Exchange Rates, Income Growth, and Chinese Agricultural Imports

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Abstract:

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Keywords: China, agricultural trade, exchange rate, import elasticities, agricultural imports
JEL classification: F31, F32, F41, F14

I. Introduction

From a closed economy 40 years ago, China has become a leading participant in world markets. However, its export surge has coincided with growing trade imbalances with the rest of the world. The undervaluation of the Chinese currency, the renminbi (RMB), and its impact on China's huge trade surplus with the United States has been a contentious issue for some time.

Despite its large overall trade surplus with the rest of the world, China has become a major net agricultural importer, especially after joining the World Trade Organization (WTO) in 2001. As Figure 1 shows, China has a deficit in agricultural trade every year since 2002. China's agricultural imports increased from 1997 to 2015 by more than 12 times, whereas its agricultural exports only quadrupled. From 2011-2015, the average trade deficit for agricultural products is about $65 billion. The same trade relationship holds vis-à-vis the United State – a large overall surplus, but a substantial deficit in agricultural trade (fig. 2). Also, in recent years, the RMB has appreciated vis-à-vis the U.S. dollar and other major currencies. This appreciation should increase agricultural imports further and expand the country's trade deficit for the sector. Will that be the case? Will the import impact differ by product category or individual commodity? The criticism that the RMB has been undervalued call for careful empirical investigation of the relationship between changes in China's exchange rate and its agricultural trade. This paper addresses these questions and issues.

The importance of exchange rates for agricultural trade was revealed by Schuh (1974), who found that the overvalued dollar in the post-World War II period caused major decline in U.S. agricultural exports and income. His work stimulated the large and still growing body of literature on the relationship between exchange rates and agricultural markets, much of which focuses on U.S. markets and trade within countries at an aggregate level (see Kritinek and Anderson (2002) for a review of this literature). However, the conclusions of this empirical work are somewhat ambiguous. While most investigators find a significant negative effect of exchange rate fluctuations on trade (Cushman 1988; Thursby and Thursby 1987; Cho, Sheldon, and McCorriston 2002; Rose 2000; De Grauwe and Skudelny 2002), others find positive trade flow effects stemming from uncertainty in the exchange rate (Klein 1990; Broll and Eckwert 1999; Jozsef 2011), or a weak or insignificant impact on trade (Rose 1990; Rose 1991; Ostry and Rose 1992). Pick (1990) and Kandilov (2008) find that the impact of exchange rate volatility on exports is much larger for developing countries than for developed ones. Some studies have examined the commodity-level trade effects of exchange rates. Anderson and Garcia (1989) find significant negative effects of exchange rate volatility on U.S. soybean exports. Shane et al. (2008) examine exchange rate impacts on U.S. agricultural exports across 12 commodity products including soybeans. In general, the results vary with the commodities examined, modeling techniques used, and the time frame of the studies.

Then for the specific case of China, the empirical relation between exchange rate and trade has received little attention. One issue is that up to mid-1980s, international trade was conducted exclusively by a small number of state-owned trading companies and were subject to government targets, leaving little role for the exchange rate to affect trade (Lardy 2002). A second is that the Chinese exchange rate was managed by the authorities from the late 1970s to the mid-1990s, making it difficult to identify exchange rate effects using aggregate data. Finally, there is a lack of data on China's trade prices, meaning that the choice of deflator can significantly alter results. Still, a few studies have attempted to estimate exchange rate elasticities using aggregate trade data[1], but they reach strikingly different elasticity estimates depending on data coverage, methodological issues in the estimation, and also a gradual shift in China's production structures. Very limited studies have been done on China agricultural trade and exchange rate. Koo and Zhuang (2007) find that U.S.-China agricultural trade can be explained by exchange rate movements. A few studies have examined the commodity-level trade and exchange rate, including Zhang et al. (2010) for soybeans, Izotov (2012) for 18 major commodities traded by China and Russia, Mutuc et al. (2011) for U.S.- China trade in corn, soybeans, and cotton, and Devadoss et al. (2014) for U.S.- China trade in milk, soybeans, bean, cotton, fruit, and fruit juice. Overall, most of the existing literature ignore the potential differences of the impact across sectors and specific products. Strong empirical evidence is lacking on the effect of changes in the exchange rate as the conclusions are highly ambiguous.

We fill this gap with several contributions. First, we examine how Chinese agricultural imports react to bilateral exchange rate movements by employing highly disaggregated bilateral trade data at Harmonized System (HS) 8-digit, and are able to estimate exchange rate elasticities at various aggregation levels. We find significant though moderate volume elasticities for Chinese agricultural imports. By examining agricultural trade for subcategories of products and individual commodities, we avoid commodity aggregation problems and provide results helpful to individual producers and traders. We

[1] Using aggregate time-series data, a few studies find the exchange rate elasticity above unity (Aziz and Li (2007), Garcia-Herrero and Koivu (2009), Thorbecke (2006)). Mann and Pluck (2007) report that price elasticity not statistically significant, but income elasticities are extremely high (around 10) over all. Marquez and Schindler (2007) find that a real appreciation would lower China's export share, whereas Cheung et al (2010) find that an RMB appreciation reduces both Chinese imports and exports.

confirm the finding by Maskus (1986) that the impact of exchange rates varies across sectors and commodities because different sectors have different degrees of openness to trade and substitutability. Second, compare with other studies, we use trade quantity instead of trade value in the analysis, and avoid the problem of seeking good trade price indexes to deflate the value. When analyzing the impact of exchange rate, typically prices are used to deflate nominal trade values because real exports and import values are needed for estimation (Bahmani-Oskooee and Goswani 2004; Marquez and Schindler 2011). The commonly used proxies for Chinese trade prices are trade price data from Hong Kong and they are complicated to be constructed (Mann and Pluck 2007; Cheung, Chinn and Fujji 2010). Since our trade data include both unit values and quantities of trade, we bypass this difficulty by relying on import quantities in the regressions. This method provides an important advantage of our paper over previous studies.

