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Evidence from Household Survey Data

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Abstract

Using urban household-level survey data from 1992 to 1998, we provide estimates of final demand for edible vegetable oils and animal fats in three regions of China based on the LinQuad incomplete demand system. For each region, the demand for the major "staple" oil is price inelastic. The demand for "condiment" or flavoring oils is more price responsive. All edible oils and fats have positive income elasticity, but smaller than one. Using the LinQuad parameter estimates, we provide exact measures of urban consumer welfare losses associated with trade restrictions on vegetable oil imports. Consumers suffer a significant welfare loss of the order of $ 392 million (1998 dollars).

Key Words: China, consumer demand, oils and fats, urban.

URBAN DEMAND FOR EDIBLE OILS AND FATS IN CHINA: EVIDENCE FROM HOUSEHOLD SURVEY DATA

Introduction

This paper is an empirical contribution to a better understanding of the rapidly changing food consumption patterns in China. First, we econometrically estimate three regional final demand systems of vegetable oils and animal fats, using recent survey panel data of Chinese urban households and the LinQuad incomplete demand system (LaFrance 1998, Agnew). The regional systems are motivated by the region-specific patterns of urban consumption of edible oils and fats. Then, based on the LinQuad estimates, we quantify welfare losses incurred by Chinese urban consumers caused by current import trade restrictions on vegetable oil imports into China.

Induced by remarkable income growth, vegetable oil consumption per capita in China increased by 440 percent from 1979 to 1999. By 1999 and despite restrictive import quotas, China had become the world's largest importing country of soybean, rapeseed, and palm oils and the second largest importer of soybean and rapeseed. These growth trends in per capita consumption and import flows are expected to continue, because China's current per capita consumption levels are much lower than those in neighboring countries (e.g., about 30 percent of that in Taiwan) as suggested by Figure 1. Hence, it is worth understanding the forces, which are behind these remarkable growth trends in oil consumption.

Because of the very different oil consumption patterns across regions, we disaggregate China into three regions in terms of edible vegetable oil and animal fat consumption. In each region, urban consumers have a region-specific "staple" vegetable oil representing about 80 percent of the oil and fat consumption, and a limited consumption of other flavoring or "condiment" oils and animal fats. The types of oil vary by regions. For each region, we estimate the demand system for the region's major vegetable oil, an aggregate other vegetable oil, and animal fats. This disaggregation provides useful insights on region-specific patterns.

The Chinese government has recently signed a joint agreement with the United States for its accession to the World Trade Organization (WTO). Highly distorting trade restrictions will be phased out with accession, inducing a major increase in edible oil imports. In particular, China's accession is likely to have implications for China's imports of soybean products, and, consequently, for exports of these products by the United States and other major soybean product exporters (Yang and Van der Sluice). Further, Chinese consumers stand to significantly gain from the trade liberalization associated with the accession, because consumer prices would decrease considerably. This is an important but overlooked argument in the current policy debate on China's accession. The latter debate has been characterized by a strong mercantilist preoccupation with the expansion of U.S. agricultural and food exports to China.

Finally, we note that patterns of consumption of the different types of oils in China have changed rapidly over the past two decades. Consumption of palm and soybean oils has been experiencing faster growth than consumption of rapeseed and peanut oils has. These relative changes in oil consumption patterns benefit large soybean products exporters, such as the United States, Brazil, and Argentina, but penalize rapeseed exporters, such as Canada. These implications would be amplified by China's accession to the WTO. Our investigation sheds light on these relative changes among the different oil types.

Limited availability of micro-level data, especially at the urban level, has constrained previous empirical studies of food demand in China. Most existing studies relied on aggregate time-series data (Kueh, Lewis and Andrews, Peterson et al., Fan et al. 1994), or provincial panel data (Fan et al. 1995, Wang and Chern). A few investigations have used household-level data, but they have focused on a single province or country (Halbrendt et al., Gao et al.). Aggregate data forego a wealth of information and make it impossible to conduct a detailed commodity analysis within a group such as oils and fats. In sum, our analysis fills a real knowledge gap on Chinese food consumption.

In applied demand analysis, incomplete demand models are the rule rather than the exception. In most cases one is concerned with demands for a small group of commodities that form a subset of the household's budget, such as a dairy group or an edible oils group. The incomplete demand system approach used in this study avoids the usual separability/two-stage budgeting approach used in many food consumption studies (Deaton and Muellbauer), yet allows generation of exact welfare measures on the impact of market distortions on final consumers.

Next, we concisely describe major trade distortions affecting edible oil markets in China and the likely changes brought by accession to the WTO. Then, we turn to the LinQuad specification, which is followed by a description of the urban household survey data used in the estimation. We then present the estimation results and the consumer welfare losses induced by the trade policies. Finally, we draw some implications based on the results obtained in the estimation.

