“Health Scare,” Excise Taxes and Advertising Ban in the Cigarette Demand and Supply*

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I. Introduction

The cigarette industry is a fascinating laboratory for industrial economists. Because of its concentrated market structure and history of conflicts over health and tax issues, the industry has been the focal point of many economic studies. Most of the recent studies have concentrated on the demand side of the market. For example, Bass, Schmalensee, Hamilton and Fujii deal with the impact of advertising and the “health scare” on cigarette demand [4; 15; 10; 8]. Barzel, Johnson, and Sumner-Ward assessed the importance of the excise tax (or *ad valorem* tax) on consumers’ cigarette demand [3; 12; 16]. On the supply side, Vernon-Rives-Naylor developed an econometric model of the tobacco industry [20], which, however, is more concerned with the agricultural aspects of the product than the industry’s market organization.

A careful review of the above studies suggests serious shortcomings which appear to limit their application to policy formulation or market analysis. First, the variables are introduced, in an ad hoc fashion without reference to existing demand (or supply) theories. Second, none of the above studies recognizes explicitly the interactions among the variables in the demand and the supply equations in the context of the determination of market equilibrium.

This paper has three objectives: 1. to apply the standard neoclassical market theory to the cigarette industry; 2. to identify the interactions between cigarette demand and supply using a simultaneous equations approach,—the first such attempt in a cigarette industry study—and 3. to evaluate the effects of cigarette taxes, advertising and “health scare” issues on the industry’s output based on the empirical results obtained from the simultaneous equations analysis.¹ The judicious selection of explanatory variables, careful data

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1. Consistent and asymptotically efficient estimates using the three-stage least squares technique with autocorrelation correction will be contrasted to the inconsistent single equation econometric estimation techniques. The time period to be studied is 1954 to 1980. This time period was chosen for two reasons, data availability, and because it coincides with the first reports linking lung cancer to smoking. During this period total consumption grew more than 60 percent, however, age adjusted per capita consumption (persons greater than 15 years old) has shown little or no growth. Also during the period the median state and federal tax per pack of cigarettes nearly doubled from 11¢ to 21¢. This study is prior to 1983 federal tax increase.
collection, and consultation with industry insiders also differentiate the empirical results of this study from existing ones.

II. Theoretical Framework

Traditional neoclassical theory demonstrates the simultaneous nature of market supply and demand. Following the Theil-Barten approach to the specification of a demand function, the quantity demanded for good \( X(Qd_x) \) in a market model can be expressed in the log scale as,

\[
Qd_x = F(Px, Pz, Y, Z),
\]

where \( Px \) is price of \( X \), \( Pz \) is a vector of prices of close substitutes or complements, \( Y \) is real income and \( Z \) is a vector of preferences or tastes [19; 15; 2, 42]. On the supply side the quantity supplied \( (Qs_x) \) may be written in a confromable form to the demand function,

\[
Qs_x = f(Px, Pw, V, T),
\]

where \( Pw \) is a vector of prices of inputs and \( V \) is a vector of other factors affecting supply, such as technology, and \( T \) denotes taxes on the product. The third equation required is the market equilibrium condition; that is,

\[
Qd_x = Qs_x = Q^*
\]

where \( Q^* \) is the equilibrium quantity. The above three equations make it clear that the equilibrium quantity and the price of the goods are determined simultaneously in the market.

Under certain conditions, single equation demand models can provide consistent estimates. To obtain consistent results in a single equation model, the causation must be unidirectional. That is, price (quantity) must be exogenous to demand, allowing demand to determine quantity (price). This implies that the supply curve must be perfectly elastic (inelastic) or close to it. Given the structure of cigarette manufacturing, a priori information requires us to reject the inelastic case. That brings us to a single equation cigarette demand model which assumes a perfectly elastic supply curve and therefore an exogenous price factor. However, cigarette manufacturers have shown some sensitivities to changes in price and therefore, we reject this argument as well [20, 155].

A final theoretical consideration in this type of market study is that to maintain the simultaneity of the system, the same price must be used in both the supply and demand equations. Traditional theory suggests that suppliers make decisions on net price and consumers on gross price [10, 31–33]. Therefore, it makes no difference whether one uses gross price, with taxes as a variable on the supply side, or net price, with taxes as an explanatory variable on the demand side.