At the aggregate level, we find that a 10 percent annual real appreciation in the RMB would increase China's overall agricultural imports by 0.5 percent. China's income growth is also found to affect strongly the demand for its agricultural imports. These results also carry over to the three major subcategories of bulk, intermediate, and consumer-ready products. We further decompose aggregate trade flows and effects to individual products. The relationships between imports and the exchange rate, and real domestic income, appear to hold for consumer-ready goods, but not for bulk and intermediate products.

The paper is divided into seven sections. The next section reviews the structure of Chinese agricultural imports and the country's exchange rate policy. Section III describes the methodology and data. Section IV reports exchange rate effects for aggregate agricultural imports, section V presents results for the major subcategories of agricultural products, and section VI presents results for individual commodities. Section VII concludes the paper.

II. The Structure of Chinese Agricultural Imports and Exchange Rate Policy

Structure of Chinese Agricultural Imports

China is a large country with 10 percent of the world's arable land and over 20 percent of its population. With its economy entering a new period of urbanization and labor scarcity, China's small scale agricultural production and low productivity cannot meet the country's growing demand for food and non-food agricultural products. Despite its relatively small share in China's overall trade, the country's agricultural sector plays an increasingly important role globally. Since joining the WTO in 2001, China's agricultural trade has grown substantially, particularly imports. In 2016, China became the second largest agricultural importing country behind the United States. China has also become one of the most important agricultural export markets for the United States. In 2012, China surpassed Canada and become the largest importer of US agricultural products.

The U.S. Department of Agriculture (USDA) classifies trade agricultural products into three distinct categories: bulk commodities, intermediate goods, and consumer-ready products based on value or level of processing. Bulk goods, such as grains, soybean, cotton, and oilseeds, are relatively standardized products that have received little or no processing, and used as raw materials and inputs. They are sold in large quantities at relatively low unit costs. Comparatively, consumer-ready products are high value products that are usually ready for final consumption by consumers. They are mostly finished products, including meats, dairy, eggs, fruits and vegetables, processed goods, chocolates, and wines. Compare with bulk commodities, they are easier to be differentiated by brand, quality, sanitary standards, and source countries. As a result, bulk goods tend to have a larger exchange rate and income elasticity because they are relatively more substitutable. Intermediate goods lies between these two categories. They are half processed, have received some processing but are not yet ready for final consumption. These include products such as hides and skins, DDG, hay, live animals, soybean meal, and sugar (see Appendix 1 for details).

Figure 3 shows the evolution of China's agricultural imports by these categories. From 2000 to 2015, Chinese agricultural imports has been concentrated on bulk commodities, followed by intermediate and consumer products. The share of bulk commodities grew steadily from 42 to 52 percent. At the same time, imports in traditional intermediate products have slowed in recent years and taken away by consumer products. The import share of intermediate agricultural goods declined by about a half, from 49 percent in 1997 to 21 percent in 2015. The drop in intermediate goods were taken away by the rising consumer-ready goods, which almost tripled from 9 to 27 percent at the same time. Since consumer-ready goods tend to be preferred by higher income consumers, this structural change in imports reflects China's rising income, rapid urbanization, expanding middle class, desire for variety, and growing food safety awareness.

Then we study the structure of trade by individual agricultural commodities. Table 1 lists the top 40 products that China imports. Column 1 ranks individual agricultural products by their average annual import value over the period of 2011 to 2015. Column 2 ranks them based on the whole sample period average of 2002-2015. Column 3 reports the average percentage share of individual commodities in total agricultural imports for the period 2011-2015, and column 4 reports their percentage share over the whole sample period. Most of China's agricultural imports are concentrated in a small number of commodities. The top 10 commodities on average accounts for 75 percent of Chinese agricultural imports, and top 20 accounts for 90 percent. The top three products ─ soybean, cotton, and rubber ─ account for almost half of the country's agricultural imports in each of the 5-year periods. Soybeans alone accounts for one-third of China's total agricultural imports over time because they are needed for China's expanding livestock industry. Non-corn grain are the next leading bulk commodities China imported. Imports of non-corn grain increased due to China's recent high corn support price and policies limiting imports of lower-priced corn from the global market. Under intermediate goods, one of the largest intermediate agricultural products China imported is hides and skins. This is because China has the world's largest leather-processing industry, which is driven by strong domestic and foreign demand for finished leather products, low environment constraints for processing hides, and low price labor.

Imports of consumer-ready products exhibit strong growth. The share and rank of the major consumer-ready products: dairy products, fresh fruit, prepared foods, beef, pork, and wine and beer, all increased in last 5-year period of 2011-15. Dairy imports have been quite strong, especially due to consumers' safety awareness. Overall, the commodity level import structure reflects China's relative scarcity of agricultural land. The rise in the import demand of consumer-ready goods reflects China's growth in per capita income.

Exchange Rate Policy in China

With the economic opening up of China in 1978, the country implemented a dual track exchange rate system with no convertibility of the RMB. In January 1994, the government unified the official and swap market rates, at 8.7 Yuan/US$, and then fixed the exchange rate at 8.28 Yuan/US$. Meanwhile, China's foreign reserves have increased from 21 billion US dollars in 1994 to 1.06 trillion by the end of 2006, when the country surpassed

Japan as the largest holder of foreign exchange reserves. Due to its longstanding conflict with the United States on exchange rate policy, in July 2005 China moved away from a fixed exchange rate to a managed float. Instead of being strictly and solely tied to the US dollar, the RMB exchange rate became adjustable with respect to a basket of currencies, including the US dollar, euro, Japanese yen, and South Korean won (Frankel and Wei 2007). After that policy change, the RMB gradually appreciated from 8.11 Yuan/US$ in 2005 to 6.83 Yuan/US$ in 2008. It then further appreciated in 2010 and reached 6.21 Yuan/$ in 2012.

