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Abstract

This study is an attempt to evaluate the short and long term effects of World Exposition 1986 on US demand for British Columbia tourism by integrating the time-series oriented approach with the theory of consumer demand. The number of more-than-one-day US visitors to BC is used as the measure of demand. Intervention and transfer function models are employed for the estimates which are made separately for US visitors arriving by automobile and by plane. The conclusions drawn are that during the six months of Expo 86, an additional 1.58 million more-than-one-day US visitors were attracted to British Columbia (1.41 million by automobile and 0.17 million by plane). The long-term or post-Expo effects of Expo 86 are found to be confined to US visitors by automobile. The growth in US visitors by plane has occurred quite independently of Expo 86. Holding the 1986 World Exposition in Vancouver has stimulated an additional 19,288 more-than-one-day US visitors by automobile, on average, in each of the 82 months immediately following Expo 86 (November 1986 to August 1993), which implies that a 14 percent average monthly increase in tourism demand in the post-Expo period is attributed to the long term effects of Expo 86. These estimates take account of the effects of changes in the US-Canada foreign exchange rate, the US travel price index, the BC travel price index and US personal disposable income over the 1981-93 period.

Short and Long Term Effects of World Exposition 1986 on U.S. Demand for British Columbia Tourism*

1. Introduction

Many cities organise international mega-events such as the Olympic and World Exposition to attract tourists. The general perception is that tourism generates positive net benefits to the host city or region. The essence of this argument is that tourism provides an opportunity for free-trade between residents and tourists in the markets for tourism-related goods and services. If goods and services are priced efficiently and resources used by tourists are owned by residents, then tourism increases net average benefits (potential Pareto improvement) for residents (Clarke and Ng, 1993). This finding is based on the assumption of efficient pricing, that is, price equals social marginal cost of production. If there exists unpriced externalities (eg, environmental costs), net benefits from tourism for residents might be negative. Thus, positive economic welfare from tourism is predicated on the presumption that potential economic gains outweigh costs arising from tourism related negative externalities.

Previous studies (Ritchie, 1984; Ritchie and Lyons, 1990) have made qualitative estimates of the impact of "hallmark" events on tourism, but quantitative estimates from multivariate statistical models have not previously been made. The "hallmark" event considered in this study is World Exposition 1986 (Expo 86), which was held in Vancouver, British Columbia between May and October of 1986. Our purpose is to measure, using a transfer function model with intervention components, the increase in the number of US visitors coming to British Columbia in each of the six months of Expo 86, and to determine whether or not there have been significant post-Expo or

^{*} The authors are especially grateful to Turgut Var of Texas A&M University for his assistance in obtaining data on the US Travel Price Index.

long-run effects on the British Columbia tourism industry. Many visitors were attracted to BC by the World Exposition, and one of the arguments used to justify the expense of holding Expo 86 is that the resulting exposure of the city and province to visitors would result in future (ie. post-Expo) increases in tourism. This study tests the validity of that claim.

Tourism is a very important industry in British Columbia reflecting in part the natural beauty of the area, an attractive summer climate, a new Convention Centre and a well-developed tourist service industry including accommodation, food and beverage, fishing, hunting, and other recreation and transportation services. Vancouver Facts and Research (1992) has estimated that in 1991, tourism industries in the Greater Vancouver area alone generated \$1.72 billion in industry output, 62,325 full-time jobs, \$810 million in taxes, and \$2.17 billion in GDP. Clearly, the tourism industry is important to British Columbia and knowledge of the short and long term stimulus to tourism given by events such as Expo 86 may have important implications for economic policy in the province.

2. Literature Review

Ritchie (1984) raised some conceptual and research issues with respect to the impact of hallmark events. He proposed a formal definition of hallmark events:

"Major one-time or recurring events of limited duration, developed primarily to enhance the awareness, appeal and profitability of a tourism destination in the short and/or long term. Such events rely for their success on uniqueness, status, or timely significance to create interest and attract attention."

Following this broad definition, Ritchie classified hallmark events into seven groups. One of these groups is world fair/exposition which is the primary interest of our study. Ritchie also identified six types of impacts of hallmark events (which are not mutually exclusive): economic, tourism/commercial, physical, socio-cultural, psychological and political. In general, the first two impacts received wide attention in the literature. In the Canadian context, a large number of studies emerged following the awarding of the XV Olympic

Winter Games (1988) to Calgary in October 1981.¹ Using data from 20 centres in the United States and Europe over the period 1986-89, Ritchie and Smith (1991) observed that the 1988 Calgary Olympic Winter Games had a positive impact on the international levels of awareness and the image of the host city. However, their results suggest a significant decline in the level of awareness over time which implies that the long-run or permanent effect of a mega-event on tourism demand may be insignificant. The latter hypothesis has not been empirically tested in their study.

Some studies attempted to quantify the partial effects of economic factors based on a multiple regression model. Chadee and Mieczkowski (1987) found that despite a depreciation in the Canada-US exchange rate over the period 1976-85, the Canadian tourism industry experienced slow growth. Using quarterly data for 1976-1 to 1985-4, they estimated a demand function for Canadian tourism. The results indicate a modest positive impact of exchange rate depreciation on US demand for Canadian tourism. The authors claim that the modest effect was the result of other offsetting factors which were omitted from the regression model. This conjecture might be valid if an omitted variable is correlated with the exchange rate. Moreover, Chadee and Mieczkowski investigated Canadian tourism demand for the pre-Expo period (1976-85), while our study examines BC tourism demand for the period 1981-93 with special attention to the effect of Expo 86. Our method of investigation also differs from their methodology.

