

Increasing Vegetable Oil Demand in China: Impacts on the International Soybean Market

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Increases in income and urbanization lead to strong demand for edible oil in China, which impacts global soybean trade. This study reviews the history of China's soybean industry and vegetable oil consumption patterns, compares the demand for vegetable oil with demand in Japan and South Korea, and then forecasts China's demand for vegetable oil and soybean imports in the coming decades.

Keywords: income increases, soybean import, urbanization, vegetable oil consumption

INTRODUCTION

China has over one-fifth of the world's consumers with an economy growing at 7%-8% annually in the last three decades. The rationing of edible oil in urban China was officially eliminated in 1993. Domestic markets for edible oils and fats have been driven by growing per capita income since then. By 1999, China had become the world's largest importing country of soybean, rapeseed, and palm oils, despite restrictive import quotas. According to the Food and Agriculture Organization of the United Nations (FAO), vegetable oil consumption per capita each year in China increased from 2.4 kg in 1978 to 8.9 kg in 2010, which is a 270% increase. Among these oil crops, soybean consumption increased most significantly, especially in the past decade. In 2003, China imported 23.2 million tons of soybeans and surpassed the European Union (EU) to become the largest soybean importer in the world. In 2010, the import volume was 57 million tons, accounting for 61% of the world soybean trade. This paper reviews China's soybean production, imports, exports and consumption in the last three decades, analyzes the driving force behind the increasing demand, studies the structural change in vegetable oil consumption, and forecasts the trends for vegetable oil consumption and the soybean trade in China.

BACKGROUND

The soybean is a species of legume, which is classed as an oilseed by FAO. The first domestication of the soybean has been traced to the eastern half of North China in the eleventh century B.C. The soybean

was one of the five main plant foods of ancient China along with rice, wheat, barley and millet. Before the 1960s, China accounted for about one quarter of world soybean production. With increasing soybean cultivation in the United States and South American countries in subsequent decades, China's share of worldwide production has continually decreased, although its annual production has always increased. In 2011, soybean production in China was 14.5 million tons and accounted for 5.6% of total world production.

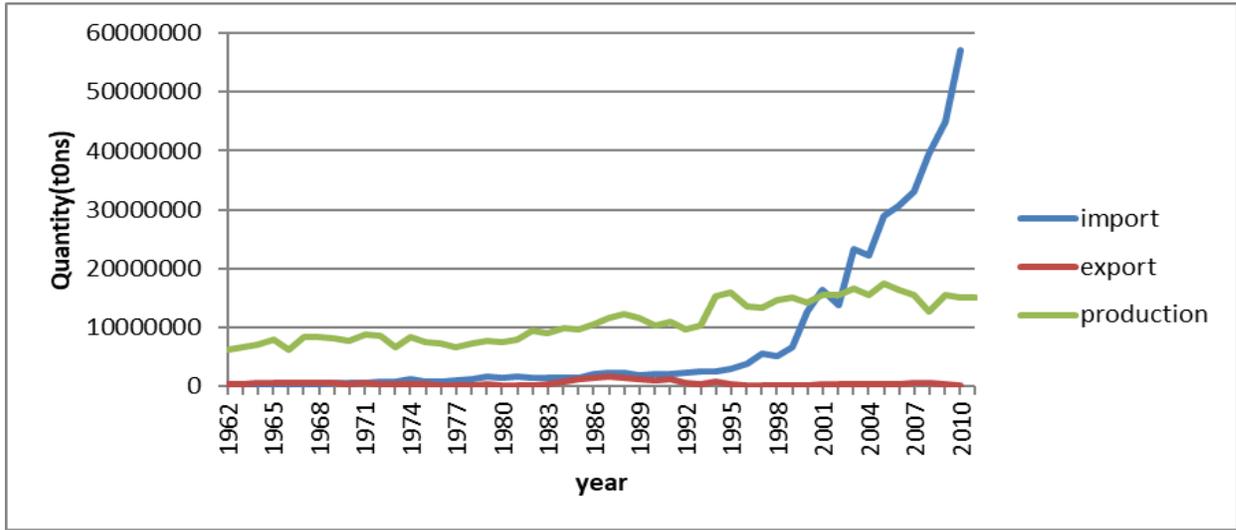
Soybeans were first introduced into the American Colonies in 1765. Most of the early introductions were obtained from China, Japan, India, Manchuria, Korea, and Taiwan. The U.S. dominated world soybean production through the 1950's, 60's, and 70's, growing more than 75% of the world soybean crops. A worldwide shortage of feed protein in the early 1970's led to the initiation of large-scale soybean production in several South American countries, most notably Argentina and Brazil. By 2011, the U.S.'s share of the world's soybean production had shrunk to 32% while Argentina's and Brazil's had increased to 19% and 29%, respectively.