III. Methodology and Data

Our method for examining the effect of exchange rate changes relies on bilateral annual variation in exchange rate movements. We use the standard reduced-form partial equilibrium trade model where imports are expected to depend on the real exchange rate and domestic income. The model is estimated in the log linear form:

$$\ln M_{jkt} = \ln ER_{j/RMB,t} + \ln Income_{kt} + \gamma_j + \gamma_k + \varepsilon_{jkt} \quad (1)$$

where M_{jkt} is the volume of China's imports of product k from market j at time t. Products are defined at the highly disaggregated Harmonized System (HS) 8-digit level. $ER_{j/RMB}$ is the real appreciation of the RMB versus foreign currency j (an increase in $ER_{j/RMB}$ denotes an appreciation of the RMB). Given that the RMB did not fluctuate much against the U.S. dollar during our period of study, we rely on the real time variation of the real exchange rate across China's bilateral trading partners for identification. $\ln Income_{kt}$ is the natural log of China's real consumer income, for which we use the common proxy of real GDP. γ_j is the exporter fixed effect, which will pick up average export supply growth. The product fixed effect γ_k will pick up average differences in import growth across products. Standard errors are clustered at the HS 2-digit level. ε_{jkt} is an error term.

We expect β_1 to be positive, indicating that a real RMB appreciation raises the price competitiveness of imports vis-à-vis domestically produced goods, thereby increasing imports. β_2 is expected to be positive, meaning China's imports increase with consumer income. Since bulk commodities are more homogeneous than consumer ready products, we expect that exchange rate and income elasticities for bulk commodities are larger than consumer ready goods.

Our empirical exercise requires data on disaggregated bilateral trade between China and each of its trading partners. Data for Chinese imports over the period 2002-2015 are available at the detailed commodity level, broken down by destination, city of origin, customs regime (including both ordinary and processing trade), and firm ownership.[2] Besides trade values, the dataset also reports the quantity of trade (in different units of measure).[3] We rely on import quantities in the regressions. Products are classified at the 8-digit HS level. China's real GDP is taken from Penn World Table 9.0.[4]

There are several ways of measuring exchange rates, including the nominal exchange rate (NER), real bilateral exchange rate (RER), nominal effective exchange rate (NEER), and real effective exchange rate (REER). We use the purchasing power parity (PPP) method to obtain the real bilateral exchange rate for China relative to each partner country at yearly frequency, which is defined as:

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[2] Data source: China Customs General Administration, Statistics Department. See Feenstra and Hong (2010) and Feenstra and Hanson (2005) for more detail.

[2] The units reported in the Chinese trade data include: Metric carat, Number, Cubic Metre, Thousand, Litre, Pair, Kilolitre, Set, Megalitre, Packet, Metre, Kilmetre, Gram, Kilogram, Square Metre, Tonne, Gigawatt hour.

3 We test different series of real GDP, expenditure side real GDP at current PPPs, output side real GDP at current PPPs, real consumption, and real domestic absorption. The results are robust across these different GDP measures.

$$RER_{j/RMB} = \frac{NER_{j/\$}}{NER_{RMB/\$}} \cdot \frac{P_{RMB}}{P_j} \tag{2}$$

where P_{RMB} is China's price level, P_j is the foreign country price level, and $NER_{j/\$}$ is the nominal exchange rate of each country *j* against the U.S. dollar. $RER_{j/RMB}$ therefore gives the bilateral real exchange rate of the foreign country per RMB, such that an increase in $RER_{j/RMB}$ represents an appreciation of the Chinese RMB. We use the CPI for both China and foreign countries to convert from nominal to real exchange rates. Both the nominal exchange rate and CPI data are obtained from the IMF's International Financial Statistics (IFS) database. We set 2000 as the base year for the CPI index for all the countries, which makes this index comparable across countries in any given year.

Figure 4 shows the change of real exchange rate between China and its major agricultural trading partners such as Argentina, Brazil, Canada, and New Zealand. We set 2000 as the base year for all the bilateral real exchange rates so as to make RER comparable across countries in any given year. Even though RMB was pegged to the US dollar most of the time in nominal terms before 2005, there have been substantial variations in the real RMB exchange rates vis-a-vis other countries both across destinations and over time.

IV. Results at the Aggregate and Sub-category Level

Table 2 reports the estimation results of equation (1) for China's agricultural imports both at aggregate and sub-category level. Column (1) gives the import regression for the aggregate agricultural import flows, and column (2) through (4) reports the results for each of the three sub-categories. For aggregate agricultural import flows, the exchange rate elasticity is 0.043 for the 2002--2015 period. Thus, if the RMB appreciates by 10 percent, Chinese agricultural imports increase by almost 0.4 percent.[5] This smaller than unity elasticity is consistent with elasticities found in the empirical literature and provides another example of the "Exchange Rate Disconnect" puzzle (Obstfeld and Rogoff 2000). On the other hand, holding other things constant, if Chinese real GDP increases by 10 percent, agricultural imports overall will rise by 7.1 percent, which is about 15 times larger than the impact of exchange rate. The large income elasticity indicates substantial expenditure-switching effects, as Chinese agricultural imports appear to be highly sensitive to domestic income fluctuation. This estimate confirms that the robust income gains in China will boost import demand for food and non-food agricultural goods.

We next examine the results for the BICO subcategories. For bulk commodities, column (2) finds that the exchange rate elasticity is negative (-0.02) but insignificant. In column (3), intermediate goods have an overall positive, but still insignificant exchange rate elasticity of 0.027. However, exchange rate elasticity for consumer-ready goods is a significantly positive 0.136. Among the three categories of agricultural products, it is the most responsive to exchange rate fluctuations. Compare the magnitude of exchange rate responsiveness, bulk goods are less responsive to exchange rate changes than intermediate or consumer goods, contradicting the common believe that they are more responsive to price changes. This may reflect the fact that China is highly reliant on importing the bulk commodities because they are necessities.

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[5] Our product-level estimates of elasticities are generally lower than those figures found in existing studies using aggregate Chinese trade data. For example, Aziz and Li (2007) find an aggregate elasticity of about -1.5; Garcia-Herrero and Koivu (2009) find an elasticity of -2.3 for the period of 1994-2005 and a lower elasticity of -1.6 for 2000-2005; and Ahmed (2009) finds a cumulative elasticity of -1.8. Only Thorbecke and Smith (2010) find an exchange rate elasticity of export lower than unity, but only for exports of processed goods. Their elasticity estimate for overall trade is around -1.2.

