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THE IMPACT OF THE HOTEL ROOM TAX: AN INTERRUPTED TIME SERIES APPROACH**

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ABSTRACT

Travel destinations commonly levy hotel room taxes to finance services demanded by tourists and residents. Evidence to date on the effects of a hotel room tax has centered on ex ante analyses of the incidence of a hotel room tax and its effect on the demand for travel and vacation goods. In this paper we employ interrupted time series analysis to estimate ex post the impact of a hotel room tax on real net hotel revenues by analyzing that time series before and after the imposition of the tax. We find that the tax had a negligible effect on real hotel revenues.

Introduction

TRAVEL destinations commonly levy special tourist taxes to finance public services demanded by tourists and residents. A popular tax is the *ad valorem* hotel room (transient accommodation) occupancy tax, typically assessed as a percentage of the rental price of an occupied hotel room. In 1990, 47 out of 50 states in the U.S. levied taxes on hotel room rentals [Hiemstra and Ismail, (April 1990, p. 4)]. Alaska, California, and Oregon do not levy state taxes on room rentals but permit localities to levy hotel room taxes.

In recent years, rising fiscal responsibilities combined with the growing reluctance of residents to pay higher taxes have induced many state and local governments to enact new taxes or increase rates on existing hotel room taxes. Since 1987, Atlanta raised its hotel room tax from 8 percent to 11 percent, Fort Lauderdale from 7 percent to 9 percent, Portland, Oregon from 6 percent to 9 percent, Dallas from 9 percent to 13 percent, and Columbus, Ohio from 11.5 percent to 15.5 percent.[1] In August 1984, the average hotel room tax rate in 45 U.S. cities with room taxes was about 7 percent (Mak, 1988). A similar survey of 242 U.S. visitor convention bureaus found that the average hotel room tax rate in January 1990 was nearly 10 percent [Hiemstra and Ismail, (1990, p. 4)]. With the enactment of a 5 percent hotel room tax by the State of New York in June 1990, New York City currently has the highest hotel room occupancy tax in the U.S. at 19.25 percent plus $2 on every room priced at $100 or more.[2]

The popularity of the hotel room tax stems from the widely held perception that its burden is largely borne by tourists rather than residents, with little negative impact on industry sales. For example, Combs and Elledge (1979, p. 203) argued, *without empirical evidence*, that the "demand for lodging in a resort [is] inelastic with respect to price," and concluded that "a small *ad valorem* tax imposed on motel rooms and other forms of temporary lodging would have very little impact on the industry and would generate substantial revenue for the local government." Hotel operators, by contrast, generally believe that a hotel room tax harms the industry.[3] However, empirical studies on the impact of the hotel room tax yield contradictory results.[4]

In a previous article in this *journal*, Fujii, Khaled and Mak (1985) estimated the *ex ante* incidence of a *proposed* hotel room tax in Hawaii.[5] We are unaware of any empirical studies that measure the *ex post* effect of the imposition of a hotel room tax. The purpose of this paper is to estimate the impact of the 1987 Hawaii hotel room tax by comparing the *real* net (after tax) rental receipts of hotel operators before and after the imposition of the tax. A novelty of this paper is the use of tax base rather than survey data to measure hotel receipts. We measure the impact of the tax on *real* net hotel rental receipts using in-

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terrupted time series analysis. Our empirical results indicate that the tax reduced *real* net rental receipts by about 1 percent. The coefficient, however, is not significantly different from zero. In sum, the State is able to raise substantial amounts of tax revenue from the new tax without imposing a significant burden on hotel operators.

Taxing Hotel Room Rentals in Hawaii

Act 340 passed by the 1986 Hawaii State Legislature imposes a 5 percent "transient accommodation" tax, commonly called the hotel room tax, on proceeds from the rental of "transient accommodations" beginning January 1, 1987.[6] The tax applies to the gross proceeds from room rentals and includes the hotel tax "visibly passed on and collected." Thus the tax base for the hotel room tax is equal to 1.0525 multiplied by the rental price of the hotel room. The effective tax rate is 5.25 percent of the rental price of the lodging.[7] With exceptions for very small hotel operators, monthly returns and payments are due by the end of the month following the transaction month. The new transient accommodation tax is in addition to the 4 percent sales (i.e., general excise) tax levied on the gross proceeds received by the sellers for all retail transactions, including hotel rentals. Hence, the combined tax on hotel room rentals rose from 4.16 percent to 9.41 percent. Tax collections under the two taxes are displayed in Table 1.