Trade Barriers and Policies Affecting Vegetable Oil Consumption

The rationing of edible oil in urban China was officially eliminated in 1993. Domestic markets for edible oils and fats have been driven by competitive forces since then. However, edible oil imports are extensively controlled by the Government of China through quotas and licensing. For example, in late-1994 soybean oil was reclassified from a Category-two commodity to a Category-one commodity, for which only the central government in Beijing determines who may import and how much. Most domestic Chinese processors, distributors and end-users are barred from directly importing seeds, meals, and oils to meet their market needs. The state trading effectively insolates the domestic market price from the world market price because import decisions do not reflect market forces.

As a result of the quotas on edible oil imports, China's domestic soy oil and rapeseed oil prices are significantly higher than those in the international market. Import duties—13 percent duty on soy oil and 20 percent duty on rapeseed oil—add to the C.I.F. price of imported oils. Rents on import licenses account for the rest of the price differential between domestic and C.I.F. prices. The refined soybean oil C.I.F. price imported from

Brazil is $630 per metric ton (mt) and the crude rapeseed oil C.I.F. price imported from Canada is $647 in 1998. The corresponding domestic wholesale prices are 49 percent and 46 percent higher than these C.I.F. prices, based on the official exchange rate, and 20 percent and 17 percent higher based on the real exchange rate. The overvaluation of the yuan constitutes an implicit subsidy to imports and offsets partially the price effect of the trade barriers in edible oil markets. Given the uncertainty on the extent of currency overvaluation in China, in the result section we consider three levels of price wedges (15-20-25 percent) between the domestic and C.I.F. prices.

With accession, China will phase out the tariff rate quota (TRQ) for soybean oil by 2006. During implementation, the TRQ will grow from 1.7 million metric tons (mmt) to nearly 3.3 mmt, with the share reserved for importation through entities other than state trading enterprises growing from 50 percent to 90 percent before the TRQ is eliminated. The in-quota duty during that period will decrease from 13 to 9 percent, while the over-quota duty will fall from 74 percent in 2000 to 20 percent by 2005. In 2006, the TRQ and state trading will be eliminated, with nothing remaining but a 9 percent duty for all imports of soybean oil. China will immediately eliminate quotas on sunflower, peanut, and corn oil and replace them with a 10 percent tariff.

Under China's tax reform program instituted on January 1, 1994, a value-added tax (VAT) was introduced to replace the Product and Commercial and Industrial Taxes previously applied to imported goods. The VAT technically applies equally to domestic and imported meal, but industry sources claim that the rules on domestic meal do not make it clear as to who actually pays the VAT. This leaves ample room for tax evasion, and anecdotal evidence cited in the U.S. Department of Agriculture (USDA) attaché reports indicates that domestic processors frequently do not pay VAT. The VAT rate is 13 percent for all oils. Given the anecdotal nature of the lack of national treatment in the application of the VAT, we do not include it in the price wedge used for the welfare calculations.

The LinQuad Incomplete Demand System

Integrability conditions are a set of theoretical restrictions that establish the connection from a system of demand back to a well-behaved expenditure function and, thus, theoretical consistency. Duality theory provides the theoretical link between preference ordering and a system of demand. LaFrance (1985, 1990), and LaFrance and Hanemann proposed a methodology of identification of this structure and recovery of the conditional preference for incomplete demand system. The LinQuad system is a new development in this line of work initiated by LaFrance (1985), which allows for more flexibility and imposes less structure on underlying preferences consistent with the incomplete system.

Maximization of a utility function subject to a budget constraint results in a complete set of demand functions with certain properties. If a subset of this complete set of demand functions is considered separately from the whole, the properties only change slightly, and, in fact, become more general in nature. A duality theory of incomplete systems is developed from this insight, along with a relaxation of the assumption of uniform functional form for all demands in the complete system.

Suppose that the n demand functions to be estimated are

$$\mathbf{x} = \mathbf{h}^{x}(\mathbf{p}, \mathbf{q}, y), \qquad (1)$$

where $\mathbf{x}=[x_1,\ldots, x_n]'$ is the vector of consumption levels for the commodities of interest, $\mathbf{p}=[p_1,\ldots, p_n]'$ is the corresponding price vector, $\mathbf{q}=[q_1,\ldots,q_m]'$ is the corresponding price vector for the vector of consumption levels of all other commodities $\mathbf{z}=[z_1, \ldots, z_m]$ with $m \geqq 2$, and y is income.

