Selected Paper prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011.

U.S. Alcohol Consumption: Tax Instrumental Variables in Quadratic Almost Ideal Demand System (QUAIDS)

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AAEA Agricultural & Applied Economics Association
PITTSBURGH 2011 AAEA & NAREA Joint Annual Meeting JULY 24-26, 2011

Introduction

- Alcohol consumption is the adverse cause of both acute and chronic consequences
- U.S. economic cost of alcohol consumption is 2.7% of GDP, according to Rehm et al. (2009)
- We consider demand analysis for more understanding of alcohol consumption pattern to find the effective policy

Statement of Problem

Policy Motivation

- Study U.S. alcohol consumption behavior
- Propose the policy identification for alcohol consumption reduction

Theoretical Motivation

- 'Demand System' versus 'Econometrics'

Empirical Motivation

- Prices exogeneity causes measurement error
- Different elasticities at varying consumption levels

Scope of Study

- Annual alcohol consumption of 50 states and the District of Columbia in 1985-2002
- Beer, spirits, and wine
- Clustered data for the light, moderate, and heavy consumptions

Objective

- Analyze alcohol consumption using price variables and economic and demographic characteristics
- Compare the estimations of elasticities
- Consider the exogeneity issue on prices

Theoretical Framework and Methodology

QUAIDS

- The quadratic logarithmic budget shares system derived from the indirect utility function can be specified as the general form of the expenditure share equations system
- Flexible price responses with an arbitrary second-order approximation to demand system
- Given the evidence on the Engel curves, it provides welfare analysis on the effects of relative prices on the real expenditure
- Estimate with the nonlinear seemingly unrelated regression (NLSUR) method using the bootstrap covariance matrix for bias reduction in the small-sample estimation

$$w_i = \alpha_i + \sum_{j=1}^{n}\gamma_{ij}\ln p_j + \beta_i[\ln m - \ln a(\mathrm{p})] + \frac{\lambda_i}{b(\mathrm{p})}[\ln m - \ln a(\mathrm{p})]^2$$

Abstract

This study analyzes the annual alcohol consumption on prices, taxes, and other economic and demographic characteristics from 50 states and the District of Columbia for 1985-2002 to study the U.S. alcohol demand behavior on beer, spirits, and wine. Young and Bielinska-Kwapisz (2003) found that the price data contains measurement error, so using the state and federal taxes as the instrumental variables could mitigate the problem. There is the improvement in estimation to use the set of all taxes instead of each individual tax.

Therefore, we use the Quadratic Almost Ideal Demand System (QUAIDS) model, proposed by Bank, Blundell, and Lewbel (1997), employing the alcohol prices or the tax instrumental variables on both pooled and clustered datasets to compare with the classical linear models. The statistical inference is based on the bootstrap variance-covariance matrix. After correct the heteroskedasticity and multicollinearity issues, the existing linear regressions models are GLS, GMM-IV, FE, RE, FE-IV, and RE-IV models. The analysis of elasticities reveals that the QUAIDS model is perform better than all linear regressions in term of explanation on consumer behavior.

We also use local constant and local linear estimators with the Gaussian kernel and the optimal cross-validation bandwidth to study the effects of prices and income on alcohol consumption. We also find the increasing trends of consumptions in all types of alcohol for each state. The empirical results indicate that the cross-substitution effects among them could imply policy necessity on the simultaneous alcohol excise taxes imposed. In term of estimation, the instrumental tax variables could improve the QUAIDS model on reflecting the different responsiveness of price and income for light, medium and heavy consumption levels.