Sumner and Ward imply that the “Barzel quality effect” (in response to a tax) is a

2. Consistent but not necessarily efficient [13, 586].
3. Tobacco is not perishable and in fact must be aged. Therefore, unlike some agricultural products, the assumption of a perfectly inelastic supply curve is not reasonable.
4. Barzel suggested that “. . . when quality is not fully controlled, the effects of the two types of taxes [ad valorem and excise] differ radically.” The implication of his hypothesis is that due to quality adjustments, that is, producers tend to upgrade the quality of cigarettes every time taxes are increased; an increase in the excise (ad valorem) tax will result in a greater (lesser) than proportional increase in price. Sumner and Ward emphasize that this quality
supply side phenomenon, not a consumer response to relative cheapening of superior brands [3, 1261]. Therefore, the gross price approach was adopted for this study in order to test the quality effect of an increase in tax on the quality of cigarette and on price. Some results using net prices will also be presented later for comparison.

III. Model Specification

Equations (1), (2) and (3) above are the general functional form for the estimation of a demand-supply model. These equations suggest that equilibrium price and quantity can be obtained by their simultaneous solution. Translating the theoretical functional forms for the demand supply system into an empirically testable form, we derived the equations below. (A double log model was chosen, since the elasticity values of the variables are of primary interest.)

\[
\ln Q = a_0 + a_1 \ln P_R + a_2 \ln DI + a_3 \ln AD + a_4 D_{64} + U_1 \quad \text{(demand)} \tag{4}
\]

\[
\ln Q = b_0 + b_1 \ln P_R + b_2 \ln T + b_3 \ln FPI + b_4 D_{71} + U_2 \quad \text{(supply)} \tag{5}
\]

where,

\( Q \) = the quantity of cigarettes consumed in millions

\( P_R \) = the retail price index per cigarette (1967 = 100)

\( DI \) = the real disposable income index (1967 = 100)

\( AD \) = the total cigarette advertising expenditures (1967 = 100)

\( T \) = the total federal and state tax per cigarette (1967 = 100)

\( FPI \) = the factor price index (1967 = 100)

\( D_{64} \) = dummy variable (= 0 for 1954–63, 1 otherwise)

\( D_{71} \) = dummy variable (= 0 for 1954–70, 1 otherwise)

\( U_1, U_2 \) = the random disturbance terms.

The dummy variables, \( D_{64} \) and \( D_{71} \), represent the market response to government action concerning cigarettes. The "health scare" dummy variable, \( D_{64} \), measures the effect on consumer preference of the 1964 Surgeon General’s report linking cigarette smoking to cancer. The advertising ban variable, \( D_{71} \), represents the industry’s (supply) response to the banning of broadcast cigarette advertising beginning in 1971.

On the demand side (equation (4)), price and income are included following the theoretical formulation. Since there are few good substitutes or complements for cigarettes, prices of such items are excluded. Advertising (\( AD \)) and a dummy variable (\( D_{64} \)) are included as measures of tastes or preferences. Due to the habitual nature of the product, both the price and income elasticities are expected to be small. A positive, significant coefficient for advertising (\( AD \)) will occur if advertising increases aggregate demand for all cigarettes. Hamilton and Tennant among others have suggested that the effects of advertising on quantity demanded in the cigarette industry tend to be small [10, 401; 17, 232]. The dummy variable \( D_{64} \) is expected to be negative in sign.

In the supply equation (5), the price coefficient is postulated to be positive, i.e., the change phenomenon is a supply side response to increased costs. They present evidence that there is no difference between the two types of taxes on cigarettes, and that the tax elasticity is significantly less than one. Here we assume the cigarette tax to be an excise tax [3, 1261].
supply curve slopes upward. Tax is included as a factor shifting supply, reducing output. We postulate a negative sign for the advertising ban, which will be discussed in more detail below.

The factor price index (FPI), which includes labor, material, capital and advertising costs, fixing output at a constant level, is used to observe the combined effects of input prices and technology on quantity supplied, and also to avoid multicollinearity between input prices: while it is clear that FPI captures manufacturers' input prices which should have a negative relationship with quantity supplied, the influence of technological change on quantity supplied is somewhat subtle. However, the issue can be clarified by viewing technological change as motivated by the desire to lower costs [5, 124–29]. That is, improved technology is assumed to reduce the quantity of inputs required for a given output, directly reducing cost. Indirectly, the reduction in the quantity of inputs required exerts downward pressure on input prices, again lowering costs. Following this reasoning, technological improvement reinforces the negative relationship between FPI and quantity supplied. The derivation of FPI and the data sources for the other variables are included in the Data Appendix.