Maximizing an increasing, quasi-concave utility function, $u(\mathbf{x}, \mathbf{z})$, with respect consumption, under the budget constraint, $\mathbf{p'x} + \mathbf{q'z} \leqslant y$, results in demands for the goods of interest with four properties:

(i) the demands are positive valued, $\mathbf{x} = \mathbf{h}^{x}(\mathbf{p}, \mathbf{q}, y) \geqq \mathbf{0}$;

(ii) the demands are zero degree homogeneous in all prices and income, $\mathbf{h}^{x}(\mathbf{p}, \mathbf{q}, y) \equiv \mathbf{h}^{x}(t\mathbf{p}, t\mathbf{q}, ty)$ for all $t \geqq 0$;

(iii) the n x n matrix of compensated substitution effects for **x**, $\mathbf{S_x} \equiv \partial \mathbf{h}^x / \partial \mathbf{p}' + \partial \mathbf{h}^x / \partial y \, \mathbf{h}^{x\prime}$, is symmetric, negative semidefinite; and

(iv) income is greater than total expenditures on a proper subset of the goods consumed, $\mathbf{p}'\mathbf{h}^x(\mathbf{p}, \mathbf{q}, y) < y$.

The four properties are the same for both complete and incomplete demand systems. The last property is the essence of an incomplete demand model and only part of the consumer's budget is allocated to the consumption of **x**. A theoretical link between complete and incomplete systems is achieved with a composite commodity encompassing all other goods. Expenditure on this composite good is defined as $s \equiv \mathbf{q}'\mathbf{z} \equiv y - \mathbf{p}'\mathbf{x}$. With a properly defined utility function and the price of s normalized to one, duality applies to the incomplete system just as if it were a complete system (Agnew). The four properties of incomplete demands and new budget identity are equivalent to the existence of an expenditure function,

$$e(\mathbf{p}, \mathbf{q}, u) \equiv \mathbf{p}'\mathbf{h}[\mathbf{p}, \mathbf{q}, e(\mathbf{p}, \mathbf{q}, u)] + s[\mathbf{p}, \mathbf{q}, e(\mathbf{p}, \mathbf{q}, u)]. \quad (2)$$

This approach implies the relaxation of uniformity of functional form that commonly holds in demand system theory, since the functional form for the composite commodity of other goods is unknown. The incomplete demand systems allow a more general class of functional forms than complete demand models (LaFrance 1985). The incomplete demand system assumes positive demands and an expenditure that sums to strictly less than income. Symmetry and concavity can be imposed and are testable hypotheses. Homogeneity, however, must be imposed on the system from the outset.

By applying integrability conditions, the LinQuad demand system is generated from the following quasi-expenditure

$$e(\mathbf{p}, \mathbf{q}, \mathbf{z}, \theta) = \mathbf{p}'\boldsymbol{\alpha} + \mathbf{p}'\mathbf{A}\mathbf{z} + 0.5\,\mathbf{p}'\mathbf{B}\,\mathbf{p} + \delta(\mathbf{z}) + \theta(\mathbf{q}, u, \mathbf{z})e^{\boldsymbol{\gamma}'\mathbf{p}}, \quad (3)$$

where **p** is now the vector of deflated prices, **z** is a set of demographic shifters, $\delta(\mathbf{z})$ is an arbitrary real valued function of all variables in **z**, $\theta(\mathbf{q},u,\mathbf{z})$ is the constant of integration, and $\boldsymbol{\alpha}$, $\boldsymbol{\gamma}$, **A** and **B** are the vectors and matrices of parameters to be estimated.

By Shepherd's lemma, demands can be derived as

$$\mathbf{x} = \boldsymbol{\alpha}+\mathbf{Az} + \mathbf{B\,p}+ \boldsymbol{\gamma}[\,\theta(\mathbf{q},u,\mathbf{z})e^{\boldsymbol{\gamma}'\mathbf{p}}]. \quad (4)$$

Solving the original quasi-expenditure function (3) for $\theta(\mathbf{q},u,\mathbf{z})e^{\gamma'\mathbf{p}}$, and replacing expenditure with y for income yields the final LinQuad model (LaFrance 1990, 1998; Agnew),

$$\mathbf{x} = \boldsymbol{\alpha}+\mathbf{Az} + \mathbf{B\,p}+ \boldsymbol{\gamma}[y- \mathbf{p}'\boldsymbol{\alpha}- \mathbf{p}'\mathbf{Az} - 0.5\, \mathbf{p}'\mathbf{B\,p} -\delta(\mathbf{z})]. \quad (5)$$

The restriction of homogeneous of degree zero of demand in prices and income are provided by deflating all prices and income by a price index. Adding up condition is not a problem for incomplete demand systems since the expenditure in a small group is smaller than total income. Symmetry of the Slutsky substitution terms is imposed by letting $B_{ij}=B_{ji}$ (LaFrance 1998).

