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China's meat and grain imports during 2000-2012 and beyond: a comparative perspective

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Abstract

This paper provides a review on China's meat trade for the 2000-2012 period and discusses its future development, with reference to China's grain trade. With marginal decreases in meat exports and slight increases in their imports, China's net imports of major meat products (including pork, beef, mutton and poultry but excluding meat offal) were just below one million tons in 2012, dwarfed by China's net imports of grains which reached 66.7 million tons in the same year. This slow growth in meat trade seems to contradict earlier expectations on increasing meat demand and imports, based upon projected shifts in consumption patterns driven by rapid per capita income growth. Several plausible explanations of this paradoxical trade pattern are offered, including mass imports of feed grains, persistent (but shrinking) gaps between Chinese and international meat prices, tariff barriers, and non-tariff measures. In the near future China may not be able to maintain such a lower profile on the world meat markets, as per capita income is projected to continue to rise and domestic production cost advantages erode due to rising labor costs. A model-based projection exercise indicates that under plausible assumptions China's meat imports may rise sharply by 2030.

Keywords: meat trade, grain trade, China, projection

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1. Introduction

Recent international and domestic discussions on China's food security situation and its impact on the world food markets seem to be squarely on the four major grains (rice, wheat, maize, and soybean). These discussions have only intensified following recent world grain price spikes (Yang et al. 2008, Nelson 2011, Hansen et al. 2009, Liu et al. 2013 and Yu and Jensen 2014, to just name a few). Within China, it has been emphasized time and again that maintaining a high level of food grain self-sufficiency is of vital importance to the stability of China's domestic markets and the national economy. Such self-sufficiency often refers to that of rice, wheat and maize. Internationally, both major importing and exporting countries closely follow the development of China's trade positions in these products, with the former (especially the poor ones) worrying about rising Chinese imports driving up world market prices and the latter pushing hard for further opening of the Chinese market. Major international organizations and national agencies in foreign countries regularly publish studies on China's future grain demand and supply (see e.g. OECD 2013, OECD-FAO 2014, FAPRI-ISU and USDA), as have been done by individual researchers (e.g. Fan et al. 1997, Fuller 1997, Chen et al. 2004, Michiel and Wim 2011, Zhong et al. 2012, Zhou et al. 2014).

What is surprising in these discussions is the lack of equally intensive debates on China's import demand for meat products, an area in which China has long been projected to drastically increase its demand due to rapidly rising per capita income and higher income elasticities of demand for these products (see e.g. Coyle et al. 1998, Cranfield et al. 1998, Yu et al. 2004 and references contained therein).[1] Rapid urbanization in China is also expected to increase consumptions of animal products even when price and income effects are controlled for (Rae 1998). Indeed, as the average consumers in China have become more affluent, changes in their food basket towards more meats and dairy products have been observed (see e.g. Ma et al. 2004b). However, rising demand of meats in China has so far largely been met with domestic production rather than from imports, a situation that greatly contrasts that for grains. This situation was noted in a few earlier studies (Rae 2008, Rae and Zhang 2009, and Gale and Huang 2009) and has remained the case in the more recent years. According to official trade statistics from the UN COMTRADE database (as reported in Tables 1 and 2), China's imports of the four major meat products (pork, beef, mutton, and poultry) increased from just over 1 million tons in 2000 to 1.23 million tons in 2012, for an average annualized

[1] Studies on China's meat production, consumption and trade do exist. Some of these studies seem to be focused on the accuracies of China's statistical data in this area and its implications (e.g. Fuller et al. 2000, Ma et al. 2004a, and more recently Yu and Abler 2014). Other studies (e.g. Yuan 2001, Ma 2000, Liu et al. 2005, Qiao 2001, and Zhang et al. 2011) focused on China's meat consumption patterns and levels, as well as China's export competitiveness in individual meat products. Several more recent studies, such as Xu (2010), Gale et al. (2012), and Hansen and Gale (2014), also discuss export opportunities on the Chinese meat markets.

growth of 1.6%.[2] In contrast, during the same period, China's imports of the four major grains rose from 11.5 million tons to 67.6 million tons, for an annualized increase of 16% which is ten times of the annual growth of meat imports.

