Analysis on the Impact of Seasonality on China's Soybean Import Allocation

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***Abstract*—As the largest importing country of soybean in the world, China's import allocation may be affected by seasonal export ability of soybean of imports-sources. Based on exporters' decision-making behavior, this paper analyzed the impact of seasonality on a country's import allocation theoretically and empirically, using monthly data of China and three major soybean exporters from the year 2010 to 2013. Empirical results show that seasonality is an important determinant of import allocation, one country's market share in China's soybean importation is significantly higher in harvest seasons than in non-harvest seasons. Changes on soybean import allocation are the result of dynamic development of soybean's comparative advantage of export countries. Adapting to this, China can make full use of seasonal complementarities and comparative advantages in both hemispheres, integrate world resources effectively and achieve stable domestic supply of food and long-term food security.**

***Index Terms*—seasonality, import allocation, soybean**

I. Introduction

Over the past decade, China's importation of major agricultural products such as grain, cotton, and oil has surged tremendously. Soybean is China's earliest opening and deepest opening product, its imports increased by 210.5 times from 299.7 thousand tons in 1995 to 63406.9 thousand tons in 2013. The dependence on foreign imports of China's soybean sector has risen to more than 80 percent, far exceeding that of corn, wheat and rice. The massive importation has increased China's supply ability to meet its domestic needs effectively and directly [1]. But it should be noted that the importation also make China's food security easier to be influenced by international market risks, particularly the risk of import sustainability as well as political sensitive issues, which are highly related to the issue of import allocation. As shown in Fig. 1, in recent twenty years, China's soybean import allocation has changed a lot. Prior to 1997, 70% of China's soybean import depended on the United States. However, by 2012, the proportion dropped sharply to below 45%, while market share of Brazil and Argentina increased to 40% and 10% respectively.

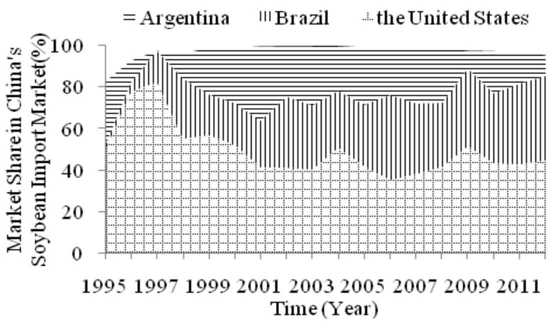

Figure 1. China's soybean import allocation (1995-2012). Data Source: China Customs Department

Import allocation often be made based on price, quality service, stability, political relations and other factors, among which, price is usually the main factor [2]. H-O theory suggests that price difference is the source of international trade. According to that, import allocation may depend primarily on price difference across imports-sources. However, as shown in Fig. 2, China's soybean import prices from all sources are highly consolidated. This may be the results of two aspects: firstly, since Brazil and Argentina introduced and cultivated genetically modified soybean developed by the United States since 80's in 20 centuries, soybean from Brazil, Argentina and the United States have become homogeneous [3]. Secondly, with the development of soybean futures market, soybean exporters of the three countries price their soybean mainly according to soybean futures market [4]. The convergence in quality and fast transmission in futures market price information narrow price gaps among countries [3], [5]. As a result, the prices of soybean imported from Brazil, Argentina

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and the United States do not show a significant difference. In this case, it's hard for China to allocate its imports-sources on the basis of price.

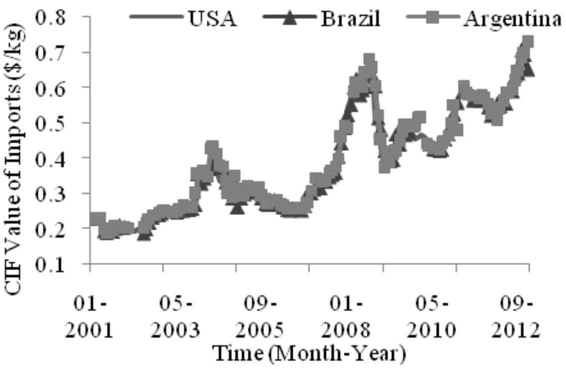

Figure 2. China's soybean monthly import prices (2001-2012)
Data Source: China Customs Department

So, why China changes its soybean import allocation even soybean from the three sources is relatively homogeneous and import prices from the three sources are nearly equal to each other? Taking into the fact that China is the world's largest importer of soybean, China's import allocation may be determined more by seasonal supply ability of imports-sources related with production seasonality than by export prices ①.This article focuses on the theoretical analysis and empirical test on the impact of seasonality on China's food import allocation from the perspective of export supply constraints, using monthly data of China and its three major soybean imports-sources from the year 2010 to 2013. This will provide reference for China to make food import allocation strategy as well as its long-term food supply strategy.