Several variables excluded from this model require some explanation. The above model specification excluded several variables included in previous single equation studies. First, the advertising ban is used as a determinant on the supply side only. If cigarette advertising is primarily a market share determinant, and exerts only a small magnitude effect on quantity demanded, then the broadcast advertising ban would be of more concern on the supply side than on the demand side.

Secondly, although the number of smokers is often used in demand studies as a scalar to measure growth in the market, it was excluded here due to the nature of the product and the time period observed. The data for this study begins in 1954 when the first reports appeared linking cigarettes with lung cancer. Due to the habitual form of the product, it is hypothesized that the health scare has a greater impact on new consumers: this, in turn, clouds the effect of the growth in the number of smokers on cigarette consumption. Fujiu used lagged consumption to capture the habitual nature of cigarette consumption, but it is excluded here on his suggestion that habit-forming characteristics of cigarette consumption will be reflected in price and income elasticities [8, 481].

Equations (4) and (5) will be estimated using a variety of econometric techniques. Since the system is specified in a simultaneous setting, both the two-stage least squares

5. Evidence will be presented below that suggests that the advertising ban is a constraint on factor inputs as indicated by Grabowski and Mueller [9, 291–92].
6. The factor price index, which was calculated by adding wage bills, material expenses, and capital costs, fixing output at a constant level captures changes in input prices and technological improvements in the industry over time. We did not separate input prices from technology because of possible measurement errors in estimating the latter, and multicollinearity between the two if measured. We have also tried the producer's price index of the cigarette industry (SIC 2111) in place of the FPI, but the results were not as indicative as we expected they would be.
7. It should be noted that our original hypothesis included the advertising ban in the demand equation as well as in the supply equation. When this hypothesis was tested, the coefficient of $D_{71}$ in the demand equation was not significant, and the results of the overall model were poor, indicating some specification errors. Thus the advertising ban is included as a supply side determinant only, as shown in equation (5).
8. This variable highlights another problem with single equation methods. Population, excluded here on theoretical grounds, was tested and found to be significant in single equation models but insignificant using a systems approach. Therefore not only do single equation techniques provide inconsistent estimates, they may also lead to inclusion of insignificant variables.
Table I. Demand Elasticities* (Dependent Endogenous = Qd)

<table>
<thead>
<tr>
<th></th>
<th>Incep.</th>
<th>Price</th>
<th>DI</th>
<th>AD</th>
<th>D64</th>
<th>R²</th>
<th>DW</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>3SLS**</td>
<td>4.583</td>
<td>−0.454</td>
<td>0.919</td>
<td>0.095</td>
<td>−0.059</td>
<td>0.907</td>
<td>—</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>(1.38)</td>
<td>(0.29)</td>
<td>(0.34)</td>
<td>(0.04)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3SLS</td>
<td>13.201</td>
<td>−0.406</td>
<td>0.861</td>
<td>0.079</td>
<td>−0.068</td>
<td>0.933</td>
<td>—</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>(1.36)</td>
<td>(1.14)</td>
<td>(1.17)</td>
<td>(0.02)</td>
<td>(0.03)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other Alternative Methods:

<table>
<thead>
<tr>
<th></th>
<th>2SLS**</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>4.441</td>
<td>−0.474</td>
<td>0.958</td>
<td>0.091</td>
<td>−0.064</td>
<td>0.901</td>
<td>1.851</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(1.50)</td>
<td>(0.30)</td>
<td>(0.37)</td>
<td>(0.05)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10.781</td>
<td>−0.506</td>
<td>0.938</td>
<td>0.106</td>
<td>−0.081</td>
<td>0.957</td>
<td>1.145</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(0.28)</td>
<td>(0.16)</td>
<td>(0.20)</td>
<td>(0.03)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9.792</td>
<td>−0.532</td>
<td>0.967</td>
<td>0.102</td>
<td>−0.082</td>
<td>0.937</td>
<td>1.692</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(0.15)</td>
<td>(0.18)</td>
<td>(0.03)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>8.760</td>
<td>−0.641</td>
<td>1.096</td>
<td>0.114</td>
<td>−0.105</td>
<td>0.959</td>
<td>1.431</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(0.59)</td>
<td>(0.13)</td>
<td>(0.17)</td>
<td>(0.03)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* D64 and price are significant at .90 and all other variables are significant at .95 in the 3SLS** estimation. Values in parentheses are standard errors of estimates.

