

## Cigarette Consumption in China: Implications for Public Health and Trade

This paper discusses the general trends in China's cigarette consumption and estimates demand elasticities for cigarettes using household survey data. Demand elasticities estimated from a LA/AIDS model indicate that household demand for cigarettes is elastic with respect to total expenditure and own price but inelastic with respect to cross prices. Our analysis suggests that China's cigarette consumption will continue to grow as income increases and smoking-related social costs are expected to increase.

**Qingbin Wang<sup>1</sup> and Catherine Halbrendt<sup>2</sup>, University of Delaware**  
**Helen H. Jensen<sup>3</sup>, Iowa State University**

### Introduction

China's steady growth in population and per capita cigarette consumption has made China the world's leading cigarette consumer since the late 1980s. With about one-fifth of the world's population, China accounted for more than one-third of world cigarette consumption during 1988 to 1992 (Ren, 1993). There are officially 300 million smokers in China and 10 percent of them are women. But the number of smokers is believed to be vastly understated because many female smokers in China don't admit to smoking (*The Wall Street Journal*, April 28, 1994). China's per capita cigarette consumption increased from 30.82 packs in 1978 to 70.02 packs in 1992. Such rapid growth in cigarette consumption is also reflected in domestic cigarette production, from 11.82 to 32.85 million cases over the same period [250 cartons per case and 200 cigarettes per carton, State Statistical Bureau of China (SSB), 1993].

Rapid growth in China's cigarette consumption and production has brought about many critical problems such as smoking-related health hazards and competition between tobacco and grain crops for the extremely limited per capita arable land (Zhao, 1993; Ren, 1993). The *China News Digest* (February 6, 1995) reported that the deaths from lung cancer and other smoking-related illnesses in China were about one million in 1992 and that number could reach 2 million by 2030. Considering China's gradual transition from a centrally-planned to a market economy, its cigarette consumption and smoking-related social costs are increasingly dependent on consumer demand and government policy. Empirical estimates of demand elasticities for cigarettes and some closely related commodities in China are important for policymakers to assess the impacts of alternative policies

and for cigarette industries to predict market demand. Information on China's cigarette demand is also important for the tobacco and cigarette industries and traders in many other countries such as the United States to understand China's trade behavior. With \$966 million cigarette and tobacco trade in 1992 (ERS/USDA, 1993), China has become an important player in the world tobacco and cigarette markets.

The objectives of this study are threefold: (1) to discuss the general trends in China's cigarette supply and demand as well as smoking-related social costs; (2) to estimate demand elasticities for cigarettes and some closely related commodities using a demand system approach; and (3) to discuss implications of China's cigarette consumption for public health and international trade. To the best of our knowledge, this may be the first empirical study on China's cigarette demand using household survey data. The following sections discuss the general trends, specify an empirical demand model, describe the data source, present the estimation results, and discuss major conclusions and implications.

### China's Cigarette Production, Consumption, Trade and Social Costs

Although historical data on China's cigarette production and consumption are quite limited, this section presents an effort to trace the general trends based on the most recent available data. Some related economic and policy issues are also briefly discussed.

#### Tobacco and Cigarette Production

The time-series data of China's flue cured tobacco leaf and cigarette outputs indicate that the growth in tobacco leaf and cigarette outputs moved together from 1950 to 1978, but tobacco leaf output has fluctuated significantly since 1978. China's cigarette output

increased from 1.85 million cases in 1950 to 32.85 million cases in 1992, while the flue cured tobacco leaf output rose from 0.06 to 3.12 mmt over the same period. China's annual tobacco area and average yield suggest that the steady growth in tobacco output since 1978 has mainly come from increased acreage rather than increased yields. In fact, the per hectare yield of flue cured tobacco declined from 2190 kilogram (kg) in 1980 to 1687 kg in 1992. In addition to weather, the expansion of tobacco production to areas with low and unstable yields has contributed to the fluctuation in average yield and total output.

Three policy factors have contributed to China's rapid growth in tobacco and cigarette production since 1978. First, the replacement of the commune system by the "household production contract system" around 1980 has allowed farmers to make their own production decisions (Lin, 1987). With a relatively high market price for tobacco leaf in the past several years, many farmers have shifted their production efforts from grain to tobacco crops. Second, because local governments can share about 38 percent of the tobacco and cigarette tax revenue, many local governments have set favorable policies for tobacco and cigarette production (Zhao, 1993; ERS/USDA, 1993). As a result, China's total tobacco leaf area in 1992 was 1.89 million ha which was 45 percent higher than the central government's target (ERS/USDA, 1993). Third, China did not have strict restrictions on cigarette production and transportation until China's Tobacco Monopoly Law was published in 1992.