II. Seasonal Differences in China's Soybean Import Allocation

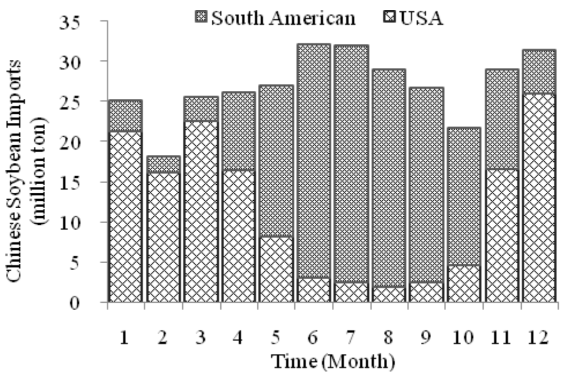

Figure 3. Monthly import allocation for China's soybean (2001 – 2012)
Data Source: China Customs Department

China's major imports-sources of soybean are the United States, Brazil and Argentina. There is a lot difference in the time for China to import soybean from the three countries. As shown in Fig. 3, China mainly imports soybean from the United States in the months of October to April the following year, and imports from Brazil and Argentina in the months of May to September annually. Seasonal trend of China's soybean import allocation is much the same as that of soybean exports from major exporting countries. As shown in Fig. 4, Among the three major exporting countries, the United States mainly export soybean from October to April the next year, while the South American countries (Brazil and Argentina) mainly export soybean from May to September.

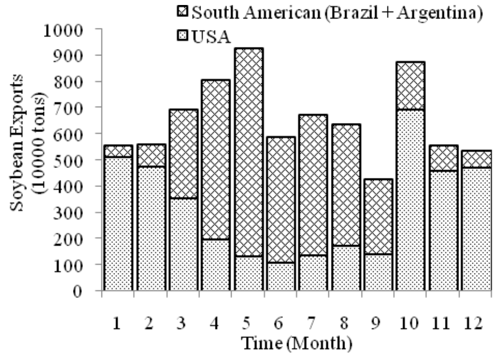

Figure 4. Average monthly exports of soybean for USA and South America (2010-2012)
Data Source: UN comtrade

As is known, the United States is in the northern hemisphere, while the South American countries are in the southern hemisphere. Production season of soybean of the two hemispheres are different. So, in order to export soybean during the soybean off-season, exporters need to bear inventory carrying costs, leading to a higher total export cost than cost of soybean exported from the other hemisphere where is in season. Therefore, there is difference in two regions' exports cost at the same time. Under the stiff competitiveness in international soybean market, soybean prices of two regions are almost equal to each other, so their soybean export profits must be unequal, given the same production cost. In pursuit of profit maximization, exporters will adjust its export volume according to production season, and importing country will change its import allocation accordingly.

Specifically, the United States begins to harvest soybean from September, and after prolonged storage time, inventory holding costs keep rising and export profits declines. So in order to maximize profits, the United States gradually reduces soybean's exports amount. As a result, the United States mainly export soybeans from October to next April. Similarly, the South American countries (Brazil and Argentina) begin to harvest soybeans from April, and the country mainly exports soybeans from May to September.

To minimize imported soybean costs, China changes its imports-sources according to seasonal changes on export volume of the two regions accordingly, even when export prices of the United States, Brazil, and Argentina have little difference. The correlation coefficients of the monthly share of USA, Brazil and Argentina in China's soybean import market and the monthly soybean export volume of the three countries from January 2010 to December 2012 were 0.52, 0.75 and 0.40 respectively, much higher than that of the share of USA, Brazil and Argentina in China's soybean import market and export prices of soybean imported from the three countries.

III. Theoretical Framework

Based on the comparative advantage theory, a country will produce and export goods with competitive advantage. If the comparative advantage theory is expanded to many countries, then from the importing country's perspective, the importing country would import products from the country with the greatest comparative advantage. Import allocation depends on difference on comparative advantage among imports-sources, which generally performance as price difference among imports-sources.