In fiscal year 1990, the State collected $82 million from the transient accommodation tax, making it the third largest source of state government revenues after the general excise tax and the state income tax. An additional $62 million was collected from the general excise tax levied on hotel room rentals.

The Model

The imposition of a hotel room tax creates a wedge between the price of hotel room rentals to consumers and the after-tax price received by hotel operators. Assuming demand and supply remained unchanged, economic theory predicts that the room tax must always increase the (after tax) price of hotel room rentals to consumers and reduce the net price received by hotel operators, except in cases where the elasticity of supply is infinite or the elasticity of demand is zero. Indeed, if the incidence of the room tax falls partly on consumers, higher after-tax prices are likely to decrease the quantity demanded for lodging and the net revenues of hotel operators.

Our model treats the imposition of the new transient accommodation tax as a quasi-experiment and measures its effect using an interrupted time series model.[8] The imposition of a transient accommodation tax in January 1987 breaks the time series for real after-tax hotel rental receipts into two discrete segments. The null hypothesis is that the new tax had no significant effect on real net hotel rental receipts. We use *monthly* data on the natural log of *real* after-tax hotel rental revenues (lnHR) constructed from the general excise tax base data on hotel receipts.[9] The data span the period from January 1980 to March 1990 (see Figure 1). We began the series in January 1980 to exclude the potential effects of the (1979) second oil crisis on travel and terminated the time series just prior to Iraq's invasion of Kuwait.

An additional exogenous event was relevant to the empirical analysis. In September 1985, the Group of Five Nations (the U.S., Great Britain, France, Germany, and Japan) agreed to intervene in foreign exchange markets to bring about a depreciation of the dollar relative to other currencies. The Plaza Agreement, as this intervention is referred to, attempted to correct for the appreciation of the dollar relative to other major currencies over the period 1981–1985 (see Yarbrough and Yarbrough, 1988, p. 437). Since demand for travel is highly sensitive to exchange rate fluctuations (see e.g., Gray 1966, and Loeb 1982), the depreciation of the dollar subsequent to the agreement is expected to have a significant impact on foreign travel to Hawaii. Japanese visitors, for example, comprise the second

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TABLE 1
TAX COLLECTIONS FROM HOTELS AND TRANSIENT ACCOMMODATIONS
(in thousands of dollars)

Fiscal Year	General Excise Tax	Hotel Room Tax	Total
1987	$49,919	$23,510	$ 73,429
1988	$56,612	$62,279	$123.951
1989	$57,608	$75,973	$133,581
1990	$61,931	$82,438	$144,369

Source: State of Hawaii, Department of Taxation, *Annual Report, 1987-1988, 1988-1989, and 1989-1990.*

Notes: The fiscal year runs from July 1 to June 30. Thus for fiscal year 1987, the transient accommodation tax was in effect for only 6 months. In that year transient accommodation tax collections were less than half of the general excise tax collections on hotel rentals; this is explained by the lag in getting operators to register for the new tax. As of June 1987, there were 8,619 filers for the transient accommodation tax. In June 1988, there were 10,770 filers.

largest group of Hawaii tourists. The yen/dollar exchange rate fell from 237 yen per dollar in August 1985 to 127 yen per dollar three years later, cutting almost in half the yen price of vacations in Hawaii. Between 1985 and 1990 the Japanese share of total Hawaii visitor traffic rose from 14.5 percent to 20.7 percent.[10] Similarly, the share of total foreign visitors rose from 29.5 percent to 36.4 percent.[11] To capture the separate effects of the Plaza Agreement in 1985 and the imposition of the hotel room tax in Hawaii in 1987 we used two policy dummies: one for the exchange rate adjustment and the other for the implementation of the hotel room tax.

