Interactions between Cigarette and Alcohol Consumption in Rural China*

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April 2009

Please Refer to:

Yu X. and D. Abler: "Interactions between Cigarette and Alcohol Consumption in Rural China", *European Journal of Health Economics*. Vol. (11):151–160.

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Abstract

The objective of this paper is to analyze interdependencies between cigarette and alcohol consumption in rural China, using panel data for 10 years (1994-2003) for rural areas of 26 Chinese provinces. There have been many studies of cigarette and alcohol consumption considered separately but few to date for China on interactions between the consumption of these two products. Taxes are often recommended as a tool to reduce alcohol and cigarette consumption. If cigarettes and alcohol are complements, taxing one will reduce the consumption of both and thus achieve a double public health dividend. However, if they are substitutes, taxing one will induce consumers to increase consumption of the other, offsetting the public health benefits of the tax. Our results indicate that the demands for both cigarettes and alcohol are very sensitive to the price of alcohol, but not to the price of cigarettes or to income. This suggests that taxes on alcohol can have a double dividend. On the other hand, an increase in cigarette taxes may not be effective in curbing cigarette or alcohol consumption in rural China.

Key Words: Interactions; Cigarette and Alcohol Consumption; Habit Persistence; Rural China; Dynamic Panel Data.

Introduction

Cigarette and alcohol policies in China face a dilemma (Hu et al. 2006). A large number of studies have shown that cigarette consumption and excessive alcohol consumption are very harmful to health. Cigarettes account for more than 13% of male deaths in China (Liu et al. 1998; Lam et al. 2002). Excessive alcohol consumption has been linked to liver cancer, female choriocarcinoma mortality, increased admission rates to psychiatric hospitals, and traffic accidents in China (Hsing et al. 1991; Le and Xu 1992; Guo et al. 1994; Cochrane et al. 2003). Furthermore, addiction to cigarettes or alcohol can crowd out other household expenditures, having a negative impact on living standards, particularly for low-income households (Hu et al. 2005). Therefore, the Chinese government is trying to adopt policies to reduce alcohol and tobacco consumption, especially the consumption of cigarettes. As shown in Table 1, as per capita income has increased in rural China, the expenditure shares of both cigarettes and alcohol consumption have continuously decreased from 1994 to 2003. The expenditure share of cigarettes dropped from 2.51% in 1993 to 1.18% in 2003, and per capita consumption decreased from 24.6 packs to 21.6 packs though there are some fluctuations during this period. The expenditure share of alcohol decreased from 1.35% in 1994 to 0.97% in 2003; however, per capita consumption increased from 6.5 kg to 7.8 kg.

On the other hand, cigarettes and alcohol are important industries in China. This is particularly true for some less developed regions in China, such as Guizhou Province and Yunnan Province, where they are important income sources for farmers and major revenue sources for the government (Hu and Mao 2002; Hu et al. 2006). In 2004 China collected 210 billion Yuan of taxes from the cigarette industry[1], which represents nearly 8% of the Chinese government's total annual revenue.

A number of studies of the demand for alcohol (Wu 1999; Pan, Fang and Malaga 2006) and the demand for cigarettes (e.g. Hu and Tsai 2000; Lance et al. 2004; Bishop, Liu and Meng 2007) have been conducted for China. However, little attention has been paid to interdependencies between alcohol and cigarette consumption in China, with the exception of Fan, Wailes and Cramer (1995). The objective of this paper is to analyze the interactions between cigarette and alcohol consumption in rural China, using panel data for 10 years

[1] Source: China Cigarette Corporation, http://www.cigarette.gov.cn//ycgk.php. Government revenue includes both local and central government revenues.

(1994-2003) for rural areas of 26 Chinese provinces. In China, most people (59.6% of the total population in 2003) still live in rural areas,[2] although urbanization is rapidly occurring.

The issue of interdependencies has important implications from both econometric and policy perspectives. From an econometric perspective, most existing empirical studies of cigarette demand for China exclude the price of alcohol, and vice versa. If there are interdependencies, the results from these studies are biased (Decker and Schwartz 2000).