However, in a highly open international market, price among all imports-sources are highly consistent, so how does importing country allocate its imports-sources under this condition? For food products, the import allocation may have correlation with the seasonal supply constraints of imports-sources caused by production seasonality. In free trade equilibrium, export prices of imports-sources at any season are highly consistent, but export costs are different because of seasonal production. So a country's food production is bound to affect its export in different seasons, and make seasonal changes on import allocation of importing country.

According to production theory, with the established cost, the output depends on factor price and production technology. This theory is mainly applicable to industrial products. As to agricultural products, besides factor price and production technology, the output of which also depends on seasons. It is hard to produce the same amount of product in non-production season as in production season given the same average cost of production with the same factor price and technology.

As shown in Fig. 5, assuming that both of production cost for a country to produce agriculture products in production season and in non-production season are PC[2]. The inventory holding costs during production season and non-production season are ICs and ICns (inventory time of agriculture products in non-production season is longer than in production season, as so when the production cost in two-season are equal, ICns>ICs), the corresponding total cost and marginal cost are TCs, TCns (TCns>TCs) and MCs, MCns(MCns>MCs). Further assume that the world market price is Pw, then the export volume of agriculture products in production season and non-production season are Qs and Qns in market equilibrium, where Pw=MCs and Pw=MCns. It is clear that MCns must be larger than MCs given the same yield, so in order to achieve maximum profit, the export volume in non-production season must be less than that in production season, i.e. Qns<Qs. Further assume that, country A export a constant amount Qc of its agricultural products to country B both in production season and in non-production season, and country B import M in all seasons, then market share of country A in the import market of country B in production season and in non-production season can be classified as (Qs-Qc)/M and (Qns-Qc)/M. Obviously, (Qs-Qc)/M>(Qns-Qc)/M. In other words, import allocation of country B changes with agricultural production season of country A.

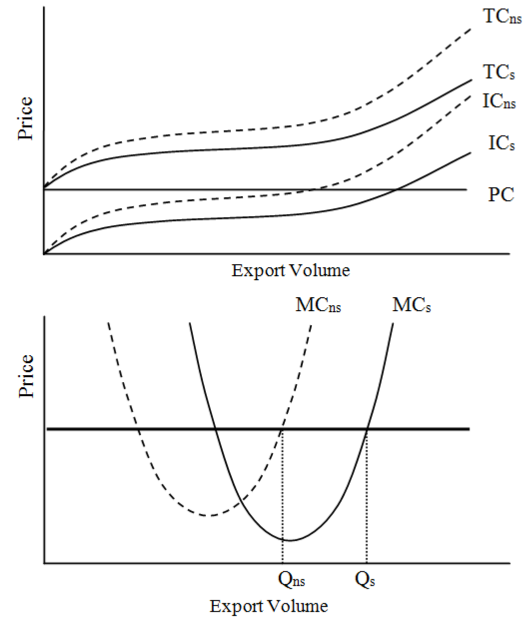

Figure 5. Production season and import allocation

IV. Empirical Analysis

A. Methodology

Almost Ideal Demand System (AIDS) has been used extensively in applied demand for food and for imports analysis [6]-[10]. AIDS model is used at a given price system and a utility level, derived from the proceeds of achieving given utility level with minimum expenditure [11]. Applying AIDS model to import allocation analysis implies an assumption that there is significant price difference between imports-sources. However, as described above, in a highly open economy market, prices of all imports-sources are almost equal to each other. The import allocation of soybean may be largely affected by production season constraints of exporting country. The issue of supply constraints imposed by exporting country on China's soybean import allocation will be discussed further.

Exporters' decision can be summarized to the issue of allocate current export volume and future export volume to maximize its expected export profit at a given product quantity. The following model is formulated to show a representative exporter id in country i with its product amount y^{id}. Assuming that the current price is p_0, the expected future price is p_t^e, and the unit production costs and inventory holding costs[3] are pc^{id} and ic^{id}. Then the expected maximum export profit can be expressed as:

$$Max\pi_{id} = \pi(q_0^{id}) + \beta\pi(q_t^{id}) = p_0 q_0^{id} + \beta(p_t^e - ic^{id})q_t^{id} - pc^{id} y_0^{id}$$

$$\text{s. t. } q_0^{id} + q_t^{id} = y^{id} \tag{1}$$

where q_0^{id} =current export volume; q_t^{id} =future export volume; β =fixed preference factor, also known as subjective discount or time preference factor.