The strong positive relationship between China's income and agricultural imports remain for different groups of agricultural commodities. At the subcategory level, a 10 percent increase in real GDP growth in China will boost the real value of Chinese imports by 12.5, 4.2, and 8.6 percent for bulk, intermediate, and consumer-ready commodities, respectively. Income elasticity for bulk goods exceeds unity, and is much larger than those of intermediate and consumer ready goods. This supports the common belief that bulk good imports are more sensitive to income growth. Income elasticities are in general about 4 to 25 times larger than exchange rate elasticity estimates, indicating that income growth matters more to China's agricultural imports than exchange rate.

V. Results at the Commodity Level

We next examine the impacts of exchange rate and income change on individual commodities, in part to avoid commodity aggregation bias. We focus on China's major agricultural imports and report the results by subcategory groups following the rank order in Table 1. The results based on the parameters of equation (1) for the selected bulk commodities are reported in Table 3. None of the exchange elasticity estimates are statistically significant for the bulk commodities, except corn. The estimated exchange rate and income elasticities for soybeans, cotton and corn are correct in sign, though not significant. However, the non-corn grains (wheat and rice) have negative exchange rate elasticity estimates, which is puzzling. The top two most important agricultural imports for China: soybeans and cotton, have positive though insignificant exchange rate elasticity. For grain products like coarse grain (exclude corn), wheat and rice, the response to exchange rate fluctuations are insignificant as well. Corn has a significantly negative exchange rate elasticity. The magnitude of exchange rate elasticity are also much smaller than unity, indicating that bulk commodities hardly respond to exchange rate fluctuations. This means that China is highly reliant on the imports of bulk commodities and is not responsive to price changes of these commodities.

Compare with exchange rate, income growth matters a lot in stimulating China's agricultural imports for bulk commodities. This is because all the income elasticity are significantly positive for bulk commodities, and most of them are larger than unity (7 out of 10), which is highly elastic.

The elasticity estimates for the major intermediate goods are reported in Table 4. The results are mixed as well. We find mostly significantly positive exchange rate elasticity, such as veg oil, soybean oil, DDG, and hay. But negative exchange rate elasticity for palm oil, and sugar (which are significantly negative). Estimates of income elasticity are now confusing: only hides and skins, DDG, and hay have positive income elasticities, whereas other products have a negative income elasticities.

Table 5 reports the results for representative consumer-ready goods. Chinese imports of these consumer-ready commodities respond positively to RMB appreciation as well as to real income growth. Almost all the exchange rate elasticities are significantly positive, except fruits and vegetables, and tree nuts. Products such as dairy, pork and poultry are highly responsive to exchange rate fluctuations, with exchange rate elasticities exceeding unity. Majority of consumer ready goods have significantly positive income elasticities. The magnitude of exchange rate and income elasticity now have a smaller gap than bulk commodities. But overall income elasticity still seem larger than exchange rate elasticity.

As a summary, we estimate exchange rate and income elasticities at three levels. At aggregate level, we find significant positive exchange rate and income elasticities, which are consistent with theoretical prediction. When estimating the responsiveness by groups of commodities, the significance of exchange rate elasticities drop for the bulk and intermediate goods compare with consumer-ready commodities. Then at the most detailed individual commodities level, we find large variation across products. Consumer-ready goods perform well *over, all have expected sign,* but not for individual bulk or intermediate goods. In general, we find expected sign among commodities that do not conflict with China's domestic for maintaining self-sufficiency and are in short-supply.

VI. Explanations

What caused the puzzle some results especially for bulk and intermediate commodities? There could be several possible explanations. When we look at individual products more carefully, we feel that overall we get expected signs among commodities that are strategically non-important, i.e. they do not conflict with China's domestic policy for maintaining self-sufficiency and are in short-supply (huge demand). Although China has adopted more open trade policies since joining the WTO, its agricultural markets are still relatively closed to foreign trade because of China's self-sufficiency policy, especially on grain (Fred Gale, Jim Hansen, Francis Tuan). Chinese agricultural markets are still relatively closed to foreign trade because of China's self-sufficiency policy, which encourages domestic production and discourages certain imports through domestic support (Gale et al. 2015).

In order to raise farmer income, maintain grain self-sufficiency, increase domestic production, and promote long term food security, Chinese government steadily intervened in the market by providing various agricultural subsidies, price support, and temporary reserve programs to the farmers. These programs led to a price gap and domestic prices are higher than international prices for agricultural commodities. China's agricultural subsidies, price controls, and import quotas interfere with the country's domestic markets for these bulk and intermediate commodities such that local prices might not change as expected in response to exchange rate movements. Although lower international price and RMB appreciation creates incentive to import more agricultural products, China uses non-transparent tariff-rate quotas (TRQs) to limit the imports of major bulk and intermediate commodities, like cotton, soybeans, corn, wheat, rice, and sugar. Sometimes antidumping duties, countervailing duties, and other non-tariff barriers (NTBs) such as SPS measures, food quality and production specifications are also used to limit the imports of the strategically important commodities. As a result, the price support and trade barriers have offset the market effects of exchange rate fluctuations. Such a relationship between domestic agricultural policies and trade in the face of exchange rate fluctuations is not limited to the Chinese case. For example, Grennes (1975) pointed out in the mid 1970's that most U.S. agricultural commodities were subsidized, and the subsidy may have offset the market effects of exchange rate fluctuations.

Another consideration is that China is a large producer of many of the agricultural products it imports. This is true even for the country's top agricultural import ─ soybeans ─ of which China is the world's biggest importer. Large domestic output allows China to adjust its production and import volumes in response to world price (and import) changes. This helps explain why the rise in world prices for grains, oilseeds, and cotton during 2006-12 did not generate much increase in China's domestic prices for these commodities.

We also think trade conducted by SOEs will be less responsive to ER fluctuation since they follow government orders to import strategic products. Table 7 summarizes the average percentage of agricultural imports conducted by SOEs for each agricultural product.