When modelling demand for tourism, measured by either tourism expenditure or tourist arrivals, researchers used two types of models: time series models and econometric causal models. Time series models are *a theoretic*, while econometric causal models are based on economic theories. Sheldon (1993) tested the forecasting accuracy of six time series methods for the United States, using annual data for the period 1970 to 1986. These are: (1) the no-

¹These studies include Ritchie (1984), Ritchie and Aitken (1984, 1985), Ritchie and Lyons (1987, 1990), Ritchie and Smith (1991), Nicholas Applied Management (1982) and DPA Group (1985).

change model, (2) the proportional change model, (3) Brown's double exponential smoothing, and (4) three trend-fitting models (linear, exponential, and log-quadratic). In addition, Sheldon used two multiple regression models (the linear model and the log-linear model) similar to those of Little (1980), Artus (1972), Leob (1982) and Chadee and Mieczkowski (1987). A common feature of these models is the use of income, exchange rate and relative price in the demand function for tourism. Other control variables such as travel cost, dummies for political disturbance and special events were also utilised in some studies. Sheldon observes that the no-change model yields the most accurate forecast of tourism expenditure in the United States. In the context of econometric causal models, the log-linear model performs better than the linear model.

In the Canadian context, Qui and Zhang (1995) examined the determinants of tourist arrivals and expenditure using annual time series data. They estimated both linear and log-linear demand functions for Canadian tourism. The demand for international tourism to Canada is measured by two alternative variables: the number of tourist arrivals and tourist expenditure in Canada. The general form of the demand (D) function is:

D = f(income, nominal exchange rate, Canadian travel price index, immigration,

crime rate, special events, time trend).

This function is estimated for five major tourist-originating countries: United States, United Kingdom, France, Germany (West) and Japan. Annual data from 1975 to 1990 are used for each country. We focus on the results of the US demand for travel to Canada since our study is concerned with US demand for British Columbia tourism. Their log-linear demand function suggests that only GNP and time trend have a statistically significant effect on the number of visitors. The log-linear specification was found to be superior to the linear specification because the Box-Cox residual sum of squares was found to be smaller for the log-linear than the linear demand function. This finding complements an earlier result found by Sheldon (1993). The dummy variables for special events (1976 Montreal Summer Olympics, 1986 Expo in Vancouver and 1988 Winter Olympics in Calgary) were found by

Qui and Zhang (1995) to have insignificant influences on the demand for travel. This unexpected result might be attributed to the small size of the sample (16 observations) and the omission of the US travel price index from the model. Furthermore, if the error term does not follow a white noise process, the demand function needs to be modified by appending an ARIMA model for the noise component. The present study overcomes this limitation by integrating the theoretical demand model with the ARIMA model for the stochastic component of demand.

In a series of papers, Crouch (1995, 1994a, 1994b, 1994c) conducted a meta-analysis of international tourism demand to integrate the empirical findings of 80 studies. The objective of his analysis was to generalise the findings for tourism demand elasticities by computing the mean and variance of the regression parameters from a large number of international tourism studies. The key results of his study are given in Table 1. The results indicate that international tourism is a 'luxury' good (income elasticity greater than unity), the own-price effect is same as the exchange-rate effect but less pronounced than the effect of transportation costs. Marketing expenditures have a moderate positive effect on tourism demand. The standard deviations of some of the elasticity parameters are found to be very high across studies. Crouch, however, did not make any attempt to generalise the effect of mega-events on international tourism demand.

(Insert Table 1)

3. Methodology

3.1 Theoretical framework

The standard consumer theory is used to specify the US demand function for BC tourism. Consider a representative US consumer who obtains utility from US tourism (T_S) , BC tourism (T_B) and a Hicksian composite consumption good (C). The utility function is separable in tourism and the composite consumption good.

(1) $U = U^{T}(T_{S}, T_{B}) + U^{C}(C)$

The consumer maximises utility subject to a budget constraint,

$$(2) \qquad P_S T_S + E P_B T_B + C = Y$$

where P_S is the US travel price, P_B is the BC travel price, E is the nominal US-Canada exchange rate expressed as the amount of US dollars which can be exchanged for a Canadian dollar, and Y represents disposable income. Note that by definition C represents expenditure on all other goods and services, expressed in terms of US dollars and the term, EP_B represents the BC travel price expressed in terms of US dollars. Maximisation of utility subject to the budget constraint yields the following demand function for BC tourism:

(3)
$$T_B = f(P_S, P_B, E, Y, \tau)$$

where, τ is an indicator of the individual's taste and preferences. Assuming that the preferences of the traveller remains unchanged, the deterministic component of the demand model can be approximated by the following log linear specification:²

(4)
$$\ln T_B = \beta_0 + \beta_1 \ln E + \beta_2 \ln P_B + \beta_3 \ln P_S + \beta_4 \ln Y$$

If the elasticity of demand with respect to the nominal exchange rate is the same as the own price elasticity ($\beta_1 = \beta_2$) and the own price effect is the negative of the cross-price effect ($\beta_2 = -\beta_3$), then equation (4) reduces to the following restricted demand model:

(5)
$$\ln T_{\rm B} = \beta_0 + \delta \ln(EP_{\rm B}/P_{\rm S}) + \beta_4 \ln Y$$

where, $\delta = \beta_1 = \beta_2 = -\beta_3$. Thus demand for tourism depends on the relative price of BC tourism faced by the US visitor (or real exchange rate for tourism industry) and real disposable personal income. Equation (4) imposes the restriction that the effect of the

²Previous studies (Qui and Zhang, 1995; Sheldon, 1993) have demonstrated the superiority of a log-normal specification compared to a linear specification.

nominal exchange rate is the same as the own-price effect. Since a previous empirical study seems to suggest that the restriction, $\beta_1 = \beta_2$ does not hold (Chadee and Mieczkowski, 1987), it is worthwhile to estimate both restricted and unrestricted specifications.