According to (1), we can get country i's maximum expected export profit:

$$Max\pi_i = p_0 q_0^i + \beta(p_t^e - ic^i)(y^i - q_0^i) - pc^i y^i$$
$$\text{s. t. } q_0^i + q_t^i = y^i \tag{2}$$

Assuming that exporters set their expected future price based on future price. The holding cost pricing principles implies that future price is equal to the sum of spot price (p_0), financing costs (r_t, the risk-free interest rate revenue), warehousing costs (w_t, including storage costs, anti-corrosion costs, insurance costs, loss costs) and convenience yield(sle_t, profit due to hold inventory of the product): $p_t^e = p_0(r_t + w_t + sle_t)$, where r_t, w_t and sle_t are functions of inventory time (t): $rt=r*t$, $wt=w*t$, $sle_t=sle*t$ [12]. Of these, *sle* is a function of inventory level (I) [13], which depends on the number of products possessed by all countries and the number of products exported currently, $\text{sle} = \alpha I = \alpha\sum_{i=1}^{n}(y^i - q_0^i)$.

As with agricultural products, inventory time (t) is mainly decided by production season (*season*): $t=f\ (season)$. In production season, the average inventory time is short, while in non-production season, average inventory time is long. Assuming that inventory holding costs only include financing costs and warehousing costs:

$$ic^i = c_0(r_t^i + w_t^i) = p_0(r_t^i + w_t^i) = p_0(r^i t^i + w^i t^i)$$

Then (2) can be further written as:

$$\max\pi_i = p_0 q_0^i + \alpha\beta f(season^i) p_0 (\sum_{i=1}^{n} y^i - \sum_{i=1}^{n} q_0^i)(y_0^i - q_0^i) - pc^i y_0^i \tag{3}$$

Assuming that the market is an oligopoly market, where each exporting country decide their exports amount (q_0^i) according to their expectation of other countries' exports amount (q_0^{ej}), and the actual export volume of all countries are equal to other exporting countries' expectation of their exports amount $q_0^{ej} = q_0^j$.

So the world's actual total export volume is $q_0 = \sum_{i=1}^{n} q_0^i$. Further assume that world price is $p_0(q_0) = p_0(q_0^i + \sum q_0^j) = a - b(q_0^i + \sum q_0^j) = a - b\sum_{i=1}^{n} q_0^i$, then (3) can be written as:

$$\max\pi_i = (a - b\sum_{i=1}^{n} q_0^i) q_0^i$$
$$+ \alpha\beta f(season^i)(a - b\sum_{i=1}^{n} q_0^i)(\sum_{i=1}^{n} y^i - \sum_{i=1}^{n} q_0^i)(y^i - q_0^i) - pc^i y_0^i \tag{4}$$

Assuming that n export countries are symmetric, reaction function of every exporter to other exporting countries has the same form, so the export level of every exporting country is the same, $q_0^1 = \ldots = q_0^i \ldots = q_0^n$, then (4) can be written as:

$$\max\pi_i = (a - bnq_0^i) q_0^i$$
$$+ \alpha\beta f(season^i)(a - bnq_0^i)(\sum_{i=1}^{n} y^i - nq_0^i)(y^i - q_0^i) - pc^i y^i \tag{5}$$

At this point, the first order conditions of the export profit-maximization problem can be simplified to:

$$x_0^i = f(n,\ season^i, \sum_{i=1}^{n} y^i, y^i) \tag{6}$$

If the exporting country is a big producing country, then y_0^i in function would be highly related to $\sum_{i=1}^{n} y^i$, so delete y^i in $\sum_{i=1}^{n} y^i$ and transform (6) into (7) to avoid multi-collinearity problem:

$$x_0^i = f(n,\ season^i, \sum_{j=1}^{n-1} y^j, y^i),\ j \neq i \tag{7}$$

Further assume that country i export a constant amount q_c of its product to the importing country, the total import amount of which is M_0, then the share of country i in the importing country's import market is:

$$w_0^i = \frac{q_0^i - q_c}{M_0} = \frac{f(n,\ season^i, \sum_{j=1}^{n} y^j, y^i) - q_c}{M_0} \tag{8}$$
$$= g(n,\ season^i, \sum_{j=1}^{n} y^j, y^i, M_0),\ j \neq i$$

Add the error correction term to the right of (8):

$$w_0^i = \beta_0 n + \beta_1 season^i + \beta_2 \sum_{j=1}^{n} y^j + \beta_3 y^i + \beta_4 M_0 + \varepsilon_0',\ j \neq i \tag{9}$$

Equation (9) suggests that one country's current share in an import market depends on the number of imports-sources (n), domestic production season (*season*), the number of products possessed by all imports-sources (y^i And $\sum_{j=1}^{n} y^j$) as well as the importing country's total import amount(M_0).