From a policy perspective, taxes are often recommended as a tool to reduce alcohol and cigarette consumption. Becker and Murphy (1988), using a theory of rational addiction, suggest that taxes may be a very useful tool to reduce harmful addictions, and a number of empirical studies have found that alcohol and cigarette consumption are responsive to price (Levit and Coate 1982; Baltagi and Levin 1986; Chaloupka 1991; Levy et al. 2005; Baltagi and Geishecker 2006; Baltagi and Griffin 2001; Baltagi, Griffin and Xiong 2000; Bishop, Liu and Meng 2007). If cigarettes and alcohol are complements, taxing one will reduce the consumption of both and thus achieve a double public health dividend. However, if they are substitutes, taxing one will induce consumers to increase consumption of the other, offsetting the public health benefits of the tax.

Studies for countries other than China have yielded conflicting results about the relation between cigarettes and alcohol. Goel and Morey (1995) find that cigarettes and liquor are substitutes in consumption using panel data for US states from 1959-1982, while Jones (1989a) finds that cigarettes are a complement to all types of alcoholic beverages using

[2] Source: *China Statistical Yearbook 2005*.

aggregate quarterly expenditure data for the UK from 1964-1983. Decker and Schwartz (2000), using individual-level data for the US from 1985-1993, find an asymmetry in Marshallian cross-price elasticities of demand: higher alcohol prices decrease both alcohol consumption and smoking, while higher cigarette prices tend to decrease smoking but increase drinking. Busch et al. (2004) reached the same conclusion using individual-level data for the US from 1995-2001.

Medical and psychological research indicates that co-occurrence rates of alcohol and cigarette addiction are very high (Batel et al. 1995), which may be partly a result of genetic factors (Madden et al. 2000). In a study of light smokers, King and Epstein (2005) find that alcohol dose-dependency increases the urge to smoke.

With some exceptions (e.g. Goel and Morey 1995), studies to date of the interactions between cigarette and alcohol consumption do not consider the biological and psychological characteristics of addiction, such as dependence, reinforcement and tolerance, which imply that current consumption may be affected by past consumption. This paper constructs a dynamic model of consumption involving a theory of habit persistence in order to account for these factors.

A Habit Persistence Model

Studies of the demand for cigarettes or alcohol typically begin with a Marshallian demand function that depends on income, prices, and a vector of household characteristics. Advertising is sometimes also included in the demand function (e.g., Baltagi and Levin 1986;

Nelson 2003), although we lack data on advertising and thus cannot include it here. For an addictive product such as alcohol or cigarettes, dependence, reinforcement and tolerance are also important factors. Dependence, also known as withdrawal effects, means that consumption of a drug takes precedence over consumption of other goods. Reinforcement means that current consumption of a good increases future consumption of that good, and tolerance means that there is a progressively decreasing response to consumption of a drug (Jones 1999; Thombs 2006).

Dependence, reinforcement and tolerance imply that current consumption of cigarettes and alcohol may depend on the past consumption path, suggesting a habit persistence model of consumption. Following the habit persistence model (Brown 1952; Nerlove 1983), per capita consumption of cigarettes or alcohol in province i of rural China at time t (Y_{it}) is assumed to be determined by past consumption:

$$\ln Y_{it} = \sum_{k=0}^{\infty} \rho_k f\left(P_{it-k}, PCI_{it-k,} Z_{it-k}\right), \tag{1}$$

where P_{it-k} is a vector of prices at time $t-k$, PCI_{it-k} is per capita income, Z_{it-k} is a vector of household characteristics, and the ρ_k are parameters reflecting the impact of the past consumption on current consumption. Suppose ρ_k is geometrically declining, i.e. $\rho_k = (1-\lambda)\lambda^k$, $0 < \lambda < 1$, where $k = 0, 1, 2, \ldots$. Then equation (1) can be rewritten as

$$\ln Y_{it} = (1-\lambda)\sum_{k=0}^{\infty}\lambda^k f\left(P_{it-k}, PCI_{it-k,} Z_{it-k}\right). \tag{2}$$

Taking a one-period lag of equation (2), multiplying that one-period lag by λ, and substituting the resulting expression into the right-hand side of equation (2) yields

$$\ln Y_{it} = \lambda \ln Y_{it-1} + (1-\lambda) f\left(P_{it}, PCI_{it,} Z_{it}\right), \tag{3}$$

which is a dynamic model of consumption that can be estimated.