** The coefficients reported in these rows are estimated by the autocorrelation correction method for a simultaneous equations system suggested by Kmenta [13, 587–89]. The autocorrelation coefficient used is 0.349.

method (2SLS) and the three-stage least squares method (3SLS) are used. The results of the 3SLS are then corrected for autocorrelations (3SLS**) following Kmenta. The single equation techniques such as the ordinary least squares method (OLS) and the autocorrelation correctional method (Cochrane-Orcutt), are also employed for the sake of comparison, but the latter are known to be inconsistent unless the supply curve is perfectly elastic because they ignore the simultaneous nature of the supply and demand system. When a relation is part of a system, some regressors are typically stochastic and correlated with the regression disturbances, causing single equation techniques to provide inconsistent estimates.

IV. Empirical Results

Tables I and II show the estimation results of equations (4) and (5). The numbers present the elasticities of demand and supply with respect to their various determinants, estimated by the econometric techniques discussed above. Note how the single equation estimates (e.g., the OLS and the Cochrane-Orcutt method) deviate in magnitude and direction on the supply side from the 3SLS estimates. This is not uncommon in cases where the number of observations is small and autocorrelations are suspected. However, all 3SLS estimates show the sign and magnitude expected, whether corrected for autocorrelations or not. The

9. Kmenta recommended a simple correctional method for autocorrelation when the model’s predetermined variables do not include any lagged endogenous variables, which is precisely our case. In this method, one may apply the 2SLS first to each structural equation in order to obtain consistent estimates of the autocorrelation coefficients; \( \rho_1, \rho_2, \ldots, \rho_k \). These can be used to transform the variables for the 3SLS estimation [13, 588–89]. An alternative way of estimating the three-stage least squares coefficients is suggested by Kmenta [13, 575–77]. The results are, however, about the same as presented above.
### Table II. Supply Elasticities* (Dependent Endogenous = $Q_s$)

<table>
<thead>
<tr>
<th></th>
<th>Incept.</th>
<th>Price</th>
<th>Tax</th>
<th>FPI</th>
<th>$D_{\eta_1}$</th>
<th>$R^2$</th>
<th>DW</th>
<th>df</th>
</tr>
</thead>
<tbody>
<tr>
<td>3SLS**</td>
<td>7.971</td>
<td>1.176</td>
<td>-0.455</td>
<td>-0.440</td>
<td>-0.046</td>
<td>.802</td>
<td></td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>(0.61)</td>
<td>(0.55)</td>
<td>(0.38)</td>
<td>(0.31)</td>
<td>(0.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3SLS</td>
<td>16.702</td>
<td>2.187</td>
<td>-1.016</td>
<td>-1.181</td>
<td>-0.093</td>
<td>.933</td>
<td></td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>(2.08)</td>
<td>(.82)</td>
<td>(.57)</td>
<td>(.54)</td>
<td>(.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Other Alternative Methods:

<p>| | | | | | | | | |</p>
<table>
<thead>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2SLS**</td>
<td>8.076</td>
<td>1.019</td>
<td>-0.262</td>
<td>-0.455</td>
<td>-0.026</td>
<td>.690</td>
<td>1.522</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(0.63)</td>
<td>(0.058)</td>
<td>(0.42)</td>
<td>(0.32)</td>
<td>(0.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2SLS</td>
<td>11.302</td>
<td>1.009</td>
<td>-0.131</td>
<td>-0.477</td>
<td>-0.075</td>
<td>.838</td>
<td>.790</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(1.75)</td>
<td>(1.06)</td>
<td>(.76)</td>
<td>(.67)</td>
<td>(.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autoreg</td>
<td>10.791</td>
<td>-0.213</td>
<td>0.689</td>
<td>0.248</td>
<td>-0.011</td>
<td>.853</td>
<td>1.825</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>(.30)</td>
<td>(.26)</td>
<td>(.21)</td>
<td>(.18)</td>
<td>(.04)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OLS</td>
<td>8.770</td>
<td>-0.596</td>
<td>1.013</td>
<td>0.532</td>
<td>-0.050</td>
<td>.912</td>
<td>1.130</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>(0.680)</td>
<td>(0.342)</td>
<td>(0.255)</td>
<td>(0.224)</td>
<td>(0.039)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Price is significant at .95 and FPI significant at .90. $D_{\eta_1}$ and taxes are not statistically significant in the 3SLS** estimation, but significant at .90 in the 3SLS. Values in the parentheses are standard errors of estimation.