#### Cigarette Consumption

China's official data on average per capita cigarette consumption are available for selected years during 1950 to 1978 and all years thereafter (SSB, 1993). Similar to the changes in cigarette and tobacco production, the average per capita cigarette consumption increased slowly from 1950 to 1978 but more than doubled during 1978 to 1992. China officially has 300 million smokers and 10 percent of them are women, but the number may be vastly understated because many female smokers do not admit to their smoking habit. According to the reports of a nationwide survey conducted by the SSB in 1992, the national average smoking rate for people over 15 years old was 34.9 percent, and Henan province had the highest provincial average rate of 41.5 percent. SSB (1992) has predicted that the number of Chinese smokers will continue to grow at a significant rate and the starting age of smoking will decline.

#### Cigarette and Tobacco Trade

China's tobacco leaf and cigarette trade has increased significantly since the mid-1980s and reached \$966 million in 1992 (ERS/USDA, 1993). Because China has successfully developed new markets in southeast Asia and the former Soviet Union, exports of tobacco leaf surged to 110,000 tons in 1992 from 72,570 in 1991, and cigarettes exports climbed from 16 to 20 billion pieces for the same period (ERS/USDA, 1993). Major importers of Chinese tobacco and cigarettes include Hong Kong, Indonesia, Egypt, Singapore and Russia. Because of a rising preference for foreign brand cigarettes, China's cigarette imports rose from 5.3 billion pieces in 1991 to 8.0 billion pieces in 1992. The United States, Hong Kong and U.K. are the major exporters of cigarettes to China. China has also imported significant amounts of tobacco leaf from Zimbabwe and Thailand. In addition to official imports, a large amount of foreign tobacco products have been smuggled into China every year. The official estimates of cigarettes smuggled into the Chinese market in 1988 accounted for about 30 percent of total foreign cigarettes sold in China in that year (Ren, 1993). As domestic production continues to outstrip demand, China's tobacco leaf and cigarette exports are expected to keep growing. On the other hand, imports of foreign brand tobacco products are also expected to increase as China moves closer to a market economy and the average personal income continues to increase. Furthermore, China's economic boom and favorable policies toward foreign investments have attracted a lot of foreign capital to China's cigarette industries. It is expected that a significant proportion of the products produced by the joint ventures will be exported. All the information suggests that China will remain as an important trader in the world tobacco and cigarette markets.

#### Social Costs of Smoking

China's rapid growth in cigarette consumption has brought about significant impacts on public health and safety. Many studies have identified smoking as the key factor for China's high rate of respiratory diseases such as lung cancer (Nath, 1986; Ren, 1993; Zhao, 1993). Respiratory system diseases were the number one cause of all the deaths in rural areas and the number two cause in urban areas in the past several years. For example, the proportion of all the deaths caused by respiratory diseases in 1992 was 26 percent in rural areas and 16.84 percent in urban areas (SSB, 1993). One estimate suggests that smoking-related diseases took the lives of about one million people who were over 20 years old in China in 1994 and that number could reach two million by 2030 (*China News Digest*, February 6, 1995).

In addition to the increasing cigarette consumption, the declining tobacco and cigarette quality has also contributed to the health hazards of smoking in China (Zhao, 1993). Another health alert for China is the high smoking rate of school students and the declining starting age of smoking. Zhao (1993) reported that the smoking rate was about 33 percent for middle school students in Nanjing city and 48 percent for high school students in the Chaoyang district in Beijing city. Besides health problems, smoking has been one of the major causes of fire accidents in both rural and urban areas (Ren, 1993). According to a report on the Chinese Workers' Daily, there were about 40,000 serious fires in 1994 that killed 2,748 people and caused about \$147 million damages and about 70 percent of the fires were triggered by smoking (*China News Digest*, February 6, 1995).

China's annual tobacco and cigarette tax was about 20-30 billion Renminbi yuan (Rmb) in the past several years. Many scholars indicate that the social costs of smoking for China are much greater than the tax revenues (Zhao, 1993; Ren, 1993). For example, one study estimated that social economic loss caused by smoking in 1989 was 27.08 billion Rmb, which was greater than the tax revenue of 24.0 billion Rmb (Zhao, 1993). China's grain production has always been a top priority of the national economy, but the rapid growth of tobacco production, from 0.512 million ha in 1980 to 1.89 million ha in 1992, has left less arable land for grain production (ERS/USDA, 1993).