Of the current studies on interdependencies between alcohol and cigarette consumption, only Goel and Morey (1995) use a dynamic equation.[3] Other studies do not employ a dynamic model, which for some studies that used individual-level survey data can be explained by the absence of a panel component in those surveys. Since this study uses provincial-level panel data for 26 provinces, a dynamic model is feasible.

In the Becker and Murphy (1988) model of rational addiction, current-period consumption depends on not only lagged consumption but also expected future consumption because rational addicts consider how much they are planning to consume in the future when making current consumption decisions. In our case we have panel data for 10 years (1994-2003). One of those years is used up by the lagged consumption term in equation (3) and another by the GMM estimation procedure we employ (Arellano and Bond 1991; Arellano

[3] There have been studies of cigarette consumption alone (Baltagi and Griffin 2001; Baltagi, Griffin and Xiong 2000; Baltagi and Levin 1986) and studies of alcohol consumption alone (e.g. Baltagi and Geishecker 2006) that have used dynamic models.

and Bover 1995; Blundell and Bond 1998). Adding a future consumption variable would use up two additional years (one for the variable itself and one for the GMM estimation procedure), leaving our panel component rather short. We therefore do not include future consumption in the demand equation to be estimated.

Empirical Model and Data

The price vector P_{it} in the model to be estimated includes prices of cigarettes, alcohol, grains, and meat. The price of grains is included because grains are both an important income source and an important food source in rural China. The price of meat is included for similar reasons—the expenditure share of meat has increased in recent years and now is close to that of grains (Yu and Abler 2009). The vector of household characteristics Z_{it} in the empirical model includes average household size, house area (in square meters) per capita, average cropland area (in *mu*) per capita,[4] and the fraction of the adult population with more than a primary school education[5]. The empirical model also includes a time-trend variable to capture other factors that may be affecting cigarette and alcohol consumption over time.

The function $f\left(P_{it}, PCI_{it,} Z_{it}\right)$ is assumed to be linear in the logs of all its arguments:

[4] A *mu* is a traditional Chinese measure of land area, with 15 *mu* equal to one hectare.

[5] An anonymous referee suggested including a variable to reflect the age structure in each province. However, data on age structure for rural areas at the provincial level are available only once every ten years from the Census. Including this variable from the Census would not change the results because the first-order difference or subtraction of the mean would fully remove the effects of this variable.

$$f\left(P_{it}, PCI_{it,} Z_{it}\right) = \alpha^* + \sum_j \beta_j^* \ln P_{jit} + \eta^* \ln PCI_{it} + \sum_k \gamma_k^* \ln Z_{kit} + \sigma^* t, \qquad (4)$$

where . α^*, the β_j^*, η^*, the γ_k^*, and the σ^* are parameters.

Let $\alpha = (1-\lambda)\alpha^*$, $\beta_j = (1-\lambda)\beta_j^*$, $\eta = (1-\lambda)\eta^*$, $\gamma_k = (1-\lambda)\gamma_k^*$, and $\sigma = (1-\lambda)\sigma^*$. Substituting equation (4) into (3), and appending a term to reflect unobserved heterogeneity among provinces (v_i) as well as an error term (ε_{it}), yields the model to be estimated:

$$\ln Y_{it} = \alpha + \lambda \ln Y_{it-1} + \sum_j \beta_j \ln P_{jit} + \eta \ln PCI_{it} + \sum_k \gamma_k \ln Z_{kit} + \sigma_1 t + v_i + \varepsilon_{it}. \qquad (5)$$

The unobserved heterogeneity term is assumed to be fixed over time.

Clearly, the error term ε_{it} is correlated with $\ln Y_{it+1}$, $\ln Y_{it+2}$, etc. in equation (5). Therefore, a fixed-effects model, a random-effects model, and the maximum likelihood estimator usually applied to static panel data models are all inconsistent (Anderson and Hsiao 1981; Arellano and Bond 1991). Taking the first difference of equation (5), Anderson and Hsiao (1981) suggest a consistent estimator for this equation using $\Delta \ln Y_{it-2}$ ($= \ln Y_{it-2} - \ln Y_{it-3}$) as an instrumental variable for $\Delta \ln Y_{it-1}$. However, Arellano and Bond (1991) and Judson and Owen (1996) point out that the Anderson-Hsiao estimator is inefficient because it does not take into account all the available moment restrictions, and the performance is very poor when the sample size is small . Arellano and Bond (1991) suggest a GMM estimator which is more efficient because it uses additional instruments whose validity is based on the orthogonality between lagged values of Y_{it} and the error term ε_{it}.