In production season, export profit may be high because the inventory time is short and inventory holding costs is low, but on the other hand, export profit may also be low due to large supply. So exporters may expand export scale or reduce the scale in production season, its share in importing country's import market may be increased or decreased in its production season. The situation in non-production season is in the opposite, export profits may be low due to increased inventory holding cost, but may also be high due to the shrinking supply. Therefore, it is hard to predict market share in non-production season. From this, it can be seen that the net effect of seasonality in a country's market share depends on the relative role of inventory time to inventory carrying costs and to convenience yield. But in the highly open world market, it is difficult for exporting country to increase export price even in non-production season, so convenience yield may be limited in non-production season, and the net effect of inventory time on a country's exports may be negative. Therefore, market share of one import source may decline in non-production season.

In order to identify that import price make little difference to one country's import allocation, AIDS model is also used in China's soybean import allocation:

$$w_{it} = a_{it} + \sum_{j=1}^{n} \gamma_{ijt} \log p_{jt} + \beta_{it} \log(M_t / P_t) + \varepsilon_{it} \qquad (10)$$

where w_{it} denotes the share of imports-sources i in China's soybean import market; p_{jt} denotes the price of soybean imported by Chin*a* from country *j* (*j = 1, ...,* *N*); M_t represents total amount of soybean imported by China; P_t represents Chinese soybean import price levels, calculated by the amended Stone price index [14].

B. Data

Limited to monthly data, the data used in the analysis were monthly data from 2010 to 2013 on market share, possession, soybean production season of three major soybean suppliers, the USA, Brazil and Argentina, as well as the number of soybean imports-sources exporting to China and China's total import amount. Among these variables, market share was the ratio of volumes of soybean exported to China from the three imports-sources to China's total import amount. Monthly possession was calculated by annual yield and monthly cumulative harvesting rate. Season was represented by the reciprocal of average inventory time, which was calculated by production, consumption, inventory, imports and exports of annual data, quarterly data or monthly data of China and the three imports-sources, combined with inventory time calculated from the start month of harvest assigned with value 0, and the first month after harvest assigned with value 1.

The data were collected from the United Nations Commodity Trade Statistics Database (Comtrade UN) ④, United States Department of Agriculture Foreign Agricultural Service (USDA-FSA ⑤ , the Food and Agriculture Policy Research Institute (FAPRI) ⑥, United States Department of Agriculture Economics, Statistics, and Market Information System ⑦ , as well as United States Department Agriculture of weekly crop progress report. The market share of China's major soybean imports-sources, the United States, Brazil and Argentina, are approximately 49.18%, 35.92% and 14.39% respectively. The average inventory times of soybean in the three imports-sources are 6.81 months, 6.07 months and 4.93 month respectively. The average monthly soybean yield of the three imports-sources is 7.37 million tons, 4.82 million tons and 4.16 million tons respectively, with their monthly average export volume of 3.24 million tons, 2.57 million tons and 0.79 million tons; China's monthly average soybean imports volume is 4.57 million tons. The average number of countries that export soybean to China is 5.51.

V. Results

A. The Impact of Import Prices on the Import Allocation

Factors affecting China's import demand for soybean would directly affect soybean export from US, Brazil and Argentina to China, so random disturbance terms in three soybean market share equations may be related to each other, resulting in self-related problems among three countries. Therefore, this paper adopted LM test, the calculated χ^2 value of which was 27.84, suggesting the rejection of independent conditions. So SUR regression method was selected to estimate (10).

Table I shows that R2 in the three market share equations are less than 40%, indicating that the AIDS model do not fit into China's soybean import allocation data. The majority of coefficients of prices for US soybean, Brazilian soybean and Argentina soybean are not significant, suggesting that the effect of soybean price of imports-sources does not show significant impact on China's soybean demand. This was consistent with our expectations. As international soybean market is highly open, soybean export price for the three countries are very similar to each other, and the effects of soybean price on China's soybean import allocation are not significant.