### An Empirical Demand Model

Consumer demand theory and previous demand studies suggest that consumer demand for cigarettes is likely determined by income, prices of cigarettes and some closely related commodities, household characteristics, etc. A demand system approach is used in this study to estimate demand elasticities for cigarettes, liquor, beer, and tea. Those commodities have been always aggregated into one group called "other food" in China's statistical system and in previous studies of China's household food demand (e.g., Halbrendt et al., 1994; Lewis and Andrew, 1989; Wang and Chern, 1992). The almost ideal demand system (AIDS) proposed by Deaton and Muellbauer (1980) is employed as the framework of estimation. This demand system is selected based on its desired properties and simplicity of estimation. The demand system can be represented as:

$$W_i = \alpha_i + \sum_j r_{ij} \ln(p_j) + \beta_i \ln(X/P) \quad (1)$$

$$\ln(P) = \alpha_0 + \sum_j \alpha_j \ln(p_j) + 0.5 \sum_k \sum_l r_{kl} \ln(p_k) \ln(p_l) \quad (2)$$

where  $W_i$  is the budget share of good  $i$ ,  $p_j$  is the price of good  $j$ ,  $X$  is the total expenditure on cigarettes, alcoholic beverages and tea, and  $P$  is a price index. In empirical studies,  $P$  has been commonly replaced by the Stone price index to reduce the AIDS to a linear system called LA/AIDS (Blanciforti and Green, 1983):

$$\ln(P^s) = \sum_j W_j \ln(p_j) \quad (3)$$

In addition to the expenditure and prices, household demand is likely to be affected by demographic variables such as household size and location (Buse, 1987). This study incorporates demographic variables into the LA/AIDS model by translating the intercept term in (1):

$$\alpha_i = a_i + \sum_k b_{ik} D_k \quad (4)$$

where  $D_k$  is the  $k^{\text{th}}$  demographic variable. Substituting (3) and (4) into (1) yields the final specification of the demand system to be estimated:

$$W_i = a_i + \sum_k b_{ik} D_k + \sum_j r_{ij} \ln(p_j) + \beta_i \ln(X/P^s) \quad (5)$$

The expenditure and uncompensated price elasticities are given by:

$$e_i = 1 + (\beta_i/W_i) \quad (6)$$

$$\delta_{ij} = -c_{ij} + (1/W_i)[r_{ij} - (\beta_i W_j)] \quad (7)$$

where  $e_i$  is the expenditure elasticity of good  $i$ ,  $\delta_{ij}$  denotes the price elasticity of good  $i$  with respect to good  $j$ ,  $c_{ij}$  equals 1 for  $i=j$  and 0 otherwise.

### Data Sources and Estimation Method

The following analysis is based on regional data sets of China's Rural Household Survey from Beijing and Jiangsu in 1990. The national survey is administered by the SSB and implemented at the provincial level. Sample households were selected by using a three-stage stratified sampling scheme: counties were first selected from each province, villages were then selected from each selected county, and finally households were selected from each village. The participating households were requested to keep detailed records of their daily income and expenditures by using the account books provided by the SSB. The account books were collected, examined, aggregated and reported by local statistical agencies every month (Taylor and Hardee, 1986).

Our data sets obtained from local statistical

agencies in Beijing and Jiangsu include 500 rural households from 5 counties in Beijing and 440 rural households from 4 counties in Jiangsu province. The data set contains 640 variables for each sample household, including household characteristics, production inputs and outputs, household consumption and expenditure, etc. A common problem in household survey data is that prices are not directly available and therefore certain estimates of the prices need to be used in estimating demand functions. One commonly used approach in cross-sectional studies is to use the unit values derived from total expenditures and quantities as estimates of the prices (e.g., Pitt, 1982; Cheng and Capps, 1988). The major problem associated with this approach is that the cross-sectional variation in unit values may reflect qualitative differences (Deaton, 1988). To incorporate the cross-sectional variation in unit values caused by qualitative differences in commodities, several studies have used the quality-adjusted unit values as estimates of the prices (e.g., Cox and Wohlgenant, 1986). The quality-adjusted prices are generally estimated using demographic variables as the proxies for household preferences over unobservable quality characteristics (Cox and Wohlgenant, 1986). The procedures discussed by Cox and Wohlgenant (1986) are used in this study to derive the quality-adjusted unit values which are then used as the prices in estimating the demand system. Our demand system includes four commodities: cigarettes, liquor, beer and tea. The demographic variables included in the demand system include location, household types, education, household size, employment, etc. Another note on the data is that liquor used in our analysis includes all alcoholic beverages except beer.

The iterated seemingly unrelated regressions (ITSUR) are used to estimate the LA/AIDS model with homogeneity and symmetry restrictions imposed on the parameters. Because the budget share equations sum to one, one equation is dropped from the system to avoid singularity in the estimation. The parameters of the dropped equation are then derived from the adding-up restrictions.

