The Interaction between Alcohol and Cigarette Consumption

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Introduction

- It has long been recognized that cigarette and alcohol not only have adverse health effects, but also negative externalities. The adverse health effects of passive smoking and the fatalities resulting from drunk driving have made these goods the targets of excise taxation.
- People who consume harmful addictive substances are likely to discount the future more compared to other people. If being a smoker is, in part, a matter of discounting the future more heavily, smokers should display more present-oriented behaviors in a whole range of activities and are more likely to drink compared to other people.
- If cigarette and alcohol are related in consumption, the information on the way in which they are related may allow a better coordination of the public policies concerning these goods.
- When modeling the demand for addictive goods like cigarettes and alcohol, the most popular framework is the ***rational addiction*** model proposed by Becker and Murphy (1988).
- In the theory of rational addiction, a good is *addictive* if past consumption increase current consumption, and addiction is *rational* as the decision involves forward-looking maximization of utility.
- In this study, we use the expenditure data of a panel of US households to analyze the relation between cigarette and alcohol consumption in a rational addiction framework.
- We believe that individual level data would be a better tool to analyze addictive behavior as aggregate data might conceal much of micro behavior. By using individual data, we can also analyze the demand for different subsamples split by demographics.

Objective

This study is conducted to determine the relation between the cigarette and alcohol consumption in order to design a better coordination of the public policies concerning these goods, such as optimal level of taxation, and the proper forms of regulation

Data

- Consumer Unit (CU) demographics and expenditures are from 2002–2006 Consumer Expenditure Interview Survey Data by Bureau of Labor Statistics. Each CU is observed over four consecutive quarters.
- The state level cigarette prices are from Orzechowski and Walker (2007). The remaining data information is collected from the websites of U.S. BLS, National Institute on Alcohol Abuse and Alcoholism (NIAAA), and Tax Foundation.
- An expenditure weighted alcohol price is constructed from beer, wine and spirit prices which are calculated based on following formula:

$$P_{it} = \bar{P}_t + (T_{it} - \bar{T}_t)\,, \quad \text{i=state, t=year}$$

- The final sample consists of 18,187 CUs.

Data (cont.)

Table I reports the pattern of observed purchases of the sample over four quarters.

Majority of non-drinkers are nonsmokers ,and vice versa.

Majority of regular smokers are regular drinkers.

Percent Row Pct Col Pct	Table 1 : Smoking and drinking patterns in the sample					
	Alcohol					
Cigarette	0	1	2	3	4	Total
0	28.97 40.80 77.71	11.40 16.06 71.89	7.51 10.57 68.11	7.41 10.43 65.55	15.72 22.14 64.06	71.01
1	1.67 32.51 4.47	0.95 18.45 5.96	0.71 13.84 6.44	0.63 12.23 5.55	1.18 22.96 4.79	5.12
2	1.34 32.71 3.60	0.68 16.62 4.30	0.68 16.62 6.19	0.57 13.81 5.01	0.83 20.24 3.38	4.10
3	1.60 28.93 4.29	0.90 16.30 5.68	0.75 13.62 6.84	0.80 14.41 7.06	1.48 26.74 6.03	5.53
4	3.70 25.99 9.93	1.93 13.56 12.17	1.37 9.62 12.43	1.90 13.36 16.84	5.33 37.47 21.73	14.24
Total	37.28	15.86	11.02	11.30	24.54	100