Under bulk goods, tobacco imports are almost 100 percent conducted through SOEs. 75 percent for wheat, 60 percent for cocoa bean, 50 percent for corn, 22 percent for soybean. Under intermediate: 62 percent of sugar are imported through SOEs, 58 percent soybean oil, 67 percent planting seeds. On average, 40 percent of bulk commodity imports are conducted through SOEs, 36 percent for intermediate, and 22 percent for consumer-ready goods. As is widely known, SOEs play a large role in agriculture. Many of Chinese agricultural imports are conducted by SOEs such as COFCO and SINOGRAIN. They enjoy preferential treatment from the government in securing licensing approvals and getting quotas. When they follow government orders to import strategic products, ER certainly won't matter their decision. Since a large share of an agricultural trade is conducted through SOEs for bulk goods, this partially explains why the impact of ER tend to be small.

Finally, we check the number of sourcing countries for each of China's imported goods. Although bulk commodities are more homogeneous and more substitutable than consumer ready goods, they are mostly land intensive and produced countries with comparative advantage. If China's imports of bulk goods are limited to a small number of major suppliers, then there is not much choice given an ER shock. As a result, being hooked with a smaller number of suppliers will certainly reduce the responsiveness to ER fluctuation. Table 8 lists the average number of sourcing countries each year over the sample period. For each of the agricultural products under BICO system. It shows that the number of sourcing countries for consumer-ready goods are in general much larger.

VII. Conclusion

In the past couple decades, China's foreign trade has grown substantially, and the country has run large overall trade surpluses. However, since China joined the WTO in 2001, its agricultural imports have grown considerably, and the country has run big agricultural trade deficits. After years of criticism that China's currency RMB has been undervalued, it has been appreciating in recent years in real terms. This paper examines how Chinese agricultural import demand responded to changes in the country's exchange rate and growing consumer income over the period 2002-2015. We find that exchange rate and income matters for Chinese agricultural imports over all. A 10 percent real appreciation of the RMB raises total agricultural imports by 0.43 percent, and a 10 percent real GDP growth will raises total agricultural imports by 7 percent. However, there is much variation in response across different agricultural product groups as well as individual products. We tend to get expected signs for elasticities for non-strategically important products that do not conflict with China's self-sufficiency and are in short-supply. China's domestic support policy and NTBs on many agricultural products disconnected the price transmission from global to domestic market, and caused confusing results on elasticity estimates. Exchange rate transmission to domestic prices in general is low, the likely cause being Chinese agricultural policies that promote domestic production and self-sufficiency and interfere in markets, such as budget subsidies, price controls, and import quotas. If the RMB continues to appreciate, Chinese agricultural imports will rise further and the country's agricultural trade deficit will widen, which would help reduce China's overall trade imbalance with the United States. Overall, exchange rate is playing a relative small role in boosting China's agricultural imports. If the government reduces its interventions, we expect that RMB appreciation can play a larger role in China's agricultural trade.

The results also show that Chinese agricultural import demand is fairly responsive to income growth, with income elasticities of demand greater than one. China's GDP and consumer income are projected to continue their high growth (though at rates below the extremely high levels of past decades). This growth should also further increase the country's agricultural imports, especially of bulk and consumer-ready products.

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Table 1: Structure of Individual Commodity Imports

BICO	Commodity	Rank by Average Ag Imp Value		Average Annual % of Total Ag Imports	
		2011-2015	2002-2015	2011-2015	2002-2015
B	Soybeans	1	1	33.2	31.7
B	Cotton	2	2	7.3	8.2
B	Rubber & Allied Gums	3	4	6.2	7.0
I	Palm Oil	4	3	5.6	7.5
I	Other Intermediate Products	5	5	5.0	6.3
C	Dairy Products	6	7	3.6	2.5
C	Fresh Fruit	7	8	3.5	2.4
I	Hides & Skins	8	6	3.7	4.5
C	Prepared Foods	9	9	3.0	2.4
I	Vegetable Oils NESOI	10	10	2.8	2.4
B	Coarse Grains (ex. corn)	11	12	2.1	1.6
C	Pork & Pork Products	12	16	1.8	1.3
B	Rapeseed	13	13	1.8	1.3
I	Sugars & Sweeteners	14	14	1.9	1.5
C	Wine & Beer	15	17	1.8	1.1
C	Processed Vegetables	16	15	1.6	1.6
I	Soybean Oil	17	11	1.3	3.2
I	Distillers Grains	18	22	1.2	0.5
B	Tobacco	19	18	1.2	1.3
B	Oilseeds NESOI	20	21	1.0	0.7
C	Beef & Beef Products	21	26	0.9	0.4
B	Rice	22	23	1.0	0.7
B	Wheat	23	20	0.9	1.2
B	Corn	24	27	0.9	0.4
C	Meat Products NESOI	25	25	0.8	0.7
C	Poultry Meat & Prods. (ex. eggs)	26	19	0.7	1.4
B	Other Bulk Commodities	27	24	0.7	0.9
C	Chocolate & Cocoa Products	28	28	0.6	0.5
C	Tree Nuts	29	29	0.5	0.5
I	Live Animals	30	32	0.5	0.4
B	Pulses	31	33	0.5	0.3
C	Processed Fruit	32	30	0.5	0.5
I	Essential Oils	33	31	0.4	0.5
C	Snack Foods NESOI	34	36	0.3	0.2
I	Hay	35	40	0.3	0.1
I	Feeds & Fodders NESOI	36	34	0.3	0.4
I	Planting Seeds	37	37	0.3	0.3
I	Oilseed Meal/Cake (ex. soybean)	38	39	0.2	0.2
C	Fruit & Vegetable Juices	39	38	0.2	0.3
I	Animal Fats	40	35	0.2	0.5

Source: Chinese Customs Trade Data.