What accounts for these drastically different changing trade volumes and patterns for meats and grains? Based on an overview on China's meat trade in the 2000-2012 period, in comparison to its grain trade, one of the objectives of this paper is to offer some possible reasons to explain why China's meat trade has remained at such low levels. Certainly, a simple application of the widely accepted regular linkage between rising per capita income and rising meat demand would not be sufficient to explain this paradoxical development. Analytical attentions must be paid to: a. China's apparent capacities in producing meat products domestically; b. linkages between domestic meat production and imports of feed grains especially maize and soybean; c. relative domestic-international price differentials across meats and grains; and d. possibly differential trade barriers. In this paper, we focus on the last three points as possible reasons to explain the observed trade patterns in the recent past while referring readers to the relevant literature on the first point.

Will the observed trend on China's meat trade in the recent past continue in the next two decades? Seeking to provide some insights into this question comprises of the second objective of this study. Judging from the already large market shares of China on the world maize and soybean markets, it seems that future potentials in relying on increased imported feed grains for domestic meat production may be constrained at some point in the future. Moreover, rising costs including labor cost will also push meat production costs ever closer to or even exceeding benchmark international prices.[3] These cost side considerations, coupled with continuously rising demand due to rising income and urbanization, will likely lead to a substantial amount of meat imports. To formalize these considerations, we use a well-known computable general equilibrium model to project China's meat trade to 2030.

The rest of the papers are organized as follows. In Section 2, we document the development of China's meat trade for the 2000-2012 period. This is followed by a comparison of China's meat and grain trade in section 3, where we also discuss how large amount of feed grain imports helped China to keep meat imports at low levels. In section 4, additional explanatory factors are gathered to further explain the slow growth of China's meat imports. Section 5 reports a set of model-based projections on China's meat production and trade in 2030. These projections suggest that China's current meat trade pattern is unlikely to continue in the next two decades. The last section concludes with discussions.

[2] Imports of edible meat offal, however, increased more in the same period. When these are included, China's total meat and edible meat offal imports rose from 1.15 million tons to 2.08 million tons during the 2000-2012 period. In this paper, we mainly focus on meat imports.

[3] Rising labor costs in China have been discussed extensively in the literature. For example, based on village survey data, Zhang et al. (20011) suggest that rural real wages in China have been on continuous rise since 2003 and that the era of surplus labor in China is now over.

2. China's meat trade pattern: 2000-2012

Due to data availabilities (especially price data), we choose to focus on the period of 2000-2012 in this study. During the 2000-2012 period (as can be seen in the upper panel of Table 1), China's meat imports fluctuated between 0.29 million tons (in 2004) and 1.27 million tons (in 2008). Comparing the imports for the beginning and ending years of the period (2000 and 2012 respectively), China's meat imports increased by 0.22 million tons only. Nevertheless, when edible meat offal imports are included, total imports increased by nearly 1 million tons, due to a sharp rise in the imports of meat offal since 2007. For most of the years in this period, the bulk of meat imports are poultry, with the peak years in 2000, 2007, and 2008. However, in the more recent years, pork imports also increased, eventually reaching 0.52 million tons in 2012 and replacing poultry as the largest meat import item. Mutton and beef imports, on the hand, remained at much lower levels.

Import values for meat products increased more than the corresponding import quantities. As can be seen from the lower panel of Table 1, China's meat imports reached US$ 560 million and US$ 2.6 billion (637 million and 4.1 billion if meat offal is included) in 2000 and 2012, respectively, representing an increase of nearly 3.7 times or 13.7% on an average annualized basis. This more pronounced increase, however, is mostly due to the generally rising import prices of meat products. The changing compositions from lower-valued poultry meats to pork as well as mutton and beef also played a role in inflating the total import values. Overall, imported meats as a percentage of domestic supply changed very little in quantity terms. For pork, this share rose from 1.4% in 2000 to 2.7% in 2011 (see Table 3). For beef and mutton, it rose from 3.3% and 1.7% in 2000 to 5.7% and 3.1% respectively. And for poultry, import share of domestic supply actually decreased from 14.8% to 11.1% in the same period. Based on this evidence, it appears that meat imports have played a quite minor role in the Chinese markets. The only area where imported meats made some inroads into China seems to be limited to poultry meats (and edible meat offal).