TABLE I. ESTIMATED RESULTS OF AIDS MODEL

	W_{US}	W_{Brazil}	$W_{Argentina}$
China's soybean	-1.649*	-0.732	0.745**
imports expenditure	(-0.97)	(-0.87)	(2.10)
USA soybean prices	-8.358	4.158	3.281
	(-5.877)	(0.82)	(1.53)
Brazilian soybean	13.008**	-7.019	5.309**
prices	(5.798)	(-1.40)	(2.51)
Argentina soybean	3.437	2.267	-1.154
prices	(2.982)	(0.88)	(-1.06)
Constant	-772.2	398.0	375.1**
	(-1.56)	(0.93)	(2.07)
R^2	0.24	0.10	0.37
LM test	27.84 (0.00)	Test Results: self-related	

Note: (1) "* * * " " * "and" * "indicates a 1 per cent, 5 per cent and 10 per cent of the level of significant. (2) The value after test in parentheses is P value.

B. The Impact of Seasonal Factors on the Import Allocation

As the same reason for AIDS model analyzed above, we made LM test first to examine the self-related issues that may exist among the three groups. The result rejected the original assumptions of independence. Therefore, we selected SUR method to estimate (9).

According to the results of Table II, the model fits data well in an overall level. As expected, the coefficients of the key variable (*season*) in the three market share equations are positive and significant at 1% level, i.e. production season have significant positive effect on the share of three imports-sources in Chinese soybean import market. As with other agricultural commodities, soybean is large in volume, heavy in quality, but low in value, and less resistant in storage, its unit value is far less than industrial product in general making its inventory carrying cost and transportation costs very high relatively to its unit value. So the savings in inventory cost due to large supply was larger than profit space suppressed by large supply in production season, while the increase in inventory cost due to prolonged inventory time was larger than the increase in convenience yield due to prolonged inventory time in non-production season. The delay in inventory time is harmful to soybean exports of China's soybean imports-sources and their share in China's soybean import market as a whole.

TABLE II. ESTIMATED RESULTS OF PCSE METHOD

	W_{US}	W_{Brazil}	$W_{Argentina}$
n	-4.742**	6.308***	5.273*
	(-2.63)	(3.30)	(2.42)
season	3.556***	1.123***	2.327***
	(10.55)	(5.28)	(4.73)
Y_{USA}	0.598	-0.843***	-0.537
	(1.73)	(-2.64)	(-1.63)
Y_{Brazil}	-0.800**	0.388*	-0.521***
	(-3.64)	(2.19)	(-3.56)
$Y_{Argentina}$	-0.172	-0.885*	0.164
	(-0.84)	(-1.82)	(0.97)
M	-3.845	4.277	0.530
	(-1.14)	(1.13)	(0.17)
Constant	118.0***	-16.47	14.75
	(9.40)	(-1.12)	(1.14)
R^2	0.90	0.79	0.48
LM test	8.64(0.03)	Test Results: self-related	

Note: (1) "* * * " " * "and" * "indicates a 1 per cent, 5 per cent and 10 per cent of the level of significant.(2) the value after test in parentheses is p value.

At the same time, with the increasing number of Imports-sources, the United States' market share drops significantly, while Brazil's and Argentina's market shares are significantly improved. Emerging market such as Brazil and Argentina increased competition in Chinese soybean import market, weakening the market power of the United States. In the three market share equations, China's soybean imports has negative effect on the United States market share, but has positive effect on market share of Brazil and Argentina. In other words, market share of the United States decreases with the increase in China's soybean import demand, while Brazil and Argentina benefit from the expansion of China's soybean import demand. In fact, Market share of Brazil and Argentina gradually increase with the increase of China's soybean import demand, while the position of the United States market drops at the same time. China's soybean import depends more and more on Brazil and Argentina.

Additionally, in the three market share equations, increase in production of one imports-sources would improve the country's market share and inhibit other imports-sources' market share. More specifically, the promoting effect of USA's yield on its market share is the largest among three countries, while the inhibitory effect of Argentina's yield on the market share of Brazil is largest; the effect of Argentina's yield on market share of the United States is the smallest. So it can be judged that there are substitution relationships between Brazil, Argentina and the United States in China's soybean import market, the substitution relationship between the United States, Argentina and Brazil, as well as between Brazil and Argentina are relatively strong, while the relationship between USA and Argentina are relatively weak. The United States occupied an important position in China's soybean import market, while Brazil's market position is vulnerable; and the status of Argentina is not very significant.