Table 2: The Effect of Changes in the Exchange Rate on China's Total Agricultural Imports, Aggregate and BIC Subcategory

VARIABLES	(1) Aggregate	(2) Bulk	(3) Intermediate	(4) Consumer
Exchange Rate	0.043*	-0.020	0.027	0.136**
(up means RMB stronger)	(0.028)	(0.032)	(0.065)	(0.072)
Domestic Income	0.706***	1.254***	0.421***	0.861***
	(0.040)	(0.149)	(0.066)	(0.055)
Constant	-4.277***	-11.273***	1.235	-1.124
	(1.685)	(2.377)	(2.579)	(7.715)
Observations	83,071	7,466	31,516	44,089
R-squared	0.205	0.329	0.230	0.180

Notes: Robust standard errors in parentheses; *** p<0.05, ** p<0.10, * p<0.20.

Table 3: Exchange Rate Elasticity Estimates for Bulk Agricultural Imports, 2002-2015

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	soybeans	cotton	rubber	coarse grains	rapeseed	corn	wheat	tobacco	rice	oilseeds	peanuts
Exchange Rate	0.550	0.045	-0.027	0.334	1.510	-0.293***	-2.245	-0.051	0.018	-0.107	-3.582
(up means RMB stronger)	(0.530)	(0.044)	(0.113)	(0.294)	(4.791)	(0.097)	(2.213)	(0.062)	(0.165)	(0.086)	(6.073)
Domestic Income	3.373**	0.619***	0.427***	3.632***	3.662*	6.347***	2.746***	0.324	3.673***	0.810***	3.496*
	(1.731)	(0.273)	(0.322)	(1.049)	(2.227)	(1.060)	(1.173)	(0.704)	(0.688)	(0.356)	(2.542)
Constant	-45.165*	3.105	13.688***	-45.00***	-54.458*	-102.26***	-30.007*	2.404	-46.94***	1.629	-40.378
	(29.222)	(4.303)	(5.189)	(16.944)	(37.998)	(17.213)	(18.944)	(11.704)	(11.212)	(5.909)	(34.805)
Observations	145	833	1,267	245	73	105	113	272	311	1,110	98
R-squared	0.573	0.530	0.525	0.602	0.573	0.844	0.768	0.427	0.665	0.474	0.498

Notes: Robust standard errors in parentheses; *** p<0.05, ** p<0.10, * p<0.20.

Table 4: Exchange Rate Elasticity Estimates for Intermediate Agricultural Imports, 2002-2015

VARIABLES	(1) palm oil	(2) Other intermediate	(3) hides	(4) veg oil	(5) sugar	(6) soybean oil	(7) DDG	(8) soybean meal	(9) hay	(10) oils
Exchange Rate	-3.246*	-0.006	-0.162	0.431*	-0.452***	0.665	4.213**	-2.946	7.788	0.230
(up means RMB stronger)	(1.975)	(0.089)	(0.139)	(0.271)	(0.214)	(2.046)	(2.284)	(3.014)	(7.242)	(0.190)
Domestic Income	-0.026	0.007	1.458***	0.151	-0.305	0.130	1.341	3.434***	7.195**	0.588***
	(0.669)	(0.104)	(0.220)	(0.163)	(0.257)	(0.829)	(1.450)	(1.388)	(3.910)	(0.150)
Constant	6.116	10.68***	-10.87***	8.91***	16.095***	5.981	-6.812	-31.757**	-110.10**	-6.553***
	(12.85)	(1.963)	(3.638)	(2.543)	(4.234)	(17.884)	(24.388)	(18.595)	(62.084)	(2.960)
Observations	417	11,966	2,447	5,364	2,337	184	74	156	54	4,482
R-squared	0.708	0.110	0.200	0.215	0.264	0.677	0.756	0.529	0.764	0.159

Notes: Robust standard errors in parentheses; *** p<0.05, ** p<0.10, * p<0.20.

Table 5: Exchange Rate Elasticity Estimates for Consumer-Ready Products, 2002-2015

VARIABLES	(1) meat	(2) dairy	(3) pork	(4) Fruits &veg	(5) juice	(6) prepared food	(7) poultry	(8) Tree nuts	(9) snacks	(10) dogfood	(11) wine	(12) chocolate
Exchange Rate	0.943***	1.203***	3.389***	-0.078	1.521***	0.420**	2.124	-0.216*	1.173**	2.099*	0.058	0.422***
(up means RMB stronger)	(0.386)	(0.472)	(1.409)	(0.109)	(0.476)	(0.220)	(1.701)	(0.135)	(0.650)	(1.461)	(0.717)	(0.152)
Domestic Income	1.171***	1.681***	2.393***	0.275***	0.278*	1.168***	-2.52***	1.077***	1.105***	0.797	3.324***	1.076***
	(0.154)	(0.190)	(0.622)	(0.108)	(0.194)	(0.162)	(0.664)	(0.310)	(0.267)	(0.666)	(0.303)	(0.193)
Constant	-14.54***	-28.13***	-20.13**	5.56***	1.014	-16.60***	48.69***	-5.555	-6.061	-3.706	-46.89***	-7.743***
	(2.761)	(2.738)	(12.077)	(1.851)	(3.038)	(2.834)	(12.138)	(5.083)	(5.726)	(10.771)	(6.773)	(3.281)
Observations	7,472	4,136	628	12,225	4,476	4,473	553	1,147	1,804	186	2,196	2,444
R-squared	0.180	0.260	0.317	0.165	0.152	0.184	0.410	0.418	0.254	0.525	0.285	0.359

Notes: Robust standard errors in parentheses; *** p<0.05, ** p<0.10, * p<0.20.