The LinQuad quasi-expenditure function is fully characterized by the demand system in which goods are a function of prices and income. The demand system satisfies integrability. This result from the duality theory of incomplete demand systems allows exact welfare measures to be obtained from the quasi-indirect utility function. To derive the equivalent variation (EV) associated with the LinQuad demand system (5), the quasi-expenditure equation (3) must be inverted with respect to θ after being set equal to income, y, or

$$\theta(\mathbf{q}, u, \mathbf{z})= [y- \mathbf{p}'\boldsymbol{\alpha} - \mathbf{p}'\mathbf{Az} - 0.5\, \mathbf{p}'\mathbf{B\,p}- \delta(\mathbf{z})]e^{-\boldsymbol{\gamma}'\mathbf{p}}. \quad (6)$$

The EV identity becomes

$$[y+EV - \mathbf{p_0}'\boldsymbol{\alpha} - \mathbf{p_0}'\mathbf{Az} - 0.5\, \mathbf{p_0}'\mathbf{B\,p_0}- \delta(z)]e^{-\boldsymbol{\gamma}'\mathbf{p_0}} = [y- \mathbf{p_1}'\boldsymbol{\alpha} - \mathbf{p_1}'\mathbf{Az} - 0.5\, \mathbf{p_1}'\mathbf{B\,p_1}- \delta(\mathbf{z})]e^{-\boldsymbol{\gamma}'\mathbf{p_1}}, \quad (7)$$

where p_0 and p_1 is a vector of prices before and after the price change, respectively.

The EV can be derived as

$$EV= [y- \mathbf{p_1}'\boldsymbol{\alpha} - \mathbf{p_1}'\mathbf{Az} - 0.5\, \mathbf{p_1}'\mathbf{B\,p_1}- \delta(z)]e^{\boldsymbol{\gamma}(\mathbf{P_0}-\mathbf{P_1})} -[y - \mathbf{p_0}'\boldsymbol{\alpha} - \mathbf{p_0}'\mathbf{Az} - 0.5\, \mathbf{p_0}'\mathbf{B\,p_0}- \delta(\mathbf{z})], \quad (8)$$

with subscript 0 and 1 indicating the original and new prices vectors.

Estimating LinQuad with consumption quantities as left-hand side variables, on the other hand, implies a heteroskedastic **Σ**-matrix (Agnew). Following Agnew, we use deflated expenditures as the left-hand side variable, by simply multiplying both sides of each equation by its corresponding price to avoid this source of heteroskedasticity. A system of equations of the form to be estimated is

$$e_i = p_i \{ \alpha_i + \mathbf{A_i z} + \mathbf{B_i}\, \mathbf{p} + \gamma_i[y - \mathbf{p'}\boldsymbol{\alpha} - \mathbf{p'Az} - 0.5\, \mathbf{p'B\, p}\,]\} + u_i , \quad i=1,2,3, \tag{9}$$

and where subscript i refers to good i, $\mathbf{B_i}$ and $\mathbf{A_i}$ are the corresponding raws of matrices **A** and **B**, and **u** is the error term assumed to be distributed N(**0**, **Σ**).

The uncompensated own- and cross-price elasticities, η_{ii} and η_{ij}, associated with equation (9) and with symmetry imposed, are:

$$\eta_{ii} = [\beta_{ii} - \gamma_i\, (\alpha_i + \mathbf{A_i z} + \mathbf{B_i p})]\; p_i/x_i\, , \qquad k=1,2,3, \tag{10}$$

and

$$\eta_{ij} = [\beta_{ij} - \gamma_i\, (\alpha_j + \mathbf{A_j z} + \mathbf{B_j p})]\; p_j/x_i\, , \qquad k=1,2,3, \tag{11}$$

with β_{ij} denoting the ijth element of matrix B.

The expenditure elasticities, ε_i, are

$$\varepsilon_i = \gamma_i\; y/x_i\, . \tag{12}$$

Income-compensated price elasticities are straightforward to calculate from equations (10)-(12) and the corresponding Slutsky equations.

Data Sources, Regional Disaggregation, and Estimation

We used panel data from several regions in China, covering the years 1992, and 1994 to 1998. The data are urban household surveys conducted by the State Statistical Bureau of the People's Republic of China (PRC). The household surveys were carried out by local agencies. The families selected in the surveys were drawn from a very large population frame, based on proportionate stratification, sampling one out of 10,000 households. The sample contains 1,486 variables related to urban household income, expenditure, production, and consumption—as well as demographic characteristics. Detailed discussion on this survey data can be found in Fang, Wailes, and Cramer. We use about 3,600 household observations for each year. The data was collected in cities from 18 different provinces in China. The full data set used in this study has about 20,000 observations.