Intuitively, intervention analysis can be thought of as a two-step process. First we identify an ARIMA noise model for the real revenue series prior to the Plaza Agreement and the imposition of the hotel room tax. This identified model is then reestimated using the full sample and the residuals are analyzed for systematic components. If the model identified for the pre-intervention sample produces random residuals when estimated over the full sample, there is no systematic effect from either policy change. Note that the validity of this approach requires a well-specified noise model for the preintervention period to eliminate systematic components in the residual series that might be mistaken for tax effects. The attraction of the time series approach is that it provides a parsimonious representation of the real revenue series in terms of its own past.

An alternative approach would be to estimate a reduced form equation for the real revenue series with the appropriate economic explanatory variables. A dummy variable would then be used to capture the effect of a policy change.[12] Such a model would, however, require deseasonalized-monthly data on a long list of variables (e.g., airfares, incomes, hotel room rates, prices of other vacation goods, competing destination prices, exchange rates, tourist taxes, etc.), not all of which are readily available.

While the time series approach does not offer a structural explanation for the behavior of the real revenue series, it does allow us to identify systematic changes in the stochastic process generating the revenue series before and after the imposition of the tax. The appropriateness of this approach is illustrated by the stability of the empirical results reported below. The noise model identified in the pre-intervention period fits the data remarkably well before and after the imposition of the tax.

Our model is described as follows:

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$$\ln HR_t = N_t + \Sigma f_j(I_{j,t}) \quad (1)$$

where

$\ln HR_t$ = ln(real net after tax hotel receipts)

N_t = the "noise" component of the ARIMA structure

$f_j(I_{j,t})$ = the transfer function capturing the effect of the discrete interventions (j = 1,2)

$I_{j,t}$ = { j = 1: 1 since September 1985 (exchange rate adjustment); 0 otherwise
j = 2: 1 since January 1987 (hotel room tax); 0 otherwise }

The *pre-intervention* series is driven entirely by N_t and is assumed to take the form of the following ARIMA model:

$$N_t = \mu + \frac{\theta_q(B) \cdot \Theta_Q(B^s)}{\phi_p(B) \cdot \Phi_P(B^s)(1 - B)^{\lambda_1}(1 - B^s)^{\lambda_2}} e_t \quad (2)$$

where

μ = mean of N_t

$\phi_p(B) = 1 - \Sigma\, \phi_i B^i$ (i = 1,2,...,p)

$\Phi_P(B^s) = 1 - \Sigma\, \Phi_{is} B^{is}$ (i = 1,2,...,P)

$\theta_q(B) = 1 - \Sigma\, \theta_i B^i$ (i = 1,2,...,q)

$\Theta_Q(B^s) = 1 - \Sigma\, \Theta_{is} B^{is}$ (i = 1,2,...,Q)

are the autoregressive, seasonal autoregressive, moving average, and seasonal moving average polynomials in the back shift operator B of order p, P, q, and Q, respectively. (1 − B) and (1 − B^s) are the reverse difference and seasonal difference operators, respectively. The parameters λ_1 and λ_2 are binary variables. If the series is first order integrated, λ_1 = 1 and 0 otherwise; if the series is first order seasonally integrated, λ_2 = 1 and 0 otherwise. The innovation series e_t is independently and identically distributed with zero mean.

The transfer function for each intervention is described as:

$$f(I_t) = \frac{\omega_h(B)}{\delta_m(B)}(1 - B)^D B^k I_t \quad (3)$$

where

$\delta_m(B) = 1 - \Sigma\, \delta_i B^i$ (i = 1,2,...,m)

D = { 0 if the impact is permanent; 1 if the impact is transitory }

$\omega_h(B) = \Sigma\, \omega_i B^i$ (i = 0,1,...,h)

k = number of periods by which the initial impact lags behind the intervention point.