Method

- When the instantaneous utility function is quadratic, the rational addiction model implies following demand functions for cigarettes and alcohol respectively (see Bask and Melkersson, 2004) :

$$C_{it}^{*} = \alpha_{1i} + \beta_{10} + \beta_{11}\,C_{it-1}^{*} + \beta_{12}C_{it+1}^{*} + \beta_{13}A_{it-1}^{*} + \beta_{14}A_{it}^{*} + \beta_{15}A_{it+1}^{*} + \beta_{16}\,X_{1it} + u_{1it}$$

$$A_{it}^{*} = \alpha_{2i} + \beta_{20} + \beta_{21}\,A_{it-1}^{*} + \beta_{22}\,A_{it+1}^{*} + \beta_{23}C_{it-1}^{*} + \beta_{24}C_{it}^{*} + \beta_{25}C_{it+1}^{*} + \beta_{26}\,X_{2it} + u_{2it}$$

where C* and A* are latent variables of cigarettes and alcohol consumption

$X_{1it}(X_{2it})$ includes real price of cigarettes(alcohol) and demographics,

α_i is individual fixed effect.

- Rational addiction implies $\beta_{i1} > 0$ and $\beta_{i2} > 0$. Economic theory implies $\beta_{i6} < 0$. $\beta_{i4} > 0$ if cigarettes and alcoholic beverages are complements. $\beta_{i4} < 0$ if they are substitutes.
- To account for censoring, dynamics, endogeneous explanatory variables and unobserved fixed effects, we use two stage within group (2-stage WG) method suggested by Bover and Arellano (1997).
- Because fixed effect is potentially correlated with exogeneous variables, we follow Bover and Arellano (1997) in assuming:

$$E(\alpha_{ki}/X_{ki}) = \eta_{k0} + \sum_{t=1}^{T} \eta_{kt}^{'} X_{it} + \eta_{kt}^{'} R_{it}$$

where X_{it} are all exogenous variables including the real price of cigarettes and the real price of alcoholic beverages. R_{it} contains non-linear terms and interactions in X_{it}.

- Therefore the reduced form of the model is given by:

$$C_i^{*} = \Pi_1 z_i + \varepsilon_{1i}$$

$$A_i^{*} = \Pi_2 z_i + \varepsilon_{2i}$$

where $z_i = [\,1,\, X_{i1}^{'}, \ldots, X_{iT}^{'}, R_{it}^{'}]$.

- We estimate each 2xT cross section equations using tobit model.
- At the second stage, based on the reduced form coefficients, we derive the relevant vector of parameters using 2-stage WG method of Bover and Arellano (1997):

$$\hat{\beta}_{kWG} = \left[\sum_{i=1}^{N} \hat{V}_{ki}^{'} K' K \hat{V}_{ki}\right]^{-1} \left[\sum_{i=1}^{N} \hat{V}_{ki}^{'} K' K I_0 \hat{\Pi}_k z_i\right] \qquad k=1,2$$

with $\hat{V}_i = [\Phi(L_1)\hat{\Pi}_k W_i : \Phi(L_2)\hat{\Pi}_k W_i : x_i]$

$\Phi(L_1)\hat{\Pi}_k W_i$ is the lagged predicted endogenous latent variable,

$\Phi(L_2)\hat{\Pi}_k W_i$ is the lead predicted latent endogenous variable,

K is the first-difference operator .

Results

- The demand for cigarettes and alcohol are estimated as two separate equations. The results are presented in Table 2.
- The coefficient estimates contradict with the rational addiction theory:
  - In cigarette equation, we find positive coefficient on lagged consumption, but lead consumption coefficient is negative (which means addiction, but no rationality).
  - In alcohol equation, we find negative coefficients on lagged and lead consumption, which does not only contradict with rationality but also addiction.
- In cigarette (alcohol) equation, current cigarette (alcohol) demand is negatively affected by current alcohol (cigarette) consumption, which means cigarettes and alcoholic beverages are substitutes.
- The results are robust to different set of instruments and specifications.

