THESIS

ANALYSIS OF CHINESE AND U.S. SOY MARKETS AND TRADE DYNAMICS

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ABSTRACT

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The stable soybean (and soy product) trade relationship between the U.S. and China is threatened by various market factors. This thesis analyzes the drivers behind soybean trade between the U.S. and China. The economic models are constructed and estimated by Seemingly Unrelated Regressions (SURs) to discover what factors may be influencing U.S. domestic soybean (and soy product) demand, as well as factors influencing U.S. export volumes and China import volumes. Discussion of policy implications will be provided based on the estimation results.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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CHAPTER I: INTRODUCTION

The U.S. and China are the two largest agricultural producers in the world and are increasingly interdependent trade partners. In the past 30 years, thanks to significant Chinese domestic population and income growth, U.S. domestic oversupply, the persistent undervaluation of Ren Min Bi (RMB), and an easing international trading environment, trade volume between the U.S. and China steadily increased in scale. Views among analysts remain broadly upbeat. However, some change is taking place.

Financial and economic crises are changing the world trade market structure and the previous trade balance is shifting. Governments commonly establish and use levers to find the balance point that creates long lasting, mutual beneficial trading terms between countries. Private sector enterprises, in order to survive in the changing trade environment, find alternative ways to maintain profits. Thus, conflicting government and private sector goals may create tension.

In this thesis, the fundamental economic standpoint is based on Keynesian economic theory; government intervention sometimes does benefit the market. But, appropriate policy can improve market efficiency or address broader economic goals. Soybeans and soy products are the research focus for this thesis because they are representative of the changing international trade relationship between the U.S. and China. Currently, stable soybean and soy product trade between the U.S. and China is threatened by various market factors and real trade volume could potentially decrease. Private sector enterprises in both the U.S. and China are starting to find possible trade partners in other countries to avoid potential losses if trade does decline. Overall, their behavior is corroding the long term and stable soybean trade between the U.S. and China. Yet, rebuilding a stable, mutually beneficial trade environment is a common goal of both governments (T. Qian, L.M. Wu, 2012). The thesis will give policy implications based on the economic analysis.

Specifically, based on the economic research presented here, the following issues can be addressed:

1. How do the fundamental supply and demand drivers affect soybean and affiliated markets?
2. What factors have been most influential in determining export and import volumes for the U.S. and China, respectively?
3. What monetary and regulatory policies may be affecting trade relationships?

In order to inform the literature on how trade between the U.S. and China is evolving, this academic thesis will be organized in the following way: it will begin with an analysis of domestic market demand relationships in the U.S. soybean sectors, and then present similar analysis for interactions between U.S. and China in the international market. Based on the empirical results from these market analyses, the emerging policy topics of Chinese currency appreciation and genetically modified technology regulation will be introduced as potential shocks that the markets may react to in the near future.

Specifically speaking, Chapter 2 provides an overview of the Chinese and U.S. market situations. In Chapters 3 and 4, the model systems are constructed and regressed using seemingly unrelated regression (SUR) analysis. Chapter 5 explores the role of currency exchange on soy product trade. Similarly, Chapter 6 discusses the effect of Chinese transgenic regulations. The final chapter, Chapter 7, presents some conclusions and policy implications.

CHAPTER II: LITERATURE AND MARKET SITUATION

2.1 Previous literature

Tuan, Fang, and Cao (2004) suggest that Chinese soybean imports would keep increasing due to the expected population growth, improved quality of life and increasing need for soymeal for feeding increasing livestock numbers. In short, the Chinese soybean industry has relied on imports to support increased food demand. Although China was able to double its domestic soybean production over the last two decades, total soybean use outstripped production growth.

Hsu (2001) compares the agricultural structures of China and the U.S. She argues that soybean production is treated differently in the two countries. The Chinese government traditionally highlights corn and rice production, both of which receive more subsidies than soybean production. As a result, the relative scale of soybean production has decreased in recent years. In the U.S., the government balances the production of corn and soybeans through different subsidy programs. Therefore, soybean production is never directly discouraged by policies supporting corn production.

Plato and Chambers (2004) develop an economic model to analyze how structural change in the global soybean market affects U.S. soybean prices. Their empirical results show that the growth rate of soybean exports from South American countries is much bigger than the growth rate for the U.S. Moreover, South American countries, to some extent, can affect the price of U.S. soybeans and influence the competitiveness of U.S. soybeans in the international market.

Song and Marchant (2006) argue that transgenic regulations in China are meant to provide oversight of food imports and protect local farmers. The Chinese domestic, non-transgenic soybean supply is inadequate for domestic consumption, and government has to make a choice between failing to meet consumer demand and allowing the public to consume genetically modified soybean. For the sake of food supply stability, the latter is likely to be the ultimate choice.

Liao (2007) suggests that the mandatory transgenic regulations increase the price gap between the domestic, non-genetically modified soybeans and imported, transgenic beans. This will stimulate Chinese producers to export traditional soybeans to Japan and South Korea, where non-genetically modified soybeans are preferred.

Cheng (2003) concludes, based on empirical research, that transgenic regulations do not decrease transgenic soybean imports. Instead, the imports of transgenic soybeans unexpectedly increased in the short term.

2.2 Market situation

In the U.S. market, nearly all soybeans are crushed to extract the oil from the resulting meal. A comparatively small portion of soybeans is used for seed, roasted for snacks, or used for on-farm dairy feed (NASS, 2011). Hence, the main U.S. domestic demanders are crushing factories and edible oil consumers, and the main suppliers are raw soybean producers. Most soybean production facilities are located near the crushing factories. In fact, a developed supply chain including production, transportation and marketing has been built and has operated for decades.

The Chinese market seems to be more complicated and somehow undeveloped. In addition to crushing factories, livestock producers are also important soy product consumers

(USDA, 2011). Their market behavior influences both soybean producers and crushing factories. The crushing factories in China are located far from the soybean production regions, and high transportation costs make Chinese soybeans less competitive in global markets (Tuan, Fang, Cao, 2004). Additionally, relatively high water content and low protein content discourages crushing factories from using domestically produced soybeans.

2.2.1. Chinese market outlook

2.2.1.1 Soybeans

China has a population of 1.4 billion, and traditionally its agricultural industry has been vital to the country's development and safety (Baidu Wiki, 2012). According to statistics published in 2005, China accounted for 31% of rice, 27% of rapeseed, 19% of corn, 27% of cotton, 16% of wheat, and 9% of soybean production globally (CDA, 2012). However, since 2004-2005, soybean production has declined. Production of Chinese domestic soybeans decreased from 1.65 billion tons in 2002 to 1.27 billion tons in 2007 (USDA, 2011). In 2008, with the support of strong policies to encourage domestic production and market self-adjustment, the production of soybeans recovered to 15 million tons (USDA, 2011). However, the production volume in 2009 dropped slightly to 14.9 million tons (USDA, 2011).

The raw soybean can be processed into different kinds of food, seasonings and other processed products. In food, soymilk and soy tofu are the main products (Cheng and Li, 2003). In the seasoning sector, soy sauce is one of the most fundamental seasonings used in Chinese homes and restaurants. Besides these, soybean edible oil has the advantage of a low price and relatively high quality compared to other kinds of edible oils (peanut oil, animal oil and olive oil)

(Baidu Wiki, 2012). The currently modest GDP per capita level for Chinese households makes soybean edible oil the best choice for most Chinese families .

In other industries, like livestock production, the soymeal produced by the soybean is the main source of feeding supplements. According to the USDA (2009), livestock production in China increased at the average rate of 3.5% from 2000 to 2009. In 2009, livestock production reached 15.9 million tons. The increasing production volume of livestock required a growing supply of soymeal.

2.2.1.2 Soy oil

Soy oil production in China is influenced by raw soybean production, net soybean imports, substitute oil production, customer preferences and the demand for soybean dregs used to produce soymeal. In general, there are three important periods that define market shifts in soy oil production over history (Wu, 2011): in the 1980s, the government subsidized crushing industries to increase soy oil supply; in the 1990s, livestock industry development led to dramatic advances in crushing factories; finally, after 1995, lower prices for imported soy oil shocked the crushing industry.

In China, soy oil is consumed for by the following stakeholders: family use, corporate and public use, processing use, and medical and industrial use. The determinants of soy oil consumption are income, population, immigration, change of consumption structure, inflation, and the price indices of the medical, food and industries (Kang and Qiao, 2005). The soy oil consumption characteristics for Chinese have gradually changed. Previously, oil made from vegetable seeds was preferred. With the living standard improving in recent years, higher quality soybean salad oil has become popular. Moreover, the production process of soybean salad oil is easier and lower-cost when compared with that made from the vegetable seeds, leading to greater demand for soy by oil processors since 1995 (USDA, 2011). In recent years, the consumption of edible oil in Chinese rural areas has surged (USDA, 2011).

2.2.1.3 Soymeal

Soymeal is primarily made from soybean dregs, which is the by-product of the soy oil production process. Soybean production and consumption in China continue to grow since there has also been an increase in the livestock industry in the 1990s (Tan, 2002). The annual average growth rate of soybean production has stayed above 5% and the total consumption quantity has increased by more than 10% annually over the past two decades (USDA, 2011). Import volume continues to grow exponentially to make up for insufficient domestic production.

2.2.1.4 Policies affecting soy product market dynamics

2.2.1.4.1 Soy oil policy

Over the recent history of Chinese soybean edible oil production, the most important policy watershed occurred in 1993. Before 1993, the production of edible oil could not meet domestic demand. In order to expand soybean production and to make up for the lack of edible oil, the government chose to conduct a target price strategy, and set the official wholesale price of soybeans 20%-30% higher to stimulate farmers to expand soybean production. After 1993, disparities between soy oil supply and demand became notable and the Chinese government filled the gap by opening the soybean import market. Imported soybeans and soy oil entered the Chinese domestic supply chain, and by the end of 1995, imported soy oil accounted for nearly 50% of consumption within the Chinese market (USDA, 2011).

2.2.1.4.2 Soymeal policy

The Chinese government has been trying to use policy tools to maintain the prices of soy oil and soymeal at reasonable levels, although this policy target is difficult to reach. In 1995, the government lifted the Value Added Tax (VAT) on imported soymeal to encourage development of the livestock industry; and this policy led to an influx of 3.6 million tons of soymeal imports in 1996-1997, and another 4.2 million tons in 1997-1998 (USDA, 2011). Subsequently, the market price of soymeal decreased sharply. Abundant supplies of soymeal hurt soybean prices, reduced domestic crushing margins, and discouraged domestic soy oil production. The resulting high soy oil price hurt the majority of citizens and the government re-imposed the VAT on imported soymeal to limit soymeal imports, increased domestic margins, and finally increased domestic soy oil production. Because of this dilemma, the Chinese government changed the soymeal policy frequently to respond to sudden market shocks in subsequent decades.

2.2.1.5 Soybean shipments

2.2.1.5.1 Low shipping ability

For raw agricultural commodities like soybeans, railway transit is the most economical method of shipment (Liu, 2006). Additionally, for transporting soybeans (or the other non-perishable agricultural commodities) from the production base (in the northeast) to more distant processing regions (southern region), rail transport is the first choice in China. However, the railway reservation centre can only satisfy about half of the current service applications (Liu, 2008). Thus, the delivery time for these commodities cannot be guaranteed.

2.2.1.5.2 Geographic disadvantage

The price of imported soybeans is the combination of the freight on board (FOB) price and the sea transit cost; so, the domestic soybean price includes the market price in the production center as well as the railway shipping cost. In China, the main soybean production regions are located in the northeast, but the main crushing factories are almost all along the southern coast (Bai, 2003). For example, the Heilongjiang province alone produces about 40% of domestic soybeans and soybean products (Liu and Guo, 2004). A relatively unreliable railway system makes the highly efficient southern factories prefer to import soybeans from other countries, especially the U.S. (Liu and Guo, 2004).