The path of $f(I_t)$ is determined by $\delta_m(B)$. The permanent impact converges to $\omega_h(1)/\delta_m(1)$. The degrees of polynomials in B, m and h, are empirically determined.[13]

Empirical Results

The model is initially fit over the pre-intervention series, 1980:1–1985:8 (i.e., before the Plaza Agreement (1985:9) and the hotel room tax (1987:1)) to identify the ARIMA structure underlying the time series. A series of diagnostic checks is performed using the estimated autocorrelation and partial autocorrelation functions. The appropriate ARIMA structure is selected using the rule of parsimony. The ARIMA structure identified from the *pre-intervention* sample is:

$$\ln HR_t = N_t = \mu + \frac{1 - \theta_9 B^9}{(1 - \phi_1 B)(1 - \Phi_{12})B^{12}} e_t \quad (4)$$

Parameter estimates are reported in the first column of Table 2.[14] The Q statistic fails to reject the null hypothesis that e_t is serially uncorrelated. Thus, we assume that the identified ARIMA structure is appropriate. It is noteworthy that the two sets of estimated parameters of the ARIMA structure in Table 2 are not statistically different from each other pairwise, with each parameter estimate within the other's 95 percent confidence interval. A comparison of forecast and actual real net hotel receipts generated by the model is displayed in Figure 1.

To estimate the impact of the imposition of the hotel room tax, we impose the pre-identified ARIMA structure on the entire sample along with transfer functions for the Plaza Accord and the hotel room tax. The *complete model* with the

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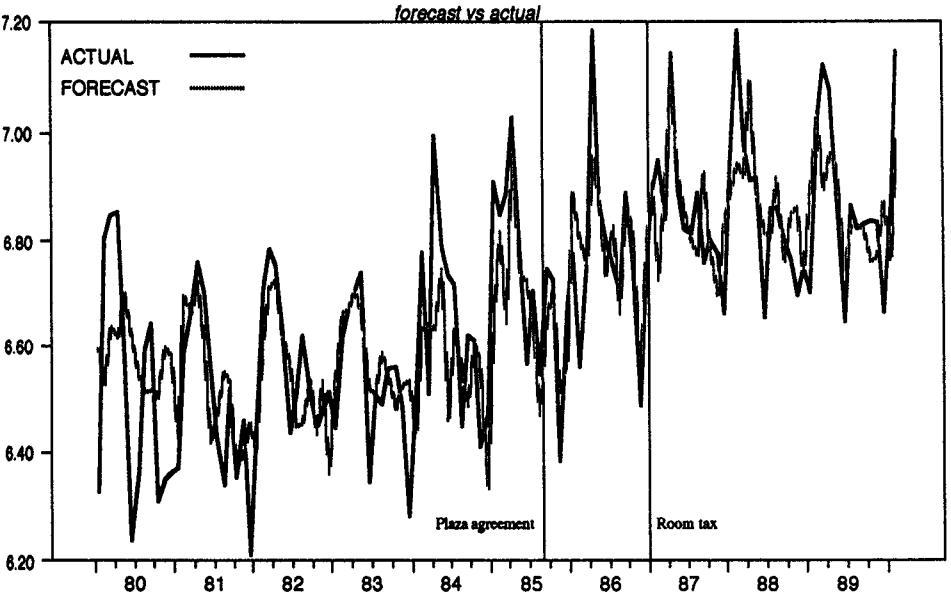
FIGURE 1
REAL HOTEL RENTAL REVENUE IN LOGARITHMS



identified transfer functions has the following form:

$$\ln HR_t = N_t + \frac{\omega_{1,0}}{(1 - \delta_{1,1}B)} I_{1,t-2} + \omega_{2,0} \cdot I_{2,t}. \quad (5)$$

The ARIMA model estimated for the full sample with the two policy dummies included is reported in the last column of Table 2. The ARIMA structure identified over the *pre-intervention* period is very stable throughout the full sample period, indicating that the two transfer functions adequately explain the change in the time series during the post-intervention period. Our results illustrate the separate effects of the two dummy variables on real after-tax hotel rental receipts.[15] Note that the coefficient of the Plaza Agreement, $\omega_{10} = 0.021$, is positive and significant (at 5 percent one-tail test) as expected, indicating that the depreciation of the dollar subsequent to the Plaza Agreement had a significant positive impact on travel to Hawaii. Exchange rate adjustments increased real hotel revenues in Hawaii by 2 percent initially, with a total long run increase of 28.5 percent.

