THE INCIDENCE AND EXPORTABILITY OF HOTEL ROOM TAXES: SOME FURTHER ESTIMATES

by

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ABSTRACT

We estimate a more complete model of the demand for and supply of hotel rooms and explore its implications for the exportability of a hotel room tax. The modelling of the demand for travel to Hawaii is expanded, taking into account not only the effect of a hotel room tax on the demand for hotel rooms by visitors subsequent to their arrival, but also its impact on the decision to visit Hawaii. Our results suggest that our earlier estimates of the elasticity of demand (in absolute terms) and supply for hotel rooms to be underestimated (1.0 vs. 1.5) and (2.0 vs. infinity), respectively. Taken together, the results suggest that hotel room taxes are fully exportable to tourists.
1. INTRODUCTION

In a recent paper (Fujii, Khaled and Mak, 1985a), we estimated the own price elasticity of tourist demand for lodging (i.e. hotel rooms) in Hawaii to be approximately -1. The estimate was derived by using the consumer allocation model which allocates a given budget among an array of vacation goods. This estimate, along with our measure of supply elasticity for lodging (+2) in another paper (Fujii, Khaled and Mak, 1985b), led us to conclude that at least two-thirds of a hotel room tax in Hawaii could be exported to tourists. This is because the extent of the exportability of a hotel room tax is approximately determined by the ratio of the price elasticities of supply and demand for lodging.

It has since been pointed out to us by many people that our demand elasticity is likely to have been underestimated, because our estimate only measures the impact of the tax on the demand for lodging per visitor once he/she arrives in Hawaii. However, imposing a hotel room tax also raises the price of vacationing in Hawaii. This, in turn, may make vacationing in Hawaii less attractive compared to vacations in other destinations. This would induce fewer people to visit Hawaii so that demand for lodging will be further reduced.

Our objective in this paper is to reassess our estimate of the incidence and exportability of a hotel room tax in Hawaii by considering the effects of a room tax on both the decision to visit Hawaii as well as the allocation of the travel budget between lodging and other vacation goods at the destination once having arrived in Hawaii.
2. **THE EXTENDED MODEL**

Our demand equation for lodging can now be decomposed into two parts:

\[
\frac{Q}{N} = \frac{Q}{V} \times \frac{V}{N}
\]  

(1)

where \(Q\) – quantity of lodging demanded  
\(N\) – population size of the country of origin  
\(V\) – number of visitors to Hawaii  
\(\frac{V}{N}\) explains trip demand to Hawaii and \(\frac{Q}{V}\) is per capita visitor demand for lodging upon arriving in Hawaii.

Demand for lodging per visitor can be modelled as

\[
\frac{Q}{V} = g(P_H, P_{NH}, E)
\]  

(2)

where:  
\(P_H\) – price of lodging  
\(P_{NH}\) – price of other visitor goods at the resort destination  
\(E\) – per capita tourist expenditure in Hawaii

Homogeneity along with the log linear form yields the equation:

\[
\ln \frac{Q}{V} = b_0 + b_1 \ln \frac{P_H}{P_{NH}} + b_2 \ln \frac{E}{P_{NH}}
\]  

(3)

The elasticity estimates are already available – approximately \(-b_1 = 1 - b_2\) from Fujii, Khaled and Mak (1985a, b). We now turn to the estimation of trip demand to Hawaii \(\frac{V}{N}\).

3. **DEMAND FOR TRAVEL TO HAWAII**

We estimate the determinants of the demand for travel to Hawaii from the U.S. mainland, the principal source of visitors to Hawaii. These estimates are then used to measure the impact of a change in the price of hotel rooms (due to a room tax) on the number of visitor arrivals.

We assume that the demand for travel to Hawaii is described by equation (4):
\[
\frac{V}{N} = h\left(\frac{P_A}{P_C}, \frac{P_V}{P_C}, \frac{Y}{P_C}\right) 
\]

where \( \frac{V}{N} \) is the number of U.S. visitors, as a proportion of the U.S. population:

- \( P_C \) - consumer price index faced by the visitor at home
- \( P_A \) - air fare to Hawaii
- \( P_V \) - Hawaii vacation price index
- \( Y \) - income per capita.