As noted in the introduction, China exhibits wide regional differences in climate, land conditions, oilseeds production and availability, socioeconomic status, culture, and living standards. Therefore, in the presence of significant transportation costs and partial market integration, it is expected that households in different regions have different food consumption patterns motivated by price, income and taste differences. Table 1 illustrates these differences in edible oil and fat consumption for three regional grouping of provinces. The Northeast region consists of Heilongjiang, Jilin, and Liaoning; the Middle and West region includes Jiangsu, Zhejiang, Anhui, Jiangxi, Hunan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, and Xinjiang; and the South region includes Guangdong, Fujiang and Guang.

Soy oil accounts for more than 80 percent in the Northeast region; rapeseed oil accounts for more than 80 percent in Middle and West China, while peanut oil accounts for more than 80 percent in total edible oil consumption in South China. Based on these regional differences in oil consumption patterns and habits, we designate regional "staple" oils for this study: soy oil for the Northeast region; rapeseed oil for the Middle and West region; and peanut oil for the South region.

Further suggested by Table 1 and in each region, the other oils, besides the region's staple oil, are sparsely or not-at-all consumed because they may not be available. These other oils are flavoring or condiment oils, which explains the small quantities consumed. Hence, many "zeros" arise from the non-availability or non-consumption of some of these condiment oils. To reduce the number of observations with zero consumption, we aggregate condiment oils used in each region into a region-specific aggregate condiment oil category.

Thus, the system of equations to be estimated in the Northeast region is soy oil (staple oil), other vegetable oil (total vegetable oil minus soy oil), and animal fats. Equations for the Middle and West region are rapeseed oil demand (staple oil), other vegetable oil demand (total vegetable oil minus rapeseed oil), and animal fats. The South regional model equations are peanut demand (staple oil), other vegetable oil demand (total vegetable oil minus peanut), and animal fats. Appendix Tables 1 to 3 present the respective price and quantity for the three oils and fats for each region.

City differences in consumption within a region are modeled as fixed effects by city dummy variables to account for effects of social and demographic characteristics. Use of a fixed-effect model can also help to mitigate the effects of heteroskedasticity (Fan, et al., Pollak and Wales).

Following Heien and Wessells, a two-step estimation procedure was employed to obtain consistent and asymptotically efficient estimates when there is zero consumption. The first step computes the inverse Mills ratio for each household. The second step uses the inverse Mills ratio as an instrument to adjust the estimates of demand system. A seemingly unrelated regressions (SUR) technique in the statistical package SAS was used to estimate the three-equation demand systems. A final remark concerns a limitation of the data. Consumption of food away from home is reported as a single good in the survey data. Hence, the oil consumption data abstract from oil consumption included in food consumption away from home.

Results

The estimation results for the three regional models are presented in Table 2; each column reports the results for a region, with the Northeast region first, the Middle and West region following, and the South region last. Results appear strong with most price and income responses being significant at the 1-percent significance level. All own-price responses are negative and all income responses are positive.

All parameters in the Northeast region model are significant, except for β_{12} and β_{13}, the responses of soy oil to the price of other oil and animal fats. All parameters in the Middle and West region model are significant at the 1 percent level. Results for the South region are all significant except for β_{23}, the response of other oils to the price of animal fat, and for γ_3, the income response of animal fats.

Based on the estimated price and income responses presented in Table 2, we compute the implied income-compensated price and income elasticities as described by equations (10) to (12). Elasticities are presented in Tables 3 to 5 for the three regional models, respectively. All staple oils are own-price inelastic. Condiment-oil demands and animal fats are more own-price elastic than staple oils—except condiment oils in the South region and animal fats in the Northeast region. Cross-price responses suggest heterogeneous substitution relationships between staple oil, condiment oils and animal fats.

Income elasticities are positive but relatively modest in the 0.09 to 0.48 range, with the income elasticity of the staple oil being systematically smaller than the elasticity of the other oils. This result suggests that people are diversifying their oil consumption pattern as their income increases. The positive income elasticity of fat consumption in all regions is seemingly surprising, because direct animal fat consumption (e.g., lard) tends to decrease with income growth and rising health concerns in many Organization of Economic Cooperation and Development (OECD) countries. However, per capita animal fat consumption is very low in urban China currently, just 0.12 kilograms (kg) per year (see Appendix Tables 1-3), and health implications of such low consumption are likely to be minimum.

Aggregate (national) income and income-compensated own-price elasticities for soy oil, rapeseed oil, and peanut oil are calculated and reported in Table 6. The calculation is based on a weighted sum of the results from three regional models and on the assumption that the price responses for the non-major oils are equal within any region. The own-price elasticity for all three major vegetable oils is very close and in the range from –0.363 to –0.538. Soy oil has the highest income elasticity, 0.276, and rapeseed oil has the smallest elasticity, 0.152.