Table 6: Average Percentage of Agricultural Imports Conducted by SOEs, 2002-2015

	product	mean	median	min	max	sd
Bulk	Coarse grain	31.4	32.4	13.1	50.8	12.8
	Cocoa bean	59.2	58.3	41.5	75.1	12.9
	coffee	10.2	9.0	4.1	17.7	4.7
	corn	50.2	45.5	9.1	96.2	28.2
	cotton	37.0	33.6	26.1	59.6	10.4
	oilseeds	40.8	37.1	29.8	66.8	9.7
	Other bulk	22.3	22.7	9.1	49.5	11.3
	peanut	8.1	7.8	0.0	24.6	8.3
	pulses	30.7	32.7	15.4	43.9	10.2
	rapeseed	33.3	25.6	7.3	85.3	24.0
	rice	35.0	31.1	14.2	76.0	17.5
	rubber	28.2	23.7	18.2	47.3	9.2
	soybean	21.6	20.1	14.7	31.6	5.0
	tobacco	99.4	99.7	97.7	99.9	0.7
	wheat	75.5	74.8	54.1	98.6	15.4
	Total	**39.2**	**32.5**	**0.0**	**99.9**	**27.0**
Intermediate	DDG	54.0	45.5	29.5	95.3	22.4
	Animal fats	21.5	12.1	3.6	61.9	19.4
	Animal live	29.5	19.2	9.5	84.0	22.7
	feeds	29.0	23.0	19.2	58.7	12.3
	hay	24.9	29.8	0.2	39.3	11.9
	hides	8.8	7.9	4.1	14.5	3.7
	oils	8.2	8.5	3.8	12.4	2.5
	Oilseed meal	54.9	61.5	12.2	76.2	19.0
	Other int	31.7	29.4	20.9	50.8	8.4
	Palm oil	24.2	17.5	6.8	65.1	17.9
	Planting seeds	66.6	60.2	51.5	86.3	13.3
	Soybean meal	42.8	55.7	0.0	89.9	30.8
	Soybean oil	58.8	59.6	41.4	87.6	12.2
	sugar	62.5	63.4	28.9	85.5	17.8
	Veg oil	27.0	24.6	11.6	44.2	10.0
	Total	**36.4**	**32.8**	**0.0**	**95.3**	**24.4**
Consumer	beef	24.2	24.1	0.1	35.2	9.0
	beverage	21.4	13.6	10.4	64.7	17.8
	chocolate	24.3	19.1	7.7	45.5	12.4
	coffee	21.0	18.5	4.0	45.6	11.3
	condiments	15.2	14.0	8.6	27.8	5.9
	dairy	29.9	25.4	18.9	55.4	12.3
	dogfood	32.4	11.3	2.3	98.1	37.3
	egg	24.1	26.8	1.1	45.8	15.3
	Fruit fresh	23.7	24.5	1.4	59.7	16.9

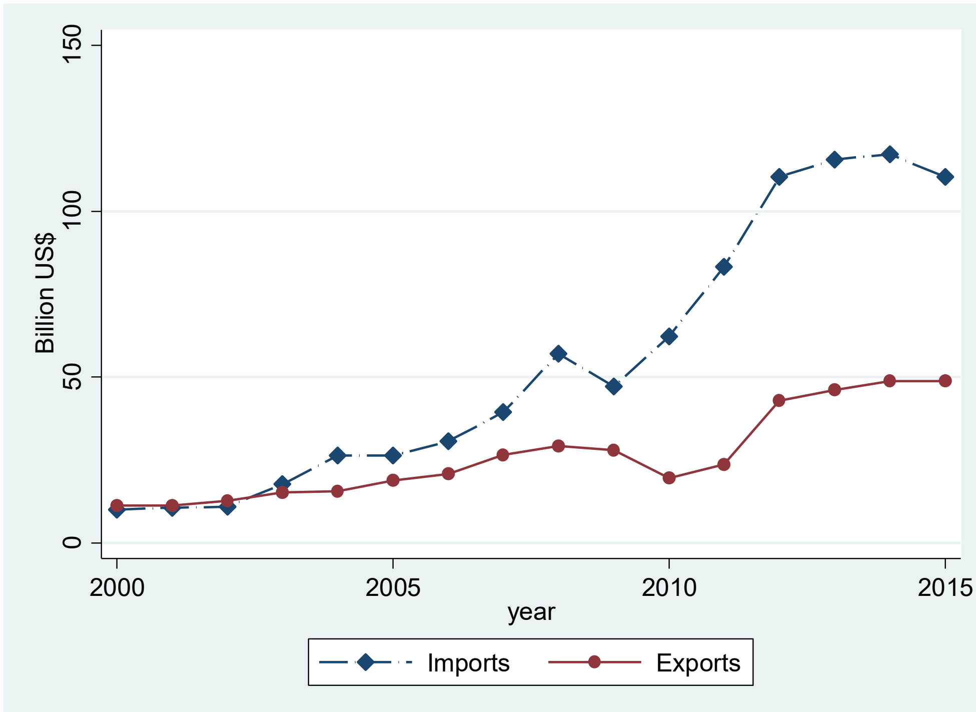
Fruit process	11.8	7.8	4.0	43.8	10.3
juice	16.3	15.5	6.8	32.0	6.5
meat	13.7	9.5	4.1	44.0	11.8
Nursery prod	33.2	29.9	8.8	71.6	21.0
pork	21.5	17.4	3.5	63.4	18.4
poultry	33.0	29.0	9.8	75.5	17.1
Prepared food	17.5	17.3	9.8	28.4	5.9
snacks	19.9	18.0	7.5	42.0	10.5
spices	12.6	4.6	1.0	57.3	17.8
tea	18.9	18.0	2.3	33.6	8.9
Tree nut	9.8	6.4	1.6	36.6	10.2
Veg fresh	21.9	15.1	4.2	59.7	18.2
Veg process	28.1	21.5	10.1	65.2	17.6
wine	26.3	17.6	10.3	66.8	18.1
Total	**21.8**	**17.3**	**0.1**	**98.1**	**16.6**

Table 7: Average Number of Sourcing Countries, 2002-2015

Bulk		Intermediate		Consumer-Ready	
Coarse grain	14.1	DDG	6.1	condiments	46.2
Cocoa bean	14.4	Animal fats	19.6	dairy	44.2
coffee	27.0	Animal live	34.3	dogfood	11.6
corn	8.8	feeds	40.9	egg	18.9
cotton	55.4	hay	5.4	Fruit fresh	36.2
oilseeds	51.6	hides	51.3	Fruit process	60.1
Other bulk	52.8	oils	57.0	juice	52.3
peanut	7.4	Oilseed meal	16.0	meat	30.6
pulses	25.6	Other int	89.0	Nursery prod	44.7
rapeseed	4.9	Palm oil	14.6	pork	16.6
rice	13.6	Planting seeds	44.1	poultry	14.0
rubber	41.7	Soybean meal	10.7	Prepared food	60.4
soybean	10.5	Soybean oil	11.8	snacks	50.7
tobacco	14.1	sugar	52.4	spices	35.5
wheat	6.4	Veg oil	57.1	tea	38.2
				Tree nut	37.8
				Veg fresh	18.9
				Veg process	53.1
				wine	63.2
Mean	22.3	33.2		37.2	
Median	12.9	37.2		38.2	

Source: Authors' calculation based on Chinese trade data.