More importantly, our results show that real after-tax hotel room receipts declined by approximately one percent as a result of the imposition of the room tax in 1987. However, the coefficient of the hotel tax dummy, $\omega_{2,0}$, is not significantly different from zero. In sum, the hotel room tax had a negligible impact on the real room receipts of hotel operators.[16]

Our results suggest that the hotel room tax is almost fully shifted forward to tourists (i.e., the price to buyers rose by the full amount of the tax) with no significant revenue loss to hotel operators. Thus, the demand for hotel lodging may be close to perfectly inelastic. This is further supported by examining data on real hotel room rates displayed in Figure 2.[17] Figure 2 shows no sharp decline in the trend of the room rate series before and after the room tax was imposed, indicating that hotel operators were able to shift virtually the entire tax on to consumers. The shifting is more extensive than predicted by the earlier work of Fujii, Khaled, and Mak (1985) for Hawaii which suggested

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TABLE 2
PARAMETER ESTIMATES

Parameters	Pre-Intervention Sample (80:1-85:8)	Full Sample (80:1 - 90:3)
μ	6.59611	6.59602
	(109.29)	(123.56)
θ_9	-0.25125	-0.25396
	(2.12)	(2.86)
ϕ_1	0.33921	0.24479
	(3.02)	(2.76)
$\phi_{1,2}$	0.59489	0.64330
	(5.72)	(8.91)
$\omega_{1,0}$		0.02105
		(1.78)
$\delta_{1,1}$		0.92623
		(16.47)
$\omega_{2,0}$		-0.00944
		(0.13)
Q(24)	21.90	24.98

Notes: Absolute t statistics are reported in parentheses below each coefficient.
Q(24) is the Ljung-Box Q statistic for the null hypothesis that the first 24 residual autocorrelations are equal to zero. The Q statistic is distributed as a chi-squared statistic with 24-k degrees of freedom, where k is the number of estimated parameters.

ex ante that about two-thirds of the tax would be shifted to tourists with a moderately large negative impact on hotel rental receipts. The results are closer to the predictions of Combs and Elledge (1979) who argued that because the demand for lodging is likely inelastic with respect to price, a small *ad valorem* tax on lodging would have little effect on net after tax hotel receipts and yield substantial revenue for the local jurisdiction.

One plausible explanation for the lack of a significant impact is that visitors did not know about the new tax. Since the room tax is typically paid by tourists when they check out, they may not have adequately anticipated or responded to the higher effective price of rooms. However, this does not apply to more than half of all tourists to Hawaii who purchase prepaid package tours that include at least round-trip airfare and lodging.[18] Another potential explanation for the absence of a significant tax impact is that other travel destinations in the U.S. have also increased their room taxes recently. However, it is difficult to imagine that various tax changes elsewhere, imposed in different amounts and at different times and places, exactly canceled out the new room tax in Hawaii.

Conclusion

In recent years many fiscally beleaguered state and local governments have either implemented new hotel occupancy taxes or substantially increased existing hotel taxes to finance public services. The popularity of the tax stems from the premise that the hotel room tax is largely exported to non-residents with little neg-

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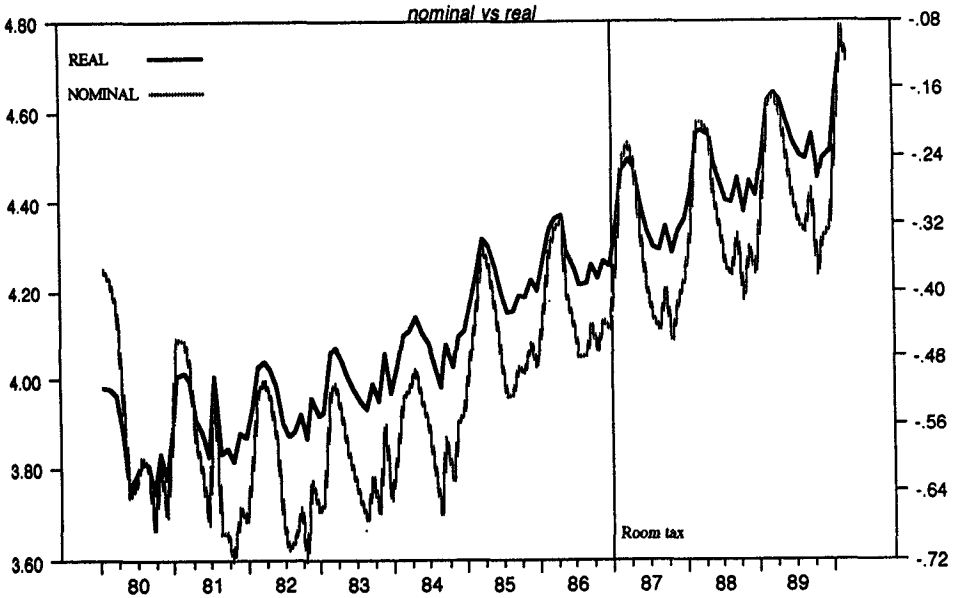
FIGURE 2
HOTEL RENTAL PRICE IN LOGARITHMS