** The coefficients reported in these rows are estimated by the autocorrelation correction method for a simultaneous equations system suggested by Kmenta [13, 588, 89]. The autocorrelation coefficient used is 0.451.

$R^2$ for the demand equation is .907 and is as high as .802 for the supply equation, when the 3SLS results are corrected for autocorrelations.

The first conclusion to be reached from these results is that while the supply response to price is elastic, as indicated by the 1.176 coefficient of price in the 3SLS** version, it cannot be considered perfectly elastic. This implies a simultaneous, not a recursive system in which price is predetermined.

To compare the effects on price and quantity of the various explanatory variables, the 3SLS** equations (from Tables I and II) were solved for their reduced form:

\[
\ln P_R = -2.077 + 0.563 \ln DI + 0.058 \ln AD - 0.036 D_{6a} + 0.279 \ln T \\
+ 0.270 \ln FPI + 0.028 D_{\eta_1} \tag{6}
\]

\[
\ln Q = 5.528 + 0.663 \ln DI + 0.068 \ln AD - 0.043 D_{6a} - 0.127 \ln T \\
- 0.123 \ln FPI - 0.013 D_{\eta_1} \tag{7}
\]

Note that the supply side exogenous variables ($T$, $FPI$, $D_{\eta_1}$) have a larger effect on price than on quantity, while the opposite is true for the demand side variables ($DI$, $AD$, $D_{6a}$). This is a reflection of the elastic supply curve and inelastic demand. Figure 1 shows the relative changes in price and quantity, given a shift in the supply or in the demand curve. For example, when the demand side variables change, the curve will shift from $D$ to $D'$, thereby changing the equilibrium quantity from $Q_A$ to $Q_B$, and the equilibrium price from $P_A$ to $P_B$. Our findings from the above estimation show that $Q_A - Q_B$ is greater than $P_B - P_A$, confirming that demand should be inelastic while supply is elastic. By the same token, a shift in the supply affects price more than quantity, as indicated by a change from point $A$ to point $C$ in Figure 1.
It is also interesting to note that the tax coefficient in equation (7) is substantially larger than the health scare ($D_{h}$) or advertising ban ($D_{a}$) coefficients. These values suggest that cigarette excise taxes had more effect on reducing consumption during the period studied (1954–80) than either the health scare or the advertising ban. In fact the small values for the health scare and the advertising ban suggest that these events had little effect in reducing cigarette demand.

In this model, advertising appears to increase demand, but only slightly. This small coefficient confirms previous studies which suggest that in the industry as a whole, advertising was not very effective in inducing more demand, but perhaps caused a change in intra-industry market share.  

The negative coefficient for the broadcast advertising ban requires careful evaluation. The resulting reduction in quantity supplied may be initially viewed as a sign of the strengthening of the cigarette cartel by the legal restriction of the most obvious form of non-price competition. However, this argument would predict a decline in advertising expenditures, whereas in fact these expenditures increased by greater than 200 percent between 1970 and 1980. A perhaps more plausible alternative explanation is that of the ban as a constraint on factor inputs. Here, as firms compete for smokers, not consumers in general, they are forced to employ less productive resources (i.e., advertising modes with

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10. This finding is again consistent with our earlier statement. See Footnote 5.
11. Hamilton argued that the ban reduced advertising expenditures, reduced costs and strengthened the cigarette cartel.
lower per dollar effectiveness) as argued by Grabowski and Mueller, resulting in increased production costs, causing an upward shift in the supply curve. This alternative explanation suggests that substitutes (even if relatively more costly) for broadcast advertising do exist.

To observe the effect of the cigarette tax (or the effect of factor price index) on price, the supply equation 3SLS** (in Table II) can be solved for price. This results in a tax elasticity well below unity, which is \(-0.455 \div 1.176 = -0.387\). Therefore, it seems difficult to accept Barzel’s hypothesis that an excise tax (through quality adjustments) will have a greater proportional effect on cigarette price [3, 1195]. It is interesting to note that the factor price index has an effect on price similar to that of taxes. This suggests that a change in the cigarette taxes can be evaluated in the same manner as a change in other input prices, that is, as one of the shifting factors on the supply side.