3.2 Empirical Model

Further modifications of the demand model are desirable for empirical investigation. First, we focus on the preference parameter τ , which is assumed to behave as a shift factor. Earlier research (Ritchie and Smith, 1991) suggests that a mega-event dramatically increases levels of awareness and enhances the image of the city/region, which is hosting the event. Thus the individual's preferences for tourist destinations might be influenced by a mega-event such as Expo 86, which in turn will provide a boost in demand for BC tourism. Figure 1 illustrates the possible short-term and long-term effects of Expo 86 on US demand for BC tourism. The pre-Expo US demand for BC tourism (ie, residual demand) is represented by D_0 . To avoid a potential identification problem, it is assumed that the supply curve (S) is highly elastic in the relevant region of market operation. The pre-Expo equilibrium occurs at point E_0 . Hosting of Expo 86 in BC shifts the demand curve from D_0 to D_s . In the short-term, the market equilibrium moves from E_0 to E_s . Put differently, the average monthly tourism demand over the period of Expo 86 increases by the amount $Q_0Q_{S_1}$. In the long term (ie in the post-Expo period), the demand curve will shift downward but it will not shift enough to coincide with the pre-Expo demand curve if the increased awareness and modified image for the host region brought by Expo 86 persists over time. Thus, we conjecture a downward shift of the demand curve from D_S to D_L and a long-term equilibrium flow of US tourists determined by the point E_L . The distance Q_0Q_L measures the long-term tourism boost resulting from Expo 86.

We incorporate a pulse function to capture the short-term effects and a step function to capture long-term effects in the theoretical demand model. In addition, a noise term is appended to the model to capture errors in optimisation, measurement of tourism demand and the impact of relevant omitted factors. Thus, appending the intervention component for Expo 86 and a stochastic component to the deterministic model (equation 4), we derive the following transfer function model.³

(6)
$$\ln T_{B,t} = \beta_0 + \beta_1 \ln E_t + \beta_2 \ln P_{B,t} + \beta_3 \ln P_{S,t} + \beta_4 \ln Y_t + \left(\sum_{i=0}^5 \omega_i B^i\right) L_t + \omega_6 S_t + N_t$$

where,

t = time subscript				
Lt (pulse function)	= 1 in May 1986			
	= 0 otherwise			
Bi	= backshift operators			
ω _i	= impact of Expo 86 in May 1986 (i=0) to October 1986 (i=5)			
S _t (step function)	= 1 after October 1986			
	= 0 prior to November 1986			
ω ₆	= average monthly increase in US tourists following Expo 86			
Nt	= noise component			

If the noise term follows a white noise process, then equation (6) can be estimated efficiently using OLS. Otherwise, an ARIMA model (Box and Jenkins, 1976, Ch. 9) for the noise term needs to be specified. The general form of the ARIMA model is

(7)
$$N_t = \frac{\theta(B)}{(1-B^{12})\phi(B)} a_t$$

³In the context of British Columbia industrial employment, Holmes and Shamsuddin (1993) demonstrated the superiority of a transfer function model over the univariate ARIMA model in predicting cyclical fluctuations of industrial employment. A transfer function model uses economic theory to specify the deterministic component of the model and the Box-Jenkins approach in modelling an ARIMA model for the stochastic component. Thus, this modelling technique is an attempt to combine the best of both worlds.

where, θ (B) = MA operator, φ (B) = AR operator, $(1-B^{12})$ = seasonal difference operator⁴ and a_t = white noise term. The specific form of equation (7) will be identified in section 5. Before presenting our econometric results in section 5, we present a preliminary analysis of the data in the next section.

4. The Data

Since about 85 percent of non-resident visitors to British Columbia come from the United States, we focus on US demand for BC tourism. There are two alternative measures of demand for tourism: tourist expenditure and tourist arrivals. Investigating the accuracy of tourist expenditure data for 40 countries, White and Walker (1982) show that expenditure data is subject to a high degree of error. This observation was applicable to both developed and developing countries and in some cases the magnitude of measurement error was more than 100 percent.⁵ Hence, we choose to use tourist arrivals rather than expenditure as the measure of tourism demand.

Two data series measuring more-than-one-day visitors from the United States to British Columbia by automobile and by plane are analysed. We concentrate on the more-than-oneday visitors because these are the people who typically purchase hotel accommodation and make other expenditures providing the biggest boost to the BC economy. The one-day visitors are a much less important source of tourist dollars. Variable definitions and data sources are noted in Table 2.

⁴The next section reveals that the tourism demand series exhibits strong seasonality. Seasonal differencing is required to transform a non-stationary series to a stationary series.

⁵Murphy and Carmichael (1991) developed and applied a formula to estimate tourism expenditure related to a special event (the 1989 BC Winter Games, Nelson). The formula is:

[&]quot;Tourist spending = number of tourist spectators or participants X per cent reporting an expenditure X average daily expenditure per person X average number of days at Games (p 35)."

They estimated tourist spending of CAD\$479,516 for the 1989 B.C. Winter Games' four-day sports festival in Nelson. This type of accounting is useful in estimating tourism demand associated with a special local event, but for an international mega-event which lasts for six months (such as World Expo) this estimation procedure might be prohibitively costly.