2.2.1.5.3 Final price comparison

In order to make prices of imported soybeans and domestic soybeans comparable, three ports are selected as the final exchange locations for both imported and domestic soybeans, and 2007 is set as the comparison period. Table 1 below shows annual average prices of domestic soybeans at these three ports and Figure 1 below shows their locations.

Table 1: Cost comparison of three main Chinese ports ($/ton)

	Procurement price	Medium business cost	Railway transit cost	Railway tax	Sum
Dalian port	433	11	10	1	455
Qingdao port	433	11	12	2	458
Guangzhou port	433	11	38	3	485

Source: Ministry of Chinese Transportation

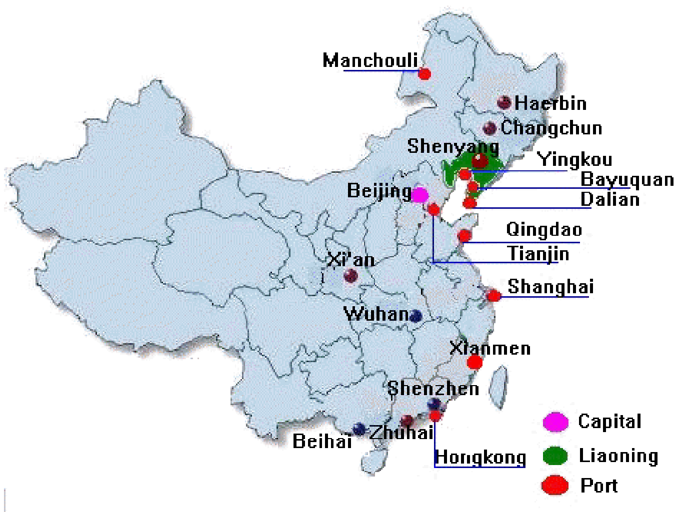


Figure 1: The geographic location of three Chinese ports

Source: MIEC, 2012

Based on the USDA 2010 database, the average market price of U.S. soybeans arriving at Chinese ports is $470/ton, and another $30 may be deducted for lower water content and high protein. Thus, the final average price of U.S. soybeans in any Chinese port is only $440/ton, giving domestic soybeans no advantage when compared with imports. This relatively low cost for imported goods is why the majority of crushing factories in China choose to process imported soybeans (USDA, 2011).

2.2.2 U.S. Soybean market dynamics

2.2.2.1 Soybean supply structure and dynamics

The U.S. soybean market structure is different from the structure in Asian countries. In addition to the traditional use of soybean edible oil and soymeal, U.S. soybean producers now consider the potential soybean biodiesel market in their expectations.

The majority of U.S soybeans production occurs in the Midwest region and has comparatively low production costs versus global competitors (USDA, 2011). The majority of harvested soybeans are either exported to the Asian region or crushed into edible oil and soymeal domestically, and only few of them are made into soy foods (USDA, 2011). Soy oil and soymeal have been over-produced over the past few decades, and the preponderance of these products are exported to global demanders (USDA, 2011).

After the 1990s, in response to concerns about the volatility of global gasoline prices, the U.S sought a way to decrease their dependence on oil from the Middle East: developing corn ethanol production capacity (Rattner, 2011). The increasing demand for corn land use largely squeezed out land previously used for soybean production. Traditional soybean producers along the Mississippi River started to seek new land where rents were lower. Considering the natural transportation advantage created by the Mississippi River, re-location of the soybean production base means a partial loss of comparative advantage. This can partly explain why the U.S. has gradually lost its dominant status in the global soybean export market (Schnepf, 2011).

Although the U.S. soybean export share has shrunk in global markets after 2000 (Plato and Chambers, 2004), the soybean industry in the U.S. is more stable and consistent when compared with South American countries (South American countries are the main competitors of U.S. in the soybean global exports market). In the South American region, a small change in currency rates, political structure, macroeconomic surroundings, or even abnormal weather can lead to unwelcome volatility in soybean production and transportation. But in the U.S., wide market participation, stable currency, and a stable political system guarantee a longer planning horizon and good trade environment for producers and exporters. Thus, the potential competitive advantage of the U.S. soybean sector is founded on its reliability in the eyes of global trade partners.

2.2.2.2 International soybean demand

International market demand seems to have a significant influence on soybean production in the U.S. Three main countries or regions below are analyzed as representative of U.S. soybean buyers.

China is an example of a ‘current consumer’ for U.S. soybeans. Most private crushing factories along the southern Chinese coast signed large purchase contracts with U.S. export companies to import soybeans and satisfy increased domestic demand. In the late 20th century, U.S. soybean exports to China accounted for over 30% of its total global exports (USDA, 2011).

The European Union is an example of a ‘future consumer.’ Although E.U. imports are shrinking due to implementation of new food regulations related to biotechnology, large future demand from biodiesel research probably will make the E.U. re-open doors to U.S. soybeans (USDA, 2011).

India is a ‘potential consumer.’ Currently, U.S. soybeans cannot enter India due to stringent barriers to trade (Delta Farm Press Exclusive Insight, 2012). However, with the population of India rapidly increasing, the mismatch between supply and demand of edible oils is expected to become problematic. Many believe that India could be the next large trading partner for U.S. soybeans (USDA, 2011).

2.2.2.3 Domestic soybean demand

The variety of uses for soybeans is growing. More and more new foods that use some components of soybeans are being created. Notable examples are soymilk and soy cake (Baidu Wiki, 2012), which were not common purchases by consumers decades ago; but now, these products attract potential customers because of their high protein content. In the soy oil market, a new kind of soy oil with lower trans-fat content is gradually being adopted in a larger share of the soy oil market (USDA, 2012).

In addition, expanded biofuel research may increase demand for soybeans. The new environmental regulations may encourage businesses and consumers to use biodiesel as a larger share of their energy use, and the outlook for soy biofuel is quite bright (Oshima, Hahn and Gerpen, 1998).

2.2.2.5 Soy oil

The market structure of the soy oil sector in the U.S. is simpler than that of China. Soy oil is the second most important oilseed crop and accounts for more than 50% of all edible oil production in the U.S. (USDA, 2011). The U.S. soy oil industry is statistically defined as a net exporter, meaning that the majority of the production resources are designated for export. Furthermore, all of the crushing factories are located near the production base.

After 2000, the export of both soybeans and soy oil from the U.S. decreased as a result of competition from South American exporters. The soy oil industry seems to be affected more seriously than producers of raw soybeans. Total U.S. soy oil export share in the world market has dropped to less than 10% from 2000 to 2010 (USDA, 2012).

2.2.2.6 Soymeal

Although the domestic demand for soymeal in the U.S. has been increasing and more diversified since the beginning of the 20th century, it is still not strong enough to affect domestic soymeal production. In general, soymeal production in the U.S. is passive and largely influenced by soy oil production (USDA, 2012). For instance, biofuel research indirectly increases soy oil production, which causes production of soymeal, a soy oil byproduct, to also increase. This dynamic can partly explain the erratic fluctuations in soymeal production and consumption since 1980 (USDA, 2011).

CHAPTER III: MODEL CONSTRUCTION AND DATA ANALYSIS

3.1. U.S. domestic market

3.1.1 Model system

This economic model system provides estimated coefficients that reflect different demand elasticities and other relationships between key variables. Because the error terms are probably correlated across the equations (for like products), this analysis uses Seemingly Unrelated Regressions (SUR) to estimate demand model systems below:

$$\ln(Demand_{soybean}) = \alpha_0' + \alpha_1' \ln(P_{soybean}) + \alpha_2' \ln(P_{soy\ oil}) + \alpha_3' \ln(P_{soymeal}) + \alpha_4' \ln(\text{per capita GDP}) + E_t$$

$$\ln(Demand_{soy\ oil}) = \beta_0' + \beta_1' \ln(P_{soybean}) + \beta_2' \ln(P_{soy\ oil}) + \beta_3' \ln(P_{soymeal}) + \beta_4' \ln(\text{per capita GDP}) + E_t$$

$$\ln(Demand_{soymeal}) = \Upsilon_0' + \Upsilon_1' \ln(P_{soybean}) + \Upsilon_2' \ln(P_{soy\ oil}) + \Upsilon_3' \ln(P_{soymeal}) + \alpha_4' \ln(\text{per capita GDP}) + E_t$$

3.1.2 Data (U.S. demand model systems)

Table 2 shows the per capita income level of U.S. from 1969 to 2010. The base line is the per capita gross domestic product (GDP) in 2005. It can be calculated as the rate of increase of per capita GDP in the U.S. is about 1%-4%, and the rate of increase in 1984 reached the historic high point - 6%. The per capita GDP in 2010 is almost double the per capita income in 1969. Because the Engel Coefficient in the U.S. is quite small, the estimated income coefficient will probably not be significant.

Table 3 shows the supply, disappearance and price of U.S. soybeans. The growth rate of domestic production is not constant, which probably results from variations in the international market. The historic high growth rates occurred in 1989, 1994 and 2004 when the rates of increase were 34%, 24%, and 27%, respectively. In 1994, due to abnormally high expectations of inflation, the Chinese people hurried to buy and stock up on soy sauce. Coincidently, the supply of U.S. soybeans increased dramatically in 1994. Among price levels, soybean prices fluctuated between $ 4.00 and $7.00 per bushel before 2007. After 2007, the price surged and even reached nearly $12 per bushel in 2010.

Table 4 shows the supply, disappearance and prices of U.S. soy oil. A stable increase can be observed in domestic consumption even though the diet habits of Americans have led them to consume less edible oil. This is probably due to increasing demand for biodiesel. The export quantity has nearly doubled from 1980 to 2010 and its average rate of increase is 11%. In 1995, the soy oil export quantity reached its lowest historic point as a result of decreasing demand in Asian countries.

Table 5 shows the supply, disappearance and price of U.S. soymeal. From 1980 to 2010, domestic production of soymeal has been increasing slowly Similarly, exports have changed at a stable rate, which results in a comparatively stable price.

The trend lines of soybeans, soy oil, soymeal and corn prices against time are shown in Figure 2. Trend lines of domestic production and consumption against time are shown in Figures 3-5. The common sample and correlation statistics are reported in the Tables 6 and 7.

Gaps in Figures 3-5 reflect the export quantities. In Figures 4 and 5, observe that the soy oil and soymeal exports in 2006 are both extremely large, and in 1988 notice that the soybean, soy oil and soymeal exports simultaneously reached their lowest levels. However, it must be clear that Figures 12-14 are drawn based on only two international marketplace participants: the U.S. and the rest of the world (ROW).

In the correlation statistics table, the correlation between soybean price and soymeal price is 0.93. The correlation between soybean supply and soy oil supply is also 0.93. The corn price is highly correlated with soybean and soy oil prices (with correlations of 0.88 and 0.88, respectively). Thus, the multicollinearity problem is a primary concern in the system regression. So, if it we notice a strong negative influence on R^2 and insignificance of estimated coefficients, lagged variables will be considered.

3.2 Soy trade between the U.S. and China

3.2.1 Model system

The next model system estimates soy trade between the U.S. and China. In the U.S. exports model system, total exports of soybeans, soy oil and soymeal are set as the dependent variables; in the China imports model system, total imports of soybeans, soy oil and soymeal from the U.S. are set as the dependent variables. In the U.S. exports model system, because of possible multicollinearity problems between the currency exchange rate and Chinese per capita GDP, only U.S. per capita GDP and the currency exchange rate are included as independent variables. In the China imports model system, the exchange rate is not included in the independent variables because of its low influence on imports quantity. In both model systems FOB prices, domestic production in China and Chinese soy products consumption are incorporated as independent variables. Because the error terms are probably correlated across the equations, Seemingly Unrelated Regressions (SUR) is used to estimate the two model systems.