Despite the fact that China only imported relatively small amounts of meats, China generally maintained its position as a net importer in terms of total meat import quantities in the 2000-2012 period, largely due to the even smaller amount of exports it managed in that period. Total export quantity of meats from China was about 0.48 million tons (0.51 million tons when including meat offal) in 2000, mainly consisting of poultry products. Since 2003, however, a general downward trend of China's meat exports can be observed; and by 2012 China's exports shrank to 0.28 million tons (0.29 million tons when including meat offal; see up-middle panel of Table 1). As a result, China's total net imports of meats reached 0.95 million ton (1.79 million ton when including meat offal) in 2012, which represents a 5% average annual increase as compared to 2000. Moreover, by 2012 China also became a net importer of all four groups of meat products, especially pork and poultry (and especially meat offal).

Due to the composition of China's meat imports and the different prices across the four meat products, China did not become a consistent net meat importer in value terms until 2007. However, the negative meat trade balance widened quickly, reaching nearly US$1.7 billion already by 2012 (lower panels of Table 1). If we include edible meat offal, the trade deficit reached a much higher level of US$3.1 billion in 2012.

One direct reason for China to be able to maintain a very low profile on the world meat markets (other than meat offal) appears to be its ability to maintain steady increase in domestic meat supply. This is evidenced by the continued rise of domestic supply (Table 3) of all four meat products.[4] For pork, beef, and poultry, where domestic supply maintained an annual growth rate of 2.6 to 2.8 percent, their domestic outputs more or less retained constant shares of the respective total domestic supply, reflecting the fact that domestic outputs were also on generally continuous rise. In what follows in the rest of the paper, we explore various aspects that may explain China's low export profile and its ability to maintain domestic self-sufficiency.

3. Comparing China's meat and grain trade

To further illustrate the seemingly low meat exports into China, this section provide a comparison between China's trade in meats and grains. This comparison also offers one key explanation on why China imported so little meats, based on the observation that large quantities of grain imports especially maize and soybean and soy based products were used as feed for China's domestic meat production.

According to Table 2, China's grain trade in the 2000-2012 period is a tale of two opposite trends. On the import side, continuous and rather large annual surges of imports are observed. In 2000, China imported more than 11.5 million tons of grains for an import value of more than US$2.5 billion. By 2012, these imports reached 67.6 million tons for a staggering value of US$38.9 billion. These changes represent 16% and 26% average annual increases in quantity and value terms, respectively. In contrast, China's grain exports dropped from the peak of 21.5 million tons in 2003 to less than 1 million tons in 2012. Compared to the initial exports in 2000 of 13.6 million tons, the amount of 0.86 million tons of exports in 2012 implies a 21% annualized reduction. In value terms, despite the general rise of nominal prices of grains on the world market, especially the most recent grain price spikes, values of grain exports dropped to US$ 652 million in 2012.

As a result of rising imports and shrinking exports of grains, China became a large net grain import in 2004. By 2012, its net grain imports reached 66.7 million tons. In value terms,

[4] Accuracies of China's statistics on livestock and meat production and consumption have long been questioned (see e.g. recent studies by Yu et al. 2014). In this paper, we mainly use international trade statistics sourced from the UN COMTRADE database which are generally considered accurate. For domestic supply and use data, we rely on the data from the FAO, rather than from Chinese sourced statistics.

China was already a net import in 2000 and its trade deficit in grains mushroomed to US$38.2 billion.

Soybean imports and maize exports have been the major drivers of China's grain trade. On the import side, soybean and soy based products had been the main imports before 2009 and had claimed almost all the grain import shares except for 2004 and 2005 (when China had significant wheat imports). By 2012, China imported more than 58 million tons of soybean products which were more than half of total world exports and nearly four times of China's domestic production for that year (see Table 4). On the export side, China's massive exports of maize (about 16.4 million tons in 2003) were the main component of China's overall grain exports. But maize exports started to level off and eventually nearly disappeared from 2009 and onwards. Accompanying this dramatic drop of maize exports, maize imports started to pick up from 2010 and onwards, reaching the level of 5.2 million tons by 2012. In contrast to the ever increasing soybean imports and shrinking maize exports (and eventual imports of maize), China has been a more inconsistent and relatively minor trader of rice and wheat, having exported both rice and wheat for the pre-2008 period and imported quite some wheat for 2004-05 as well as the post-2010 period.