Our estimating equation is:

\[
\ln \frac{V}{N} = d_0 + d_1 \ln \frac{P_V}{P_C} + d_2 \frac{P_A}{P_C} + d_3 \ln \frac{Y}{P_C} 
\]  

Unfortunately, substantial collinearity was detected among the explanatory variables, with simple correlation coefficients between pairs of variables generally exceeding .9. This collinearity was sufficient to make it impossible to estimate precisely the effects of individual regressors on visitor flows using conventional regression techniques.

The problem of multicollinearity has been encountered by nearly all other researchers using ordinary least squares (OLS) regression techniques to estimate time series travel demand equations. For example, in studies by Artus (1972) and Straszheim (1978), the collinearity was so severe that airfare coefficients were frequently positive (as with our OLS results below) rather than negative.

We addressed the problem of multicollinearity by using ridge regression. See Hoerl and Kennard (1970).

Equation (5) was then fitted to U.S. data over the period 1961-1980. Data were obtained from numerous sources. Visitor arrivals were obtained from Hawaii Visitors Bureau (Annual Research Report, 1980). U.S. population and U.S. personal disposable income estimates were obtained from the Economic Report of the President, 1982. Price and income
variables were deflated by the U.S. consumer price index (Economic Report of the President, 1982) to satisfy the homogeneity restriction of consumer demand theory. The San Francisco to Honolulu coach, off-peak fare (July 1) was employed as the airfare variable (State of Hawaii Data Book, 1983 and Schmitt, 1976). It would have been desirable, but too costly, to compute a weighted airfare series incorporating all fare classes. Nonetheless, it is likely that the latter series, even if available, would have been highly correlated with the San Francisco-Honolulu airfare. The Hawaii vacation price index \( P_{V} \) was constructed from data discussed in Fujii, Khaled, and Mak (1985a) using the Divisia index method. The estimated coefficients are displayed in Table 1.

The OLS estimates were perverse. When ridge regression was employed, all the elasticities bore the correct signs. Moreover, the elasticities appear to be empirically plausible.

The coefficient of the real Hawaii vacation price index \( \frac{P_{V}}{P_{C}} \) is relatively high (-1.933). Thus demand for travel to Hawaii by U.S. visitors is highly sensitive to changes in the price of vacationing in Hawaii.

4. COMPOSITE DEMAND ELASTICITIES

We are now in a position to combine the demand elasticities in our two-stage approach in which per capita demand for lodging is given by,

\[
\frac{Q}{N} = \frac{Q}{V} \cdot \frac{V}{N} = g(P_{H}, P_{NH}, E) \cdot h(P_{V}, P_{A}, P_{C}, Y)
\]

(6)

Since we calculated the index \( P_{V} \) such that approximately, \( \ln P_{V} = \sum_{i} \ln P_{i} \), where the summation is over vacation goods including lodging, it follows that the overall price elasticity of demand for lodging is, \( \varepsilon_{HH} + S_{H} \varepsilon_{V} \varepsilon_{HH} \) where \( \varepsilon_{HH} \) is price elasticity of demand for lodging in Hawaii, \( S_{H} \)
Table 1

Estimates of the U.S. Demand for Travel to Hawaii:
1961-1980

<table>
<thead>
<tr>
<th>Variable</th>
<th>OLS</th>
<th>ridge k=.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\frac{P_A}{P_C}$</td>
<td>.320 (.313)</td>
<td>-.707 (.086)</td>
</tr>
<tr>
<td>$\frac{P_V}{P_C}$</td>
<td>1.035 (1.43)</td>
<td>-1.933 (.43)</td>
</tr>
<tr>
<td>$\frac{V}{P_C}$</td>
<td>5.978 (.751)</td>
<td>1.787 (.151)</td>
</tr>
<tr>
<td>Intercept</td>
<td>-53.669</td>
<td>-.977</td>
</tr>
<tr>
<td>$R^2$</td>
<td>.986</td>
<td>.934</td>
</tr>
</tbody>
</table>