Export system (U.S.):

$$\textbf{Exports}_{\text{soybean}} = \alpha_0 + \alpha_1 P_{\text{soybean U.S.}} + \alpha_2 \textbf{Currency} + \alpha_3 \textbf{Supply}_{\text{soybean China}} + \alpha_4 \textbf{Demand}_{\text{soybean China}} + \alpha_5 \textbf{Income}_{\text{U.S.}} + E_t$$

$$\textbf{Exports}_{\text{soy oil}} = \beta_0 + \beta_1 P_{\text{soy oil U.S.}} + \beta_2 \textbf{Currency} + \beta_3 \textbf{Supply}_{\text{soy oil China}} + \beta_4 \textbf{Demand}_{\text{soy oil China}} + \beta_5 \textbf{Income}_{\text{U.S.}} + E_t$$

$$\textbf{Exports}_{\text{soy meal}} = \Upsilon_0 + \Upsilon_1 P_{\text{soy meal U.S.}} + \Upsilon_2 \textbf{Currency} + \Upsilon_3 \textbf{Supply}_{\text{soy meal China}} + \Upsilon_4 \textbf{Demand}_{\text{soy meal China}} + \Upsilon_5 \textbf{Income}_{\text{U.S.}} + E_t$$

Import System (China):

$$\textbf{Imports}_{soybean} = \alpha_0' + \alpha_1' P_{soybean\ U.S.} + \alpha_2' \textbf{Supply}_{soybean\ China} + \alpha_3' \textbf{Demand}_{soybean\ China} + \alpha_4' \textbf{Income}_{China} + \alpha_5' \textbf{Income}_{U.S.} + E_t$$

$$\textbf{Imports}_{soy\ oil} = \beta_0' + \beta_1' P_{soy\ oil\ U.S.} + \beta_2' \textbf{Supply}_{soy\ oil\ China} + \beta_3' \textbf{Demand}_{soy\ oil\ China} + \beta_4' \textbf{Income}_{China} + \beta_5' \textbf{Income}_{U.S.} + E_t$$

$$\textbf{Imports}_{soy\ meal} = \Upsilon_0' + \Upsilon_1' P_{soy\ meal\ U.S.} + \Upsilon_2' \textbf{Supply}_{soy\ meal\ China} + \Upsilon_3' \textbf{Demand}_{soy\ meal\ China} + \Upsilon_4' \textbf{Income}_{China} + \Upsilon_5' \textbf{Income}_{U.S.} + E_t$$

In order to estimate these model systems, data have been collected from several USDA databases. Recall that the U.S. per capita GDP is shown in Table 4. Table 8 shows the per capita GDP of China from 1969 to 2010. Table 9 shows the currency exchange rate between U.S. dollars and Chinese Yuan (RMB). Supply and disappearance of Chinese soybeans, soy oil and soy meal are shown in tables 10-12, respectively. Additionally, general statistics and correlation statistics are reported in Tables 13 and 14.

3.2.2 Data (International model systems)

First, per capita GDP in China is almost always below $200 before 1979 (ERS-IMDS, 2011). Between 1979 and 1982, per capita GDP increases sharply with an average annual rate increase reaching 9.2%. Per capita GDP surged in 1984, when it increased by more than 13% compared to the baseline. In 2011, the per capita GDP of China is about 10 times more than that of 1969. The sharp GDP growth across 40 years is expected to enhance the soybean, soy oil and soymeal demand dramatically. Thus, it can be anticipated that the coefficient of Chinese per capita GDP will be significant.

Second, the currency exchange rate disputes between the U.S. and China never stop. From 1970 to 1979, RMB stays at the devaluation status partly because of the half-open economic system (Gong and Lan, 2011). After 1979, China participated more fully in the world economic system and gradually, deliberately released some currency controls. From 1979 to 1994, RMB value decreased; it should be noted that this decrease was partly a result of worldwide preference for USD (Gong and Lan, 2011). At that time, Chinese exports kept growing and imports decreased due to the high exchange cost of USD. After 1995, continuous net exports and large foreign exchange reserves caused increasing pressure for RMB appreciation. The Chinese government responded with a gradual appreciation policy.

Another interesting trend from table of Chinese soybean supply and disappearance is that the Chinese domestic soybean harvest area increased about 5% annually from 2000 to 2011. However, the annual consumption growth rate was about 8% and this annual growth rate was quite stable between 2000 and 2011. In short, supply deficiencies are mainly solved by increasing imports.

Fourth, the table of soy oil supply and disappearance (table 11 is analyzed. The total quantity of soybeans used to crush nearly doubled in 2011, compared to the baseline. Thanks to technology improvement, the extraction rate of soybeans increased from 17.8% in 2000 to 18.8% in 2011. The increasing soybean production and extraction rate make soy oil production rise from 8,073 million tons in 2000 to 17,269 million tons in 2011 with an annual average growth rate of 8%. As the annual increase in the rate of consumption is only 6%, the Chinese domestic production of soy oil can almost cover domestic consumption.

Fifth, some useful information is displayed in the table on soymeal supply and disappearance. Soymeal production grew from 14,835 million tons in 2000 to 41,434 million tons in 2011. However, the dramatic increase in domestic supply may still not satisfy continuously growing demand. As evidence, from 2000 to 2011, the imported quantity of soymeal increased by 450%. The average annual growth rate reached 45%, which is much larger than that of soybeans at 9.8%.

Finally, in the correlation table, the independent variables are highly correlated, again indicating a potential problem with multicollinearity. The correlation indices among independent and dependent variables in both export and import systems are quite high. So again, if it has strong negative influence on R^2 and significance of estimated coefficients, lagged variables will be considered.

Table 2: U.S. real per capita GDP data from 1969-2010

Year	Per capita GDP	Year	Per capita GDP	Year	Per capita GDP
1969	$21,145	1983	$26,224	1997	$36,112
1970	$20,915	1984	$27,866	1998	$37,247
1971	$21,320	1985	$28,763	1999	$38,599
1972	$22,189	1986	$29,486	2000	$39,750
1973	$23,244	1987	$30,158	2001	$39,769
1974	$22,901	1988	$31,114	2002	$40,108
1975	$22,627	1989	$31,923	2003	$40,769
1976	$23,611	1990	$32,157	2004	$41,792
1977	$24,450	1991	$31,656	2005	$42,681
1978	$25,542	1992	$32,279	2006	$43,332
1979	$26,051	1993	$32,765	2007	$43,726
1980	$25,675	1994	$33,684	2008	$43,178
1981	$26,070	1995	$34,122	2009	$41,313
1982	$25,321	1996	$34,989	2010	$42,189

Source: ERS International Macroeconomic Data Set

Table 3: Supply, disappearance and price of U.S. soybeans from 1980-2010

Year	Supply, million bushes			Disappearance, million bushes					Average price received by farmers $/bu.
Beginning September	Beginning stocks	Producti on	Total	Crush	Exports	Seed, feed and residu al	Total	Endin g stocks	
1980	358	1,798	2,156	1,020	724	99	1,843	313	7.57
1981	313	1,989	2,302	1,030	929	89	2,048	255	6.07
1982	255	2,190	2,445	1,108	905	87	2,100	345	5.71
1983	345	1,636	1,980	983	743	79	1,805	176	7.83
1984	176	1,861	2,037	1,030	598	93	1,721	316	5.84
1985	316	2,099	2,415	1,053	741	85	1,879	536	5.05
1986	536	1,943	2,479	1,179	757	106	2,042	436	4.78
1987	436	1,938	2,375	1,174	804	95	2,073	302	5.88
1988	302	1,549	1,855	1,058	527	88	1,673	182	7.42
1989	182	1,924	2,108	1,146	622	101	1,869	239	5.69
1990	239	1,926	2,169	1,187	557	96	1,840	329	5.74
1991	329	1,987	2,319	1,254	684	103	2,041	278	5.58
1992	278	2,190	2,471	1,279	771	129	2,179	292	5.56
1993	292	1,870	2,168	1,276	588	95	1,959	209	6.40
1994	209	2,515	2,729	1,405	840	150	2,395	335	5.48
1995	335	2,174	2,514	1,370	849	111	2,330	183	6.72
1996	183	2,380	2,573	1,436	886	119	2,441	132	7.35
1997	132	2,689	2,826	1,597	874	155	2,626	200	6.47
1998	200	2,741	2,944	1,590	805	201	2,596	348	4.93
1999	348	2,654	3,006	1,578	973	165	2,716	290	4.63
2000	290	2,758	3,052	1,640	996	168	2,804	248	4.54
2001	248	2,891	3,141	1,700	1,064	169	2,933	208	4.38
2002	208	2,756	2,969	1,615	1,044	131	2,791	178	5.53
2003	178	2,454	2,638	1,530	887	109	2,525	112	7.34
2004	112	3,124	3,242	1,696	1,097	193	2,986	256	5.74
2005	256	3,068	3,327	1,739	940	199	2,878	449	5.66
2006	449	3,197	3,655	1,808	1,116	157	3,081	574	6.43
2007	574	2,677	3,261	1,803	1,159	94	3,056	205	10.10
2008	205	2,967	3,185	1,662	1,279	106	3,047	138	9.97
2009	138	3,359	3,512	1,752	1,501	108	3,361	151	9.59
2010 2/	151	3,329	3,495	1,655	1,590	110	3,355	140	11.60

Sources: Crop Production, Grain Stocks and Agricultural Prices, National Agricultural Statistics Service, USDA and U.S. Trade; Oilseed crushing, U.S. Census Bureau, 2011.

Table 4: U.S. soy oil supply, disappearance, and price from 1980-2010

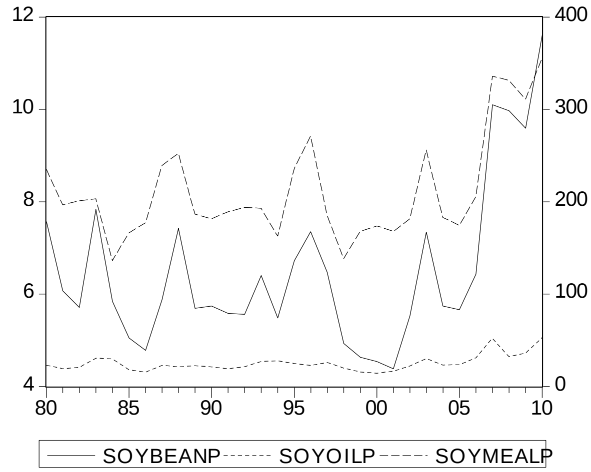
Year	Supply, million bushes				Disappearance, million bushes				Price Crude, Decatur Cents/lb
Beginning October	Beginning stocks	Production	Imports	Total	Domestic	Exports	Total	Ending stocks	
1980	1,210	11,270	0	12,480	9,113	1,631	10,744	1,736	22.73
1981	1,736	10,979	0	12,716	9,536	2,077	11,613	1,103	18.95
1982	1,103	12,040	0	13,143	9,857	2,025	11,882	1,261	20.62
1983	1,261	10,863	0	12,124	9,579	1,824	11,403	721	30.55
1984	721	11,468	20	12,209	9,916	1,660	11,576	632	29.52
1985	632	11,617	8	12,257	10,054	1,257	11,311	947	18.02
1986	947	12,783	15	13,745	10,833	1,187	12,020	1,725	15.36
1987	1,725	12,975	194	14,893	10,927	1,874	12,801	2,092	22.67
1988	2,092	11,737	138	13,967	10,591	1,661	12,252	1,715	21.09
1989	1,715	13,004	22	14,741	12,082	1,353	13,435	1,305	22.28
1990	1,305	13,408	17	14,730	12,136	808	12,944	1,786	20.98
1991	1,786	14,345	1	16,132	12,248	1,644	13,892	2,239	19.13
1992	2,239	13,778	10	16,028	13,012	1,461	14,473	1,555	21.24
1993	1,555	13,951	68	15,574	12,940	1,531	14,471	1,103	26.96
1994	1,103	15,613	17	16,733	12,914	2,683	15,597	1,137	27.51
1995	1,137	15,240	95	16,472	13,465	992	14,457	2,015	24.70
1996	2,015	15,752	53	17,821	14,267	2,033	16,300	1,520	22.51
1997	1,520	18,143	60	19,723	15,262	3,079	18,341	1,382	25.83
1998	1,382	18,078	83	19,543	15,652	2,372	18,024	1,520	19.80
1999	1,520	17,825	83	19,427	16,059	1,375	17,434	1,993	15.59
2000	1,993	18,420	73	20,486	16,318	1,401	17,719	2,767	14.09
2001	2,767	18,898	46	21,711	16,833	2,519	19,352	2,359	16.46
2002	2,359	18,430	46	20,835	17,081	2,263	19,344	1,491	22.04
2003	1,491	17,080	306	18,877	16,866	936	17,802	1,076	29.97
2004	1,076	19,360	26	20,462	17,439	1,324	18,763	1,699	23.01
2005	1,699	20,387	35	22,122	17,959	1,153	19,112	3,010	23.41
2006	3,010	20,489	37	23,536	18,574	1,877	20,451	3,085	31.02
2007	3,085	20,580	65	23,730	18,335	2,911	21,246	2,485	52.03
2008	2,485	18,745	90	21,319	16,265	2,193	18,459	2,861	32.16
2009	2,861	19,614	103	22,577	15,862	3,357	19,219	3,358	35.95
2010 1/	3,358	19,035	115	22,508	17,100	3,000	20,100	2,408	52-56

Sources: National Monthly Feedstuff Prices, Agricultural Marketing Service, USDA and Global Agricultural Trade System, Foreign Agricultural Service, USDA and Oilseed crushing, U.S. Census Bureau, 2011.