(Insert Table 2)

The most striking aspects of our two series on US arrivals is their strong seasonal patterns and the upward shifts occurring during the six months of Expo 86 (May to October of 1986). Both phenomena are revealed in Figures 2 and 3. Strong seasonality in the US arrivals by automobile series is reflected in values which are 6.2 times as large in August of 1993 as in January of that year (421,700 vs. 67,685). A less profound but still very strong seasonal pattern is found in our US arrivals by plane series, which is 3.3 times larger in August than January 1993 (76,808 vs. 23,170). These strong seasonal fluctuations are typical of all of the years in our study for both series. In addition to their extremely seasonal nature, the two series also exhibit a profound upward shift during the six months of Expo 86. US arrivals by auto series averaged 503,317 for the six months of Expo 86 which is 98 percent higher than the average (254,090) for the same six months of 1985, and 83 percent higher than the average (275,076) for the same six months of 1987. The influence of Expo 86 on our US arrivals by plane series is smaller, but still very large. From May to October of 1986, our US. arrivals by plane series averaged 67,666, which is 71 percent higher than the average (39,500) for the same six months of 1985, and 47 percent higher than the average (45,988) for the same six months of 1987.

Some tentative evidence for the short-term and long-term effects of Expo 86 on BC tourism are presented in Figures 3 and 4. We compare monthly visitor arrivals for the six months of Expo 1986 (May to October) with the corresponding average monthly visitor arrivals for the pre-Expo period (January 1981 to April 1986) to determine the short-term effect. To evaluate the long term effect we compare average monthly visitor arrivals for the post-Expo period (November 1986 to August 1993) with that of the pre-Expo period. The results indicate a quantitatively significant positive short-term effect of Expo 1986 for US visitor arrivals regardless of the mode of transportation. The long-run or permanent effect of Expo

86 is also positive for both types of tourists; however, the permanent effect is significantly smaller in magnitude than the short-term effect.

(Insert Figures 2 to 5)

Although these findings are interesting, to isolate the partial impact of Expo, the effects of other relevant variables on tourism demand must be taken into account. These variables are travel price indices, US-Canada exchange rates and US personal disposable income. Figures 6 to 8 reveal the patterns of these series over the sample range. The BC travel price index shows a higher growth rate and volatility than the US travel price index. In particular, a marked upward shift in BC travel price occurs during the period of Expo 86. The nominal US-Canada exchange rate stood at \$0.84 in January, 1981. By the beginning of Expo (May 1986), it had decreased to \$0.73 and after Expo, had risen to \$0.88 in October 1991, falling again to \$0.76 in August 1993. The real exchange rate for the tourism industry showed a similar pattern but it had less volatility than the nominal exchange rate. These large changes in the value of the Canadian dollar might have had an impact on the number of US tourists coming to British Columbia. The time series for US personal disposable income is shown in Figure 8. This series shows an expected upward trend over the sample period, but no obvious relation between tourist arrivals and income can be identified from the relevant graphs.

(Insert Figures 6 to 8)

5. Empirical Results

This section begins with a description of the our modelling strategy and then presents the estimation results. Our overall modelling strategy is the following:

• We identify a univariate ARIMA model for the US tourist demand series using 64 observations in the pre-intervention period (the period of observations prior to Expo 86

extending from January 1981 to April 1986). The use of the data for pre-Expo 86 period ensures that the dramatic increase in tourist flows resulting from the Expo does not distort the model identification procedure.

- Next, we add only the intervention component (pulse and step functions) to our univariate ARIMA model in order to obtain a first approximation of the short and long run effects of Expo 86 on US demand for BC tourism.
- In order to determine whether the post-Expo increases in US tourists to BC have been due to Expo 86 or to changes in other variables, we estimate the unrestricted transfer function model (4) with appropriate ARIMA specification for the noise component.⁶
- Finally, we impose the restriction that β₁ = β₂ = -β₃, and estimate the restricted transfer function model (5) to examine the validity of this restriction.

Thus, we estimate four models: Univariate ARIMA, Intervention Model, Unrestricted Transfer Function Model and Restricted Transfer Function Model. Each model is estimated for three series: total US tourist arrivals, US tourist arrivals by automobile and US tourist arrivals by plane. All models are estimated without a constant term and using the exact maximum likelihood technique as described in Hillmer and Tiao (1979). The SCA computing software is used for estimation.

5.1 The Results for Total US Visitor Arrivals

Table 3 presents the results for total US demand for BC tourism. An ARIMA (1,0,0) $(0,1,2)_{12}$ is found to be adequate in explaining the fluctuation in tourism demand. Column 2 provides the estimated ARIMA model for the pre-intervention period. The constant term

⁶See Pankratz (1991, Ch. 4-6) for the procedure for identification of a transfer function model.

was dropped from the model due to its statistical insignificance. All of the remaining coefficients are statistically significant at the 5 percent significance level and the R^2 is very high. The model also passed diagnostic tests for the stationarity of AR parameters, invertibility for MA parameter and white noise residual (see the Q-statistic).

The intervention component is then added to the above ARIMA model to assess the impact of Expo 86. Column 3 shows the estimates obtained over the entire range of our data (January 1981 to August 1993) for the intervention model. The ARIMA component of this model remains adequate in explaining the data generating process. The estimated ω_i coefficients are of most interest. The first six of these parameters (ω_0 to ω_5) estimate the change in the log of the number of US tourists coming to British Columbia during the six months of Expo 86. In addition to the extra US visitors during the six months of Expo 86, the coefficient of the step function (ω_6) indicates an increase in the log of the number of US visitors per month over the 82 months following Expo 86 (November 1986 to August 1993). The estimated coefficients of both the pulse and step functions are statistically significant (t > 2), indicating significant short- and long-term effects of Expo 86 on total US demand for BC tourism demand.