Traditional food uses of soybeans in China include direct eating, soy milk, tofu, tofu skin, and soy sauce. However, soybeans were not used to any great extent for fodder for livestock or vegetable oil in China. Globally, the majority of the soybean crop is processed into oil and meal. A 60-pound bushel of soybeans yields about 11 pounds of oil or about 48 pounds of meal. Oil extracted from soybeans is made into shortening, margarine, cooking oil, and salad dressings. In 2011, soybean oil accounted for 25% of total vegetable oils consumed in the world, ranking second after palm oil, which was 30%. Soybean oil is also used in industrial paint, varnishes, caulking compounds, linoleum, printing inks, and other products. Development efforts in recent years have resulted in several soybean oil-based lubricant and fuel products that can replace non-renewable petroleum products. Soybean meal (also known as soybean oil cake) is a solid residue bi-product, created after grinding the soybean to extract soybean oil. It is widely used as a filler and source of protein in animal diets, including pig, chicken, cattle, horse, sheep, and fish feed.

CHINA'S SOYBEAN TRADE

China has been a net exporter of soybeans since 1970. However, it mainly consumes its own production with little imports and exports before 1995, because the Chinese government sets a quota for soybean imports. It imposes a 3% tariff on imports under quota and a 114% tariff for import over quota. The monopoly structure of China's state trading may hinder the China's agricultural trade (Drewnowski and Popkin, 1997). After 1996, the tariff rate was set to 3% and the quota was eliminated, which boosted the import of soybeans (figure 1). China's WTO accession agreement in 2003 weakens the state monopolies further. Imports of soybeans first exceeded domestic production in 2003, and imports have increased continually in the following years. In 2010, soybean imports accounted for 75% of the total domestic supply.

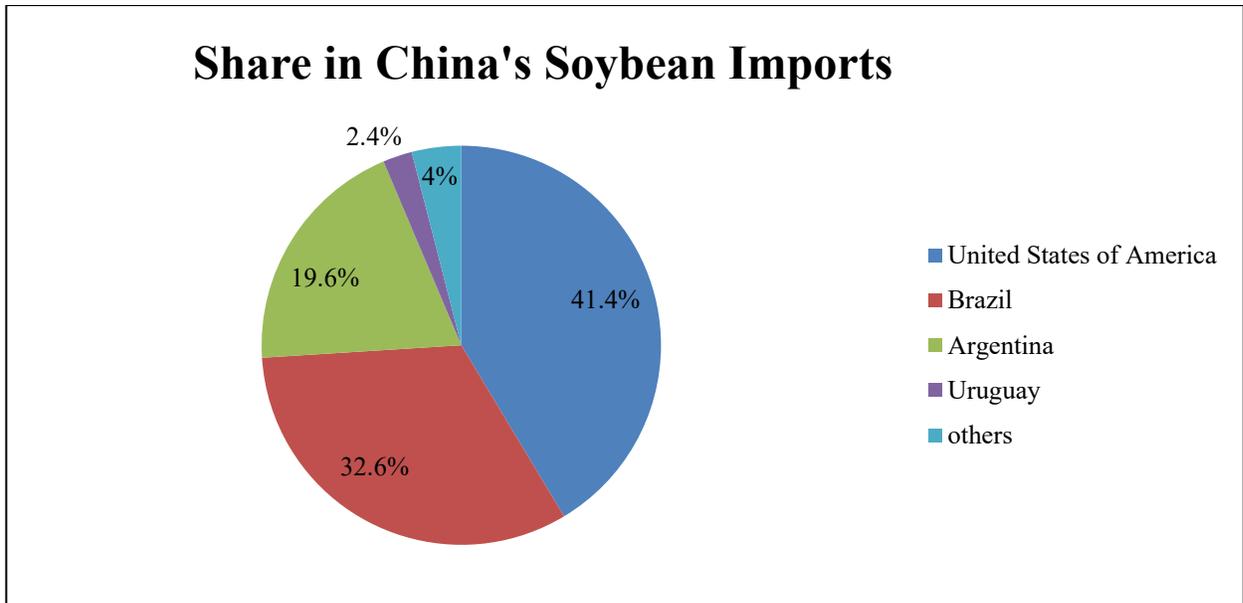
**FIGURE 1
CHINA'S SOYBEAN IMPORTS/EXPORTS**



