computing the ratio of the partial sums $S(t) = \sum_{t=1}^{N} \hat{\varepsilon}_t$ of the residuals from estimating Equation (2):

$$LM = \sum_{t=1}^{N} S(t)^2 \Big/ \hat{\sigma}_\varepsilon^2 . \tag{3}$$

where $\hat{\sigma}_\varepsilon^2$ is the estimate of the variance of the residuals. If the computed statistic is larger than the asymptotic critical value the null hypothesis of stationarity is rejected.

Due to the highly seasonal nature of tourist arrivals, and because the ADF and KPSS tests assume that there are no other roots in the system, we account for this feature of the data by testing for the presence of seasonal unit roots in the series x_t. If a variable exhibits stochastic seasonality, the series is seasonally integrated and can be of order *I*(0,1) [seasonally integrated only] or order *I*(1,1) [integrated at all frequencies]. The HEGY procedure developed by Hylleberg et al. (1990) is used to assess the separate influence of seasonal and nonseasonal components in x_t. For quarterly data, the test is based on the following regression which is estimated by ordinary least squares (OLS):

$$\varphi(L)x_t = \pi_1 x_{1,t-1} + \pi_2 x_{2,t-1} + \pi_3 x_{3,t-1} + \pi_4 x_{4,t-1} + \mu_t + \varepsilon_t \quad (4)$$

where $\varphi(L) = (1 - L^4)$ is the seasonal differencing operator; $x_{1,t-1} = (1 + L + L^2 + L^3)x_{t-1}$; $x_{2,t-1} = -(1 - L + L^2 - L^3)x_{t-1}$; $x_{3,t-1} = -(1 - L^2)x_{t-1}$; $x_{4,t-2} = -(1 - L^2)x_{t-2}$; μ_t is a set of deterministic components such as a constant, three seasonal dummies, or linear time trend; and ε_t is a white noise process. Lags of the dependent variable are used to whiten the residuals. A *t* test is used to examine the significance of π_1 and π_2 respectively; and an *F* test is used for the joint significance of π_3 and π_4. Critical values can be found in Hylleberg et al. (1990, pp. 226-227) for *n* = 200.

Three null and alternative hypotheses are tested as follows:

$(a) H_0 : \pi_1 = 0; H_1 : \pi_1 < 0$

$(b) H_0 : \pi_2 = 0; H_1 : \pi_2 < 0$

$(c) H_0 : \pi_3 = \pi_4 = 0; H_1 : \pi_3 \neq 0$ and/or $\pi_4 \neq 0$

The *t* test is used for hypotheses (a) and (b), and the *F* test for hypothesis (c). With hypothesis (a) failure to reject of H_0 means that the series possesses a unit root at the zero frequency, that is, the series possesses a nonseasonal unit root; with hypothesis (b) failure to reject H_0 means that there is a unit root at the semi-annual or biannual frequency; and finally, with hypothesis (c) failure to reject H_0 means that the series possesses a unit root at the annual frequency. A rejection of all three hypotheses implies that the series is stationary and the order of integration is *I*(0,0,0).

2.2 Panel Unit Root Tests

A major shortcoming of the univariate unit roots tests for time series analysis is that of low power (Levin and Lin, 1993; Shiller and Perron, 1985), particularly when the techniques are applied to small samples. While our sample is relatively large, we exploit the panel structure of the database to benefit from the superior power properties of panel unit root tests of the random walk hypothesis.[2] The authors use four panel tests for unit roots: those by Levin, Lin and Chu (2002), Breitung (2000), Im, Pesaran and Shin (1997) and Hadri (2000).

[2]The power of panel unit roots tests is conditional upon the number of stationary units in the panel (Karlsson and Löthgren 2000; Gutierrez 2003). Hence, it is prudent to run unit roots tests on each individual country to determine whether the null hypothesis of a unit root can or cannot be rejected.

The Levin, Lin and Chu, and Breitung tests both use a multivariate version of Equation (1):

$$\Delta x_{it} = \rho_i x_{it-1} + \sum_{j=1}^{k_i} \beta_{ij} \Delta x_{it-j} + \varepsilon_{it} \tag{5}$$

where the lag orders for the difference terms are given by k_i. The Levin, Lin and Chu as well as the Breitung tests both assume that $\rho_i = \rho$, or that the persistence parameter is common across all cross-sections (i.e., there is a common unit root process). The Levin, Lin and Chu derive estimates of ρ from values for Δx_{it} and Δx_{it-1} that are standardized and free from autocorrelation and deterministic components. The null hypothesis, of a unit root process, is then rejected if the coefficient, ρ, is significantly less than zero. Breitung removes only the autocorrelation components before standardization. After standardization, then the deterministic components are removed. Besides these two differences, the two tests are conceptually quite similar. The Im, Pesaran and Shin (1997) test, in contrast, allows the persistence parameter, ρ_i, to vary across cross-sections. The test estimates separate ADF regressions for each cross-section, averages and standardizes the *t*-ratios on ρ_i to obtain the test statistic.

