

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

by

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Working Paper No. 91-24
November 1991

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 have 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.

I. 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% to 11%, Fort Lauderdale from 7% to 9%, Portland, Oregon from 6% to 9%, Dallas from 9% to 13%, and Columbus, Ohio from 11.5% to 15.5%.¹ In August 1984, the average hotel room tax rate in 45 U.S. cities with room taxes was about 7% (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% [Hiemstra and Ismail, (1990, p. 4)]. With the enactment of a 5% 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% 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*

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.

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 rental receipts using the method of interrupted time series analysis.

II. Taxing Hotel Room Rentals in Hawaii

Act 340 passed by the 1986 Hawaii State Legislature imposes a 5% "transient

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, predict the incidence of the tax *ex ante*.

accommodation" tax, commonly called the hotel room tax, on proceeds from the rental of "transient accommodations"⁶ beginning January 1, 1987. 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% 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% 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% to 9.41%. 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.⁸

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, in order to net room revenue (R), hotels must add on a tax to guests of 5.25%. That is:

$$B = 1.0525 \cdot R$$

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

⁸ See the State of Hawaii, Department of Taxation, *Annual Report, 1989-1990* (Honolulu, 1990).

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. 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.

III. 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 supply or demand elasticity for lodging take extreme values.⁹ 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.

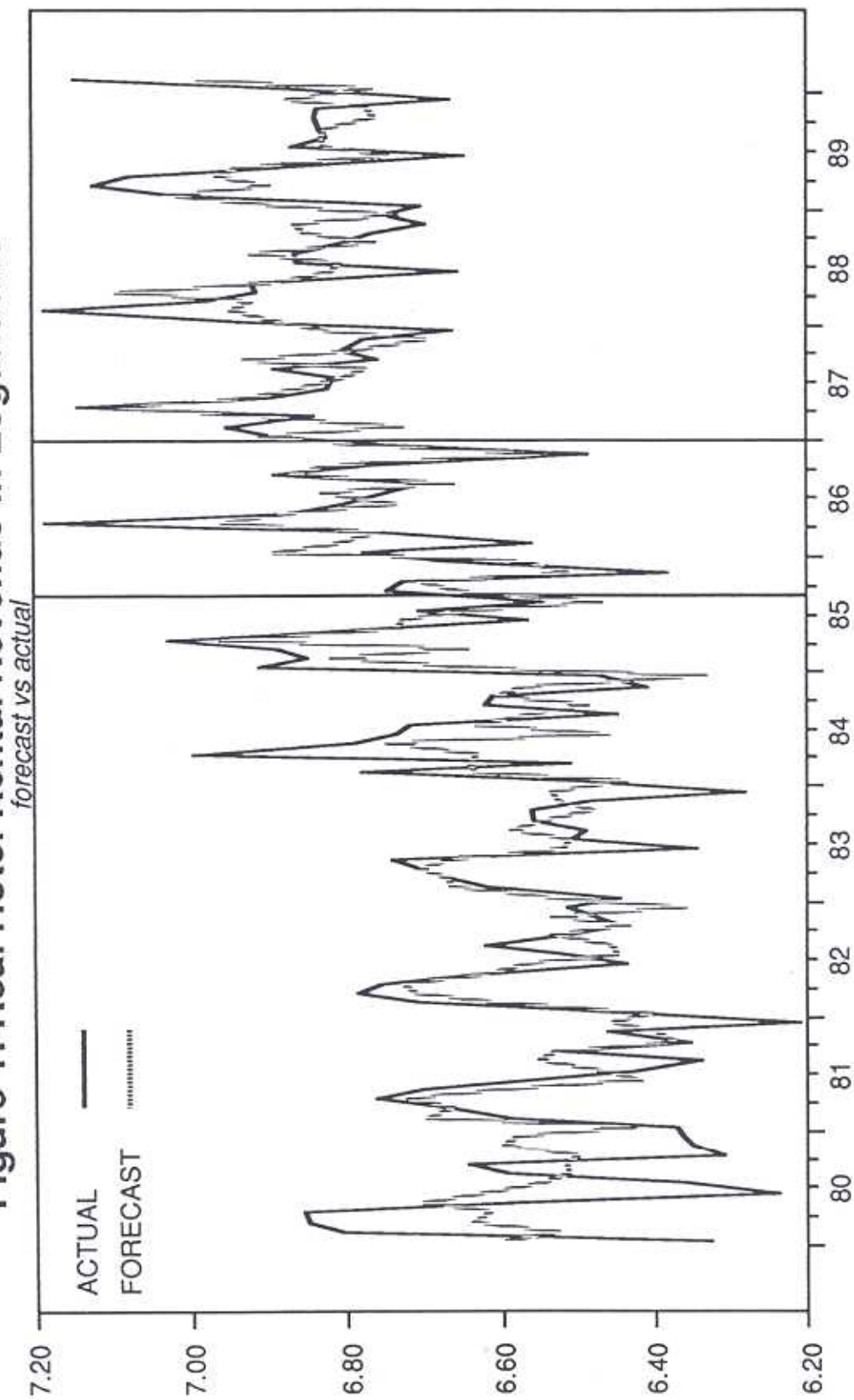
To ascertain the impact of the Hawaii transient accommodation tax on hotel industry sales revenues, we applied interrupted time series analysis to monthly data on the natural log of real after-tax hotel rental revenues (lnHR). The hotel revenue series was constructed from the general excise tax base data on hotel receipts.¹⁰ The data span the period from January 1980 to March 1990. See Figure 1.