ative impact on hotel operators.

Our analysis of the effects of the 1987 Hawaii hotel room tax indicates that the tax did not have a significant negative impact on hotel rental receipts. Our finding may not be entirely surprising since a 5 percent increase in lodging expenditures represents less than 1.5 percent of the total cost of a typical vacation in Hawaii inclusive of round-trip airfare. That may not be true of travel to other destinations. Therefore it is important to perform similar analyses for other travel destinations.

ENDNOTES

**The authors are indebted to Chung H. Lee, Ken White, three anonymous referees, and the editor for helpful comments.

[1]Wall Street Journal, *Tax Report*, March 8, 1989.

[2]See "New York's Hotel Tax Highest in the Nation," *The Sunday Honolulu Star Bulletin and Advertiser* (September 16, 1990), p. F4.

[3]See, for example, Schofield (1991), p. 1.

[4]See, for example, Fujii, Khaled and Mak (1985), Zuraski and Sanders (1989), and Hiemstra and Ismail (1991).

[5]This partial equilibrium model demonstrated that the burden of a hotel occupancy tax is approximately equal to the ratio of the supply and demand elasticities for lodging. Empirical estimates suggested a supply elasticity of 2 and a demand elasticity of 1, yielding the prediction that approximately two thirds of a hotel room tax would be passed on to visitors in the form of higher prices. This study, however, like other extant studies, predicts the incidence of the tax *ex ante*.

[6]Transient accommodations are defined as accommodations that are customarily occupied by a transient for less than 180 consecutive days. A transient is a person who does not have the intention of making the accommodation a permanent place of domicile. Exemptions are granted for health care facilities, school dormitories, nonprofit corporations, military personnel on permanent duty, and government-subsidized low-income renters. See Bock, Brilliant, and Gerding (1990).

[7]For example, since the tax base (B) is inclusive of the tax charged hotel guests, to net the same room revenue as before the tax, hotels must add on a tax to guests of 5.25%. That is:

$$B = 1.0525*R$$

After tax (= .05*B), hotels net (1-.05)*B = .95*B = .95*1.0525*R = R.

[8]Time series intervention analysis was first proposed by Campbell and Stanley (1966) and Cook and Campbell (1979) to assess the impact of a discrete intervention in a social process. The methodology is described in McDowell, McCleary, Meidinger, and Hay (1980). It has a broad range of applications. For example, Box and Tiao (1975) used it to examine the effectiveness of air pollution control laws. McPheters,

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Mann, and Schlagenhauf (1984) analyzed the impact of more severe penalties for the use of firearms on property crime. More recently, Fomby and Hayes (1990) employed intervention analysis to examine the impact of the War on Poverty on families in the lowest quintile of the income distribution.

[9]The hotel revenue series is derived by dividing the general excise tax base data on hotel receipts (=total hotel rental receipts * 1.0416) by the U.S. consumer price index times 1.0416. Two adjustments were made to the series. First, since we are modeling consumption and not tax revenues *per se*, the data are lagged one period (e.g. January tax collections reflect December receipts). Therefore, the data used in the empirical analysis actually begin in December 1979. Moreover, since visitor lengths of stay can span two monthly reporting periods (and average length of stay is about 10 days), we weighted current and previous month receipts by 2/3 and 1/3, respectively.