Table 2: Cigarettes and alcohol are substitutes

	2-stage WG	2SLS	
	(i)	(ii)	(iii)
Cigarettes			
Intercept	-0.04496	1.797417	2.334312
	(0.00529)	(2.1019)	(2.8804)
$\Delta\, C_{it-1}$	0.02318	0.202604	0.18797
	(0.00787)	(0.201)	(0.1977)
$\Delta\, C_{it+1}$	-0.87839	-0.5425	-0.52795
	(0.01214)	(0.2591)	(0.2529)
$\Delta\, A_{it-1}$	0.01951	0.112069	0.097703
	(0.00183)	(0.2031)	(0.202)
$\Delta\, A_{it}$	-0.00118	-0.0929	-0.11696
	(0.00224)	(0.3406)	(0.3378)
$\Delta\, A_{it+1}$	0.01346	0.06917	0.061991
	(0.00187)	(0.171)	(0.1706)
$\Delta\, p_{ct}$	-0.01406	-19.6281	-25.4098
	(0.09612)	(7.6793)	(10.3354)
R^2(adj)	0.234	-0.1679	-0.1497
N	18,187	18,187	12,918
Alcohol			
Intercept	-0.55059	2.875294	3.945947
	(0.01739)	(1.5917)	(2.2157)
$\Delta\, A_{it-1}$	-0.22434	-0.39922	-0.3928
	(0.00596)	(0.1447)	(0.1467)
$\Delta\, A_{it+1}$	-0.47418	-0.37421	-0.37577
	(0.0052)	(0.114)	(0.1139)
$\Delta\, C_{it-1}$	-0.01983	0.119932	0.113576
	(0.02654)	(0.1841)	(0.1834)
$\Delta\, C_{it}$	-0.01391	-0.13412	-0.14488
	(0.025)	(0.2807)	(0.2842)
$\Delta\, C_{it+1}$	0.01551	-0.11046	-0.0815
	(0.04644)	(0.2723)	(0.269)
$\Delta\, p_{at}$	-1.00879	-4.54166	-6.96303
	(1.03024)	(53.3382)	(68.8205)
R^2(adj)	0.3389	0.3831	0.3825
N	18,187	18,187	12,918

Notes: Quarterly dummies included. The instruments include demographics and all period prices. In column (iii),people who report zero consumption for both cigarette and alcohol in all time periods are dropped. In column (i) std errors are not corrected.

Results (cont.)

- Long-run own price elasticities of the 2-stage WG model evaluated at the sample mean are presented in Table 3. Both demands are inelastic, with cigarette demand more inelastic than alcohol demand.

Table 3: Cigarette demand is more inelastic

$(\partial C/\partial P_c) \times (P_c/C)$	-0.0008
$(\partial A/\partial P_a) \times (P_a/A)$	-0.0359

- The demands are also estimated as a semi-reduced system, the cross price elasticities are 0.018 and 0.364 for cigarettes and alcohol respectively.

Discussion & Conclusion

- We found that cigarettes and alcoholic beverages are substitutes. However, both cigarette and alcohol demand do not fit the model so well. There might be some possible explanations for data not fitting the model, which means rational addiction might still be valid.
- The theoretical model is constructed according to consumption patterns. On the other hand, we use expenditure data in this study. If there are inventory effects, the expenditure data might not fit the theoretical model. Inventory effects are likely to be stronger for alcohol.
- We might also have weak instruments problem. In our analysis, we use demographics and prices as instruments. The only time varying instruments are prices; and because the time-span is short (4 quarters) there is not much variation in prices over time.
- Moreover, we use the same price level for the individuals within the same state, although prices are likely to vary across individuals due to quality differences of the products being purchased (i.e. expensive wine versus cheap wine).
- How should we go on from here?
  - The study can be replicated using a data set that reports consumption levels rather than expenditure. The consumption data is likely to be a better fit for the model.
  - A pseudo panel data approach can be used. While the pseudo panel is disaggregated enough, it also has two main advantages compared with panel data:
    1. It avoids the attrition problem that many panels suffer from (in our panel data, time-span is 4 quarters due to attrition).
    2. There may be less bias due to measurement error problems as we are typically working with a group average.

*** **For further information, please contact Aycan Koksal at akoksal@ncsu.edu**.

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