This method is further extended by Arellano and Bover (1995) and fully developed by Blundell and Bond (1998). Roodman (2006) provides a pedagogic instruction to the practice of linear GMM with STATA. GMM methods for dynamic panel data are used to estimate the econometric model in this study.

The panel dataset consists of data for 10 years (1994-2003) for rural areas of 26 Chinese provinces, with data being at the provincial level. Data are from the China National Statistics Bureau (CNSB). The dataset begins in 1994 in order to avoid prior years in which prices were significantly distorted by government regulations. Even though China began food policy reforms in the late 1970s, price regulations were not abandoned until 1993 (Ma et al. 2004). A descriptive statistics of the data can be seen in Table 1.

Prices for 1994 are derived from *Rural Household Survey Statistics* (RHSS), a CNSB publication, dividing total expenditure in each group by the total quantity consumed. Starting with the 1994 unit values, we use the provincial consumer price indices (CPI) for cigarettes, alcohol, grains, and meat for 1995-2003 to compute prices for those years. CPIs are obtained from the *China Statistical Yearbook of Prices and Urban Household Survey* (various editions), published by CNSB. Data on the consumption of alcohol (measured in kilograms per capita, including spirits, beer and wine) and cigarettes (measured as packages per capita), as well as the household characteristic variables in equation (5), are from *Rural Household Survey Statistics* (various editions). *Rural Household Survey Statistics* covers 27 provinces, of which Tibet is excluded from our analyses because of missing data, leaving 26 provinces.

Nominal values are converted to real terms using the provincial overall rural CPI, with all prices expressed in 1994 Yuan.

The optimal matrix of instruments in GMM estimation depends on whether the explanatory variables are predetermined or strictly exogenous. We assume that prices and per capita income are predetermined while the household characteristic variables (as well as a time trend) are strictly exogenous.

Results and Discussion

Table 2 reports the estimation results for cigarette and alcohol demand in rural China, using the fixed-effects model and the first-difference model. The results show that the first-difference model fits the data very poorly. Both the coefficients of lagged consumption for cigarettes and alcohol are negative in the first-difference model, which does not make sense. Though the fixed-effects model is not consistent for a dynamic panel dataset, the results can be used for comparison with GMM methods such as the Arellano-Bond (1991) and Arellano-Bover (1995) methods.

Using GMM, Table 3 shows the estimation results for cigarette and alcohol demand in rural China. We report the estimation results for both the Arellano-Bond method and the Arellano-Bover method. The Arellano-Bover method proposes an orthogonal deviations transformation, subtracting the mean of all available future observations, rather than first-order differences (subtracting the previous observation as in Arellano-Bond method). In this way the lagged observations of a variable do not enter the formula for the transformation;

they remain orthogonal to the transformed errors and are valid as instruments (Arellano and Bover 1995). However, like differencing, taking orthogonal deviations still removes fixed effects.

The tests for over-identifying restrictions reject the null hypothesis of over-identifying restrictions for the one-step method for both the alcohol and cigarette equations in both the Arellano-Bond model and the Arellano-Bover model, but do not for the two-step method in the Arellano-Bover model. This implies that there is an identification problem for the one-step GMM methods.

The consistency of GMM estimators hinges heavily upon the assumption that $E[\varepsilon_{it}\varepsilon_{it-2}] = 0$ rather than $E[\varepsilon_{it}\varepsilon_{it-1}] = 0$ (Arellano and Bond 1991). The Arellano-Bond test of the null hypothesis of no second-order correlation cannot be rejected for any of the GMM models, which indicates that the estimators are consistent.