[10]State of Hawaii, *The 1990 State of Hawaii Data Book*, (Honolulu: Department of Business, Economic Development and Tourism, 1991), p. 197.

[11]Hawaii Visitors Bureau, *1991 Annual Research Report* (Honolulu, 1992), p. 4.

[12]See Slemrod (1982) for an example of such an approach used to measure the impact of the Revenue Act of 1978 on the volume of stock transactions.

[13]A transfer function model is a multivariate ARIMA model where causal input variables determine the output variable, and the error term (capturing the combined effects of all other factors influencing the output series) is modeled as an ARIMA process. Here, the real revenue series is influenced by policy dummy inputs. In a more general model the revenue series could be determined by inputs such as the explanatory variables used in a reduced form model. The dynamic response of real revenues to the policy change is described by the general rational distributed lag, $f(I_t)$, called a transfer function, or an impulse response function. In contrast to the usual static-dummy variable approach using a reduced form model, the transfer function model allows for a dynamic response of real hotel revenues to policy changes. The path of $f(I_t)$ is determined empirically and provides information on the impact, transition, and long run effects of the policy change.

[14]The identified noise model reported in Table 2 contains a nine month moving average component included to whiten the residuals by capturing the significant autocorrelation in the hotel revenue series at lag nine. While some researchers have attributed significant autocorrelations at long lags to chance and thus elected to ignore them (e.g. Granger and Newbold (1986), pp. 107–114), others have chosen to model the observed correlation (e.g., Thompson and Tiao (1971), Fackler and Krieger (1986), Koch and Rasche (1988), and Hanssens and Vanden Abeele (1987)). We choose to model the observed correlation to eliminate all systematic fluctuations in the residuals of the preintervention model to avoid mistaking them for systematic effects of the hotel room tax. Furthermore, the seasonal and aseasonal behavior of the revenue series is complex enough to generate such correlations. There are a wide variety of factors affecting the seasonal pattern of the revenue series. Hotel room revenues exhibit annual peaks that typically occur in June and December and troughs in October and February (peaks and troughs are highly variable, changing from year to year). Visitors to Hawaii must negotiate a wide variety of factors in planning their vacations. When are airfares lowest? When does Golden Week or Spring Break fall? Note that school and work holidays fluctuate from year to year as do cold spells in both the East and West. Income is certainly not a smooth series either. The lumpiness of Japanese income due to significant bonuses in June and December may contribute to the observed behavior of our data. Finally, the conclusions of this paper are unchanged when our model is estimated without the moving average parameter.

[15]Notice that the dummy for the Plaza Agreement, I_1, is lagged one period, while the dummy for the hotel room tax, I_2, is not. The lagged impact of each policy change is determined empirically. The tax dummy is not significantly different from zero either contemporaneously or with a lag.

[16]We have treated the Plaza agreement as an exogenous policy change. An alternative would be to specify a transfer function for the real after-tax revenue series and extract the information in the yen/dollar exchange rate by including it as an independent variable. Using this alternative specification, the *pre-intervention* sample for the transfer function model ends immediately prior to the imposition of the hotel room tax, not prior to the Plaza agreement. Although the sample periods are different, we find that the noise model from this alternative specification is quite similar to that reported in Table 2, and the imposition of the hotel room tax had a very small negative impact on real hotel revenues. The hotel room tax dummy has a coefficient of -.0065 with a t-statistic of 0.04 as compared with a coefficient of -0.0094 with a t-statistic of (.13) as reported in Table 2. Thus, in both cases, the imposition of the hotel room tax had a negligible impact on real hotel room rental receipts.

[17]These are computed from data on average hotel room rates provided by the accounting firm of Pannell Kerr Forster based on their monthly surveys of individual hotel properties in Hawaii. The surveys cover approximately two thirds of all hotel rooms and is subject to measurement error. Thus we use the price series only as supporting evidence.

[18]Hawaii Visitors Bureau, *1990 Annual Research Report* (Honolulu, 1991), p. 50. In 1990, the percentage of Hawaii tourists purchasing package tours was 54%.

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