In terms of domestic consumption and use (see Table 4), both rice and wheat imports played minor roles in China's domestic supply, with the former contributing to less than 1 percent of domestic supply in most years and the latter adding to mostly 2 to 2.5 percent pf domestic supply. Shares of maize imports in China's domestic maize supply are generally higher with shares between 3 and 4 percent. In the case of soybean, imports have a dominant share in domestic supply, starting at about 47% in 2000 and peaked at nearly 85% in 2010.

While the above analysis certainly paints a starkly difference picture on China's grain imports, especially those of soybean and maize, as compared to the meager meat imports (excluding meat offal) in the same period, it also offers a first explanation on why China imported so little meats in that period. This explanation relies on the obvious role of soybean, soy based products, and maize as feed to livestock and meat production in China (see e.g. Chen et al. 2009 for linkages between China's food demand and soybean imports). To reveal this point, Table 4 presents the utilization of the four grains across food, feed and processing. The relatively less imported rice and wheat are mainly used for food consumptions in China with food consumption shares generally being above 80% and feed shares being below 10% in most of the years. Clearly, these two grains have long been the main food staples in China and have been emphasized in China's agricultural policy framework as food grains. For maize, the food-feed split is the opposite with between two-thirds and three-quarters of total supply are used as feed and less than 7% as food. It is reasonable to assume, therefore, that most of the maize imports have been used as feed. In the case of soybean and soy based products, the food share dropped from 20% in 2000 to about 8% in 2012, whereas the direct feed share rose from 7.4% in 2000 to the peak of 13.3% in 2010. But this increase in direct feed use is hardly the whole story because the bulk of soybean supply in China – up to 80% – were used for processing in recent years. The processing of soybean for vegetable oil also

produces residuals used as feedstuff. So the total feed use of soybean supply and imports should be far larger than what is indicated in Table 4.

Based on the above analysis, it is quite apparent that China has fully opened up its import markets for maize and especially soybean but maintained high level self-sufficiency targets (and outcomes) of rice and wheat through trade and domestic policy measures (See e.g. Hansen et al. 2009, and Yu and Jensen 2014). An important reason underlying this decision is related to the feed demand from China's livestock and meat sectors. The massive imports of soybean and maize have helped China to maintain high level self-sufficiency of meat products, as these products are used as key feed grains. Of course, while vital to keep China's increasing meat demand towards domestically produced meats, increased imports of soybean and maize is not the only reason behind China's low level of meat imports. The next section discusses other possible reasons.

4. What else accounts for the slow growth of China's meat imports?

Aside from the massive imports of feed grains into China, possible other reasons include: persistent price differentials between imported and domestic produced meat products, tariff barriers, and non-tariff measures (NTM).

In Tables 5 and 6, average producer's prices of meat and grain products are listed and compared with their respective benchmark world market prices for the period of 2004-2012.[5] China's domestic producer prices for maize and soybean had been consistently higher than the relevant international benchmark prices. The lone exception is the year of 2008, when world grain market experienced dramatic price spikes. Even in that year, Chinese prices for these products were comparable to the respective benchmark world market prices. It should be noted that since China has been a large trader on the world soybean and maize markets, it would be reasonable to assume that world maize and soybean prices are correlated to China's import demand. Similarly, China's wheat price also exceeded that on the world market, except for the 2007-08 period when insulation trade policy measures were applied by the Chinese government (see Yu and Jensen 2014). In the case of rice, domestic prices were consistently lower; but this is consistent with the fact that China has been a smaller net exporter of rice with modest gross imports of rice.

As compared to the grain price differentials, China's production cost and producer prices of pork, meat and mutton were consistently lower than the benchmark world market prices. However, a generally shrinking gap between these prices can also be observed. For instance, the domestic/world market price ratio for pork rose from 52% to 100% in 2011 before levelling off to 89% in 2012. The same ratio for beef started at 36% but increased to 93% in

[5] Note that Chinese domestic prices in Tables 5 and 6 are expressed in current US dollars using official exchange rates. Therefore, in addition to rising production costs, rising nominal exchange rate of Chinese Yuan against the US dollar also contributes to the shrinking gaps between Chinese and benchmark world market prices. However, exchange rate appreciation alone can only explain part of the rising Chinese prices.