The over-identification tests cannot reject the null hypothesis of over-identifying restrictions for the two-step Arellano-Bover method; neither can the test of exogeneity of instrumental variables. Furthermore, the estimation results of the two-step Arellano-Bover method are consistent with that of the fixed-effects model. Therefore, the following discussion is based on these results. Arellano and Bond (1991) and Blundell and Bond (1998) point out that though the two step method is asymptotically more efficient, the reported two-step standard errors tend to be severely downward biased. Windmeijer (2005) developed a finite-sample correction to the two-step covariance matrix, which makes the two-step method more efficient than the one-step method. Table 3 reports both the uncorrected t-ratios and the corrected t-ratios for the two-step Arellano-Bover method. The discussion here is based on the corrected t-ratios.

Dependence, Reinforcement and Tolerance

The lagged terms for both cigarettes and alcohol are statistically significant and positive, implying that the effects of dependence, reinforcement and tolerance are important for both products. The coefficients for cigarettes and alcohol are 0.426 and 0.146, respectively. This implies that the consumption of cigarettes has stronger dependence, reinforcement and tolerance effects than alcohol, and current consumption of cigarettes has stronger impacts on future consumption of cigarettes than on alcohol consumption. .

Prices

The most interesting result of this study is that the demands for both alcohol and cigarettes are highly sensitive to the price of alcohol. The estimated own-price elasticity of demand for alcohol is about –1.53 in short run, substantially higher than the estimate of -0.34 in Fan, Wailes and Cramer (1995). Our estimated short-run cross-price elasticity of the demand for cigarettes with respect to the price of alcohol is about -0.62, which indicates that cigarettes are a Marshallian complement to alcohol. This is also substantially larger in absolute value than the estimate of -0.19 in Fan, Wailes and Cramer (1995). Our estimated long-run cross-price elasticity is approximately -1.08.

. Our results imply that taxes on alcohol may be a very effective tool for reducing consumption of both alcohol and cigarettes. Similar results can be found in Decker and Schwartz (2000) and Busch et al. (2004). A possible explanation based on the medical and psychological literature, as mentioned above, is that alcohol dose-dependency increases the urge to smoke, at least among light smokers (King and Epstein 2005).[6]

Interestingly, our results fail to show a statistically significant effect of the price of cigarettes on either cigarette consumption or alcohol consumption. The point estimate of the own-price elasticity of demand for cigarettes is positive and very small (about 0.09 in the short run and 0.16 in the long run). The policy implication is that an increase in cigarette taxes may not be effective in curbing cigarette or alcohol consumption in rural China, although it could be an efficient way of raising government revenue. Similar results concerning the impacts of prices of cigarettes and alcohol can be found in the fixed-effects model.

The estimated short-run cross-price elasticity of demand for alcohol with respect to the price of grains is about 0.64 and statistically significant. The estimated impact of grain prices on cigarette consumption is also positive, but it is not statistically significant. The results for alcohol consumption may be explained by the income effect of an increase in grain price: as grain prices increase, rural incomes increase and hence the demand for alcohol increases. The estimated short-run cross-price elasticities of demand for cigarettes and alcohol with respect to the price of meat are not statistically significant.

[6] To our knowledge similar research to King and Epstein (2005) has not been done for heavy smokers.

Income

The per capita income variable is not statistically significant for either cigarettes or alcohol. The point estimates of the income elasticities are 0.19 and 0.13, respectively. The results imply that demands for alcohol and cigarettes are not sensitive to income. This finding is consistent with some studies on cigarette consumption (Yen 2005; Bishop, Liu and Meng 2007) which argue that income may not play a significant role in the consumption of addictive products due to dependence effects.

Household Size, House Area, and Cropland Area

The estimated impact of average household size on the demand for cigarettes is negative and marginally significant, while the estimated impact on the demand for alcohol is not statistically significant. A possible explanation is that an increase in household size raises the pressure on smokers within the household to quit, because smoking often crowds out expenditures for other goods (Busch et al. 2004). Smoking can also have serious health effects on other members of the household through second-hand smoke, and the number exposed to second-hand smoke increases as household size increases.