Table 5: U.S. soymeal supply, disappearance and price

Year beginning October	Supply, thousands tons				Disappearance, thousands ton				Price 48% protein, Decatur (solvent) $/ton
	Beginning stocks	Production	Imports	Total	Domestic	Exports	Total	Ending stocks	
1980	226	24,312	0	24,538	17,591	6,784	24,375	163	235.13
1981	163	24,634	0	24,797	17,714	6,908	24,622	175	196.62
1982	175	26,714	0	26,889	19,306	7,109	26,415	474	200.94
1983	474	22,756	0	23,230	17,615	5,360	22,975	255	203.21
1984	255	24,529	0	24,784	19,518	4,879	24,397	387	136.40
1985	387	24,951	0	25,338	19,090	6,036	25,126	212	166.20
1986	212	27,758	0	27,970	20,435	7,295	27,730	240	177.31
1987	240	28,060	0	28,300	21,323	6,824	28,147	153	239.35
1988	153	24,943	17	25,113	19,497	5,443	24,940	173	252.40
1989	173	27,719	37	27,928	22,194	5,416	27,610	318	186.48
1990	318	28,325	50	28,693	22,775	5,633	28,408	285	181.38
1991	285	29,831	69	30,185	22,854	7,101	29,955	230	189.21
1992	230	30,364	95	30,689	24,086	6,398	30,484	204	193.75
1993	204	30,514	75	30,793	25,163	5,481	30,644	150	192.86
1994	150	33,269	71	33,490	26,427	6,839	33,266	223	162.60
1995	223	32,527	100	32,850	26,549	6,089	32,638	212	235.90
1996	212	34,211	119	34,543	27,222	7,111	34,333	210	270.90
1997	210	38,176	66	38,452	28,619	9,615	38,234	218	185.30
1998	218	37,797	112	38,126	30,103	7,693	37,796	330	138.55
1999	330	37,591	71	37,993	30,080	7,619	37,700	293	167.70
2000	293	39,385	55	39,733	31,264	8,085	39,350	383	173.61
2001	383	40,292	148	40,823	32,567	8,015	40,583	240	167.72
2002	240	38,194	173	38,607	32,074	6,314	38,388	220	181.58
2003	220	36,324	285	36,830	31,449	5,169	36,619	211	256.05
2004	211	40,715	147	41,073	33,561	7,340	40,902	172	182.90
2005	172	41,244	141	41,557	33,195	8,048	41,243	314	174.17
2006	314	43,032	156	43,502	34,355	8,804	43,159	343	205.44
2007	343	42,284	141	42,768	33,232	9,242	42,474	294	335.94
2008	294	39,102	88	39,484	30,752	8,497	39,249	235	331.17
2009	235	41,700	160	42,095	30,619	11,175	41,794	302	311.27
2010 2/	302	39,583	165	40,050	30,500	9,250	39,750	300	340-370

Sources: National Monthly Feedstuff Prices, Agricultural Marketing Service, USDA and Global Agricultural Trade Internet System, USDA and Oilseed crushing, U.S. Census Bureau, 2011.



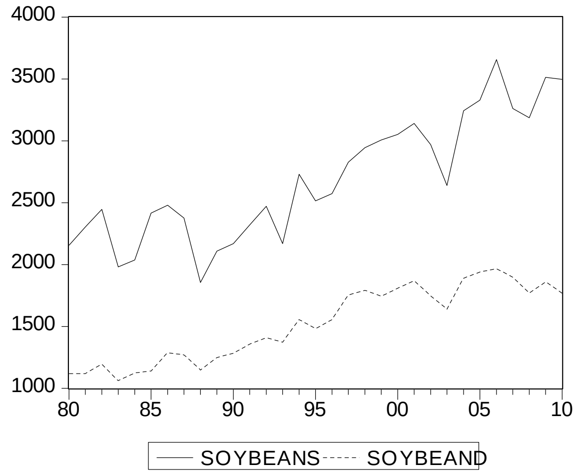
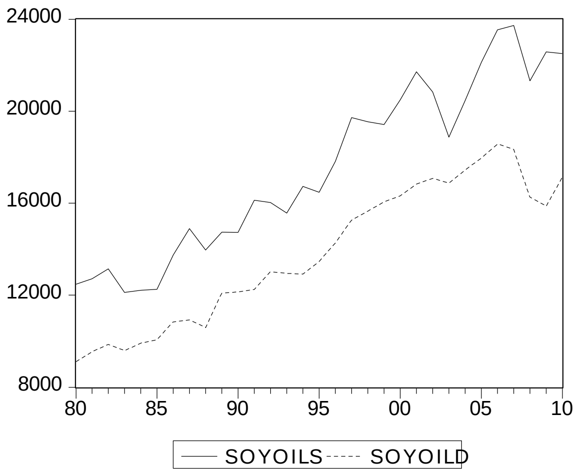


Figure 2 (Left): Real prices of soybeans, soy oil, soymeal and corn against time. The lateral axis is the timeline from 1980 to 2010. The unit of the right vertical axis is $/ton, used to measure the price of soymeal, and the unit of the left vertical axis is $/bushel, used to measure the price of soybeans and soy oil.

Figure 3 (Right): Domestic supply and demand quantity data against time for soybeans. The lateral axis is the timeline from 1980 to 2010, and the vertical axis is million pounds



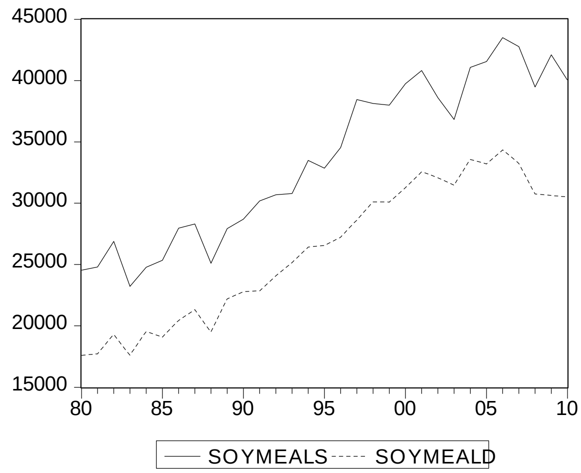


Figure 4 (Left): Domestic supply and demand quantity data against time for soy oil. The lateral axis is the timeline from 1980 to 2010, and the vertical axis is thousand tons

Figure 5 (Right): Domestic supply and demand quantity data against time for soymeal. The lateral axis is the timeline from 1980 to 2010, and the vertical axis is thousand tons

Table 6: Summary statistics

	SOYBEANP	SOY OILP	SOYMEALP	CORNP	SOYBEANS	SOY OILS	SOYMEALS	SOYBEAND	SOY OILD	SOYMEALD
Mean	6.502581	25.13484	212.4852	2.410645	2688.627	17503.93	33587.79	1520.643	13841.14	26184.80
Median	5.840000	22.67000	192.8600	2.250000	2572.636	16733.22	33489.64	1554.652	13464.78	26548.75
Maximum	11.60000	53.00000	355.0000	5.020000	3655.086	23730.41	43501.67	1964.780	18574.45	34354.75
Minimum	4.380000	14.09000	136.4000	1.370000	1855.317	12123.82	23230.00	1061.710	9113.072	17591.00
Std. Dev.	1.760939	9.005143	57.21495	0.765075	503.0568	3798.924	6618.020	301.7162	3066.098	5634.512
Skewness	1.322715	1.768344	1.128680	1.607788	0.239222	0.076354	-0.065970	-0.062081	-0.058885	-0.156352
Kurtosis	4.144033	6.237799	3.374263	5.905601	1.927466	1.634621	1.509017	1.474309	1.574369	1.544428
Jarque-Bera	10.73002	29.69736	6.762840	24.26065	1.781517	2.438124	2.893899	3.026568	2.643129	2.862946
Probability	0.004677	0.000000	0.033999	0.000005	0.410344	0.295507	0.235287	0.220186	0.266718	0.238957

Table 7: Correlation across variables (only the data related to models are shown)

	SOYBEANP	SOYOILP	SOYMEALP	CORNP	INCOME	SOYBEANS	SOYOILS	SOYMEALS	SOYBEAND	SOY OILD	SOYMEALD
SOYBEANP	1.00	0.87	0.93	0.88	0.31	0.27	0.32	0.22	0.17	0.21	0.16
SOY OILP	0.87	1.00	0.74	0.88	0.41	0.39	0.43	0.35	0.30	0.36	0.31
SOYMEALP	0.93	0.74	1.00	0.79	0.36	0.31	0.37	0.28	0.22	0.26	0.22
CORNP	0.88	0.88	0.79	1.00	0.32	0.35	0.36	0.27	0.22	0.27	0.22
INCOME	0.31	0.41	0.36	0.32	1.00	0.88	0.97	0.96	0.95	0.98	0.97
SOYBEANS	0.27	0.39	0.31	0.35	0.88	1.00	0.93	0.94	0.93	0.88	0.88
SOY OILS	0.32	0.43	0.37	0.36	0.97	0.93	1.00	0.99	0.98	0.97	0.96
SOYMEALS	0.22	0.35	0.28	0.27	0.96	0.94	0.99	1.00	1.00	0.98	0.98
SOYBEAND	0.17	0.30	0.22	0.22	0.95	0.93	0.98	1.00	1.00	0.97	0.98
SOY OILD	0.21	0.36	0.26	0.27	0.98	0.88	0.97	0.98	0.97	1.00	0.99
SOYMEALD	0.16	0.31	0.22	0.22	0.97	0.88	0.96	0.98	0.98	0.99	1.00

Table 8: Real Chinese per capita income from 1969 to 2010

Year	Per capita GDP	Year	Per capita GDP	Year	Per capita GDP
1969	$124	1983	$268	1997	$910
1970	$144	1984	$304	1998	$974
1971	$150	1985	$340	1999	$1,041
1972	$152	1986	$365	2000	$1,121
1973	$161	1987	$400	2001	$1,208
1974	$161	1988	$437	2002	$1,311
1975	$172	1989	$448	2003	$1,434
1976	$166	1990	$458	2004	$1,571
1977	$176	1991	$493	2005	$1,739
1978	$194	1992	$557	2006	$1,950
1979	$206	1993	$628	2007	$2,216
1980	$220	1994	$702	2008	$2,417
1981	$228	1995	$771	2009	$2,627
1982	$245	1996	$840	2010	$2,883