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. Time series intervention analysis was first proposed by Campbell and Stanley (1966) and Cook and

⁹ See the Technical Appendix below.

¹⁰ 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 modelling 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 $\frac{2}{3}$ and $\frac{1}{3}$, respectively.

Figure 1: Real Hotel Rental Revenue in Logarithms



Campbell (1979) to assess the impact of a discrete intervention in a social process.¹¹ In our case, 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.

Two potential exogenous factors are relevant to the empirical analysis. First, in September 1985, the Group of Five nations (the United States, 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.¹² Second, the Gulf War raised concerns with respect to international terrorism and reduced demand for travel both to Hawaii and elsewhere.

For these reasons, we employed time series intervention analysis with two policy change dummies, one for the exchange rate adjustment and the other for the hotel room tax. We terminated the time series prior to Iraq's invasion of Kuwait.

We employed the following model:

$$\ln HR_t = N_t + \sum f_i(I_{i,t})$$

where: $\ln HR_t = \ln(\text{real net after tax hotel receipts})$

¹¹ 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, while McPheters, Mann, and Schallagenhauf (1984) analyzed the impact of more severe penalties for the use of firearms on property crime.

¹² 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). The impact was swift. The yen/dollar exchange rate, for example, 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. Japanese visitors are a major segment of the Hawaii travel market, accounting for 20% of tourist arrivals but nearly 27% of total tourist expenditures. Not surprisingly, the share of Japanese visitors to Hawaii increased sharply following the devaluation of the yen. An alternative specification which uses the yen/dollar exchange rate in place of the Plaza accord dummy yields very similar results and are available on request.

$N_t =$	the "noise" component of the ARIMA structure
$f_i(I_{i,t}) =$	the transfer function capturing the effect of the discrete interventions ($i=1,2$)
$I_{1,t} =$	1 since September 1985 (exchange rate adjustments) 0 otherwise
$I_{2,t} =$	1 since January 1987 (hotel room tax) 0 otherwise

7.

The preintervention series is driven entirely by N_t and is assumed to take the form of the following ARIMA model:

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

where	$\mu =$	mean of N_t
	$\phi_p(B) =$	$1 - \sum \phi_i B^i \quad (i=1,2,\dots,p)$
	$\Phi_P(B^s) =$	$1 - \sum \phi_{is} B^{is} \quad (i=1,2,\dots,P)$
	$\theta_q(B) =$	$1 - \sum \theta_i B^i \quad (i=1,2,\dots,q)$
	$\theta_Q(B^s) =$	$1 - \sum \theta_{is} B^{is} \quad (i=1,2,\dots,Q)$

are the autoregressive, seasonal autoregressive, moving average, and seasonal moving average polynomials in the backshift 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, $\lambda_1=1$ and 0 otherwise; if the series is first order seasonally integrated, $\lambda_2=1$ 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:

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

where: $\delta_m(B) = 1 - \sum \delta_i B^i$ ($i=1,2,\dots,m$)
 $D =$ 0 if the impact is permanent
 1 if the impact is transitory
 $\omega_h(B) = \sum \omega_i B^i$ ($i=0,1,\dots,h$)
 $k =$ 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 $\omega_h(B)/\delta_m(1)$.