Similar to the KPSS test, the Hadri (2000) unit root test has a null hypothesis of no unit root in any of the series in the panel. The test is based on the residuals from the individual ordinary least squares (OLS) regressions of x_{it} on a constant, or on a constant and a trend. The test statistic is then obtained by averaging the individual test statistics:

$$LM = \frac{1}{N}\left(\sum_{i=1}^{N} \left(\sum_{i} s_i(t)^2 / T^2 \right) / \bar{f}_o \right) \tag{6}$$

where $\bar{f}_0$ is the average of the individual estimators of the residual spectrum at frequency zero, and $s_i(t)$ are the cumulative sums of residuals.

For each of the unit root tests employed, univariate and panel, the procedures include both trend and intercept (drift); for the HEGY test, the seasonal component is included. The results from these tests will thus categorize the series as follows:

- Stationary—the impact of external shocks will gradually diminish over time. This would imply that the number of tourist arrivals will return to their "normal" long-term trend. That is, the impact of shocks will have a temporary effect.
- Non-stationary—the impact of external shocks will not diminish over time. This would imply that shocks have a permanent effect on the number of tourist arrivals.

3. Empirical Findings and Analysis

As a preliminary investigation into testing the nature of shocks to tourist arrivals, Figure 1 plots the log arrivals series for each market. The plots reflect the trends discussed in Section 2: a slowdown in tourist arrivals from the USA after strong growth for forty years; the continued strong growth of the UK market; the slowdown and gradual decline in the Canadian market from about 1980; the strong performance of the CARICOM market after a period of decline in the mid 1980s to mid 1990s; arrivals from OTHER peaking in the mid 1990s and declining thereafter;

and TOTAL growing at a high rate over the first half of the sample, then at a relatively slower rate over the second half of the sample.

Tables 2 and 3 present the results of the unit root tests. The evidence based on the ADF and KPSS tests indicates the presence of unit roots (in terms of log levels) in visitor arrivals to Barbados from each major source market, the minor markets together, and total tourist arrivals. With respect to the panel tests, insignificant Levin, Lin and Chu, Breitung, and IPS statistics and significant Hadri statistics are indicative of panel unit roots, and vice versa. Table 3 shows that each test is in agreement.

Results from the HEGY test shown in Table 2 are revealing. They indicate that tourist arrivals from the UK, Canada, CARICOM and OTHER markets are stationary at the biannual frequency but have unit roots at the zero and annual frequencies; while tourist arrivals from the USA and TOTAL are stationary at the annual frequency but possess unit roots at the zero and biannual frequencies. The finding of seasonal unit roots for all series is evidence in favour of varying seasonal dynamics for each market, and against a constant seasonal pattern.

Putting the findings from Tables 2 and 3 together we conclude that each visitor arrivals series is nonstationary and the order of integration of the series from each country is as follows: USA—$I(1,1,0)$; UK—$I(1,0,1)$; Canada—$I(1,0,1)$; CARICOM—$I(1,0,1)$; OTHER—$I(1,0,1)$; and TOTAL—$I(1,1,0)$. It should be pointed out that the USA and TOTAL possess the same unit root properties, which is not surprising given that the USA was the largest source market for arrivals for virtually the entire period under study, only being overtaken by the UK market in the last decade, 1996-2005.

Several implications arise from our results. First, our findings indicate that the effect of external shocks to visitor arrivals to Barbados from each market is permanent. The efforts of tourism authorities to mitigate negative shocks and enhance the effects of positive shocks will therefore be critical to the continued survival of Barbados' tourism sector. Since individual source markets possess unit roots (at different seasonal frequencies), this suggests that perhaps, tourism authorities should handle external shocks according to each particular market separately, as tourists, even from within the same country, are not a homogenous group and do not necessarily react in the same manner. This is even more pertinent when we also consider that "each crisis situation is unique and difficult to resolve with simple formulas" (Sonmez et al., 1999, pp. 17-18).

In response to negative shocks, Sonmez et al. (1999) recommend recovery strategies that include aggressive marketing and promotion efforts. Incentives such as tax breaks can be offered to businesses to use local convention centres and hotels (Pitts, 1996). Devising strategies to increase visitation levels such as new tourism products, supported by heavy promotion can also help to overcome negative shocks (Witt and Moore, 1992). Wahab (1996) recommends maintaining good contacts with the international press, and providing comprehensive information to international tour operators and travel agents.