Table III presents the three-stage least squares estimates with the cigarette taxes included in the factor price index. All elasticity estimates are similar to the previous model (where tax was an independent argument), except the supply price elasticity.

The supply price elasticity, while still elastic, is a little less so than when the tax was not included in the factor price index. This is not unusual considering that the tax must be paid in fixed proportion to output and cannot vary in response to a change in the price of

12. Grabowski and Mueller present empirical evidence of a strong rivalry between cigarette firms in the print media. They state that “any money withdrawn from TV advertising and shifted to other media will have a lower productivity in increasing sales” [9, 291–92].
any of the other inputs (holding output constant). Indeed, classical theory suggests that the supply curve will be less elastic given any fixed element in price.

By now it should be clear that to suggest that suppliers base their output decisions on net price (as opposed to consumers’ use of gross price), implies that suppliers consider not only the market price but also the prices of the factors of production. Table IV presents the three-stage least squares estimates using the net price approach. Note that both supply and demand are less responsive to net price. This is as expected since, on the demand side, consumers react to gross, not net, price. On the supply side, gross price is the sum of two elastic responses (net price and tax) and therefore suppliers would naturally be more responsive to it. The conclusion that a tax has no significant effect on demand reinforces the argument that the cigarette taxes must be evaluated as a cost factor on the supply side.

V. Conclusions

This paper has demonstrated that neoclassical market theory requires the use of a simultaneous equations approach to evaluating the market for cigarettes. Previous studies that failed to follow economic theory in the selection of explanatory variables and to use proper econometric techniques resulted in inconsistent estimates and suspect conclusions.

Given the major impact of taxation on this industry, several methods of evaluating the effect of taxes have been presented. This study suggests the cigarette taxes can best be evaluated as a supply side cost, fixed in proportion to output.

Based on 1954–80 data, evidence has been presented that the health scare has had little effect on cigarette demand. Slow growth in the industry appears to be more strongly attributed to increasing costs, especially taxes. The broadcast advertising ban which began in 1971 increased, rather than decreased, production costs, which in turn resulted in an upward shift in the supply curve. This shift in the supply curve, however, was not particularly effective in reducing the equilibrium quantity because demand is inelastic. The study also found that suppliers’ use of other advertising modes does not appear to have had a significant impact on the quantity demanded. Thus, in determining market price and quantity, it can be argued that rising costs and taxes on output has had a greater effect on quantity than either the advertising ban or the health scare.

Appendix: Data Sources

Since this study is primarily concerned with such variables as taxes, health scare and advertising, the quantity variable is the amount domestically consumed, not produced. Demand is defined as that part of production subject to federal tax. Data for demand as well as retail price and tax are from the Tobacco Institute (1982). It should be noted that price and tax are median values for all states. State price is a weighted average of pack, machine and carton sales.

The total cigarette advertising index \((AD)\) was derived from two sources. Data from 1964 to 1980 were obtained from the Federal Trade Commission Report on Cigarette Advertising [14]. To extend the series backward to 1954 the FTC data were extrapolated using Schmalensee’s total cigarette advertising index [15, 278–79].

The factor price index \((FPI)\) is defined as the sum of the total payrolls, total materials, and the cost of capital, and advertising expenditures \((AD)\), fixing output at the 1967 level. That is, 
\[
FPI = (\Sigma P_i F_i / Q_i)Q_0
\]
where \(P_i\) and \(F_i\) are prices and quantities of factors used in a certain year,
and $Q_t$ is output in that year. $Q_0$ is output in the base year (1967). This may not exhaust all the costs incurred, but certainly captures the majority of them, so that it reflects the trend of factor costs over time.

The cost of capital is defined simply as the Aaa bond rate times total assets. The assets series published by the Bureau of Census was not complete (only 12 observations). To fill in the missing years the following equation was estimated using the Cochrane-Orcutt technique:

$$\ln \text{Assets} = \ln 5.185 + 0.077 \times \text{Time}; \quad R^2 = .87.$$  
\begin{align*}
(1.153) & \quad (0.008)
\end{align*}

A 7.7% rate of change was used to estimate the missing data.

The data for total payrolls, materials and assets is from the Census of Manufacturers (various years). The Aaa bond rate and disposable income are from the Economic Report to the President [7]. Total cigarette production was obtained from the U.S. Department of Agriculture's Annual Report on Tobacco Statistics [1]. The data for FPI, AD, and others are available from the authors upon request.

References