Data Source: FAO

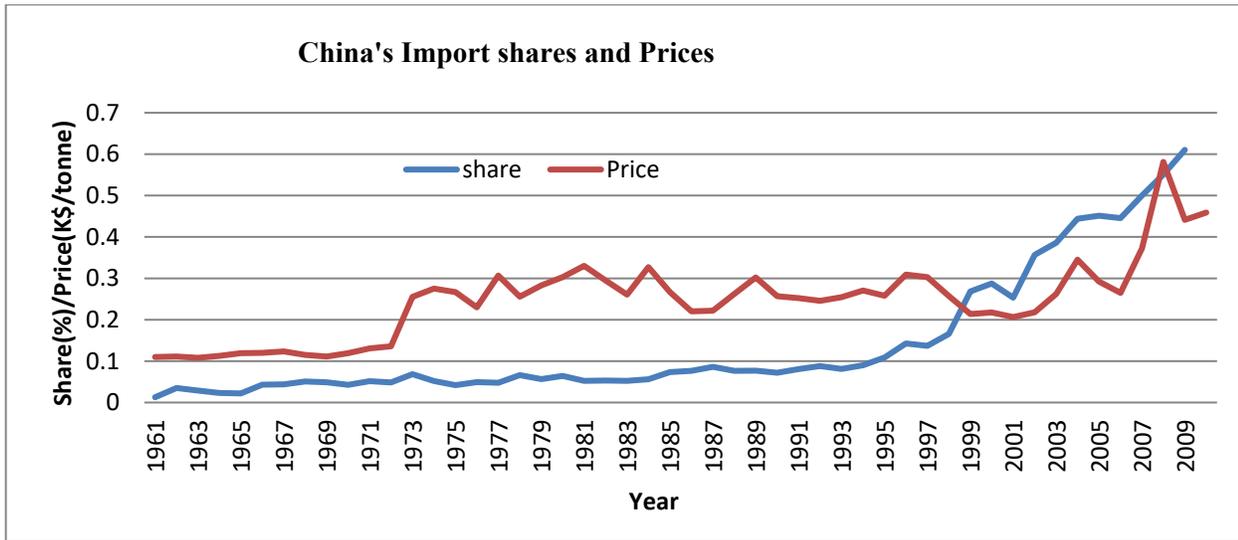
The top three exporters to China are the United States, Brazil, and Argentina. In 2010, they supplied 96% of China's total soybean imports. The market share for each exporter is shown in figure 2.

**FIGURE 2
SHARE OF CHINA'S SOYBEAN IMPORTS IN 2010**



Data Source: FAO

FIGURE 3
SOYBEAN: CHINA'S IMPORT SHARES AND PRICES



Data Source: FAO

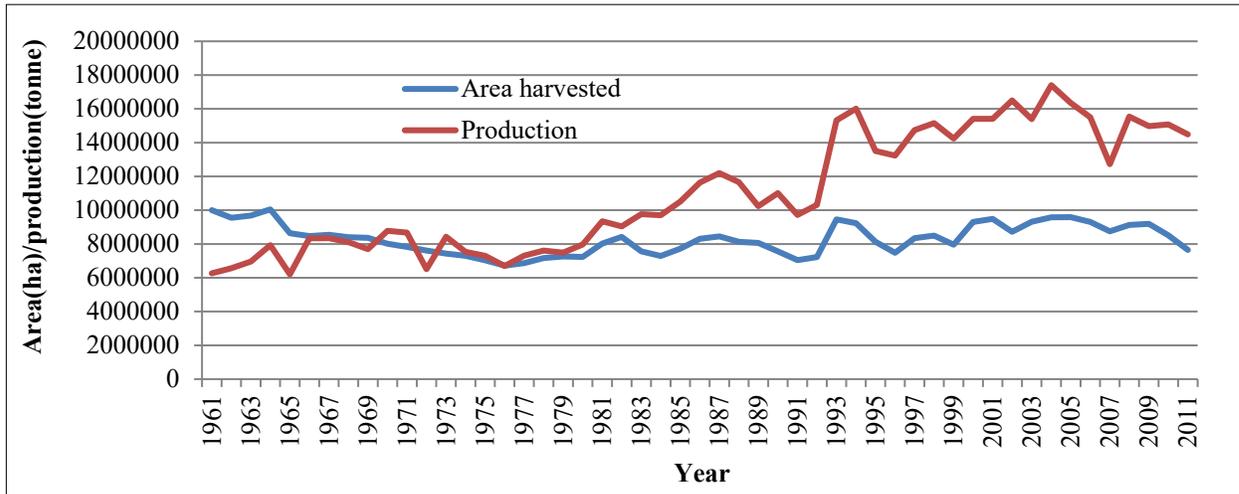
With the biggest share of the international soybean market, China's imports impact global soybean prices greatly. Although there are other reasons for soaring soybean prices in recent years, such as the demand for biofuel, the increasing demand from China pushed the soybean price higher in the past two decades. Figure 3 shows the long run trend of this link. From 2000, in which year China had a 28% share of the soybean trade, China's import prices are highly correlated with its market share. A correlation analysis shows the correlation coefficient is 0.81. An unexpected low price appeared in 2009 due to the prospects of record crops in South America (USDA, 2010)