NOTE: The values in ( ) are standard errors.
The dependent variable is $\frac{V}{N}$. 
is the share of lodging expenditure in total visitor expenditures and \( \varepsilon_{VV} \) is the elasticity of trip demand to Hawaii with respect to the vacation price index.\(^1\) The average budget share of lodging was 26.7% during 1961-80. Using our estimates of \( \varepsilon_{HH} = -1 \) and \( \varepsilon_{VV} = -1.93 \), the aggregate price elasticity of visitor demand for lodging in Hawaii is calculated to be about -1.5. Thus, the composite demand elasticity for lodging is much larger than obtained in our previous paper.

5. SUPPLY ELASTICITIES

Our supply equation is given by the marginal cost pricing rule,

\[
P_H = MC (P_K, P_L, P_O, Q)
\]

(7)

where the price of capital, labor and other inputs into the production of lodging services are represented by \( P_K \), \( P_L \) and \( P_O \) respectively. With homogeneity and the choice of a log linear function form, the (inverse) supply equation can be written as:

\[
\ln \frac{P_H}{P_K} = a_0 + a_1 \ln \frac{P_L}{P_K} + a_2 \ln \frac{P_O}{P_K} + a_3 \ln Q,
\]

(8)

with the supply elasticity being equal to \( \frac{1}{a_3} \).

The reduced form after substitution from (5) is:

\[
\ln \frac{P_H}{P_K} = c_0 + c_1 \ln \frac{P_L}{P_K} + c_2 \ln \frac{P_O}{P_K} + c_3 (\ln \frac{Y \cdot N}{P_K} + d_1 \cdot \ln \frac{P_V}{P_C} + d_2 \ln \frac{P_A}{P_C} + d_3 \ln \frac{Y}{P_C} )
\]

(9)

where \( c_0, c_1, c_2, \) and \( c_3 \) are composed of structural form coefficients.\(^2\)

In particular, \( c_3 = \frac{a_3}{1+a_3} \).

We estimated equation (9) after inserting estimated values from section 3 for \( d_1 = -1.933, d_2 = -0.707 \) and \( d_3 = 1.787 \).
In estimating equation (9), time series data were employed for the period 1961-1980. Data on $P_H$, the index of lodging prices were obtained from sources described in Fujii, Khaled and Mak (1985a). The price of capital $P_K$ is measured as the building price index multiplied by the interest rate. For the latter, we employed Moody's Baa corporate bond rate (Economic Report of the President, 1982). The construction price index for high rise building is taken from Schmitt (1976, p. 387) and spliced with the Builder Report Pacific series for the years 1961-65 from the State of Hawaii Data Book (1980, p. 492). For labor, $P_L$, we employed the average hourly wage in Hawaii's hotels (Schmitt, 1976; State of Hawaii Data Book, 1977, 1980, and 1983) Other inputs comprise largely of supplies and utility expenses but also include taxes and insurance. For lack of better price information, we employed the U.S. producer price index for finished goods (Economic Report of the President, 1982) to represent $P_0$. The results are shown in Table 2.3

Since $c_3$ does not differ significantly from zero, it follows that $a_3$, the inverse of supply elasticity is not significantly different from zero implying that the elasticity of supply is (i.e. infinitely) large. It is much larger than the supply elasticity obtained in our earlier paper (+2) (Fujii, Khaled and Mak, 1985b). At first glance, this result may seem implausible because land for hotel construction in Honolulu is very limited in supply. However, the outer islands are yet to be fully developed and they can accommodate additional demand without substantial rise in costs.