The degrees of polynomials in B , m and h , are empirically determined.

The model is initially fit over the pre-intervention series (80:1 - 85:8) 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 transfer functions are then identified and the model is then reestimated with the previously identified ARIMA function imposed on the entire series (80:1 - 90:3).

IV. Empirical Results

The ARIMA structure identified from the pre-intervention sample is:

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

Parameter estimates are reported in the first column of Table 2. 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.

To estimate the impact of the imposition of the hotel room tax, we then imposed the pre-identified ARIMA structure on the entire sample along with two transfer functions for the Plaza accord and the hotel room tax. The complete model with the identified transfer functions has the following form:

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

The ARIMA model estimated for the full sample with the two policy dummies included is reported in the last column of Table 2.¹³ A comparison of forecast and actual real net hotel receipts generated by the model are displayed in Figure 1. While the impact of the exchange rate adjustments was statistically significant, with the subsequent monthly impacts gradually increasing toward the steady state level of $\omega_{1,0}/(1-\delta_{1,1})$, the impact of the imposition of the hotel room tax was negative but not significantly different from zero.¹⁴

¹³ The data set employed and the SAS programs used to compute the empirical results reported in this paper have been forwarded to the editor and are also available from the authors on request.

¹⁴ 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% confidence interval. The ARIMA structure estimated 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.

Table 2
Parameter Estimates

Parameters	Pre-Intervention Sample (80:1-85:8)	Full Sample (80:1 - 90:3)
μ	6.59611 (109.29)	6.59602 (123.56)
θ_9	-0.25125 (2.12)	-0.25396 (2.86)
ϕ_1	0.33921 (3.02)	0.24479 (2.76)
ϕ_{12}	0.59489 (5.72)	0.64330 (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.

V. Conclusion

The new hotel room tax has provided a significant source of new tax revenues for Hawaii without a significant negative impact on the local hotel industry. Our results suggest that the hotel room tax is entirely shifted forward to tourists (i.e. the price to buyers rose by the full amount of the tax) with no revenue loss to hotel operators. Thus, the demand for hotel lodging may be close to perfectly inelastic. This is further supported by examining real hotel room rates.¹⁵ 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 the tax entirely on to consumers. The results are at variance with the earlier findings of Fujii, Khaled, and Mak (1985) for Hawaii which suggested *ex ante* that about two-thirds of the tax would be shifted to tourists with a moderately large negative impact on hotel rental receipts.