2012. China's mutton price appears to be much lower as compared to the relevant world market price, with the domestic/world market price ratio being 19% in 2004 but rising to 70% by 2012. The lone exception is related to poultry price, where China's production cost and producer's price had been consistently and significantly higher. As shown in Table 5, China's producer price exceeded the relevant world benchmark price by as much as 55% in recent years. Faster increases in domestic prices in China can also be visually glanced from Figure 1, where Chinese producer prices for all four meats outpaced the respective world benchmark prices for selected years in the period. In comparison, domestic and world market grain price indices are much more comparable, as can be seen in Figure 2.

Overall, these price comparisons provide a direct explanation on the observed low level of meat imports, on the overall differences between grain and meat imports, and on the different import patterns within meat products and grain products. However, as the price gaps continue to shrink, it is not surprising to see that (net) imports of pork, beef and mutton have been on the rise in recent years. It is also reasonable to expect a reversal of these price gaps towards more expensive domestic prices in China. In that case, meat imports may increase significantly. A forward looking projection exercise is provided in the next section to explore this possibility.

In addition to the observed price gaps (which reflects production cost differentials and exchange rate movements), tariff and non-tariff measures may have also played a role in restricting meat imports into China. As part of its WTO accession agreement, China agreed to reductions of its MFN (Most Favored Nation) tariffs and the staging of these tariff reduction commitments. In the case of wheat, rice and maize, tariff rate quotas were also established, allowing for near- zero in-quota tariffs for these products (Table 7). In 2011, average MFN tariff rates of the four meat products were between 15 and 20 percent, as compared to the higher general duty rate for non-WTO members who do not have access to any preferential treatment. These MFN tariff rates for meat products are significantly lower than the MFN tariff rates (i.e. out-quota rates) for the grain products except soybean. However, since China's imports of wheat, rice, and maize were generally lower than import quotas assigned to these products (i.e. these quotas were not binding), the applied tariff rates were actually 1 percent, obviously significantly lower than the applied tariffs for the meat products. These differences in applied tariffs in meat and grain products likely also contributed to the relatively smaller imports of meat products into China, as the generally higher applied meat tariff rates augmented the gaps between world and domestic prices.

In terms of non-tariff measures, China's grain trade have mainly handled by China's state trading enterprises but certain import shares have also been allocated to non-STEs according to China's WTO accession agreement. On the imports of meat products, a system of "automatic import licenses" has been put into place covering most meat products (WTO 2014, MOFCOM 2014). Importers are to apply for automatic licenses beforehand, while China's Ministry of Commerce (MOFCOMM) and the General Administration of Customs of China (GACC) use these automatic licenses to monitor their volumes for statistical purposes. It is

concluded by the WTO secretariat (WTO 2014) that the process and the terms to obtain these licenses have been subject to major changes. Other NTMs include anti-dumping measures, countervailing measures, as well emergency and regular Sanitary and Phyto-Sanitary measures (SPS; see summary in Table 8). After China's WTO accession, few such measures have been applied to meat products. One notable instance is the anti-dumping and countervailing duties applied to broiler products originated from the US which entered in force on September 27, 2010 for a duration of 5 years. There have been 19 instances of regular SPS measures on swine products, poultry meats, and fish on all members with the initiation time in 2002 and 2004. However, there have no changes in any of the procedures to establish SPS requirement in China since 2010. In addition to the regular SPS measures, China established 11 emergency measures targeting several poultry and swine products exporters, mainly in responding to some virus outbreaks in these products. In the areas of Technical Barriers to Trade (TBT), only one such instance can be found, concerning the China's national standard on poultry meats.

Judging from the instances of the NTMs used, it does not appear to be the case that China has actively been pursuing NTMs for restricting meat imports after it became a WTO member. The automatic license system also appears to be a monitoring and statistical measure, rather than a trade restrictive measure. Of course, more research should be conducted to understand the effects of these measures. However, if the gaps between domestic and world market prices for meat products continue to shrink or even reverse in the near future, whether or not, to what extent, and for what purposes these NTMs will be applied in meat imports will become interesting questions to ask in the near future.

In summary, in addition to the strategy of mass importing feed grains, another major reason for China to maintain very low level of meat imports appears to be the relative cost advantages manifested in the relatively lower domestic producer prices. However, the relatively lower domestic meat prices have been eroded considerably due to rising costs and exchanges rate adjustment in recent years. Trade barriers, especially import tariffs, augment the gaps between domestic market prices of domestically produced and import meats, thereby plausibly contributing to the lower level of meat imports. NTMs, on the other hand, does not seem to have caused similar effects, as they are relatively few and have been kept stable since China's WTO accession.