Figure 1: Chinese Agricultural Imports and Exports, 2000-2015

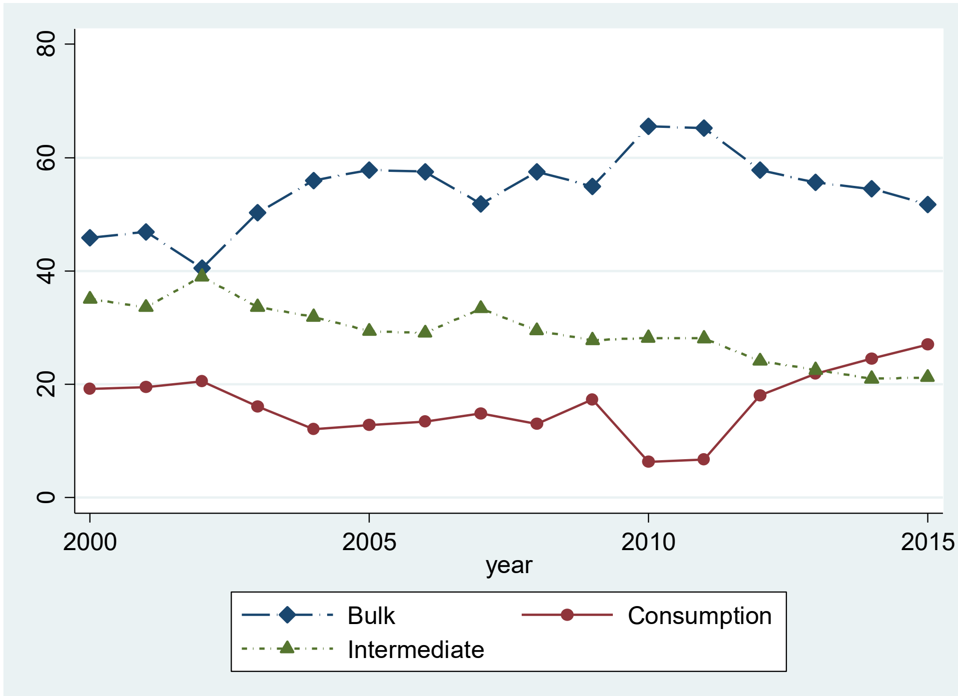


Source: Chinese Customs Trade Data.

Figure 2: Chinese Agricultural Trade with the United States

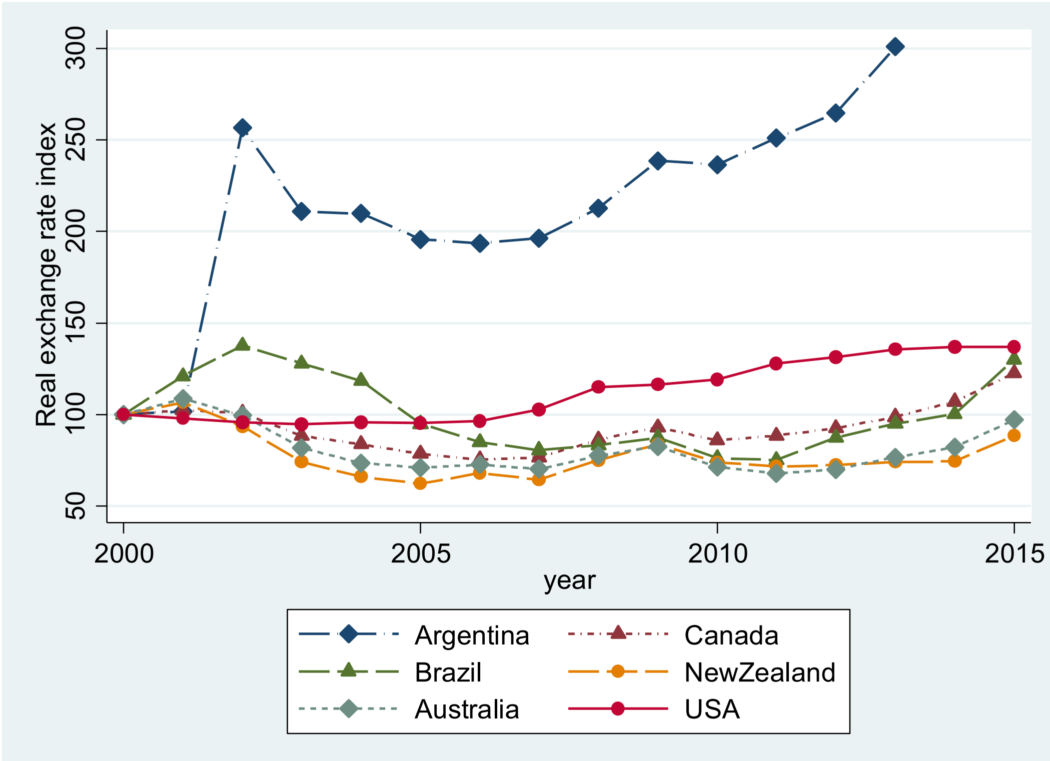
Source: Chinese Customs Trade Data.

Figure 3: Share of Chinese Agricultural Imports by BICO Group, 1997-2015



Source: Chinese Customs Trade Data.

Figure 4: China's Real Exchange Rate to Major Trading Partner



Source: Authors’ calculation based on IFS database.