House area and cropland area per capita do not have a statistically significant effect on the demand for alcohol. House area also is not statistically significant for cigarette consumption. Cropland area per capita has a negative and statistically significant impact on cigarette consumption, while the estimated impact on the demand for alcohol is not statistically significant. Mullahy and Sindelar (1993) suggest that addictive goods, such as alcohol, are complementary in consumption with leisure. As cropland area per capita increases, there is more farm work to do; hence leisure decreases and in turn the demand for cigarettes decreases.[7]

Education

Another interesting result of this study is that education in rural China increases cigarette and alcohol consumption. The estimated impacts of an increase in the fraction of the population with more than primary education on consumption of these two goods are positive, and statistically significant for alcohol consumption. In the short run, an increase in this fraction by 1% increases alcohol consumption by about 1.84% .

Wu (1999) and Pan, Fang and Malaga (2006) also find that education is positively associated with consumption of alcoholic products in China, except for the demand for wine coolers (Pan, Fang and Malaga 2006). Hu and Tsai (2000) find that education is positively correlated with consumption of cigarettes.

In rural China, higher education is often associated with more social activities where cigarettes and alcohol are available and consumption is encouraged. Peer pressure (Flay et al. 1983) in these settings may induce more people to consume cigarettes and alcohol, and those already consuming to consume more. The policy implication for reducing the consumption of

[7] For this argument to be valid the market for hired farm labor must be limited in some way or hired labor must be an imperfect substitute for farm household labor in production. Otherwise a farm household with more cropland would simply hire more labor to work that land. Because land in rural China is equally divided among peasants at the village level, hired labor is very rare.

alcohol and cigarettes is to promote alternative, healthier lifestyles and other types of social activities that do not involve cigarettes or alcohol.

Studies for other countries suggest more ambiguous effects of education on cigarette and alcohol consumption. For the US, Grossman, Chaloupka and Sirtalan (1998) found that education has a positive impact on alcohol consumption. However, another study for the US by Decker and Schwartz (2000), and a study for Russia by Baltagi and Geishecker (2006), suggest that the relation between education and alcohol consumption might have an inverted U-shape: as education increases, alcohol consumption increases at first, and then decreases, with the peak typically occurring at a high school education level. Testing a U-shaped model for rural China is not really feasible because the percentage of the population in rural China with more than a high school education is still very low, only 1.1% in 2005.[8].

Studies for the UK (Jones 1989b) and US (Decker and Schwartz 2000; Yen 2005) suggest that education is negatively associated with the demand for cigarettes. A possible explanation in these countries is that education may increase the cognitive skill of an individual regarding the health risks of smoking to both the individual and others in the household through second-hand smoke.

Time Trend Variable

The time trend is statistically significant and negative for both cigarettes and alcohol consumption. in rural China. The estimated values of the coefficients are such that, other

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[8] Source: *Rural Household Survey Statistics 2006*.

things equal, the demand for cigarettes and alcohol per capita continuously declined during 1994-2003 period.

Conclusions

Using aggregate data for 26 provinces from 1994 to 2003 to estimate a habit persistence model of the demand for cigarettes and alcohol, this paper explored the interactions between cigarette and alcohol consumption in rural China. The main findings are that:

(1) The dependence, reinforcement and tolerance effects are statistically significant both for cigarette consumption and for alcohol consumption, with a stronger effect for cigarettes than alcohol.

(2) The demands for both cigarettes and alcohol are very sensitive to the price of alcohol, but not to the price of cigarettes or to income.

(3) The consumption of alcohol is positively associated with education. In rural China, higher education is often associated with more social activities where alcohol is consumed.

Our results imply that taxes on alcohol can have a double dividend—they may be a very effective tool for reducing consumption of both alcohol and cigarettes. On the other hand, an increase in cigarette taxes may not be effective in curbing cigarette or alcohol consumption in rural China, although it could be an efficient way of raising government revenue. Our results for education suggest the promotion of alternative, healthier lifestyles and other types of social activities that do not involve alcohol. Our results indicate that cigarettes are a Marshallian complement to alcohol, so that reducing alcohol consumption may also reduce consumption of cigarettes.