5. Projecting China's meat trade to 2030

Projections on the world food markets have been routinely conducted by researchers and major international and national agencies for predicting food security situation and changing consumption patterns. Various quantitative economic tools have been applied, among which are the computable general equilibrium models. For purposes of capturing the inter-sectoral linkages through the goods and factors markets, such as those between the livestock sectors and the grain sectors, and of consistently tracking utility-maximizing consumers' changing consumption patterns due to income growth, a general equilibrium model is most desirable for

this study. Moreover, the focus of the projection exercise on changing trade patterns also mandates a model with explicit trade linkages. For these reasons, the GTAP model (Hertel 1997), a widely used model in analyzing global trade issues, is adopted in this paper. Similar applications based on the GTAP model on projecting food demand, supply, and trade include: Anderson et al. (1997), Bach et al. (2000), Rae et al. (2000), Nin et al. (2004), Yu et al. (2004) and Anderson et al. (2013), to just name a few. The projection contained in this section is based on the most recent GTAP version 9 database which has 2011 as its base year. To limit the computation burden and for ease of analyzing the results, the GTAP database is aggregated into 18 countries or regions and 21 sectors, of which 13 are agricultural, livestock product and food sectors. In particular, we include wheat, rice, maize (and other coarse grains), oil seeds including soybeans, cattle meats (including beef and mutton), and other meats (mainly pig meats and poultry meats) as individual sectors/products in this aggregated database.

In projecting China's future meat trade patterns, several important drivers should be considered, ranging from per capita income growth, population and demographic changes, factors that impact production costs, development in related products especially feed grains, as well as domestic and trade policies. Among these drivers, per capita income growth and population changes are the most emphasized ones in similar projections (see e.g. Anderson et al. 2013). The main assumptions used in the current paper are sourced from the baseline maintained by CEPII (Fouré et al. 2012, and Fouré 2013) and are detailed in a related study by Yu (2014). The most significant assumption is China's GDP growth rate at 236.5% during the 2011-2030 period, whereas its population is expected to grow at single digit (6.3%) during the same period. In addition, skilled labor force is projected to grow by 66.4% whereas unskilled labor is to shrink by 7.2%. In order to reach the projected GDP growth rate, both capital stocks and total factor productivity are allowed to adjust endogenously in the model. Similarly, macroeconomic shocks to other countries/regions are included in the projection. Table 9 reports the main results from the projection scenario for meats, dairy, and grains. For comparison purposes, we also list the results from an alternative scenario where quantities of meat imports are fixed as the base case level of 2011. This scenario is simulated by endogenizing China's import tariffs on meat products while fixing the quantity of meat imports.[6]

As compared to the base case of 2011, China's cattle meats and other meat outputs are expected to increase by respectively 75% and 88%, exceeding the projected increases of grain outputs (Table 9). This is largely due to higher income elasticities of demand for meat products as compared to those of grains. Similar output increases are also projected to milk and dairy products. While outputs are projected to grow significantly for meat products, the projected increases still lag behind the projected demand expansion (at about 90%) fueled by the assumed income growth. As such, dramatic increases in meat imports are expected,

[6] In a general equilibrium model such as GTAP, import tariffs are normally exogenous as they are policy variables, whereas quantities of imports are endogenous.

leading to reduced meat self-sufficiency ratios for both cattle and other meats (from respectively 94.8% and 99.7% in 2011 to 87.7% and 93.4% in 2030) and increased shares of world meat imports (from 4% and 5.2% in 2011 to 14% and 31.7% in 2030 for cattle and other meats, respectively).

The projected increases in China's meat import shares appear to be particularly large and deserve some further discussion in relation to its impact on the grain markets. To sustain the large increase in meat demand induced by income growth, feed grain imports also have to rise. Indeed in the projection, maize, soybean (oilseeds) and wheat imports are expected to increase by 104, 87, and 199 percent, respectively. In the case of soybean, China's share of total world imports will approach 50%. As a result, self-sufficiency ratios continue to deteriorate for these three products, especially for soybean (decreasing from 38.8% to 28.2%). Domestically, feed demand for domestically produced grains is also expected to rise, leading to generally larger increases in their outputs, as compared to the projected increase in food demand for grains. However, soybean remains an exception as its growing domestic demand is projected to be met by imports.