Source: ERS International Macroeconomic Data Set

Table 9: Currency exchange rate between U.S. and China

Year	Exchange Rate 1 $	Year	Exchange Rate 1 $	Year	Exchange Rate 1 $
1970	3.50	1984	4.80	1998	7.20
1971	3.47	1985	5.94	1999	7.46
1972	3.11	1986	6.57	2000	7.75
1973	2.78	1987	6.86	2001	7.93
1974	2.90	1988	6.42	2002	8.08
1975	2.85	1989	5.53	2003	8.25
1976	3.00	1990	6.87	2004	8.24
1977	2.87	1991	7.74	2005	8.19
1978	2.69	1992	7.86	2006	8.12
1979	2.63	1993	7.67	2007	7.74
1980	2.73	1994	9.84	2008	6.90
1981	3.28	1995	8.02	2009	6.66
1982	3.79	1996	7.38	2010	6.62
1983	4.01	1997	7.13	2011	6.24

Source: USD-CNY historical statistics, Currency Summary, Google Finance, 2012, http://www.google.com/finance?q=USDCNY

Table 10: Supply and disappearance of Chinese soybeans

CHINA			SOYBEANS		OUTPUT SCENARIO				
Crop year	Area harvest	Yield	Production	Imports	Exports	Total cons	Food use	Feed	Ending stock
2000	9,300	1.656	15,400	13,200	240	26,470	6,500	-	5,064
2001	8,700	1.724	15,000	14,000	240	29,600	6,700	-	4,224
2002	9,934	1.777	17,658	15,728	255	33,237	6,927	-	3,494
2003	11,790	1.771	20,881	17,132	270	37,792	7,150	-	3,446
2004	12,057	1.795	21,646	19,279	285	40,765	7,358	-	3,320
2005	12,652	1.812	22,929	20,908	300	43,617	8,418	-	3,240
2006	13,208	1.833	24,206	22,573	315	46,532	9,101	-	3,172
2007	13,805	1.851	25,546	24,202	330	49,465	9,312	-	3,125
2008	14,335	1.867	26,757	25,866	345	52,289	9,907	-	3,114
2009	14,703	1.883	27,687	27,536	360	54,877	10,858	-	3,100
2010	15,070	1.897	28,587	29,225	375	57,426	13,151	-	3,111
2011	15,311	1.912	29,278	30,857	390	59,728	13,558	-	3,129

Source: USDA soybean database, updated 2011
Units are 1,000 hectares for area, metric tons per hectare for yield, and 1,000 metric tons for other variables.

Table 11: Chinese soy oil supply and disappearance

CHINA SOY OIL 2011 USDA BASELINE									
Crop year	Crush	Extract rate	Production	Imports	Exports	Total cons	Food use	Feed use	Ending stock
2000	48830	17.8	8703	1514	77	10435	10435	0	171
2001	57800	17.9	10317	2000	70	12198	12198	0	220
2002	63617	18.0	11435	2038	84	13195	13195	0	413
2003	67505	18.1	12194	1694	86	13832	13832	0	384
2004	70739	18.2	12842	1646	85	14424	14424	0	364
2005	73878	18.3	13479	1596	75	15016	15016	0	348
2006	77023	18.3	14124	1542	61	15626	15626	0	327
2007	80260	18.4	14791	1486	54	16253	16253	0	296
2008	83211	18.5	15411	1427	52	16815	16815	0	267
2009	86136	18.6	16033	1365	46	17380	17380	0	238
2010	89094	18.7	16666	1301	49	17945	17945	0	211
2011	91856	18.8	17269	1233	53	18479	18479	0	181

Source: USDA soy oil database, updated 2011
Units are percentage for extraction rate and 1,000 metric tons for other variables.

Table 12: Chinese soy meal supply and disappearance

CHINA SOYMEAL OUTPUT SCENARIO									
Crop year	Crush	Extract rate	Production	Imports	Exports	Total cons	Food use	Feed use	Ending stock
2000	18,670	79.5	14,835	125	60	14,900	-	14,900	-
2001	21,600	79.5	17,165	300	100	17,365	-	17,365	-
2002	25,109	79.0	19,836	450	100	20,186	-	20,186	-
2003	29,775	79.0	23,522	650	100	24,072	-	24,072	-
2004	33,040	79.0	26,102	1,050	100	27,052	-	27,052	-
2005	36,078	79.0	28,501	1,650	100	30,051	-	30,051	-
2006	39,152	79.0	30,930	2,350	100	33,179	-	33,179	-
2007	42,194	79.0	33,333	3,050	100	36,284	-	36,284	-
2008	45,044	79.0	35,585	3,750	100	39,235	-	39,235	-
2009	47,664	79.0	37,654	4,450	100	42,005	-	42,005	-
2010	50,187	79.0	39,648	5,150	100	44,698	-	44,698	-
2011	52,448	79.0	41,434	5,850	100	47,183	-	47,183	-

Source: USDA soy meal database, updated 2011
Units are percentage for extraction rate and 1,000 metric tons for other variables.

Table 13: Summary statistics

	GDPC	GDPU	CURRENCY	SOYBEANS	SOYBEAND	SOYOILS	SOYOILD	SOYMEALS	SOYMEALD	SOYBEANP	SOYOILP	SOYMEALP	SBEANIMPC	SBEANEXPU	SOILIMPC	SOILEXPU	SMEALIMPC	SMEALEXPU
Mean	1967.183	41754.64	7.560555	22964.58	41211.83	13605.33	15133.17	29045.42	31350.83	7.865000	33.17833	253.3208	21708.83	1196.930	1570.167	2159.529	2402.083	8259.962
Median	1844.638	41990.59	7.838873	23567.50	42102.00	13801.50	15321.00	29715.50	31615.00	6.885000	30.49500	230.7450	21740.50	1106.826	1528.000	2228.393	2000.000	8291.045
Maximum	3130.000	43726.18	8.252946	29278.00	57006.00	17269.00	18479.00	41434.00	47183.00	13.50000	65.00000	365.0000	30857.00	1690.000	2038.000	3356.540	5850.000	11174.63
Minimum	1121.000	39750.00	6.240823	15000.00	23536.00	8703.000	10435.00	14835.00	14900.00	4.380000	14.09000	167.7200	13200.00	886.5510	1233.000	935.9801	125.0000	5169.419
Std. Dev.	681.4178	1406.764	0.738529	4965.864	11372.13	2624.462	2433.271	8903.842	10855.21	2.991973	15.81518	80.57038	5980.817	262.6184	249.5690	819.2066	2016.986	1536.165
Skewness	0.354227	-0.194807	-0.677541	-0.380335	-0.214134	-0.351968	-0.405458	-0.191724	-0.064950	0.501366	0.760791	0.220879	0.034285	0.769552	0.696137	-0.096737	0.419340	-0.263608
Kurtosis	1.796037	1.682176	1.820225	1.867707	1.804201	2.166363	2.267752	1.779311	1.729231	1.985195	2.460829	1.286584	1.721713	2.248835	2.626272	1.636711	1.758281	3.226325
Jarque-Bera	0.975717	0.944230	1.614059	0.930354	0.806675	0.595238	0.596886	0.818557	0.815863	1.017650	1.302958	1.565473	0.819360	1.466545	1.039050	0.947995	1.122625	0.164590
Probability	0.613940	0.623682	0.446182	0.628024	0.668087	0.742584	0.741972	0.664129	0.665024	0.601202	0.521274	0.457153	0.663863	0.480335	0.594803	0.622509	0.570460	0.921000

(Notes: GDPC: the Chinese per capita GDP; GDPU: per capita GDP of U.S.; SOYBEANS: the Chinese domestic soybean supply; SOYBEAND: the Chinese domestic soybean demand; SOY OILS: the Chinese domestic soy oil supply; SOY OILD: the Chinese domestic soy oil demand; SOYMEALS: the Chinese domestic soymeal supply; SOYMEALD: the Chinese domestic soymeal demand; SOYBEANP: FOB of U.S. soybean; SOY OILP: FOB of U.S. soy oil; SOYMEALP: FOB of U.S. soymeal; SBEANIMPC: the Chinese soybean imports from U.S.; SBEANEXPU: U.S. total soybean exports; SOILIMPC: the Chinese soy oil imports from U.S.; SOILEXPU: the U.S. total soy oil exports; SMEALIMPC: the Chinese imports of soymeal from U.S.; SMEALEXPU: the U.S. total soymeal exports)

Table 14: Correlation table

	GDPC	GDPU	CURRENCY	SOYBEANS	SOYBEAND	SOY OILS	SOY OILD	SOYMEALS	SOYMEALD	SOYBEANP	SOY OILP	SOYMEALP	SBEANIMPC	SBEANEXPU	SOILIMPC	SOILEXPU	SMEALIMPC	SMEALEXPU
GDPC	1.0000	0.6263	-0.8693	0.9540	0.9730	0.9616	0.9569	0.9754	0.9851	0.9479	0.8890	0.8970	0.9906	0.9134	-0.8269	0.6895	0.9982	0.6872
GDPU	0.6263	1.0000	-0.2319	0.7661	0.7434	0.7314	0.7308	0.7418	0.7195	0.5559	0.5938	0.5322	0.7037	0.3142	-0.5907	0.1868	0.6001	0.4110
CURRENCY	-0.8693	-0.2319	1.0000	-0.7106	-0.7487	-0.7231	-0.7153	-0.7539	-0.7838	-0.8476	-0.7085	-0.8216	-0.8038	-0.9431	0.7341	-0.7523	-0.8910	-0.6789
SOYBEANS	0.9540	0.7661	-0.7106	1.0000	0.9961	0.9842	0.9801	0.9933	0.9886	0.8931	0.8388	0.8532	0.9828	0.7705	-0.8250	0.5203	0.9384	0.6019
SOYBEAND	0.9730	0.7434	-0.7487	0.9961	1.0000	0.9922	0.9888	0.9992	0.9975	0.9066	0.8547	0.8591	0.9944	0.8141	-0.8131	0.5768	0.9604	0.6317
SOY OILS	0.9616	0.7314	-0.7231	0.9842	0.9922	1.0000	0.9996	0.9937	0.9903	0.8966	0.8534	0.8438	0.9848	0.8061	-0.7383	0.5959	0.9463	0.5937
SOY OILD	0.9569	0.7308	-0.7153	0.9801	0.9888	0.9996	1.0000	0.9909	0.9870	0.8915	0.8496	0.8393	0.9808	0.8010	-0.7212	0.6005	0.9411	0.5883
SOYMEALS	0.9754	0.7418	-0.7539	0.9933	0.9992	0.9937	0.9909	1.0000	0.9987	0.9057	0.8546	0.8591	0.9955	0.8208	-0.8054	0.5933	0.9636	0.6446
SOYMEALD	0.9851	0.7195	-0.7838	0.9886	0.9975	0.9903	0.9870	0.9987	1.0000	0.9175	0.8636	0.8702	0.9988	0.8452	-0.8149	0.6186	0.9758	0.6613
SOYBEANP	0.9479	0.5559	-0.8476	0.8931	0.9066	0.8966	0.8915	0.9057	0.9175	1.0000	0.9487	0.9729	0.9206	0.8568	-0.7786	0.6545	0.9414	0.5112
SOY OILP	0.8890	0.5938	-0.7085	0.8388	0.8547	0.8534	0.8496	0.8546	0.8636	0.9487	1.0000	0.8949	0.8672	0.7876	-0.7085	0.6342	0.8774	0.4659
SOYMEALP	0.8970	0.5322	-0.8216	0.8532	0.8591	0.8438	0.8393	0.8591	0.8702	0.9729	0.8949	1.0000	0.8680	0.7935	-0.7532	0.6640	0.8926	0.5094
SBEANIMPC	0.9906	0.7037	-0.8038	0.9828	0.9944	0.9848	0.9808	0.9955	0.9988	0.9206	0.8672	0.8680	1.0000	0.8644	-0.8245	0.6321	0.9832	0.6759
SBEANEXPU	0.9134	0.3142	-0.9431	0.7705	0.8141	0.8061	0.8010	0.8208	0.8452	0.8568	0.7876	0.7935	0.8644	1.0000	-0.7085	0.8056	0.9270	0.7071
SOILIMPC	-0.8269	-0.5907	0.7341	-0.8250	-0.8131	-0.7383	-0.7212	-0.8054	-0.8149	-0.7786	-0.7085	-0.7532	-0.8245	-0.7085	1.0000	-0.3573	-0.8301	-0.6569
SOILEXPU	0.6895	0.1868	-0.7523	0.5203	0.5768	0.5959	0.6005	0.5933	0.6186	0.6545	0.6342	0.6640	0.6321	0.8056	-0.3573	1.0000	0.7117	0.7422
SMEALIMPC	0.9982	0.6001	-0.8910	0.9384	0.9604	0.9463	0.9411	0.9636	0.9758	0.9414	0.8774	0.8926	0.9832	0.9270	-0.8301	0.7117	1.0000	0.7135
SMEALEXPU	0.6872	0.4110	-0.6789	0.6019	0.6317	0.5937	0.5883	0.6446	0.6613	0.5112	0.4659	0.5094	0.6759	0.7071	-0.6569	0.7422	0.7135	1.0000