Ritchie (2004) advocates teams or crisis management units to deal with tourism crises and disasters, made up of representatives from local government, travel and tourism industry

professions and community leaders. These teams should include a public relations team; a promotional team; an information coordination team; and a fund raising team (Sonmez et al., 1999). However, Ritchie offers that a strategic, holistic and proactive approach to crises is preferable through: "proactive scanning and planning; implementing strategies when crises or disasters occur, and evaluating the effectiveness of these strategies to ensure continual refinement of crisis management strategies" (Ritchie 2004, p. 680).

Second, although positive shocks (such as hosting a major sporting event) will also have permanent effects, Lorde and Moore (2008) find that that negative shocks have a larger impact on tourist arrivals (to Barbados) volatility than do positive shocks. Coupled with the results from this study, the implication is that the impacts of a positive shock on tourist arrivals, tourism receipts and on other sectors via the multiplier effect will not diminish but will, however, be smaller in magnitude than the impacts from a negative shock.

Finally, the findings of seasonal unit roots have implications for forecasting visitor arrivals to Barbados. Since this implies that seasonal patterns change over time, it calls into question the accuracy of studies forecasting visitor arrivals to Barbados which ignored initial testing for seasonal unit roots such as Dharmaratne (1995) and Worrell et al. (1997). Among studies that have examined the impact of seasonal unit roots on forecasting accuracy are Franses (1991) who points out that it is extremely important to determine the nature of seasonality since this bears heavily on forecasting accuracy; and Paap et al. (1997) who found that if there is more than one seasonal unit root present, the HEGY procedure outperformed seasonal mean shift models.

4. Concluding Remarks

The permanence or transience of shocks to the tourism sector, both positive and negative, can have direct or indirect impact on the welfare of all Barbadian residents. Against this background, our study applied various econometric procedures to determine whether shocks to visitor arrivals to Barbados from 1956-2005 for major markets such as the USA, the UK, Canada and CARICOM; minor source markets as a group—OTHER; and total arrivals—TOTAL. Our empirical findings imply that exogenous shocks will have permanent effects on visitor arrivals to Barbados from each market. Our recommendation is for tourism authorities to handle external shocks to each particular market differently, as tourists, even from within the same country, are not a homogenous group and each shock has unique characteristics. Apart from this, recovery strategies should include forming crisis management teams to undertake aggressive marketing, promotion and public relations; developing new tourism products; and other policies to assist the country in recapturing any revenue lost as a result of falling market shares.

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Table 2: Government Investment in Barbados Tourism Industry

	Source					
	Min. of Tourism ($)	**BTA ($)**	**BIDC ($)**	**CTO ($)**	**Tourism Development Program ($)**	**Total Investment ($)**
1993-1994	967,212	29,380,363	898,985	40,000	19,030	31,305,590
1994-1995	912,343	32,657,860	594,074	40,000	242,094	34,446,371
1995-1996	1,069,592	35,787,529	3,134,918	40,000	785,730	40,817,769
1996-1997	1,451,998	42,399,228	3,956,375	40,000	5,438,538	53,286,139
1997-1998	1,568,538	37,050,000	2,719,368	40,000	5,539,366	46,917,272
1998-1999	1,519,803	43,364,474	1,760,123	40,000	5,160,378	51,844,778
1999-2000	1,960,081	42,769,590	1,063,612	40,000	1,749,328	47,582,611
2000-2001	4,189,188	48,698,000	3,364,562	40,000	NA	56,291,750
2001-2002	2,077,593	50,150,138	19,056,404	52,000	NA	71,336,135

Notes: The data is sourced from the Statistical Department of Barbados. The fiscal year runs from April 1st to March 31st. All figures are in Barbados dollars. 2 BBD = 1USD. BTA stands for Barbados Tourism Authority; BIDC stands for Barbados Industrial Development Corporation, and CTO stands for Caribbean Tourism Organization. NA means "not available".

Table 2: Univariate Unit Root Tests on Log Arrivals

Series	ADF	KPSS	HEGY		
			π_1	π_2	$\pi_3 \cap \pi_4$
log(USA)	-1.619	0.399***	-1.930	-1.747	8.212**
log (UK)	-1.919	0.348***	-2.303	-3.303*	4.500
log (CANADA)	-2.248	0.397***	-2.740	-3.878***	3.238
log (CARICOM)	-2.149	0.347***	-2.393	-4.101***	5.242
log(OTHER)	-1.145	0.320***	-1.086	-4.548***	2.325
log(TOTAL)	-1.618	0.426***	-1.866	-1.647	8.556**

Note: *** indicates significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level.

Table 3: Panel Unit Root Tests on Log Arrivals

Test	Statistic
Levin, Lin and Chu	-0.069
Breitung	1.638
Im, Pesaran and Chin	1.271
Hadri	15.842***

Note: The data generating process assumed is an individual intercept and trend. *** indicates significance at the 1% level; ** indicates significance at the 5% level; and * indicates significance at the 10% level.

Figure 1: Quarterly Tourist Arrivals to Barbados by Source Market 1956-2005