C. Robustness Test

To verify the robustness of empirical results on Table II, a single equation approach was used to (9). According to the results of the Hausman test, amended Wald test, Wooldridge test and Breusch-Pagan LM test, we chose the PCSE method to estimate (9) to obtain a valid estimation.

TABLE III. ESTIMATED RESULTS OF ROBUST TEST

Variable	Coefficient	Standard error	Z statistics	P value
n	- 0.872	1.205	- 0.72	0.47
season	1.771 * * *	0.326	5.44	0.00
Y_i	0.393 * *	0.169	2.33	0.02
$\sum y_j$	- 0.332 * * *	0.119	- 2.80	0.01
M	- 1.374	1.833	- 0.75	0.45
Constant	- 56.45 * * *	9.833	5.74	0.00
Hausman Test		48.50 (0.00)		
The amended Wald Test			1.94 (0.58)	
Wooldridge Test			25.14 (0.04)	
LM Test		8.64 (0.03)		
Wald chi^2			68.49 (0.00)	
R^2			0.42	

Note: (1) "* * * " " * "and" * "indicates a 1 per cent, 5 per cent and 10 per cent of the level of significant. (2) The value after test in parentheses is P value.

Table III showed the estimated results of PCSE method, the results were consistent in the size of coefficients, factor symbols and significant with the results in Table II as a whole. In particular, the production season has a significantly positive relationship with a country's share in China's soybean import market. The market share is significantly higher in production season than in non-production season. Increase in the number of imports-sources and China's total soybean import volume would decrease the share of one country in China's soybean import market. At the same time, the increase of production would increase the share of one country in China's soybean import market and suppress other countries' market share. There are substitution relationships between imports-sources in China's soybean import market. The above analysis showed that there is no substantive difference in the results estimated by different methods. The results in Table II were robust.

VI. CONCLUSIONS AND POLICY RECOMMENDATIONS

This article analyzed the impact of seasonality on China's soybean import allocation, based on export decision-making behavior, using data of soybean of production, consumption, stock and trade of China and its three major import sources-the USA, Brazil and Argentina from the year from 2010 to 2013. Empirical results show that production season is an important factor that influences China's soybean import allocation. Although in non-production season, the delay of inventory time may boost the convenience yield due to the decrease of soybean supply in the world market, but at the same time, the profit may be suppressed because of the increasing inventory holding cost. In an overall level, soybean market share of one country in production season was significantly higher than in non-production season s.

Changes on soybean import allocation are as a result of dynamic development of soybean's comparative advantage of imports-sources. In the highly open international market, import prices among imports-sources tend to converge, the impact of import price on import allocation has greatly diminished, and Chinese soybean import allocation is mainly affected by production season of imports-sources. In production season, savings in inventory cost due to large supply was larger than profit space suppressed by large supply, while in non-production season, the increase in inventory cost due to prolonged inventory time was larger than that in convenience yield, so countries in production season have stronger comparative advantages and higher share in China's soybean import market than in non-production season.

In the trend of economic development, population growth and urbanization, for long-term sustainable use of international food resources, China should treat food import allocation issues strategically, change its import allocation according to seasonal changes on comparative advantages of imports-sources, develop and nurture new imports-sources with seasons different to existing sources, pay more attention to food import market diversification strategy to avoid single market risk and volatility, increase efforts to foreign agricultural development and enhance global food supply capacity.

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ANNOTATION

1. The political economy in the area of importing and exporting is not within the scope of this study.

2. The production cost includes fixed cost and variable cost. It is assumed that the production costs in agricultural production season and in non-production season of are equal.

3. The inventory Carrying Cost refers to cost related to logistics activities, caused mainly by activities of inventory control, packaging, waste disposal and so on, which is composed of financing costs, inventory service cost (insurance and taxes), storage cost and inventory risk cost. Because inventory service cost and inventory risk cost are relatively small, this paper mainly considers financing costs and storage cost.

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5. http: /apps. FAS. usda. Gov/gats/Default.aspx

6. http:// www. fapri. iastate. Edu/

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