DRIVING FORCE OF THE INCREASING DEMAND

Income Increases and Urbanization

Many Chinese scholars attribute the increase of soybean imports to the impact of GMO soybean cultivation in the United States and the South American countries. They believe cheap soybeans from these countries damage domestic farmers' incentive for soybean cultivation, leading to the shortage of domestic supply of soybeans in recent years. This explanation is weak. Figure 4 shows that there is no remarkable shrinkage of the soybean harvest area in past two decades. Soybean production remained above 14 million tons in most years. In light of the fact that China's population only increased 16% in the 1990's and 2000's, from 1.16 billion in 1991 to 1.35 billion in 2011, the huge shortage of soybean supply in recent years is clearly due to reasons other than increasing population and decreasing cultivation.

**FIGURE 4
SOYBEAN CULTIVATION AND PRODUCTION IN CHINA**



Data Source: FAO

China has a much larger labor force employed in agriculture than other developed countries and most of its population lives in rural areas. Traditionally, grains (mostly rice and wheat) and vegetables make up the main sources of food consumption in China. Consumption of fruits, sugar and sweeteners, and fats and oils is lower. These differences in food consumption between China and the rest of the world reflect a combination of low per capita incomes in China and differing tastes and preferences. China's high consumption and production of vegetables, which yield high quantities per unit of land, makes efficient use of scarce land resources. As incomes rise and populations become more urbanized, consumption of all foods will grow, but consumption of meat, fruits, fish, fats and oils, and sugar and sweeteners will grow the fastest. Societies enter different stages of what has been called the nutrition transition. Diets high in complex carbohydrates and fiber give way to more varied diets with a higher proportion of fats, saturated fats, and sugars. Drewnowski and Popkin (1997) confirmed that positive income elasticity between income and fat consumption exists in China for a wide range of incomes. They also expect that the early stages of the nutrition transition in China would be accounted for by sharply increased availability of vegetable oil. Across Asia, the behavior of consumers changes dramatically as countries urbanize. Urban dwellers consume less rice and more meats, milk products, and fish than do their rural counterparts, even after accounting for the differences in income and prices. China is undergoing mass urbanization during the beginning of the 21st century, which has dramatic effects on food consumption. According to the China Bureau of Statistics, only 36% of the population lived in cities and towns in 2000. This urbanization rate was 10% points below the world average and lower than the rate in many other countries at similar development levels. In 2011, the urbanization rate had reached 51%. This population shift has a great impact on national food consumption because consumption patterns are inherently different for rural and urban consumers. Income differentials, expenditure growth, rates of change of population, and other demographic factors also vary dramatically between rural and urban regions (Huang, et al., 1999). Increased income and urbanization in China helped propel the growth in demand for animal protein products and vegetable oils. Soybean demand derives from increased consumption of soybean oil and soybean meal, which is mainly fed to livestock and its demand derives from demand for meat and other animal products.

TABLE 1
SOYBEAN BALANCE (TONS)

Year	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Domestic supply quantity	59676604	56586832	45676299	45767359	43224243	39524928	37123862	31553649	30772329	27011850
Export Quantity	410290	538716	532863	449416	468120	402768	350548	362235	322302	279046
Feed	2020770	1509155	1708421	3215816	3013609	3594374	2911341	1906674	2655486	2009406
Food supply quantity	4993318	4594248	5298593	5426076	5520142	5096659	4994540	4776054	5344569	5396121
Import Quantity	44961805	39573763	33197818	30702375	29082753	22303070	23241709	13896318	16440259	12776081
Other Utility	665	632	685	683	682	681	669	661	770	801
Processing	44110000	39584000	36859000	35330000	32801500	28828000	27392000	22901000	20947400	17780000
Production	14981221	15542141	12725147	15500187	16350213	17404280	15393341	16505368	15407328	15411495
Seed	1232065	1232065	1272490	1237000	1275745	1354705	1343995	1354390	1317115	1393240
Stock Variation	143868	2009644	286197	14213	-1740603	220345	-1160640	1514198	-752956	-896679
Waste	7319793	9666736	537112	557783	612564	650507	481316	614873	506990	432283