(Notes: GDPC: the Chinese per capita GDP; GDPU: per capita GDP of U.S.; SOYBEANS: the Chinese domestic soybean supply; SOYBEAND: the Chinese domestic soybean demand; SOY OILS: the Chinese domestic soy oil supply; SOY OILD: the Chinese domestic soy oil demand; SOYMEALS: the Chinese domestic soymeal supply; SOYMEALD: the Chinese domestic soymeal demand; SOYBEANP: FOB of U.S. soybean; SOY OILP: FOB of U.S. soy oil; SOYMEALP: FOB of U.S. soymeal; SBEANIMPC: the Chinese soybean imports from U.S.; SBEANEXPU: U.S. total soybean exports; SOILIMPC: the Chinese soy oil imports from U.S.; SOILEXPU: the U.S. total soy oil exports; SMEALIMPC: the Chinese imports of soymeal from U.S.; SMEALEXPU: the U.S. total soymeal exports)

CHAPTER IV: EMPIRICAL RESULTS

4.1 U.S. Domestic market

Table 15 below shows the SUR regression results for the U.S. model systems developed in the last chapter. The independent variables are presented in rows and the dependent variables are in the columns.

Table 15: SUR results for U.S. domestic market system

Dependent variable	ln(Soybean price)	Std.	ln(Soy oil price)	Std.	ln(Soymeal Price)	Std.	ln(GDP)	Std.	R^2
Ln(Soybean demand)	-0.142	0.1764	0.0381	0.0861	0.0009	0.1157	1.1304**	0.0704	0.9208
ln(Soy oil demand)	-0.1876**	0.1194	0.0821	0.0583	0.0276	0.0783	1.2849**	0.0476	0.9714
ln(Soymeal demand)	-0.2776**	0.1329	0.1186**	0.0649	0.0435	0.0872	1.2453**	0.053	0.963
Determinant Residual Covariance (system)			1.17E-09						

(Notes: T is the time trend variable and the GDP represents per capita GDP of U.S.;**represents the estimated coefficient is significant at the **10%** level, * represents the estimated coefficient is significant at the **15%** level)

4.2 International market

Table 16 shows the SUR regression result of international trade model systems developed in the last chapter. The independent variables are presented in rows and the dependent variables are in the columns.

Table 16: SUR results for international market systems

		SOYBEANP	St. deviation	CURRENCY	St. deviation	SOYBEANS	St. deviation	SOYBEAND	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
	SBEANEXPU	5.7336	14.0841	-125.9379**	55.3061	-0.1402**	0.0397	0.0762**	0.0185	N / A	N / A	-0.0420*	0.0222	0.9641
		SOY OILP	St. deviation	CURRENCY	St. deviation	SOY OILS	St. deviation	SOY OILD	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
Exports System	SOILEXPU	22.3455*	12.2918	-1000.149**	308.8426	-6.4512**	1.2368	6.8156**	1.2516	N / A	N / A	0.0250	0.1547	0.7810
		SOYMEALP	St. deviation	CURRENCY	St. deviation	SOYMEALS	St. deviation	SOYMEALD	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
	SMEALEXPU	-10.1727*	5.7686	-1827.754	1624.120	-0.1201	1.2729	0.1215	1.1061	N / A	N / A	0.4258	0.4214	0.6239
Determinant Residual Covariance		4.43E+13												
		SOYBEANP	St. deviation	CURRENCY	St. deviation	SOYBEANS	St. deviation	SOYBEAND	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
	SBEANIMPC	-166.0116**	21.3651	N / A	N / A	-0.2065**	0.0619	0.3704**	0.0377	4.6729**	0.2648	0.1032**	0.0244	0.9999
		SOY OILP	St. deviation	CURRENCY	St. deviation	SOY OILS	St. deviation	SOY OILD	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
Imports System	SOILIMPC	1.9483	1.7479	N / A	N / A	-1.9521**	0.2634	2.1028**	0.2625	-0.2526**	0.1106	-0.0357**	0.0158	0.9691
		SOYMEALP	St. deviation	CURRENCY	St. deviation	SOYMEALS	St. deviation	SOYMEALD	St. deviation	GDPC	St. deviation	GDPU	St. deviation	R 2
	SMEALIMPC	-0.0521	0.0579	N / A	N / A	-0.9386**	0.0237	0.9398**	0.0521	0.1773*	0.0957	-0.0028	0.0030	0.9999
Determinant Residual Covariance		1.19E+08												

(Notes: GDPC: the Chinese per capita GDP; GDPU: per capita GDP of U.S.; SOYBEANS: the Chinese domestic soybean supply; SOYBEAND: the Chinese domestic soybean demand; SOY OILS: the Chinese domestic soy oil supply; SOY OILD: the Chinese domestic soy oil demand; SOYMEALS: the Chinese domestic soymeal supply; SOYMEALD: the Chinese domestic soymeal demand; SOYBEANP: FOB of U.S. soybean; SOY OILP: FOB of U.S. soy oil; SOYMEALP: FOB of U.S. soymeal; SBEANIMPC: the Chinese soybean imports from U.S.; SBEANEXPU: U.S. total soybean exports; SOILIMPC: the Chinese soy oil imports from U.S.; SOILEXPU: the U.S. total soy oil exports; SMEALIMPC: the Chinese imports of soymeal from U.S.; SMEALEXPU: the U.S. total soymeal exports; * represents the coefficient is significant at the level of 10%, ** represents the coefficient is significant at the level of 5%.)

4.3 Empirical Results

4.3.1 The U.S. market

There are several findings that can be discussed in terms of explaining the factors that drive soybean trade. For the estimated model, the general R^2 in the U.S. demand systems is fairly high, suggesting the multicollinearity was addressed through the use of lags.

In the U.S. soy product demand system, the significant estimated coefficients of soybean price in the soy oil and soymeal demand equations (-0.1876 and -0.2776, both significant at the 10% level) indicate that when the price of soybeans increases, the demand of soy oil and soymeal, to derivative products, decreases. The most likely explanation is that in the majority of the U.S., soybeans are crushed into soy oil and soymeal, and few of them are consumed in bean form. Thus, when the soybean price surges, the crushing factory responds by decreasing production of soy oil and soymeal, and resulted high market prices of soy oil and soymeal affects overall demand for soy and soy products.

It is somewhat surprising to find a positive significant coefficient on the soy oil price in the soymeal demand equation (+0.1186, significant at the 10% level) which shows that the technical relationship between soy oil and soymeal is one of substitutes rather than complements. Considering that (as mentioned in the supply system analysis) the future demand of soy oil will increase as a result of soy oil fuel research stimulation, the demand of soymeal is anticipated to decrease because of substitute demand relationship. As explained earlier, soy oil and soymeal are usually produced together. When the production of soy oil is driven by increasing demand, the soymeal is easily overproduced.

Last, three positive and significant estimated coefficients of U.S. per capita GDP shows the potential large demand of soy product in the U.S. The probable potential demand of soybean soy oil and soymeal in the U.S. is probably driven by new industrial use of soybeans (like soy ink and methyl esters), increasing popularity of soy biofuel, and good prospects for the livestock industry, which uses soy products to supplement feed rations.

Given this look at recent dynamics, some policy implications can be presented based on U.S. demand model systems. The market situation shared earlier suggests that expanded soy oil production is likely to result in soymeal overproduction. As one option, reinforcement of soymeal exports is assumed to be a solution. Thus, the subsidization of exports of soymeal should be encouraged to spur this solution.

4.3.2 International market

In the U.S. export system, the price effect and currency effect will be defined as the influence of the U.S. FOB price and the currency exchange rate, respectively, on the total volume of U.S. soybean, soy oil and soymeal exports. In the exports equations for soybeans and soy oil, the coefficient of FOB price is not significant in either equation; however, the negative estimated coefficients of the currency exchange rate (-1000.149, -1827.754) are highly significant. The negative coefficients indicate that appreciation of RMB will stimulate soybean and soy oil exports. In other words, the currency effect is as expected.

In the soymeal exports equation, a somewhat different situation exists. The estimated coefficient of FOB price is negative and significant at the 10% level (-10.1727). This negative coefficient shows that lower prices rather than appreciation of the RMB plays the most important role in changes in the export markets for soymeal. This would support any implications made in the last section associated with subsidizing soymeal exports to decrease the U.S. domestic soymeal surplus. Specifically speaking, the export of soymeal is encouraged to be subsidized by providing exporters with direct price supports.

Special attention will be paid to the six estimated coefficients that explain changes in Chinese domestic supply and demand for soybeans, soy oil and soymeal. As is shown in the regression results, all six estimated coefficients have the expected economic relationships. However, only the coefficients in the soybean and soy oil equations (-0.1402, +0.0762; -6.4512, +6.8156) are significant, while the two coefficients in the soymeal equation (-0.1201, +0.1215) are not significant. Again, this supports the policy implication first considered in discussion of the U.S. model system from another prospective. U.S. soymeal exports, which may be primarily driven by its status as an oil by-product, are not directly influenced by the Chinese supply and demand situation, but are influenced by U.S. policy itself. Thus, a special subsidy for soymeal exports is encouraged.

In the Chinese import system, the significant coefficient on soybean price in the soybean imports equation (-166.0116, significant at the 5% level) shows that Chinese importers are quite sensitive to the price of imported soybeans. Unlike in the export system, in the import system, all six coefficients of Chinese domestic supply and demand quantity (those for soybeans, soy oil and soymeal) are significant at the 5% level, which indicates that, in China, the import quantity of all soy products is strongly influenced by the domestic production situation.

All of the coefficients on Chinese per capita GDP are significant. But the coefficients for soybeans and soymeal are positive, while that of soy oil is negative. One possible explanation is that, with the increase of Chinese per capita GDP, the growing demand for protein is partly reflected in the increasing demand for soybean and soymeal. Besides, future GDP growth may unleash substantial demand in Chinese rural areas. However, the demand for soy oil will possibly decrease. The most likely explanation is that increasingly affluent Chinese consumers may begin trading off for more protein in their diet, thereby shifting demand.