Columns 4 and 5 of Table 3 presents the results for restricted and unrestricted linear transfer function models.⁷ The most notable aspect of the results is that none of the input variables, except disposable personal income, has statistically significant effect (at the 5 percent level) on total US tourism demand. The income elasticity of demand obtains a value of unity in both restricted and unrestricted transfer functions. The results with respect to the pulse function are similar to those obtained from the intervention model. However, the long-term effect, indicated by the coefficient of the step function, decreases from 0.30 to 0.11 when we

⁷Distributed lags on the input variables (exchange rate, US travel price index, BC travel price index and US disposable personal income) as well as a "corner table" have been employed to estimate the rational form of the transfer function [see Pankratz (1991) Ch. 4-6]. The result of that analysis is that all input variables are introduced into the model with linear coefficients and no lags. Absence of any significant lagged effects from input variables to output variables indicate that travellers do not make systematic mistakes in predicting their future incomes or market conditions (ie, values of exchange rate and travel prices).

move from the intervention model to the transfer function models. This suggests that the post-Expo increases in US visitors have been partly due to changes in other economic variables, principally US disposable personal income.

(Insert Table 3)

5.2 The Results for US Visitor Arrival by Mode of Transportation

In order to determine whether or not the mode of transportation for tourist arrival has any effect on our parameter estimates we estimate each model separately for, US visitors arriving by automobile (see Table 4) and US visitors arriving by plane (see Table 5). We identify an ARIMA (1,0,0) $(0,1,2)_{12}$ for the US visitors by automobile series (USVA) and an ARIMA $(2,0,0)(0,1,1)_{12}$ for the US visitors by plane series (USVP). The diagnostic tests suggest that both ARIMA models have desirable properties with respect to parameter estimates and residuals. The key findings with respect to our intervention and transfer function models are the following: First, estimates of the short-term and long-term effects are reasonably robust, that is, these estimates are not highly sensitive to model specification. Second, the short-term effects of Expo 86 are highly significant for both groups of visitors, but the long-term (post-Expo) effect is statistically significant only for US visitors by automobile. Third, US visitors by plane behave like typical neoclassical consumers with respect to changes in BC travel price, US travel price and income, but US visitors by automobile principally take into account their incomes in making decisions about BC travel.

Partial Short-term and Long-term Effects of World Exposition 1986

The partial short-term effects are estimated for each of the six months of Expo 86 from the pulse function, while the long-term effect is estimated from the step function. The unrestricted transfer function models are used to yield those estimates. The coefficient ω_i (i=0,1, ..., 5) represents the change in the log of the number of US visitors arriving in BC in the ith month due to Expo 86:

$$\ln T_{B,i}^{X} - \ln T_{B,i}^{R} = \omega_{i} \qquad \text{or} \qquad \frac{T_{B,i}^{X} - T_{B,i}^{R}}{T_{B,i}^{R}} = (e^{\omega_{i}} - 1)$$

where, $T_{B,i}^{X}$ and $T_{B,i}^{R}$ represent the number of US visitors arriving in the ith month during the Expo period and the pre-Expo period respectively. For the pre-Expo period, we use the average number over all i months. Thus, the short-run effect or the percentage change in the number of tourists in the ith month due to Expo 86 can be computed as:

$$\lambda_i^{SR} = (e^{\omega_i} - 1) 100, \quad i = 0, 1, ..., 5.$$

Similarly, using the step function, the long-term effect is computed as:

$$\lambda^{LR} = (e^{\omega_6} - 1) 100$$

where, ω^6 is the coefficient of the step function. The term λ^{LR} measures the average monthly percentage change in US tourist arrivals in the post-Expo period due to Expo 86. Figure 9 presents short-term and long-term partial effects obtained from the unrestricted transfer function models for two sub-groups of visitors. Detailed numerical results are provided in Table 6. The results reveal that short-term effects of Expo 86 were quantitatively significant regardless of the mode of transportation. For US visitors by automobile, the monthly increase arising from Expo 86 lies between 143 and 81 per cent in the short term. The greatest increase occurred in September 1996. Similar but less pronounced short-term effects are observed for visitors arriving by plane. With respect to long-term effects of Expo 86, we observe a 14 per cent average monthly increase in tourist arrivals by automobile but a negligible 0.39 per cent increase in tourist arrivals by plane. Overall, British Columbia experienced an eleven percent average monthly increase in total US tourist arrivals in the post-Expo period (November 1986 to August 1993).

Estimated Demand Elasticities

Estimated demand elasticities obtained from the transfer functions are presented in Table 7. The elasticity of tourism demand with respect to the real exchange rate is insignificantly different from zero both at the aggregated and the disaggregated levels.⁸ The results with respect to income elasticity of demand are not sensitive to model specification. The income elasticity coefficients are unity for all visitors, less than unity for visitors arriving by automobile and greater than unity for visitors arriving by plane. Thus the findings seem to suggest that tourists arriving by plane consider BC tourism as a 'luxury'. None of the other economic variables (travel prices and nominal exchange rate) are significant for the model of US visitors by automobiles. As noted earlier, visitors arriving by plane behave more like neoclassical consumers. One per cent increase in BC travel price leads to a 1.24 per cent decrease in BC tourism demand, while a one per cent increase in US travel price increases BC tourism demand by 1.61 per cent. Thus, US air travellers consider the BC tourism experience a close substitute for the domestic tourism experience. The coefficient of the nominal exchange rate is insignificantly different from zero at the 5 per cent level for both visitor groups.

6. Conclusion

Our conclusions involve the effect of Expo 86 on the number of US visitors to British Columbia during the six months of Expo and in the post-Expo period. Our empirical analysis leads us to the following conclusions:⁹

• Over its six month period (May to October 1986), Expo 86 attracted to British Columbia an additional 1,413,291 more-than-one-day visitors by automobile, and an

⁸However, it is important to recognise that the test for the coefficient of the real exchange rate involves a joint test of the hypotheses that (i) the relative price of tourism has no effect on demand and (ii) the impact of BC travel price is the negative of the impact of US travel price. Thus it is not clear from the results for the restricted transfer function model, what part of the joint hypothesis is rejected by the data. Hence, we also report elasticity estimates from the unrestricted transfer functions.