Data Source: FAO

TABLE 2
SOYBEAN OIL BALANCE (TONS)

Year	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Domestic supply quantity	10247533	9604783	9396562	7820123	7938979	7439442	6885707	5179649	4134164	3911698
Export Quantity	91693	155059	86829	137277	93034	48319	43299	117229	93412	75622
Feed	0	0	0	0	0	1	1	2	1	1
Food supply quantity	3232117	3089366	3476144	3404707	3110646	2995606	2844539	2647314	2424662	2366199
Import Quantity	2468626	2673942	2930891	1613400	1825713	2666061	2032406	1193278	469176	551220
Other Utility	7015417	6515417	5920417	4415417	4828333	4443834	4041166	2532334	1709500	1545501
Production	7874100	7087700	6623900	6345000	5893800	5181700	4923600	4122600	3772400	3204100
Stock Variation	-3500	-1800	-71400	-1000	312500	-360000	-27000	-19000	-14000	232000

Data Source: FAO

Table 1 shows that, from 2000 to 2009, the soybean supply remained at about 5 million tons while soybean oil supply increased from 2.4 million tons to 3.2 million tons (figure 2). At the same time, the total soybean oil supply almost tripled, increasing from 3.9 million tons to 10.2 million tons. Within the domestic supply, the supply of soybean oil for other uses increased from 1.5 million tons to 7.0 million tons. Based on information from the oil crush industry, most of the soybean oil in the other-use category goes to the food manufacturing industry and restaurants, and to a lesser extent for industrial usage, which means that most of the other-utility soybean oil is finally consumed as food but not counted in the food supply. Comparing the quantities of processed and imported soybeans in table 1, as well as the soybean oil production in table 2, we reasonably conclude that over 95% of the imported soybeans are crushed into soybean oil and soybean meal, which supply the increasing food and feed demands in recent years.

The increasing demand partly comes from income growth and partly from urbanization. Table 3 shows the urban population proportion and per capita consumption of vegetable oil by urban and rural households.

TABLE 3
PER CAPITA CONSUMPTION OF VEGETABLE OIL (KG) BY URBAN AND RURAL HOUSEHOLDS

Year	Urban population Proportion (%)	Rural	Urban					
			National	Lowest income households (first decile group)	Middle income household (third quintile group)	Upper middle income household (fourth quintile group)	High income household (ninth decile group)	Highest income household (tenth decile group)
2011	51.27	6.6	9.26	8.4	9.7	9.5	9.31	8.89
2010	49.95	6.31	8.84	7.82	9.14	9.15	9.08	8.74
2009	48.34	5.42	9.67	8.26	10.09	10.22	9.73	9.92
2008	46.99	5.36	10.27	8.69	10.72	10.73	10.81	10.37
2007	45.89	5.06	9.63	8.13	10.05	10.22	9.93	9.61
2006	44.34	4.72	9.38	8.7	9.82	9.38	9.25	8.46
2005	42.99	4.9	9.25	8.69	9.62	9.58	8.97	8.39
2004	41.76	4.31	9.29	8.87	9.4	9.47	9.2	8.39
2000	36.22	5.45	8.16	7.8	8.19	8.13	7.89	8.16
1995	29.04	4.25	7.11	6.43	7.09	7.34	7.61	7.66
1990	26.41	3.54	6.4	5.04	6.16	6.47	7.17	7.62