Our estimate of the supply elasticity is also in line with that of Arbel and Ravid (1983) for the U.S. hotel industry and those of Deleeuw
TABLE 2

Estimates of the Supply Coefficients*

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Estimates</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>c₀</td>
<td>5.463</td>
<td>3.504</td>
</tr>
<tr>
<td>c₁</td>
<td>0.571</td>
<td>0.312</td>
</tr>
<tr>
<td>c₂</td>
<td>0.580</td>
<td>0.246</td>
</tr>
<tr>
<td>c₃</td>
<td>0.177</td>
<td>0.135</td>
</tr>
</tbody>
</table>

R² = .991

* Corrected for serial correlation using the grid search procedure.
and Struyk (1975) and Ozanne and Thibodeau (1980) for the U.S. housing market.

6. CONCLUSION

Many tourist destinations impose taxes on hotel room rentals. It is a popular tax because seemingly it falls on visitors and not on residents. In an earlier paper, we estimated visitor demand and supply elasticities for lodging in Hawaii and concluded that a hotel room tax is readily, though not fully, exported. Moreover, taxes imposed on hotel rentals have a moderately large negative output effect on the lodging industry.

Since numerous people have noted that our earlier estimate of demand elasticity for lodging is underestimated, because we only considered the effects of a hotel room tax on visitors upon their arrival in Hawaii and ignored the potential effects on visitors' decisions to come to Hawaii, we have, in this paper, reassessed the incidence and exportability of hotel room taxes by re-estimating our demand and supply elasticities for lodging in Hawaii.

We find that the tourist demand elasticity for lodging in Hawaii is much larger (-1.5 vs. -1) than we previously obtained. As well, the supply elasticity also rises from +2 to infinity. These results somewhat modify our earlier conclusion. Hotel room taxes are fully exportable to tourists, but the tax has a relatively large negative impact on the tourist demand for lodging services. Not surprisingly, hotel room taxes are vigorously opposed by the lodging industry. To counter such opposition, legislators might earmark part of the proceeds to promote and upgrade the attractiveness of the visitor destination.
FOOTNOTES

1. We derive the elasticity as follows:

By definition, \( \ln \frac{Q}{N} = \ln \frac{Q}{V} + \ln \frac{V}{N} \)

Differentiating with respect to \( \ln P_H \), we have the aggregate elasticity equal to

\[
\frac{\partial}{\partial \ln P_H} \ln \frac{Q}{V} + \frac{\partial}{\partial \ln N} \ln \frac{V}{N},
\]

\[
\frac{\partial}{\partial \ln P_V} \ln P_V = \varepsilon_{HH} + S_H \varepsilon_{VV},
\]

treating the share weights in the relation, \( \ln P_V = \sum_i \ln P_i \) as ex-post constants.

2. The reduced-form is actually,

\[
\ln \frac{P_H}{P_K} = a_0 + a_3 b_0 + a_3 b_1 + \frac{a_1}{1-a_3 b_1} \ln \frac{P_L}{P_K} + \frac{a_2}{1-a_3 b_1} \ln \frac{P_O}{P_K}
\]

\[
+ \frac{a_3}{1-a_3 b_1} \ln N + \frac{a_3 b_1}{1-a_3 b_1} \ln \frac{P_K}{P_{NH}} + \frac{a_3 b_2}{1-a_3 b_1} \ln \frac{E}{P_{NH}}
\]

\[
+ \frac{a_3 d_1}{1-a_3 b_1} \ln \frac{P_V}{P_C} + \frac{a_3 d_2}{1-a_3 b_1} \ln \frac{P_A}{P_C} + \frac{a_3 d_3}{1-a_3 b_1} \ln \frac{V}{P_C}
\]

We tried to estimate the extended reduced-form equation directly, but without success due to serious problems of multicollinearity. We were, therefore, forced to estimate equation (9), substituting \(-b_1 = 1 = b_2\).

3. Since \( P_V \) contains our endogenous variable \( P_H \), we have used the Honolulu consumer price index in its place. This is a reasonable procedure since the simple correlation between the two series during 1961-1980 is .99.
REFERENCES