⁹Detailed numerical results are presented succinctly in Tables 6 and 7.

additional 165,702 by plane (a total of 1.58 million). The additional average monthly US visitors (more-than-one-day) during Expo 86 were 235,549 by automobile and 27,617 by plane. The lowest additional increase in tourist arrivals for both groups was in October, the last month of Expo (97,237 by automobile and 14,976 by plane), while the highest additional increase in tourist arrivals for both groups was in August for visitor by automobile (302,319) and in September for visitors by plane (39,180). For both series the marginal impacts of Expo 86 on US demand for BC tourism gradually increased from May to their peak and then they declined, with much the lowest demand boost occurring in October, the last month of Expo 86.

- There have been no long-term or post-Expo effects of Expo 86 on more-than-one-day US visitors by plane. The growth in this series over the post-Expo period has occurred quite independently of both Expo 86 and the US-Canada exchange rate. Expo 86 has stimulated substantial numbers of more-than-one-day US visitors by automobile over the post-Expo period. We estimate that over the 82 months immediately following Expo 86 (November 1986 to August 1993), the 1986 World Exposition held in Vancouver has stimulated, on average, an additional 19,288 US visitors by automobile to British Columbia, which implies an average monthly increase of 14 percent. Thus, Expo 86 seems clearly to have had a major long-run effect on US demand for British Columbia tourism.
- Over the sample range 1981-93, the changes in the US-Canada exchange rate do not explain the changes in the number of US visitors to British Columbia. For US visitors arriving by plane, estimates of own-price, cross-price and income elasticities are statistically significant and compatible with the prediction of standard consumer theory. Economic factors, rather than Expo 86, has governed the post-Expo changes in the number of US visitors by plane. In the case of US visitors by automobile, we observe that among economic factors only the income elasticity of tourism demand is

statistically significant, and the post-Expo upward shift in this series is principally due to the long-run effects of Expo 86.



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Figure 1: Impact of Expo 86 on the Market for BC Tourism



Figure 2: More than One Day Visitors from the US to British Coulumbia by Automobile, January 1981 to August 1993

Figure 3: More than One Day Visitors from the US to British Columbia by Plane, January 1981 to August 1993





Figure 4: Average Monthly More than One Day Visitors from the US to British Columbia by Automobile

Figure 5: Average Monthly More than One Day Visitors from the United States to British Columbia by Plane





Figure 6: Travel Price Indices of United States and British Columbia, January 1981 to August 1993

Figure 7: Monthly US-Canada Nominal and Real (1981=100) Exchange Rates, January 1981 to August 1993





Figure 8: US Disposable Personal Income at 1981 constant prices





Explanatory variables	Means of Demand Elasticities	Standard deviations of Demand Elasticities
Income	2.21	3.81
Own-price	-0.87	4.27
Exchange Rates	-0.88	2.32
Transportation costs	-1.17	2.13
Marketing expenditures	0.41	0.09
Time-trend	0.045	0.011

 Table 1: Crouch's Meta-Analysis of International Tourism Demand

Source: Crouch (1995, Table 1, P111)

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Table 2: Variable Definitions

Variable Name ^a	Variable Description
D145672	Total US residents entering BC
D145674	Total US residents entering BC and returning on the same day
D145677	Total US residents entering BC by plane
D145680	Total US residents entering BC by plane and returning on the same day
B51115	US Quarterly disposable personal income in billions current Canadian dollars.
D 2400	Canada-US nominal exchange rate
B3400 B53204	US consumer price index
Measures of tourism demand (T_B) :	
USVA = D145672 - D145674 -	Total US visitors by auto staying more than one day
USVP = D145677 - D145680	Total US visitors by plane staying more than one day
TUSV = USVA + USVP	Total US residents entering BC staying more than one day
Economic factors:	
E = (1/B3400)	Nominal US-Canada Exchange Rate
PB	BC travel price index (1981=100) ^b
P _S	US travel price index (1981=100) ^c
$R_{E} = (E.P_{B}/P_{S})$	Real exchange rate (1981=100): E(PB/PS)
Y	US monthly personal disposable income in billions 1981 US dollars. ^d

Note:

a. A variable name prefixed with either a "D" or a "B" represents the CANSIM code number. These variables are retrieved from the CANSIM main database of Statistics Canada.

c. Obtained from the Travel Data Centre in the US.

b. Obtained from the Central Statistical Branch of the Ministry of Government Services, BC.

d. The US personal disposable income series is available quarterly in Canadian dollars. First, the quarterly series is converted to monthly series using the cubic spline function as specified in the CANSIM. Then we express the monthly series at 1981 constant US dollars utilising the US-Canada exchange rate and the consumer price index.