Data source: National Bureau of Statistics of China

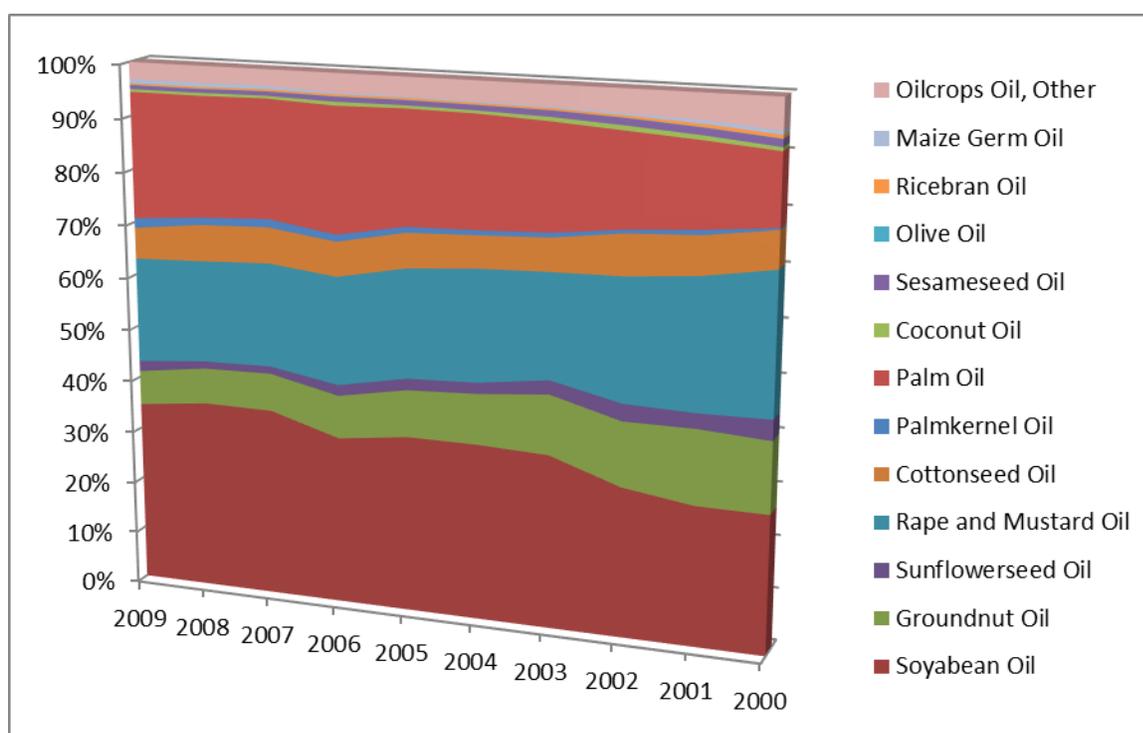
Per capita consumption of vegetable oils in Urban China increased from 6.4 kilograms in 1990 to 9.3 kilograms in 2004 and then remained at that level until 2011. Rural consumption of vegetable oil grew continually from 3.5 kilograms in 1990 to 6.6 kilograms per person in 2011. The urban population proportion almost doubled in those two decades. The income growth and urbanization together led to the vegetable oil demand increase before 2004. After that, the main driving force was the consumption pattern change caused by urbanization.

Change in Vegetable Oil Consumption Pattern

Historically, rapeseed oil was the leading vegetable oil consumed in China, but soybean oil supply grew rapidly and surpassed rape and mustard oil supply in 2001. Rapeseed production competes in land use with winter wheat production, and its acreage could not be vastly expanded. Figure 3 shows the shares of

vegetable oil supply from 2000 to 2009. The top four items are soybean oil, palm oil, rape and mustard oil, and ground nuts oil. Soybean oil consumption grew faster than consumption of most other vegetable oils, including peanut oil, cottonseed oil, and sesame oil. From the late 1990s, the soybean crushing industry developed quickly in China, especially after 2000. Crushing plants in Heilongjiang, Shandong, Jiangsu, Guangdong, and Sichuan provinces expanded. According to the Ministry of Commerce of China, the crushing capacity was less than 70 thousand tons per day in 2000. By the end of 2010, the crushing capacity had increased to 270 thousand tons per day, over 78 million tons per year. Since the quantities of oil exports are less than 0.1 million tons in most years, the rapidly increasing crushing capacity is induced by domestic demand for soybean oil and soybean meal. Figure 5 shows the supply share of each vegetable oil. The supply of ground nuts oil, a traditional oil in China, remained relatively constant in the decades of the 1990s and 2000s. Most of the increasing supply came from soybean oil, palm oil, and rape and mustard oil. In 2009, soybean oil accounted for 35% of total vegetable oil supply, ranking first among all vegetable oils. Palm oil supply increased quickly in the 2000s. It will be a strong competitor with soybean oil in the future.

**FIGURE 5
SHARE OF VEGETABLE OIL SUPPLY**



FORECAST FOR VEGETABLE OIL DEMAND AND SOYBEAN IMPORTS

Increases in income and the shift of the nation’s population from the countryside to cities have resulted in significant changes in China’s consumption patterns. These changes will continue as income growth and urbanization continue. According to a forecast in “Investment Blue Book: China Investment and Development Report (2003)” by the Institute of Developing Investment of China and Social Science Press, the urbanization rate will reach 70% in 2030 and 80% in 2050, which will be the upper limit of urbanization in China. The demand for vegetable oil, therefore, will continue to increase in coming decades. However, China’s consumption statistics are becoming less useful because they were designed to measure at-home consumption of basic commodities. Chinese consumers are eating more meals in restaurants, cafeterias, and dining halls, and these meals are not captured in consumption surveys. Statistics probably understate