Next, we consider the welfare consumer impact of trade distortions in the edible oil markets. To quantify the impact of these trade distortions on consumer welfare, we assume three levels of *ad-valorem* price distortions of 15 percent, 20 percent, and 25 percent differences between the domestic and border prices. These values are around the estimates of *ad-valorem* distortions mentioned in the policy section when currency overvaluation is taken into account. The equivalent variation results are reported in Table 7. Per Capita EV of total China is calculated by a population weighted average of three regional per capita EVs. Total cost for China is obtained by multiplying per capita EV of

China by total China's urban population (379.42 million) in 1998. The total cost to urban consumers due to government policy under the combined 25 percent price wedge scenario is quite considerable and equal to 4.3 billion yuan in 1998, or $ 417 million using the PPP exchange rate of 10.31 yuan per dollar. A priori, these figures could be considered small, but expressed in percent of real income (EV/y), they are about nine times as large as is the consumer welfare loss induced by the U.S. sugar program on the average U.S. consumer using the same LinQuad EV measure relative to income (0.02 percent of U.S. real income for the U.S. sugar program in 1998) (Beghin and El Osta).

Conclusions and Policy Implications

We used the LinQuad incomplete demand system and household survey panel data to estimate urban final demand for edible oils and fats in China. Because of the very different oil consumption patterns across regions, we disaggregated China into three regions in terms of edible oils and fats consumption. In each region, urban consumers have a staple vegetable oil representing about 80 percent of the oils and fats consumption, and a limited consumption of other flavoring or condiment oils and animal fats. The types of oils vary by regions. For each region, we estimated the demand system for the region's major vegetable oil, an aggregate other vegetable oils, and animal fats.

We found that for each region's major vegetable oil, demand is price inelastic. However, the demands for flavoring vegetable oils and animal fats tend to be more price responsive, with two exceptions. All vegetable oils and fats have positive income elasticity, but less than one. The income elasticities for condiment vegetable oils are larger than those for staple vegetable oils in all the regions. We suggested that Chinese urban consumers will diversify their oil consumption as income increases.

Real income in urban China has grown at about 7 percent in the last decade and urban population has grown at 2.3 percent per annum. These income and population growth trends are expected to continue and, therefore, total food demand in urban China is projected to continue to grow at more than 4.22 percent, 3.37 percent, and 3.60 percent each year for soy oil, rapeseed oil, and peanut oil, respectively, based on our estimated income elasticities from this study with the assumption of no price effects.

If accession to the WTO takes place, the impact of the induced price reduction on edible oil and fat consumption will be considerable on consumer welfare. The results of the exact welfare measures show that support to domestic soybean oil and rapeseed oil crushers and refiners through trade restrictions costs urban consumers about 4.038 billion yuan in 1998 or about $ 392 million.

In future work, our estimates of urban demand could be incorporated into a more exhaustive analysis and quantification of the impact of China's accession to the WTO on world agricultural markets, especially oilseeds.

Table 1. Per capita oil consumption in urban China (kg)

Year	Northeast Region	Middle and West Region	South Region
		Total Oil	
1992	7.40	9.61	6.51
1994	8.66	10.25	7.00
1995	8.94	9.25	7.20
1996	9.70	9.54	7.13
1997	8.74	8.96	7.02
1998	8.72	9.57	7.45
		Rapeseed Oil	
1992	0.00	7.64	0.27
1994	0.00	7.79	0.09
1995	0.00	6.26	0.50
1996	0.00	7.22	0.12
1997	0.00	6.65	0.19
1998	0.00	6.94	0.27
		Peanut Oil	
1992	0.00	0.01	5.93
1994	0.00	0.01	6.58
1995	0.00	0.83	6.69
1996	0.00	0.04	6.72
1997	0.00	0.02	6.42
1998	0.01	0.02	6.78
		Soy Oil	
1992	7.40	0.17	0.03
1994	8.49	0.26	0.04
1995	8.63	0.21	0.03
1996	9.43	0.19	0.07
1997	8.51	0.33	0.12
1998	8.47	0.31	0.12
		Animal Fat	
1992	0.21	1.42	0.17
1994	0.12	1.51	0.22
1995	0.22	0.67	0.13
1996	0.23	1.19	0.13
1997	0.18	1.03	0.14
1998	0.12	0.99	0.13

Source: Calculated by authors from survey data.