Review of Related Literatures

Exogeneity

- Price data from the American Chamber of Commerce Researchers Association (ACCRA) has been widely used for empirical analysis of the U.S. alcohol consumptions
- Young and Bielinska-Kwapisz (2003) found the measurement errors, thus the biased and inconsistent linear estimators, and suggested to use state and federal taxes as the instrumental variables
- In Hausman and Leonard (2005), the instrumental variables could mitigate the simultaneity problem in the AIDS model

Different responsiveness in price

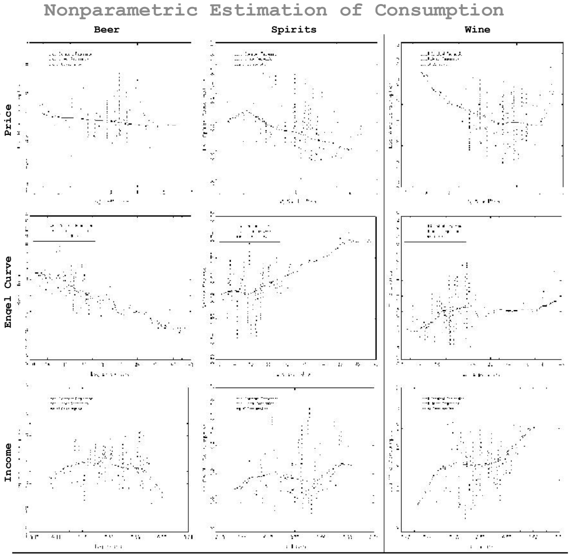
- Manning, Blumberg, and Moulton (1995) found that alcohol prices have different effects on light, moderate, and heavy drinking
- The heavy and light consumptions have less price elasticities than the moderate consumption
- Moreover, the heavy alcohol consumers are essentially unresponsive to prices
- Young and Bielinska-Kwapisz (2003) discussed that measurement errors are likely to bias the estimated responses for both heavy and light consumptions, so the responses of both groups are probably underestimated

Empirical Results

Trend Analysis of Consumption

- Increasing trends with very small coefficients

Nonparametric Estimation of Consumption



Conclusion and Policy Implication

- Law of Demand in nonparametric linear form with small slope downward trends, except at the higher price level for spirits and wine
- Locally-smoothed Engle curves for consumption shares illustrate that spirits and wine are normal goods but not for beer
- Income has positive effects except for beer at the high level of income
- There is strong endogeneity in wine price data
- We have improvement in estimation from using the set of all taxes for spirits and wine
- Find asymptotic normal, but there exist multicollinearity and heteroskedasticity
- Thus, using the Principal Component Analysis (PCA) and the weighted covariance matrix
- Improvement for the linear models from using the instrumental variables is inconclusive
- However, the QUAIDS model has more reasonable variations of responsiveness from prices and income, when using the tax instruments
- Positive cross-price elasticities implies simultaneous excise taxes imposed for the effective alcohol reduction policy