urban consumption of foods that are consumed outside the home (Gale, et al., 2002). That is the reason that the per capita consumption of vegetable oil in urban areas stopped increasing beginning in 2004 in table 3, and the other uses of soybean oil increased significantly each year beginning in 2002 in table 4. To estimate the future increase of vegetable oil demand, we compare China with two East Asia countries – Japan and South Korea, which have similar food consumption patterns and higher per capita income than China. Table 5 shows the comparison. We use the per capita total vegetable oil supply to include the oil consumption outside the home. For Japan, per capita vegetable oil consumption has remained relatively unchanged for over ten years, no matter the per capita food supply or per capita total supply of vegetable oil. For South Korea, per capita total vegetable oil supply increased about 26%, from 19.6 kg/yr. in 2000 to 24.8 kg/yr. in 2009. Over that same period, per capita total vegetable oil supply in China increased about 90%, from 11.4 kg/yr. in 2000 to 21.7 kg/yr. in 2009. Considering China’s food pattern is more like South Korea’s than Japan’s, we conclude that per capita total vegetable oil supply in China will increase to between 28 kg/yr. and 30 kg/yr. in the future two decades.

**TABLE 4
VEGETABLE OIL SUPPLY**

Items	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000
Vegetable Oils Total	29613	26617	26145	24454	23610	22151	20841	18173	15579	14803
Soyabean Oil	10248	9605	9397	7820	7939	7439	6886	5180	4134	3912
Groundnut Oil	1932	1810	1883	2008	2112	2126	2367	2227	2215	1996
Sunflowerseed Oil	598	375	365	502	515	466	550	591	443	574
Rape and Mustard Oil	5887	5119	5132	5001	4860	4666	4117	4192	3835	3937
Cottonseed Oil	1743	1832	1773	1602	1547	1345	1293	1391	1120	1022
Palmkernel Oil	540	370	407	319	262	196	183	121	143	48
Palm Oil	7033	6032	5797	5757	5036	4617	4096	3141	2415	1948
Coconut Oil	150	147	131	174	134	123	160	162	131	103
Sesameseed Oil	216	185	203	222	215	209	240	234	205	203
Olive Oil	20	18	14	14	13	11	9	10	10	8
Ricebran Oil	90	90	90	90	90	75	75	75	90	98
Maize Germ Oil	227	184	167	83	55	52	56	67	94	100
Oilcrops Oil, Other	931	851	787	862	832	827	808	784	745	855

Data Source: FAO

**TABLE 5
COMPARISON OF VEGETABLE OIL SUPPLY**

Country	Year	Population (Thousand)	Supply (1000 tons)	Per Capita total Supply (Kg/Yr.)	Other Uses (1000 tons)	Food (1000 tons)	Per Capita food Supply (Kg/Yr.)
China	2009	1365580	29613	21.69	17332	12156	8.9
	2008	1358790	26617	19.59	15735	10776	7.9
	2007	1351832	26145	19.34	14846	11197	8.3
	2006	1344764	24454	18.18	13408	10939	8.1
	2005	1337612	23610	17.65	13544	9975	7.5
	2004	1330416	22151	16.65	12452	9620	7.2
	2003	1323107	20841	15.75	11182	9593	7.3
	2002	1315485	18173	13.81	8860	9269	7
	2001	1307272	15579	11.92	6846	8692	6.6
	2000	1298268	14803	11.40	6285	8492	6.5
Japan	2009	126552	2616	20.67	680	1923	15.2
	2008	126545	2737	21.63	735	1988	15.7
	2007	126515	2665	21.06	662	1988	15.7
	2006	126465	2733	21.61	706	2014	15.9
	2005	126393	2653	20.99	632	2008	15.9
	2004	126299	2647	20.96	629	2010	15.9
	2003	126184	2582	20.46	671	1902	15.1
	2002	126048	2553	20.25	626	1919	15.2
	2001	125894	2536	20.14	550	1978	15.7
	2000	125720	2538	20.19	556	1974	15.7
South Korea	2009	47964	1191	24.83	342	849	17.7
	2008	47734	1000	20.95	232	768	16.1
	2007	47499	964	20.30	206	758	16
	2006	47268	935	19.78	218	717	15.2
	2005	47044	942	20.02	232	711	15.1
	2004	46831	919	19.62	205	714	15.3
	2003	46625	838	17.97	194	644	13.8
	2002	46421	846	18.22	269	577	12.4
	2001	46211	843	18.24	269	573	12.4
	2000	45988	806	19.62	211	595	12.9