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Table 1. Per Capita Cigarette and Alcohol Consumption in Rural China (1994-2003)

Year	Net Disposable Income (Current Yuan)	Average Household Size (Persons)	House Area per Capita (m^2)	Cropland Area per Capita (mu)	Fraction of Population with > Primary Education (%)	Total Expenditure (Yuan)	Cigarettes				Alcohol			
							Consumption (Packs)	Average Price (Yuan/Pack)	Expenditure (Yuan)	Expenditure Share (%)	Consumption (Kg)	Average Price (Yuan/Kg)	Expenditure (Yuan)	Expenditure Share (%)
1994	1220.98	4.73	19.52	2.53	47.4	1016.81	24.60	1.04	25.51	2.51	6.53	2.10	13.74	1.35
1995	1577.74	4.65	20.32	2.54	48.9	1310.36	27.39	1.07	29.43	2.25	7.11	2.36	16.81	1.28
1996	1926.07	4.58	20.59	2.69	51.92	1572.08	25.00	1.13	28.37	1.80	7.13	2.51	17.89	1.14
1997	2090.13	4.52	21.34	2.42	53.42	1617.15	23.64	1.13	26.80	1.66	6.98	2.56	17.84	1.10
1998	2161.98	4.45	22.18	2.40	54.8	1590.33	23.09	1.12	25.94	1.63	6.98	2.53	17.68	1.11
1999	2210.34	4.40	22.96	2.42	56.18	1577.42	23.86	1.09	25.97	1.65	7.02	2.50	17.52	1.11
2000	2253.42	4.34	23.61	2.32	58.49	1670.13	23.28	1.06	24.71	1.48	7.10	2.47	17.52	1.05
2001	2366.40	4.29	24.33	2.33	59.77	1741.09	22.75	1.06	24.07	1.38	7.50	2.45	18.37	1.05
2002	2475.63	4.27	25.11	2.34	60.48	1834.31	22.10	1.06	23.43	1.28	7.70	2.43	18.73	1.02
2003	2622.20	4.23	26.18	2.30	61.38	1943.30	21.60	1.06	22.88	1.18	7.80	2.43	18.94	0.97

Source: *China Statistical Yearbook of Prices and Urban Household Survey* (Various Editions)

Table 2. Estimation Results I

	Fixed-Effects Model				First-Difference Model				First-Difference/SURE Model			
	ln(Cigarette Consumption)		ln(Alcohol Consumption)		ln(Cigarette Consumption)		ln(Alcohol Consumption)		ln(Cigarette Consumption)		ln(Alcohol Consumption)	
	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t	Coef.	t
ln(Lagged Consumption)	0.215	3.45***	0.121	3.27***	-0.353	-6.63***	-0.055	-1.77*	-0.349	-6.99***	-0.028	-0.96
ln(Cigarette Price)	0.147	1.11	0.043	0.20	-0.105	-0.54	0.255	0.89	-0.105	-0.56	0.198	0.71
ln(Alcohol Price)	-0.743	-3.51***	-0.772	-2.36**	-1.401	-5.57***	-0.329	-0.91	-1.399	-5.72***	-0.308	-0.88
ln(Grain Price)	-0.022	-0.19	0.487	2.66***	-0.049	-0.43	0.266	1.61	-0.048	-0.44	0.298	1.86
ln(Meat Price)	-0.058	-0.47	0.130	0.65	-0.115	-0.95	0.149	0.84	-0.116	-0.98	0.119	0.69
ln(Per Capita Income)	-0.138	-1.07	0.272	1.31	0.347	2.50**	0.002	0.01	0.345	2.56	0.039	0.20
ln(Average Household Size)	-1.806	-3.83***	-1.542	-2.13**	-1.280	-2.22**	-0.075	-0.09	-1.280	-2.28	-0.160	-0.20
Ln(House Area per Capita)	-0.148	-1.44	0.026	0.15	-0.077	-0.70	0.218	1.31	-0.077	-0.71	0.177	1.10
ln(Cropland Area per Capita)	-0.177	-2.56***	0.035	0.33	-0.065	-1.05	0.003	0.03	-0.065	-1.08	0.007	0.08
Ln(Fraction of Population with > Primary Education)	0.055	0.20	1.199	2.71***	0.429	1.60	1.140	2.91***	0.431	1.66*	1.216	3.19***
Time	-0.037	-3.87***	-0.022	-1.50	-0.079	-6.13***	-0.004	-0.24	-0.079	-6.29***	-0.007	-0.36
Intercept	7.490	5.50***	2.829	1.34								
Significance Test for the Model	F(11,197)	=12.06***	F(11,197)	=7.37***	F(10,197)	=110.40***	F(10,197)	=2.36**	Chi(10)	=110.40***	Chi(10)	=22.51**

(1)*** Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level

(2) In order to improve the efficiency of the First-Difference Model, the seemingly unrelated estimation (SURE) (Zellner 1962) is used.