### Estimation Results

The quality-adjusted unit values are estimated using the approach discussed in the previous section. The estimation results, not reported in this paper, indicate that demographic variables can explain only a small percentage (around 5 percent) of the cross-sectional variation in unit values. This is similar to the results of Cox and Wohlgenant (1986) for U.S. vegetable demand.

The LA/AIDS model with 10 demographic variables is estimated using the data and estimation

method described in the last section. According to the t-ratios of the estimated parameters (not reported in this paper), most of the estimates are significantly different from zero at the 95 percent level. The signs and t-ratios of the estimated parameters of the demographic variables suggest several conclusions: (1) household demand for those commodities are quite different across regions, especially across provinces; (2) households with at least one member as a village leader or working in the state sector are likely to consume more cigarettes and liquor; (3) households with more children under 11 years old tend to consume less cigarettes; and (4) the impacts of education on cigarette consumption are not significant.

The estimated demand elasticities and marginal expenditure shares based on sample means are reported in Table 1. The demand is expenditure elastic for cigarette and relatively inelastic for other three commodities. This result implies that Chinese rural households in Beijing and Jiangsu will consume more cigarettes as their total expenditure on this group of commodities increases. The marginal expenditure shares derived from the estimated expenditure elasticities and mean expenditure shares suggest that the allocations of the additional expenditure for this particular group of commodities are 58.8 percent for cigarettes, 25.56 percent for liquor, 7.85 percent for beer, and 7.79 percent for tea.

As expected, all the estimated own-price elasticities are negative. With respect to their own prices, the demand is elastic for cigarettes and beer but inelastic for liquor and tea. According to the estimated cross-price elasticities, cigarettes and liquor are likely complements, whereas beer and liquor, and tea and beer tend to be substitutes. As one limitation of our empirical estimation, the significance of the estimated elasticities are not tested and therefore it is possible that some estimated elasticities are not significantly different from zero.

### Concluding Remarks

With more than 300 million smokers and an increasing smoking rate, China's tobacco situation and social costs of smoking require urgent attention of the Chinese government and the international community. This study first discusses the general trends in China's cigarette supply and demand as well as smoking-related social costs and then estimates demand elasticities for cigarettes by applying a demand system approach to the household survey data from Beijing and Jiangsu in China. Results suggest several conclusions: First, cigarette consumption in rural China is significantly determined by income, prices and demographic variables. Second, the relatively high expenditure elasticity and marginal

Table 1  
Estimated Marginal Budget Shares and Demand Elasticities

Commodity (i)	Expenditure elasticity	Marginal budget share	Uncompensated price elasticity of good i with respect to good j			
			Cigarette	Liquor	Beer	Tea
Cigarette	1.1624	0.5880	-1.176	0.141	-0.022	-0.045
Liquor	0.8808	0.2556	-0.102	-0.785	0.017	-0.011
Beer	0.8109	0.0785	0.061	0.072	-1.022	0.078
Tea	0.7270	0.0779	0.006	0.015	0.079	-0.827

expenditure share for cigarettes suggest that the demand for cigarette will continue to grow at a significant rate as income increases. This is consistent with the observations from many other developing countries (Nath, 1986). Third, because the demand for cigarettes is elastic with respect to its own price, increasing cigarette tax may have a negative impact on cigarette consumption. Fourth, changing the tax rates for cigarettes and liquor may have similar effects on their demand because they tend to be complements for Chinese rural households.

This study suggests two major implications: First, the smoking-related health hazards such as lung cancer and other social costs like fire disasters have been a serious problem for China. Although the tobacco and cigarette industries have been a major source of state revenues, the social costs of smoking could offset the tax revenues. With one-fifth of the world's population, China's cigarette consumption and social effects require international attention. Second, because of the rapidly growing domestic production and increasing demand for Chinese cigarettes in many southeast Asian countries and the former Soviet Union, China will continue to be an important tobacco and cigarette exporter in the world markets. On the other hand, with rapid income growth and strong preferences for foreign brand cigarettes, China is likely to expand its imports of cigarettes from western countries such as the United States. Thus the anticipated growth in China's cigarette production and consumption will bring about both opportunities and challenges for western tobacco and cigarette companies which have faced continuing declines in domestic demand for their products.

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#### Endnotes

1. Research Associate, Department of Food and Resource Economics
2. Associate Professor, Department of Food and Resource Economics
3. Helen Jensen, Associate Professor, Department of Economics and Head, Food and Nutrition Policy Division, Center for Agricultural and Rural Development