CHAPTER V: THE INFLUENCE OF A POTENTIAL APPRECIATION OF THE CHINESE CURRENCY ON THE SOYBEAN TRADING MARKET

5.1 General analysis

The Chinese government maintains a cautious currency appreciation process in order to avoid damaging the domestic financial system and the traditional manufacturing exports industry (Yang, 2003). Yet, such currency appreciation decreases potential import demand for agricultural products to some extent. Geographic constraints prevent land-intensive crops like soybeans from having a competitive advantage compared to U.S. crops. RMB devaluation has prevented U.S. soybean imports from reaching the level that may be expected given market signals. The contradiction in regard to Chinese currency manipulation becomes even more problematic given its increasing presence in the world economy. In short, one would expect the requirement from the Western world to appreciate the RMB will become even greater as the size of the Chinese economy grows.

The Chinese foreign currency exchange rate formation process faces intervention from the Renmin Bank of China, which functions as the central bank and one division of the Chinese State Council. The benchmark of the everyday exchange rate is not formed by the market, but is set by the central bank. Under pressure from the U.S. and other Western countries, the Chinese government began currency reform in 2005. Figure 6 below shows the exchange rate trend between U.S. dollars and Chinese RMB from 1960 to 2010.

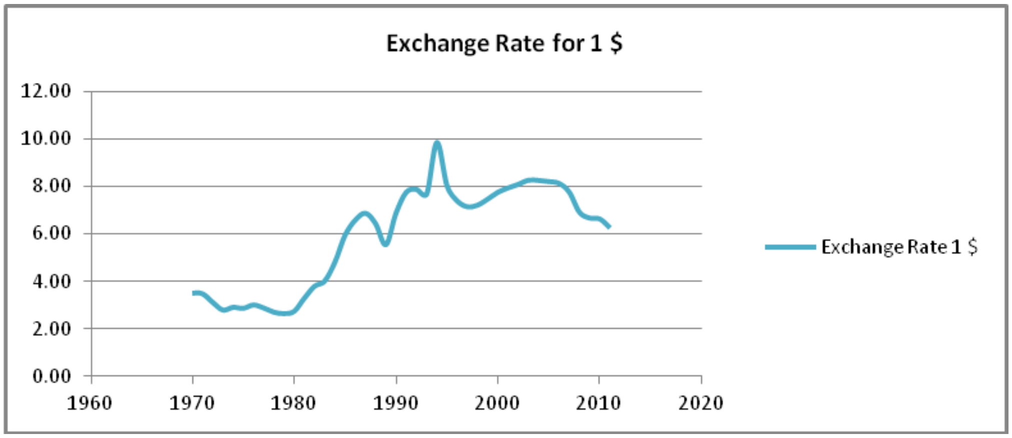


Figure 6: Exchange rate between U.S. dollars and Chinese RMB, 1960 to 2010

Source: USDA, 2011

One can observe that the Chinese currency appreciates gradually after 2005. Total depreciation of U.S. dollars is about 23% from 2005 to 2010. However, it is important to recognize how that 23% depreciation affects the soybean market over these 5 years.

Generally speaking, in terms of agricultural commodities other than soybean, the 23% depreciation of U.S. dollars will not significantly promote agricultural exports of U.S. According to purchasing power parity (PPP), and excluding the exchange rate, the purchasing power of U.S. dollars is about 2-3 times more than the purchasing power of RMB (Zhao, 2009). The appreciation level of RMB from 2005 to 2011 does not essentially change the distortion for most agricultural commodities, because after the gradual appreciation of RMB in recent years, most agricultural commodities produced in China still maintain a clear price advantage.

However, for soybeans, the situation is different. U.S. soybean production has a cost-based price advantage over both Chinese soybeans and South American soybeans, excluding PPP and the currency exchange rate. So, traded in overvalued U.S. dollars, U.S. soybeans can still have a comparative advantage for at least part of the Chinese market for many years. But the price advantage of U.S. soybean is not transparent because of the undervalued RMB, and so a small change in the RMB value is likely to impact soybean trade between the U.S. and China. In other words, the currency exchange rate is the most sensitive and interesting determinant on the level of Chinese soybean imports.

5.2 Economic model

In the import model system built in Chapter 3, the currency exchange rate is not included in order to prevent possible multicollinearity problems between the currency exchange rate and Chinese per capita GDP. In this section, the currency exchange rate is the topic of interest and the model built and estimated by Ms. Yin Wang (NAUC) will be introduced to show the influence of the currency exchange rate on Chinese soybean imports. The model is

$$Q_{0t} = \alpha_0 + \alpha_1 C + \alpha_2 P_{1t} + \alpha_3 P_{2t} + \ldots \alpha_4 P_{4t} + \alpha_5 P_{5t} + \mu_1 S_{1t} + \mu_2 S_{2t} + \mu_3 S_{3t}$$

where Q_{0t} is the annual soybean quantity imported by China from the U.S, C represents the currency index, and P_{1t} to P_{5t} represent Chinese domestic soy oil price, Chinese domestic vegetable seed oil price, Chinese domestic corn oil price, Chinese domestic soymeal price, and FOB price of U.S. soybean, respectively. Finally, $S_{1\text{-}3\,t}$ represents the seasonal differentiation index (Wang, 2010).

The regression results show that the coefficient on currency value is highly significant at the 5% level and increasing the RMB by 1% is expected to lead to a 200,000 tons increase in soybean imports (Wang, 2010). Also, a price increase for Chinese domestic soy oil will result in the growth of U.S. soybean export levels. The influence of substitute products is quite small and can be ignored. In addition, the U.S. FOB price has little influence on Chinese soybean imports.

5.3 A Potential policy dilemma

Although research suggests that the appreciation of the RMB will stimulate soybean imports, the appreciation policy is actually hard to implement. First, it seems plausible that a currency appreciation policy could solve the soybean shortage problem, but the Chinese government will continue to hold a comparatively strong position against RMB market driven valuation.

Although RMB appreciation may increase soybean imports, it meanwhile indirectly injures the benefits of Chinese soybean producers, and even shakes the stability of the Chinese agricultural structure. Second, based on the J-curve effect raised by Magee (1973), currency appreciation will not necessarily lead to an increase in import quantity. At different times, the effects are different. For soybean imports, quick appreciation of RMB would probably result in decreasing imports in the short term. Third, different countries hold different views on RMB appreciation. On the one side, the Western economies support market-valued currencies, as RMB appreciation could decrease their net imports. On the other hand, RMB appreciation is unwelcomed by some developing countries that are dependent on food imports. As RMB appreciation strengthens purchasing power of China, and, because China is a large world food importer, could drive the price of food to a higher level. Considering the world food prices have increased in recent years because of the wide use of biodiesel in the E.U. and the U.S. RMB appreciation is likely to encounter more resistance from developing countries.

CHAPTER VI: THE EFFECTS OF CHINESE GENETIC MODIFICATION REGULATIONS ON SOYBEAN TRADE BETWEEN CHINA AND THE U.S.

6.1 Background analysis

The term 'genetically modified' (GM) refers to an increasingly adopted breeding technology that has had implications for the production and marketing activities of several business sectors since 1980. Although transgenic technology works pretty well in increasing output production, debates about its safety and uncertain environmental influences persist.

In China, the transgenic issue was raised by the National Congress because of increasing soybean imports from the U.S. With more and more consumers being sensitive about genetically modified products, followed by other U.S. trading partners, the National Council implemented GM-based regulations at the beginning of the 21st century.

With the implementation of regulations, Chinese soybean imports experienced some large fluctuations. In 2001, the quantity of imported soybeans was about 14 million tons (DRC, 2005). In 2002, import quantity decreased by 19% and was only about 11 million tons (DRC, 2005). However, in 2003, the quantity of imported soybeans returned to previous levels (DRC, 2005). Many specialists argue that the target of transgenic regulation is not to protect domestic soybean producers (Xuan and Cui, 2007), but to protect Chinese ecology. However, it cannot be ignored that the implemented regulations will exert some costs on importers and indirectly protect local producers. In the broader scheme, all food trade dynamics are likely to be affected.

6.2 Economic model and regression results

The economic model below is built to test the influence of transgenic regulations as described above on Chinese soybean imports:

$$\mathbf{Ln\ IMP_t = \alpha+\beta\ Ln\ P_{1t}+\sigma Ln\ P_{2t}+ \Upsilon\ Ln\ I_t + \mu.D_t}$$

The model is essentially a demand function for China. Because it is a log-log model, the estimated coefficients directly give demand elasticities and show the effect of transgenic regulations. In the model, IMP represents the imported quantity of U.S. soybeans (1992-2011). P_{1t} and P_{2t} are Chinese soybean price and U.S. soybean price (1992-2011). Chinese domestic soybean price data is available at the website of the Chinese Statistics Department (PROC). I_t represents the income level of Chinese citizens. D serves as the dummy variable to test the structural change. 2002 is the key year for food oversight regulation; the value of I_t is set at 0 before 2002 and at 1 after 2002. The significance of estimated μ is expected to reflect the impact of the transgenic regulations.

The model was run using ordinary least squares regression (OLS) and the results are given in Table 17.

Table 17: Regression results of Chinese GM regulation model

	Coefficient	Standard Deviation	R^2, Adjust R^2	D-W	F-statistics	P
P1	0.1303*	0.0434	0.9990, 0.9984	3.1405	1764.8820	0.0001
P2	-0.1852**	0.0332				
I	0.9351**	0.0358				
D	0.0815**	0.0118				

* *significant at the level of 0.1%; * significant at level of 5%

Based on the regression results, the coefficient of D is significant at the 0.1% level, so transgenic regulation does have a structural influence on imports of transgenic soybeans. However, its influence is positive rather than the anticipated negative result, because annual growth rate of soybean imports after 2002 is even larger than that before 2002 (USDA, 2011). The result can be explained using the following perspectives:

First, transgenic regulation has no impact on absolute demand, which can be explained by fairly inelastic demand elasticities. Essentially, Chinese soybean supply shortages have led to a situation where the country must rely on imports.

Second, most crushing factories rely on a consistent and continuous supply of soybeans. Transgenic regulations increase their time costs in the custom clearance, so they are more willing to increase single imports volume.

Third, Chinese Customs only requires that transgenic soybeans be correctly packaged and identified. In order words, customs formalities become more complicated than before, but actual imports behavior is not affected by this increased complexity.

Fourth, transgenic food is more acceptable in Chinese society than in other Asian countries. Relatively low purchasing power makes Chinese people pay attention to price rather than other factors.

Fifth, since the majority of supermarkets stock transgenic soy oil, consumers probably have the right to know, but do not have a real right to choose. Traditional soy oil has been difficult to find in mainstream markets for a long time. So, there is no clear way for potential consumer-driven market signals to make their way to the processing sector

Sixth, in China, sometimes markets do not influence consumption behavior. Under the current accounting scheme, many companies choose to pay part of their employee bonuses by issuing commodities. Rice and edible oil are preferred as they're daily necessities. Typically, employers purchased edible oil in wholesale price and distribute them as welfare or bonus to the employees. In order to make whole process operate smoothly, employers always order the edible oil from wholesalers at least month before. Constant orders from large companies make the demand for soy oil pretty stable.

Seventh, any actual decreasing consumption of imported soy products due to transgenic regulations will be offset due to constant increased demand driven by the country's growing population. In addition, the potential demand in Chinese rural areas is likely to be gradually increasing. Figure 7 below describes Chinese edible oil consumption trends in cities and rural regions. An upward trend of soy oil consumption can be observed since 2004.