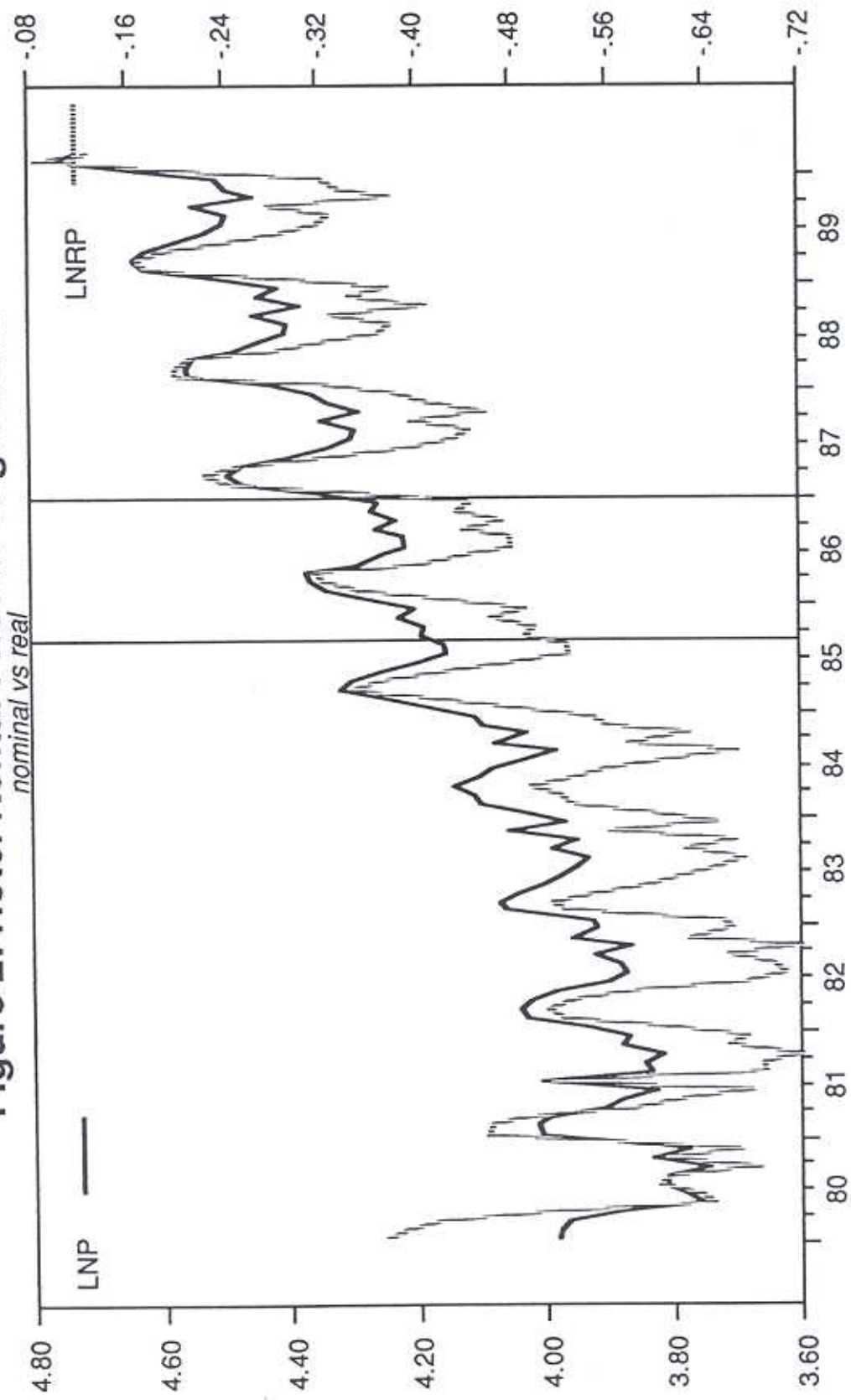
One plausible explanation for the lack of a significant impact may be that visitors did not know about the new tax. Since the room tax is typically paid by tourists when they check out, they may not have adequately anticipated or responded to the higher effective price of rooms. This would not apply to large numbers of tourists travelling on pre-paid package tours. Another potential explanation 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.

In the case of Hawaii, the results may not be surprising, since a 5% increase in

¹⁵ These are average hotel room rates computed by the firm Pannell Kerr Forster based on their monthly surveys of individual hotel properties in Hawaii. The surveys cover approximately two thirds of all hotel rooms.

lodging expenditures represents less than 2% of the total cost of a typical vacation in Hawaii. That may not be true of travel to other destinations. Therefore it is important to perform similar analyses for other travel destinations.

Figure 2: Hotel Rental Price in Logarithms



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APPENDIX

We use a simple model of demand and supply of hotel rooms to derive comparative static results on the impacts of an ad valorem hotel room tax on: (a) the after-tax rental prices of hotel rooms to buyers and sellers, (b) the tax base, and (c) the net after tax revenues of hotel operators.

The model

An ad valorem tax on hotel room rental receipts drives a wedge between the price of the hotel room to buyers and the net, after tax price to sellers:

$$p_s = p_b(1 - \tau) \quad (1)$$

In (1), τ is the ad valorem tax on rental of hotel rooms, p_b is the after tax rental price of lodging to buyers, and p_s is the seller's price after taxes are paid. The tax base, B , and net after tax revenues of hotel operators, R , are:

$$B = p_b \cdot Q^d(p_b) \quad (2)$$

$$R = p_s \cdot Q^d(p_b) = p_b \cdot (1 - \tau) Q^d(p_b) = (1 - \tau) B \quad (3)$$

The quantity of hotel lodging demanded, Q^d , is a decreasing function of the buyer's price.