In the alternative scenario where meat imports are restricted to the levels of 2011[7], simulation results indicate that rising meat demand will have to be met with large increases in domestic meat production. In that case, China will have to further increase imports of feed grains, leading to even lower self-sufficiency ratios in these products.

From this preliminary projection exercise, it appears that demand-driven forces will likely push China's meat demand beyond its supply capacities in the future, should current production practice and trade policies remain unchanged. In the case where China decides to curb the expected import surge of meat products, increasing feed grain imports will be resulted.

6. Conclusions and discussions

Earlier projections on rising meat demand in China due to per capita income growth have shown up in China's domestic statistics on meat demand and outputs; however, these projections have so far not been translated into larger quantities of meat imports. During the 2000-12 period, China has only consistently imported poultry meats and meat offal on a yearly basis but even in these products China's imports have been a tiny fraction of its domestic demand. The main purpose of this paper is therefore to provide a descriptive analysis on China's meat trade patterns, in reference to its grain trade patterns, for purposes of

[7] As shown in Table 7, China's MFN tariff rates for meat products are between 15 and 20 percent. These tariff barriers are not likely to act as effective restrictions on future imports, when future domestic/world market price gaps reverses in favor of lower world market prices. In that case, NTMs such as SPS and TBT measures based on legitimate consumer health concerns and sounded scientific evidence (as required by relevant WTO rules) might become the more likely policy instruments, should China choose to restrict meat imports while allowing for increased grain imports.

understanding China's hitherto low profile on the world meat markets.[8] Evidence seems to suggest that one of the main reasons behind China's seemingly paradoxical meat trade pattern is its ability to secure large amount of feed grain imports from the world market, especially with regard to the imports of soybean and also maize. In the case of soybean and soybean based products, China's imports have been nearly half of the total world trade in recent years.

Aside from the reliance on imported feed grains, several other observations also help to explain China's small meat imports. First, China's domestic prices for meat products (except poultry) have been lower than the relevant benchmark world market prices, possibly reflecting the relatively lower production costs. However, such gaps have been narrowed significantly in the more recent years, perhaps due to rising production costs and currency appreciations. Second, China still maintained some tariff barriers for meat imports, which are generally higher than the tariff rates applied to within-quota grain imports. These tariffs likely acted as a second buffer to shield China's meat market from increasing meat imports. Lastly, China also maintains some non-tariff measures, mainly through SPS regulations. However, our limited exposure to the functioning of the latter measures cannot yet offer any substantive insights as to their restrictiveness on China's meat imports.

Are earlier projections on China's meat imports entirely wrong? Based on the current analysis, this does not appear to be the case, especially considering the shrink price gaps between China's domestic market and the world market and the perspectives on continuing rapid economic growth in China. In addition, animal diseases, food safety concerns, and environmental damages arisen from intensive livestock production, are all likely to augment rising production costs in constraining expansion of domestic meat production. Indeed, in the near future China may not be able to maintain such a lower profile on the world meat markets, as per capita income is projected to continue to rise and domestic production cost advantages erode due to rising labor costs. A model based projection exercise indicates that under plausible assumptions China's meat imports may rise to nearly one-third of the world market by 2030, if no further tariff barriers or restrictive NTMs are introduced. Should China wish to resist this expected import surge, new trade policy options are likely to be limited to non-tariff measures. In regards to the linkages between meats and grain imports, the scenario of restricted meat imports will have to be accompanied by even higher feed grain imports.

Two caveats on the current analysis should be noted. In our attempt to understand China's apparently low level of meat imports, evidence on price and cost advantages is gathered. However, due to space limitations no efforts have been made in this study to explain this evidence. Readers are therefore referred to the relevant literature (e.g. Rae 2008, Waldron et al. 2007, and Nin et al. 2004) on productivity progress in China's livestock sectors as well as on the more general "livestock revolution" taken place in China. It should also be noted that projections presented in this paper addresses China's meat supply and trade prospects from a

[8] A natural follow-up study to this descriptive analysis is to use quantitative economic models to formally estimate the relationship postulated in the current paper.

rather “static” sense, without explicitly considering potential productivity growth, innovations and organizations of China’s livestock sector, and current and future policy actions aiming at supporting the livestock sectors. As such, there are considerable uncertainties on the future outcomes vis-à-vis the preliminary projections presented in the last section of the paper.