Data Source: FAO

The level of China's soybean imports depends on the demand for vegetable oil and the domestic production of oil crops as well as imports of other oil crops and crop oil. On the demand side, based on world population prospects by the United Nation, China's population will achieve 1.396 billion in 2026 and

then drop quickly (Nations, 2010). If per capita total vegetable oil supply in China remains stable at 28 kg/yr. to 30 kg/yr., the highest demand for vegetable oil would be 39 million tons to 42 million tons. If soybean oil retains one-third of the share of total vegetable oil consumption, the supply of soybean oil would be between 13 million tons to 14 million tons. Considering massive soybean oil crushing capacity in China, imports of soybean oil will be less than 2 million tons. Therefore, the total production of soybean oil will be between 11 million tons and 12 million tons, which means the demand for soybeans used to crush oil will be 60 million tons to 65 million tons.

On the supply side, soybean production in China is concentrated in the Northeast (Heilongjiang and Jilin) and the North China Plain (Shandong, Henan, and Hebei). These two regions together produce about 60% of China's soybeans. The North China Plain is largely a double-crop region, and its summer soybean output is crippled by low yields due to a short growing season. It would be neither agronomically feasible nor economically practical to substitute two crops—mainly winter wheat and summer corn, or cotton—for a single crop of soybeans sown in the spring. Soybean output therefore can only be significantly expanded if China shifts large areas of corn or spring wheat in the Northeast region into soybean production (Tuan, et al., 2004). Policy makers in China were concerned primarily with supplying enough grain to meet basic nutritional needs of China's vast population (Gale, et al., 2002). Limited to arable land and slow growth of soybean yields, the production is not expected to change considerably in the future two decades.

Based on the trends discussed above and taking into account soybeans used for food, feed, export, seed, and waste, the shortage of soybeans should be 60 million tons to 65 million tons by 2026, which will be the future demand for soybean imports in China. Several factors might affect the vegetable oil demand and the soybean oil demand. First, fat consumption may be governed, not by physiological mechanisms, but by the amount of fat available in the food supply (Drewnowski and Popkin, 1997). China's consumers are sensitive to food prices, suggesting that realignments of prices could have serious effects on oil demand. If vegetable oil prices increase significantly, the demand would be curbed. Second, little is known about how China's consumers will respond to genetically modified organisms (GMOs), which could play a crucial role in China's future consumption and trade. Although the Chinese government continues to be active in setting policies - it issued import certificates for three GMO soybeans in June 2013 - the opponents of GMOs have increased markedly in recent years. Consumer's opposition will lead to a decrease in consumption of GMO soybean oils, which account for half of the total supply. Third, vegetable oil is a strong substitute for soybean oil. If consumers do not have access to enough soybean oil, they would turn to ground nuts oil or palm oil. Continually increasing demand has led to significant soybean oil price increases in recent years, which in turn has propelled Chinese importers to look for substitutes. Palm oil imports have therefore increased continually in the decade of the 2000's. In 2009, palm oil accounted for 24% of total vegetable oil supply. Palm oil plays a leading role in the global vegetable oil market. So it will impact the leading role of soybean oil in China. However, one limitation is that importing palm oil cannot offer feed for the livestock industry like crushing soybeans.

CONCLUSION

Increasing income and urbanization led to increasing edible oil consumption. With the rapidly-changing patterns of oil consumption in China over the decades of the 1990's and 2000's, consumption of soybean oils has been experiencing faster growth than consumption of rapeseed and peanut oils has, inducing massive soybean demand, particularly for crushed soybean oil and meal. China's strained natural resources and high levels of fertilizer and pesticide use mean that further expansion of agricultural output through greater input may not be sustainable. To accommodate growing consumer demand for food, the agricultural sector will probably need to make more efficient use of its limited land. Therefore, with increasing integration with the global economy, China's trade pattern in agricultural commodities follows its comparative advantage: it imports land-intensive commodities (soybeans, cotton, barley, rubber, and oils made from soybeans and palm kernels), and exports labor-intensive commodities (fish, fruits, vegetables, and processed agricultural goods). Importing soybeans, which have low yields per hectare, allows China to free up land for higher yielding crops. This shift of arable land to higher yielding crops, which has been

adopted as agricultural policy by the Chinese government, will cause the shortage of soybean supply to persist for the long term.

Comparing vegetable oil consumption in China with consumption in Japan and South Korea, two neighboring countries with similar food consumption patterns, we estimate that the per capita vegetable oil supply will achieve 28-30 kg/yr in the decade of 2024's, and the shortage of soybean supply will be about 60-65 million tons. Prices of other edible oils, panic among consumers over potential risks of GMOs, and competition from other substitutes will also affect the demand for soybean imports.

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