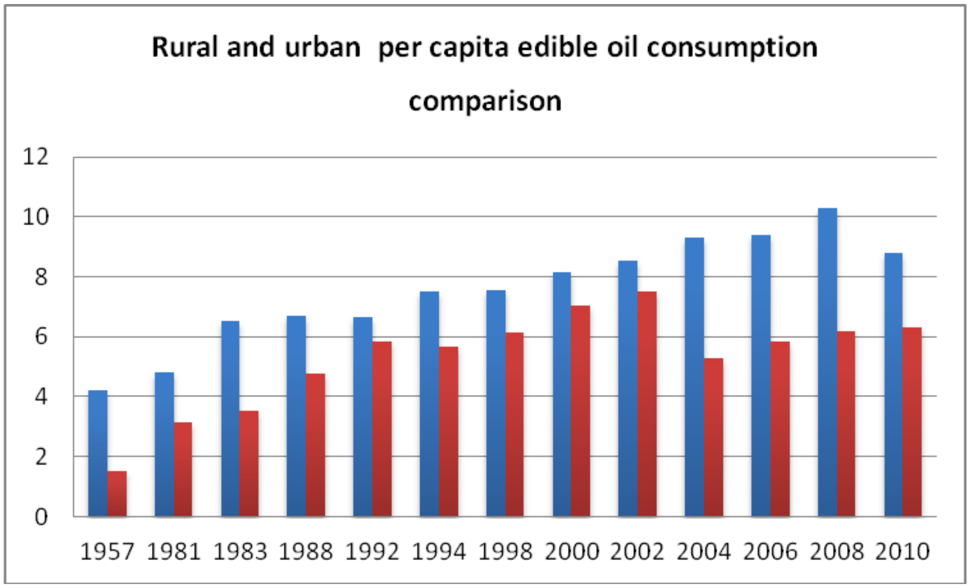


Figure 7: Chinese per capita consumption of edible oils in cities and rural regions from 1957 to 2010. The unit of consumption is kilograms. Blue refers urban per capita consumption and red refers to rural per capita consumption. Edible oils include soy oil, peanut oil, sunflower oil and grape seed oil. Soy oil is the main kind.

Source: China National Statistics, USDA, 2011

CHAPTER VII: POLICY IMPLICATIONS

Policy implications are given in two sections: U.S. policy implications and Chinese policy implications. The latter one consists of three different factors: tax combination, currency exchange rate administration and transgenic regulations revision.

7.1 U.S. policy implications

Based on the empirical results, soymeal in the U.S. is over-produced, making it a by-product of its co-product oil. Consider that the U.S., soymeal's price effect is larger than the currency effect, so one could encourage a special subsidy program to support soymeal exports as one solution to the market imbalance.

7.2 China policy implications

7.2.1 Tax Options

There are several tax levers the government could use to incentivize different actions in the soybean market.

Option A: *High tax on soybean imports and high VAT on imported soymeal and soy oil*

This stringent trade protection policy combination will probably result in trade disputes. Besides, it does not solve the problem of insufficient domestic supply.

Option B: *Low tax on soybean imports and high VAT on imported soymeal and soy oil*

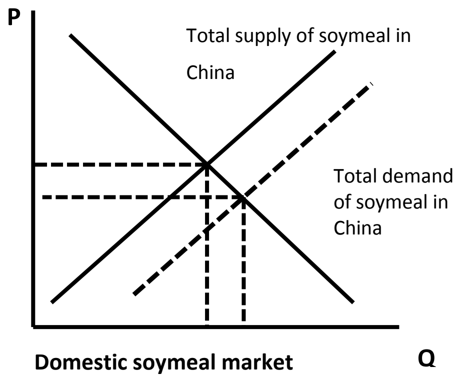
This option is designed to promote the building of more crushing factories, therefore creating more job positions. Insufficient domestic soybean supply will be solved at the expense of Chinese farmers. Overall, this policy combination would be preferred by government based on the theory of concentrated benefit and diffused cost.

Option C: *Low tax on soybean imports, low VAT on imported soymeal, and high VAT on imported soy oil*

Under this policy, soymeal imports will likely increase, which potentially increases profits for U.S. crushers as well as livestock feeders in China. However, the interests of Chinese crushers are likely to be negatively affected as a result of decreasing margins. A shortage in the supply of soy oil will likely take place and Chinese soy oil wholesale sellers will probably have to resort to the black market (Tuan, Fang, Cao, 2004) .

As is shown in Figures 8-10 below, a low VAT tax imposed by China on soymeal imports increases the soymeal supply in the international market and the quantity of soymeal imported into China from the international market also increases, which results in increased domestic supply and a low equilibrium price. Furthermore, the low domestic price of soymeal will largely reduce the margin of domestic crushing factories. Their response will be to reduce the quantity of crushed raw soybeans, which will reduce the domestic supply of both soymeal and soy oil. This leads to a supply deficiency in the soy oil market.

The soy oil wholesale sellers will have to resort to the international market to import more soy oil to cover the domestic deficiency. However, the high VAT for imported soy oil and the quota limitation mean that the deficiency cannot be fully covered. The wholesale sellers will then resort to the black market. In general, the domestic price of soy oil increases significantly in this process, and the soy oil imported through the illegal channel cannot fully solve the domestic soy oil deficiency. A possible solution for government is to alternatively lift and impose a VAT on imported soymeal to balance the benefits of livestock farmers and soy oil consumers.



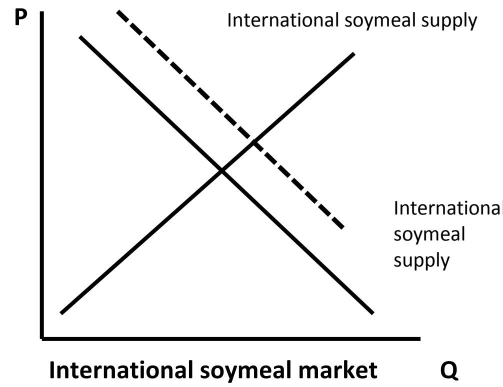


Figure 8: The response of Chinese and international markets to the exemption of soymeal from VAT tax

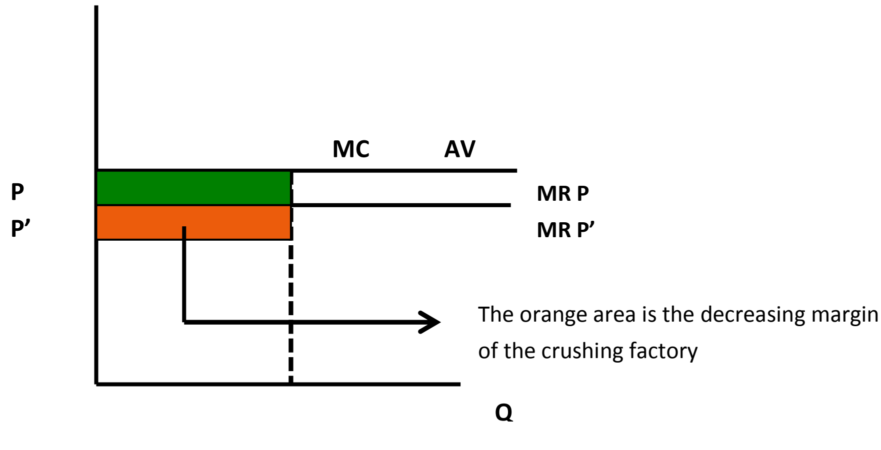


Figure 9: Marginal change of Chinese crushing after exemption of soymeal from VAT tax

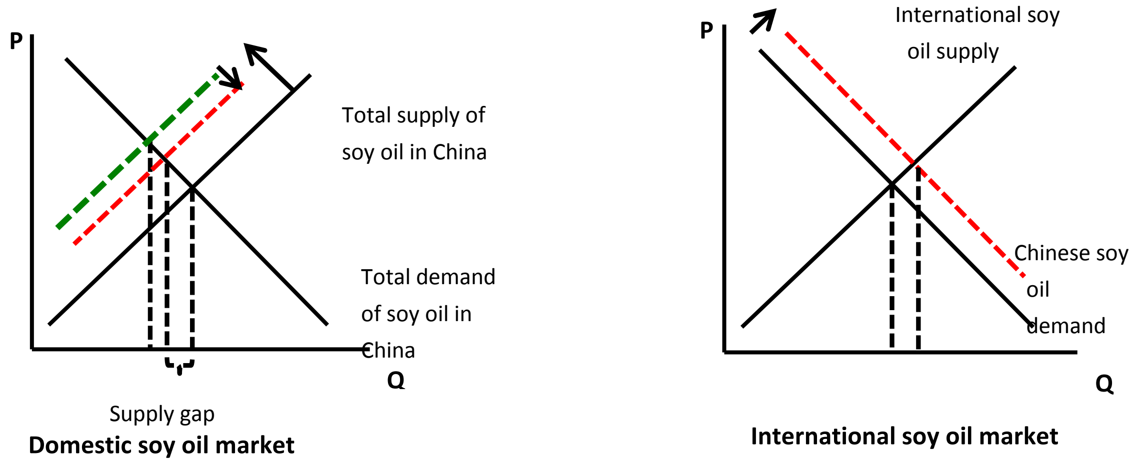


Figure 10: The Chinese crushing factories resort to smuggling to solve the soy oil deficiency

Option D: *Low tax on soybean imports, high VAT on imported soymeal, and low VAT on the imported soy oil*

Chinese soy oil consumers are likely to benefit from this tax combination at the expense of Chinese livestock feeders.

Option E: *High tax on soybean imports and low VAT on imported soymeal and soy oil*

This combination should discourage domestic crushing factories from being built but encourage domestic raw soybean production. All the domestic demand for soy oil and soymeal will be satisfied by imported soy oil and soymeal. The farmers should find the new and creative ways to sell their produced soybeans, for example, exporting them to Japan and Korea. The U.S. soybean producers decreases' surplus while the surplus of U.S. crushers increases.

To provide the greatest overall benefit to China, strongly suggest decreasing the international dependence on the dependence on international soybean supply and increasing the imported quantity of value added products such as soy oil and soymeal. In other words, recommend constructing a soybean industry chain across the U.S., China, Japan, and South Korea. In this industry chain, China mainly imports the value added soy products (soy oil and soymeal) from the U.S. rather than raw soybeans. In this way, U.S. farmers and crushing factories can maximize their profits by producing value added products, and a Chinese domestic policy dilemma will not occur. The supply of soy oil and soymeal in China will be more stable, and the Chinese government will not need to make policies that benefit one side while hurting others. Besides, reduction of soybean imports will encourage the Chinese to produce more soybeans that are not genetically modified and are therefore attractive to Japanese and Korean consumers. This will stimulate exports of Chinese domestically produced soybeans. On the whole, in this industry chain, all the market participants in the U.S. and China will benefit. The potential risk lies only in that the Chinese soymeal and soy oil consumers must tolerate the uncertain risks of transgenic products.

7.2.2 Currency Exchange Rate Administration

In China, the currency exchange rate does not currently fully follow the market discipline and is partly controlled by the Central Bank of China. Quick appreciation of RMB is not suggested for the following reasons: First, according to the J-curve effect of S.P. Magee, the specific effect of RMB appreciation is uncertain in the short term. Potential political and economic costs are hard to measure. Second, the quick appreciation of RMB will rapidly increase the purchasing power of Chinese importers and cause overall agricultural commodity price inflation in the international market. Although the pressure from the Western world disappears, new pressures from other developing countries that depend on agricultural commodity imports will emerge. Third, the quick appreciation of RMB will attract many international merchants to invest in Chinese crushing industries and increase Chinese crushing ability. This creates potential obstacles to expanding U.S. exports of soy oil and soymeal. In this way, the international supply chain (section 7.2.1) might not be realized. Finally, the pressure from Chinese farmers cannot be ignored. The quick appreciation of RMB will decrease competitiveness of Chinese agricultural commodities. In conclusion, the quick appreciation of RMB is not recommended.

7.2.3 Transgenic Regulation Recommendations

The current version of transgenic regulation is acceptable, but greater regulation is not recommended. Based on the analysis in Chapter 6, if current “inactive oversight regulation” becomes active, more loss than gain will occur in both markets.

7.5 Summary of Policy Combinations

Generally speaking, in order to create mutual benefit between the U.S. and China and construct a healthy international trade chain, increasing subsidies to U.S. soymeal exporters is highly recommended, in addition to instituting a high soybean imports tax and low VAT tax in China on both imported soy oil and soymeal. Additionally, suggest allowing gradual appreciation of RMB and maintaining transgenic regulations at their current status.

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