Table 2. Parameter estimates of edible oil and fat expenditure by region

Parameters	Northeast Region	Middle and West Region	South Region
α_1 (staple oil)	12.27551	6.583061	5.580491
	(9.79)	(14.83)	(8.67)
α_2 (other oil)	0.635899	2.341687	0.352889
	(6.38)	(10.73)	(3.07)
α_3 (fat)	0.0.521054	0.807863	0.468087
	(4.85)	(5.32)	(4.72)
β_{11} (staple oil, staple price)	-1.404853	-0.767855	-0.313349
	(--4.57)	(-9.74)	(-3.34)
β_{12} (staple oil, other oil price)	0.029667	0.203085	-0.040613
	(1.53)	(7.55)	(-2.81)
β_{13} (staple oil, fat price)	0.012557	-0.104361	0.031383
	(0.55)	(-5.01)	(2.58)
β_{22} (other oil, other oil price)	-0.050029	-0.282182	-0.013819
	(-7.87)	(-16.93)	(-6.05)
β_{23} (other oil, fat price)	-0.055093	0.106045	0.003154
	(-7.45)	(9.79)	(0.87)
β_{33} (fat, fat price)	-0.015453	-0.152251	-0.032444
	(-2.49)	(-13.35)	(-2.67)
γ_1 (staple oil, income)	0.00051373	0.00038719	0.000286
	(2.01)	(5.80)	(3.35)
γ_2 (other oil, income)	0.0000728	0.00033837	0.0000799
	(4.48)	(9.47)	(4.86)
γ_3 (fat, income)	0.0000493	0.000048072	0.0000107
	(2.39)	(2.13)	(1.17)
Mill Ratio (staple oil)	0.725935	0.460838	0.25988
	(3.86)	(9.52)	(3.01)
Mill Ratio (other oil)	-0.041807	0.131898	0.070112
	(-1.28)	(9.01)	(4.65)
Mill Ratio (fat)	0.007262	0.431017	-0.288607
	(0.79)	(10.74)	(-13.62)

Notes: Fixed effects are not reported; numbers in parentheses are t values.

Table 3. Northeast region income and income-compensated price elasticities

	Price			Income
	Soy Oil	**Other Vegetable Oil**	**Animal Fat**	
Soy oil	-0.671	0.022	0.005	0.103
Other vegetable oil	0.463	-1.231	-0.684	0.476
Animal fat	0.264	-1.829	-0.259	0.434

Note: Northeast region—Heilongjiang, Jilin, and Liaoning.

Table 4. Middle and West region income and income-compensated price elasticities

	Price			Income
	Rapeseed Oil	**Other Vegetable Oil**	**Animal Fat**	
Rapeseed oil	-0.435	0.153	-0.078	0.116
Other vegetable oil	0.333	-0.613	0.229	0.292
Animal fat	-0.370	0.496	-0.707	0.089

Note: Middle and West region—Anhui, Jiangsu, Zhejiang, Jiangxi, Hunan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, and Xinjiang.

Table 5. South region income and income-compensated price elasticities

Income	Price			
	Peanut Oil	**Other Vegetable Oil**	**Animal Fat**	
Peanut oil	-0.272	-0.038	0.025	0.131
Other vegetable oil	-0.434	-0.158	0.031	0.450
Animal fat	1.142	0.123	-1.085	0.206

Note: South region—Guangdong, Fujiang, and Guangxi.

Table 6. China income-compensated own-price and income elasticities

	Price	**Income**
Soy oil	-0.538	0.276
Rapeseed oil	-0.363	0.152
Peanut oil	-0.524	0.186

Note: Calculated from Tables 3-5 based on weighted average from three regional models.

Table 7. Equivalent variation (EV) for soy oil and rapeseed oil price increase, 1998

Increase	Northeast Region		Middle and West Region		South Region		Total China	
	Per Capita (Yuan)	Total (Million Yuan)	Per Capita (Yuan)	Total (Million Yuan)	Per Capita (Yuan)	Total (Million Yuan)	Per[1] Capita (Yuan)	Total (Million Yuan)
15 percent	5.08	312	8.26	1101	0.93	45	6.00	2278
20 percent	7.24	445	11.25	1501	1.25	60	8.26	3134
25 percent	9.63	593	14.37	1916	1.58	76	10.64	4038

Note: [1] Calculated on urban population weighted average from three regional models.