In equilibrium, quantity demanded equals quantity supplied:

$$Q^d(p_b) = Q^s(p_s) \quad (4)$$

Impact on the buyer's price:

Differentiate equations (1) and (4) with respect to τ :

$$\frac{\partial p_s}{\partial \tau} = \frac{\partial p_b}{\partial \tau} \cdot (1 - \tau) - p_b \quad (5)$$

$$\frac{\partial Q^d}{\partial p_b} \cdot \frac{\partial p_b}{\partial \tau} = \frac{\partial Q^s}{\partial p_s} \cdot \frac{\partial p_s}{\partial \tau} \quad (6)$$

Substitute (5) into (6):

$$\frac{\partial Q^d}{\partial p_b} \cdot \frac{\partial p_b}{\partial \tau} = \frac{\partial Q^s}{\partial p_s} \cdot \left[\frac{\partial p_b}{\partial \tau} \cdot (1 - \tau) - p_b \right] \quad (7)$$

Using equations (1) and (4), solve equation (7) for $\frac{\partial p_b}{\partial \tau}$.

$$\begin{aligned} \frac{\partial p_b}{\partial \tau} &= - \frac{\frac{\partial Q^s}{\partial p_s} p_b}{\frac{\partial Q^d}{\partial p_b} - (1 - \tau) \frac{\partial Q^s}{\partial p_s}} \\ &= \frac{p_b}{(1 - \tau)} \cdot \frac{E_S}{|E_D| + E_S} \geq 0 \end{aligned} \quad (8)$$

E_S and E_D are the elasticity of supply and demand for hotel rooms respectively. Equation (8) states that, *ceteris paribus*, the imposition of a hotel room tax must raise the rental price of hotel rooms to consumers (p_b) unless supply is perfectly inelastic or demand is perfectly elastic; in which case, the rental price of hotel rooms is unchanged.

Impact on the seller's price:

Substituting equation (8) into (5), it follows that:

$$\frac{\partial p_s}{\partial \tau} = - p_b \cdot \frac{|E_D|}{|E_D| + E_S} \leq 0. \quad (9)$$

Equation (9) states that the imposition of a hotel room tax, *ceteris paribus*, must lower the net price received by hotel operators, unless demand is perfectly inelastic or supply is perfectly elastic; in which case, the (after-tax) seller's price is unchanged.

Impact on the tax base:

Differentiate equation (2) and substitute $\frac{\partial p_b}{\partial \tau}$ from equation (8) to produce,

$$\begin{aligned}\frac{\partial B}{\partial \tau} &= \frac{\partial p_b}{\partial \tau} \cdot Q^d(p_b) + p_b \cdot \frac{\partial Q^d(p_b)}{\partial p_b} \cdot \frac{\partial p_b}{\partial \tau} \\ &= Q^d(p_b) \cdot \frac{\partial p_b}{\partial \tau} (1 - |E_D|) \\ &= \frac{B}{1-\tau} \cdot \frac{1 - |E_D|}{1 + \frac{|E_D|}{E_S}}\end{aligned}\quad (10)$$

As long as demand is inelastic, imposing a hotel room tax will increase the tax base.

Impact on the after tax revenues of hotel operators

Differentiate equation (3) with respect to τ , and substitute $\frac{\partial B}{\partial \tau}$ from (10) to produce:

$$\begin{aligned}\frac{\partial R}{\partial \tau} &= \frac{\partial}{\partial \tau} (1 - \tau)B \\ &= -B + (1 - \tau) \frac{\partial B}{\partial \tau} \\ &= B \cdot \left[\frac{1 - |E_D|}{1 + \frac{|E_D|}{E_S}} - 1 \right] \leq 0\end{aligned}\quad (11)$$

Equation (11) states that a hotel room tax will, *ceteris paribus*, reduce the net after-tax revenue of hotel operators unless demand is perfectly inelastic; in which case, hotel revenues remain unchanged.