Table 3. Estimation Results II

	ln(Cigarette Consumption)							ln(Alcohol Consumption)						
	Arellano-Bond One-step		Arellano-Bover One-Step		Arellano-Bover Two-Step			Arellano-Bond One-step		Arellano-Bover One-Step		Arellano-Bover Two-Step		
	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Corrected t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Coeff.	t-ratio	Corrected t-ratio
ln(Lagged Consumption)	0.207	2.45**	0.385	3.12***	0.426	8.13***	3.16***	0.054	1.16	0.148	2.74***	0.146	5.31***	1.82*
ln(Cigarette Price)	0.115	0.56	0.093	0.69	0.089	1.32	0.63	0.072	0.28	0.005	0.02	0.049	0.31	0.15
ln(Alcohol Price)	-1.366	-4.38***	-0.590	-2.55***	-0.619	-5.56***	-2.33**	-0.782	-2.29**	-0.728	-2.23**	-1.526	-4.20***	-1.94*
ln(Grain Price)	0.014	0.11	0.016	0.14	0.017	0.27	0.11	0.656	4.24***	0.510	2.81***	0.635	5.83***	3.02***
ln(Meat Price)	-0.159	-1.26	-0.063	-0.52	-0.068	-1.48	-0.65	0.081	0.53	0.095	0.47	-0.029	-0.36	-0.18
ln(Per Capita Income)	-0.008	-0.05	-0.182	-1.40	-0.188	-2.33**	-1.17	0.150	0.78	0.306	1.47	0.125	0.86	0.43
ln(Average Household Size)	-1.670	-2.44**	-1.531	-3.07***	-1.377	-4.80***	-1.93*	-0.473	-0.61	-1.551	-2.20**	-1.203	-2.88***	-1.28
Ln(House Area per Capita)	-0.150	-1.10	-0.139	-1.35	-0.088	-1.25	-0.56	0.018	0.10	-0.003	-0.02	0.161	1.46	0.57
ln(Cropland Area per Capita)	-0.088	-1.03	-0.157	-2.25**	-0.143	-4.51***	-1.96**	-0.105	-1.10	0.032	0.30	0.053	0.82	0.42
ln (Fraction of Population with > Primary Education)	0.086	0.25	0.175	0.61	0.269	1.83*	0.85	1.723	4.32***	1.246	2.86***	1.848	5.69***	2.46**
Time Trend	-0.046	-3.99***	-0.030	-2.94***	-0.032	-8.80***	-3.36***	-0.017	-1.22	-0.023	-1.62	-0.031	-4.29***	-2.23**
Test of Over-Identifying Restrictions														
	chi2(35) = 100.315***		chi2(14) = 44.40***		chi2(14) = 20.51			chi2(35) = 59.736***		chi2(14) = 25.20**		chi2(14) = 17.52		
Tests of Exogeneity of Instrument Subsets														
	-		chi2(10) = 31.65***		chi2(10) = 8.91					chi2(10) = 20.63**		chi2(10) = 13.46		
Test of First-Order Non-Autocorrelation among Residuals														
	Z=6.120***		Z=-5.270***		Z=-1.880*			Z=-1.941*		Z=-1.980**		Z=-2.200**		
Test of Second-Order Non-Autocorrelation among Residuals														
	Z=0.835		Z=1.350		Z=1.490			Z=-1.096		Z=-0.750		Z=-0.42		

(1) *** Statistically significant at the 1% level; **Statistically significant at the 5% level; *Statistically significant at the 10% level.

(2) Sargan test of Over-Identification is used for Arellano-Bond estimator, and the Hansen's test used for Arellano-Bover estimator. As the number of instruments increases, the Hansen's test is more robust.

(3) Correction of the variance for two-step estimation suggested by Windmeijer (2005).