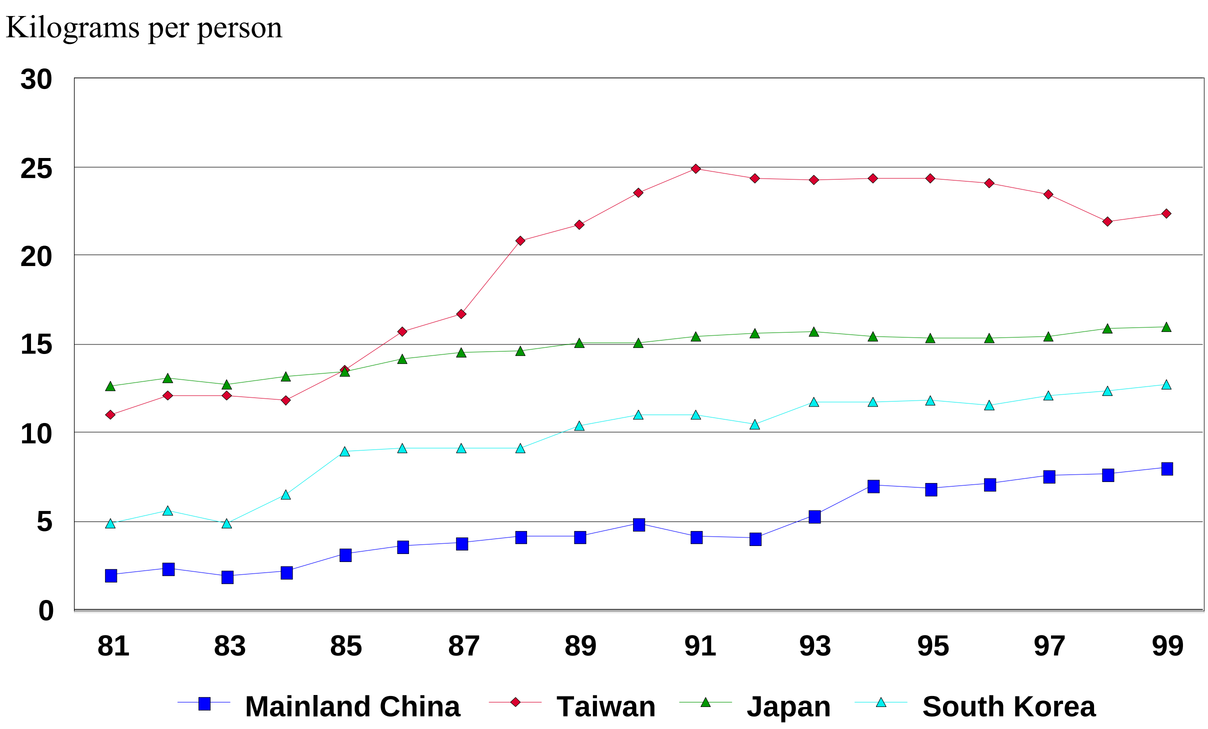

Figure 1. Per Capita Oil Consumption in Selected Asian Countries

Appendix Table 1.
China's oil and fat price and per capita consumption in the Northeast region

	Price			Quantities		
Year	**Soy Oil**	**Other Oil**	**Animal Fat**	**Soy Oil**	**Other Oil**	**Animal Fat**
1992	3.91	5.04	2.74	7.15	0.26	0.21
1994	4.48	6.64	3.70	8.49	0.16	0.12
1995	4.46	6.57	3.63	8.63	0.31	0.22
1996	3.64	7.14	2.83	9.43	0.26	0.23
1997	3.49	6.52	3.20	8.51	0.22	0.18
1998	3.73	5.22	2.68	5.47	0.24	0.12

Source: Calculated by authors from survey data.

Appendix Table 2.
China's oil and fat price and per capita consumption in the Middle and West region

	Price			Quantities		
Year	**Rapeseed Oil**	**Other Oil**	**Animal Fat**	**Rapeseed Oil**	**Other Oil**	**Animal Fat**
1992	3.30	4.64	4.55	7.64	1.97	1.42
1994	4.83	5.62	5.59	7.79	2.46	1.51
1995	4.66	5.43	6.05	6.26	2.99	0.67
1996	3.73	5.37	5.58	7.22	2.31	1.19
1997	3.68	5.56	5.25	6.65	2.31	1.03
1998	3.85	5.30	4.67	6.94	2.62	0.99

Source: Calculated by authors from survey data.

Appendix Table 3.
China's oil and fat price and per capita consumption in the South region

	Price			Quantities		
Year	**Peanut Oil**	**Other Oil**	**Animal Fat**	**Rapeseed Oil**	**Other Oil**	**Animal Fat**
1992	5.12	4.68	4.56	5.93	0.58	0.17
1994	6.64	5.55	5.87	6.58	0.39	0.22
1995	6.03	5.97	5.02	6.69	0.52	0.13
1996	5.53	5.41	5.52	6.72	0.41	0.13
1997	5.33	5.14	5.04	6.42	0.60	0.14
1998	5.36	5.49	5.27	6.78	0.67	0.13

Source: Calculated by authors from survey data.

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