Models:	Pooled		Panel				QUAIDS : Pooled		QUAIDS : Clustered States by Level of Consumption					
									Light		Medium		Heavy	
Elasticities:	GLS	GMM-IV	FE	RE	FE-IV	RE-IV	Price	IV - Taxes	Price	IV - Taxes	Price	IV - Taxes	Price	IV - Taxes
e1	0.2017	-0.1856	0.0300	0.0266	0.0948	0.0696	0.9132	1.1441	0.8951	1.2621	0.9383	1.2150	0.9392	0.9761
e2	0.8357	0.8833	-0.2632	-0.2258	-1.1483	-1.2306	1.0293	0.9500	1.0270	0.9112	1.0138	0.9473	1.0324	0.9899
e3	1.9273	2.1837	0.1613	0.2771	0.1690	0.2997	1.0648	0.9042	1.1497	0.8073	1.1056	0.6709	0.9450	1.1715
eu11	-0.0670	0.1372	-0.0083	-0.0085	-0.0345	-0.0263	-0.9870	-0.8910	-0.9586	-0.9526	-0.9791	-0.9431	-0.9886	-0.8556
eu12	0.1142	0.0191	-0.0145	-0.0108	-0.0079	-0.0060	0.0053	-0.1405	-0.0176	-0.1410	-0.0009	-0.1126	0.0060	-0.1502
eu13	-0.1131	-0.1327	0.0116	0.0081	0.0161	0.0113	0.0056	-0.0083	0.0051	0.0214	-0.0030	-0.0036	-0.0006	0.0123
eu21	-0.0128	-0.1402	0.0119	0.0115	-0.0339	-0.0611	-0.0155	-0.0990	-0.0414	-0.0698	-0.0144	-0.0621	-0.0107	-0.1406
eu22	-0.1762	0.1016	-0.0425	-0.0489	0.3445	0.4315	-0.9967	-0.8743	-0.9752	-0.8670	-0.9996	-0.9030	-0.9941	-0.8581
eu23	-0.0575	-0.1638	0.0033	0.0010	-0.0923	-0.1228	-0.0068	0.0056	-0.0009	-0.0057	0.0050	-0.0007	-0.0162	0.0052
eu31	-0.0536	-0.0708	-0.0651	-0.0703	-0.0794	-0.0724	0.0022	0.0786	0.0015	0.1622	-0.0066	0.1009	-0.0018	0.1424
eu32	-0.3018	-0.3510	-0.0533	-0.0795	-0.0971	-0.0889	-0.0083	0.0342	-0.0080	0.0218	0.0005	0.0185	-0.0105	0.0960
eu33	-0.0808	-0.0977	-0.0010	0.0014	0.0654	0.0084	-0.9988	-1.1054	-1.0049	-1.1693	-1.0020	-1.0942	-0.9835	-1.2515
ec11	-0.0114	0.0860	-0.0001	-0.0011	-0.0083	-0.0072	-0.7352	-0.5755	-0.7119	-0.6046	-0.7204	-0.6082	-0.7296	-0.5865
ec12	0.2450	-0.1011	0.0049	0.0064	0.0535	0.0391	0.5970	0.6007	0.5624	0.6767	0.6070	0.6746	0.6145	0.4822
ec13	-0.0977	-0.1469	0.0139	0.0101	0.0233	0.0166	0.0754	0.0792	0.0735	0.1178	0.0687	0.0893	0.0711	0.0869
ec21	0.2176	0.1033	-0.0606	-0.0507	-0.3505	-0.4004	0.2682	0.1629	0.2417	0.1814	0.2651	0.1990	0.2739	0.1323
ec22	0.3652	0.6739	-0.2130	-0.1952	-0.3995	-0.3658	-0.3195	-0.2764	-0.3004	-0.3080	-0.3380	-0.3078	-0.3139	-0.2203
ec23	0.0063	-0.0963	-0.0169	-0.0163	-0.1801	-0.2169	0.0989	0.0321	0.1025	-0.0180	0.0953	0.0231	0.0926	0.0716
ec31	0.4777	0.5312	-0.0206	0.0061	-0.0328	0.0102	0.2957	0.3278	0.3184	0.3848	0.2982	0.2859	0.2587	0.4654
ec32	0.9469	1.0637	0.0512	0.1000	0.0124	0.1052	0.6815	0.6200	0.7368	0.5448	0.7168	0.4532	0.6017	0.8550
ec33	0.0665	0.0692	0.0113	0.0226	0.0784	0.0313	-0.9174	-1.0363	-0.9170	-1.1076	-0.9175	-1.0429	-0.9113	-1.1620

Note: 1.) i,j = 1,2,3 ; 1 = Beer, 2 = Spirits, and 3 = Wine
2.) e(i) = Income Elasticity of Good i
3.) eu(i,j) = Uncompensated Demand Elasticity of Goods i on Price j
4.) ec(i,j) = Compensated Demand Elasticity of Goods i on Price j
For Linear Models, ec(i,j) is calculated from eu(i,j) + [w(j) x e(i)] ; w(j) = sample mean of budget share.

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Acknowledgement

Mr. William R. Ponicki, Prevention Research Center, for his generosity to provide the datasets