Estimation per	iod:	1981-1 to 1986-4		1981-1 to 1993-8	
Explanatory variables (Coefficients)		ARIMA model for the pre-intervention period	Intervention model	Restricted transfer function model	Unrestricted transfer function model
ln (R _E)	$\left(\beta_{1}^{1}\right)$			0.1081 (0.62)	
ln (E)	$\left(\beta_{1}\right)$				0.0713 (0.36)
ln (P _B)	$\left(\beta_{2}\right)$				-0.2059 (-0.48)
ln (P _S)	$\left(\beta_{3} \right)$				0.3110 (0.66)
ln (Y)	$\left(\beta_{4} \right)$			1.0868 (6.08)	1.0314 (2.58)
Pulse function	(L):				
May 1986	$\left(\omega_{0}\right)$		0.8504 (13.18)	0.7810 (12.43)	0.8055 (11.99)
June 1986	$\left(\omega_{1}\right)$		0.8198 (11.01)	0.7168 (10.87)	0.7423 (10.50)
July 1986	$\left(\omega_{2}^{}\right)$		0.6838 (8.72)	0.5563 (8.29)	0.5885 (7.91)
Augt 1986	(ω ₃)		0.2147 (9.04)	0.5748 (8.53)	0.6091 (8.03)
Sept 1986	$\left(\omega_{4}^{}\right)$		1.0078 (13.17)	0.8479 (12.71)	0.8736 (12.21)
Oct 1986	$\left(\omega_{5}\right)$		0.8512 (12.34)	0.6852 (10.44)	0.7125 (9.97)
Step function:	$\left(\omega_{6}^{}\right)$		0.2960 (8.70)	0.1058 (2.79)	0.1083 (2.77)

Table 3: US Total Demand for BC TourismDependent variable: Natural log of the number of US visitors (TUSV)

Table 3 (continued)

Estimation period:	1981-1 to 1986-4		1981-1 to 1993-8	
Explanatory variables	ARIMA model for the pre-intervention period	Intervention model	Restricted transfer function model	Unrestricted transfer function model
$\mathbf{AR}(1) \qquad \left(\phi_{1}\right)$	0.6313 (6.20)	0.5893 (8.24)	0.3321 (3.89)	0.3320 (3.89)
$\mathbf{MA}(12) \left(\boldsymbol{\theta}_{12}\right)$	0.4323 (2.86)	0.6287 (7.32)	0.5901 (6.98)	0.5883 (6.87)
MA(24) $\left(\theta_{24}\right)$	-0.3553 (-2.56)	0.3173 (3.62)	0.2137 (2.47)	0.2205 (2.52)
Effective number of observations	51	134	134	134
Residual sum of square	0.2404	0.5969	0.5463	0.5416
R-square	0.989	0.990	0.991	0.991
Q-statistic at lag 12	14.2	18.9	17.7	18.1

Note: t-statistics of parameters are given in brackets. Q-statistic has a chi-square distribution with 12 degrees of freedom under the null hypothesis that the residuals from the estimated model are white noise. The critical value of chi-square at the 95% confidence level is 21.03.

Estimation pe	riod:	1981-1 to 1986-4	1981-1 to 1993-8			
Explanator variables	ry ;	ARIMA model for the pre-intervention period	Intervention model	Intervention model Restricted transfer function model		
$ln (R_E)$	$\left(\beta_{1}^{1}\right)$			0.0175		
ln (E)	$\begin{pmatrix} \beta_1 \end{pmatrix}$			(0.08)	0.0192 (0.08)	
ln (P _B)	(β_2)				0.0643 (0.12)	
$\ln (P_S)$	$\left(\beta_{3} \right)$				-0.0712 (-0.12)	
ln (Y)	$\left(\beta_{4} \right)$			0.9030 (4.02)	0.8985 (1.77)	
Pulse function (May 1986	(L) (ω_0)		0.8910 (11.97)	0.8381 (11.14)	0.8349 (10.31)	
June 1986	(ω_1)		0.8666 (10.36)	0.7865 (9.77)	0.7833 (9.05)	
July 1986	(ω_2)		0.7001 (8.08)	0.6028 (7.31)	0.5987 (6.52)	
Aug 1986	$\left(\omega_{3}\right)$		0.7259 (8.35)	0.6216 (7.50)	6.6171 (6.58)	
Sept 1986	(ω_4)		1.0093 (11.90)	0.8895 (10.82)	0.8863 (10.03)	
Oct 1986	$\left(\omega_{5}\right)$		0.8659 (11.19)	0.7431 (9.24)	0.7396 (8.43)	
Step function: S	$\left(\omega_{6}^{}\right)$		0.2840 ((8.64)	0.1290 (2.65)	0.1290 (2.57)	
AR (1)	$\left(\varphi_{1} \right)$	0.5800 (5.71)	0.5214 (6.94)	0.3826 (4.63)	0.3818 ((4.60)	

Table 4: US Demand for BC Tourism: Visitors by AutomobileDependent variable: Natural log of the number of US visitors by Automobile (USVA)

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Table 4 (continued)

Estimation period:	1981-1 to 1986-4	1981-1 to 1993-8			
Explanatory variables	ARIMA model for the pre-intervention period	Intervention model	Restricted transfer function model	Unrestricted transfer function model	
MA (12) $\left(\theta_{12}\right)$	0.3865 (2.73)	0.6853 (8.02)	0.6714 (7.96)	0.6711 (7.92)	
MA (24) $\left(\theta_{24}\right)$	-0.3834 (-2.98)	0.3064 (3.48)	0.2281 (2.64)	0.2276 (2.62)	
Effective number of observations	51	134	134	134	
Residual sum of square	0.3212	0.7561	0.7345	0.7347	
R-square	0.987	0.989	0.989	0.989	
Q-statistic at lag 12	8.5	20.5	12.9	12.9	
				1	

Note: t-statistics of parameters are given in brackets. Q-statistic has a chi-square distribution with 12 degrees of freedom under the null hypothesis that the residuals from the estimated model are white noise. The critical value of chi-square at the 95% confidence level is 21.03.

Estimation pe	eriod:	1981-1 to 1986-4 1981-1 to 1993-8				
Explanator variables	ry S	ARIMA model for the pre-intervention period	Intervention model	Restricted transfer function model	Unrestricted transfer function model	
ln (R _E)	$\left(\beta_{1}^{1}\right)$			0.2387		
ln (E)	$\begin{pmatrix} 1 \end{pmatrix}$			(0.85)	0.4214 (1.77)	
ln (P _B)	$\left(\beta_{2}\right)$				-1.2447 (-2.28)	
1n (P _s)	$\left(\beta_{3} \right)$				1.6075 (2.86)	
ln (Y)	$\left(\beta _{4}\right)$			2.0018 (5.34)	2.001 (3.82)	
Pulse function	(L):					
May 1986	$\left(\omega_{0}\right)$		0.6190 (9.31)	0.5772 (8.49)	0.6671 (9.59)	
June 1986	(ω_1)		0.4291 (5.73)	0.4002 (5.60)	0.4884 (6.78)	
July 1986	$\left(\omega_2^{}\right)$		0.4227 (4.79)	0.3821 (4.82)	0.4896 (6.21)	
Aug 1986	$\left(\omega_{3}\right)$		0.4555 (4.70)	.4250 (5.18)	0.5495 (6.68)	
Sept 1986	(ω_4)		0.7290 (6.97)	0.7187 (8.84)	0.7952 (10.42)	
Oct 1986	$\left(\omega_{5}^{}\right)$		0.4751 (4.27)	0.4830 (5.82)	0.5857 (7.42)	
Step function:	$\left(\omega_{6}^{}\right)$		-0.0622 (-0.55)	0.0028 (0.04)	0.0039 ((0.08)	
AR (1)	(ϕ_1)	0.3692 (2.96)	0. 4996 (6.11)	0.3729 (4.39)	0.3174 (3.66)	

Table 5: US Demand for BC Tourism: Visitors by PlaneDependent variable: Natural log of the number of US visitors by plane (USVP)

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Table 5 (continued)

Estimation period:	1981-1 to 1986-4	1981-1 to 1993-8			
Explanatory variables	ARIMA model for the pre-intervention period	Intervention model	Restricted transfer function model	Unrestricted transfer function model	
$\mathbf{AR}(2) \qquad \left(\boldsymbol{\theta}_{12}\right)$	0.5023 (4.11)	0.4106 (5.11)	0.2842 (3.39)	0.2264 (2.63)	
MA (12) $\left(\theta_{24}\right)$	0.5492 (4.47)	0.5058 (6.64)	0.5434 (7.41)	0.5708 (7.87)	
Effective number of observations	50	133	133	133	
Residual sum of square	0.2456	0.7471	0.6769	0.6125	
R-square	0.980	0.982	0.984	0.986	
Q-statistic at lag 12	18.6	14.0	9.2	11.1	

Note: t-statistics of parameters are given in brackets. Q-statistic has a chi-square distribution with 12 degrees of freedom under the null hypothesis that the residuals from the estimated model are white noise. The critical value of chi-square at the 95% confidence level is 21.03.

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			Short-term Partial Effects of Expo 86 (Expo period)			
		r	Visitors by	Automobile	Visitors	by Plane
	Pre-EXPO 86 average monthly number of visitors by automobile	Pre-EXPO 86 average monthly number of visitors by plane	Percentage increase in visitor arrivals ^a	Increase in visitor arrivals ^b	Percentage increase in visitor arrivals ^c	Increase in visitor arrivals ^d
January	47030	12152				
February	56541	12195				
March	77871	15677			-	
April	879421	17195				
May	147491	22659	130.46	192422	94.86	21494
June	221640	37039	118.87	263463	62.97	23324
July	334847	47362	81.98	274507	63.17	29918
August	354210	50260	85.35	302319	73.24	36810
September	198684	32249	142.61	283343	121.49	39180
October	88793	18810	109.51	97237	79.62	14976
November	64924	13914				
December	59067	16551				
			Long-term Partial Effects of Expo 86 ^e (Post-Expo average monthly increase)			
	Pre-EXPO 86 number of visitors per month by automobile	Pre-EXPO 86 number of visitors per month by plane	Percentage increase in visitor arrivals by automobile	Increase in visitor arrivals by automobile	Percentage increase in visitor arrivals by plane	Increase in visitor arrivals by plane
	140072	24024	13.77	19288	0.39	94

Table 6: Short-term and Long-term Partial Effects of EXPO 86 on US demand for BC tourism

Note:

a. Computed from the unrestricted transfer function model in Table 3 using the formula, $(e^{\omega_i} - 1) 100$, where i=1, ..., 5.

b. $(e^{\omega_i} - 1)$ x Pre-EXPO 86 average number of visitors by automobile for ith month.

c. Computed from the unrestricted transfer function model in Table 4 using the formula, $(e^{\omega_i} - 1)$ 100.

d. $(e^{\omega_i} - 1)$ x Pre-EXPO 86 average number of visitors by plane for ith month. e. Estimates of long-run effects are based on the parameter, ω_6 found in the unrestricted transfer functions by mode of transportation.

Table 7: Estimated Demand Elasticities

	Measures of tourism demand			
Explanatory Variables	All visitors	Visitors by automobile	Visitors by plane	
Real exchange rate ^a	0.1081	0.0175	0.2387	
US personal disposable income ^a	1.0868**	0.9030**	2.0018**	
US personal disposable income ^b	1.0314**	0.8985*	2.001**	
Nominal exchange rate ^b	0.0713	0.0192	0.4214	
BC travel price ^b	-0.2059	0.0643	-1.2447**	
US travel price ^b	0.3110	-0.0712	1.6075**	

Note:

** The elasticity coefficient is significant at the 5 per cent level.
* The elasticity coefficient is significant at the 10 per cent level.
a. These estimates are taken from the restricted transfer function models.
b. These estimates are taken from the unrestricted transfer function models.

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