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Table 1. China's Meat Trade: 2000-2012

	Import						Export						Net Import					
	Pork	Beef	Mutton	Poultry	Other	Total	Pork	Beef	Mutton	Poultry	Other	Total	Pork	Beef	Mutton	Poultry	Other	Total
	Quantity (1000 tons)																	
2000	136	6	18	850	134	1145	53	17	4	405	36	514	83	-11	14	446	99	630
2001	94	4	25	707	143	974	103	21	3	403	41	571	-9	-17	22	304	103	403
2002	145	11	35	574	115	880	162	12	5	328	17	524	-17	-1	30	246	98	356
2003	149	8	34	644	213	1048	213	9	12	276	11	522	-64	-1	22	368	201	526
2004	71	3	33	185	246	538	291	16	24	119	16	466	-221	-12	9	66	230	72
2005	31	1	41	383	176	633	251	19	30	157	17	474	-219	-18	11	226	159	159
2006	24	1	37	588	200	851	269	26	33	136	20	485	-245	-25	3	453	180	366
2007	86	4	47	804	400	1340	134	28	22	165	18	368	-48	-25	24	639	382	973
2008	373	4	55	833	564	1830	82	23	15	168	16	303	291	-18	41	665	548	1526
2009	135	14	66	750	399	1365	87	13	10	174	18	302	48	1	57	576	382	1063
2010	201	24	57	542	718	1542	110	24	13	206	15	368	91	0	43	336	703	1174
2011	468	20	83	421	913	1905	81	22	8	211	14	335	387	-2	75	210	899	1569
2012	522	61	124	522	854	2083	66	12	5	194	16	294	456	49	119	328	838	1789
	Values (million dollars)																	
2000	58	7	14	481	77	637	69	24	6	587	68	753	-10	-17	8	-107	9	-116
2001	42	6	20	444	87	598	136	33	4	597	71	841	-94	-27	15	-153	16	-243
2002	82	13	27	426	79	627	209	19	8	401	27	665	-128	-6	19	26	52	-38
2003	91	12	39	462	154	758	269	15	21	320	22	646	-178	-3	18	142	133	112
2004	54	10	43	154	215	476	460	30	42	145	30	707	-405	-20	1	9	185	-231
2005	29	9	55	334	160	587	406	42	57	194	44	743	-377	-33	-2	140	116	-156
2006	21	8	50	462	143	686	401	64	67	167	48	747	-380	-56	-17	295	96	-61
2007	123	14	79	945	359	1520	284	79	54	261	53	731	-160	-65	24	684	306	788
2008	524	18	106	1088	585	2320	276	96	50	324	52	798	248	-77	56	764	532	1522
2009	136	44	139	984	398	1701	263	61	42	336	63	764	-126	-17	98	648	335	937
2010	209	84	157	963	812	2225	332	109	69	428	57	995	-123	-25	88	535	755	1230
2011	848	95	276	872	1321	3411	326	120	53	524	53	1075	522	-24	223	348	1268	2336
2012	981	255	422	956	1494	4108	295	81	43	502	60	980	686	174	379	454	1434	3127

Note: Pork refers to HS code 0203; beef: 0201+0202; mutton: 0204; poultry & offal-0207; other: 0205+0206+0208+0209+0210. Source: UN Comtrade database. http://comtrade.un.org/data/

Table 2. China's Grain Trade: 2000-2012

		Import					Export					Net Import				
		Wheat	Rice	Maize	Soybean	Total	Wheat	Rice	Maize	Soybean	Total	Wheat	Rice	Maize	Soybean	Total
Quantity (1000 tons)	2000	876	239	0	10419	11534	3	2953	10466	211	13632	873	-2714	-10465	10208	-2098
	2001	690	269	36	13939	14935	455	1859	5998	248	8561	235	-1590	-5962	13691	6374
	2002	605	236	6	11314	12161	688	1978	11674	276	14615	-83	-1742	-11667	11039	-2454
	2003	424	257	0	20741	21422	2237	2601	16399	267	21506	-1813	-2344	-16399	20474	-83
	2004	7233	756	2	20230	28222	784	896	2318	335	4333	6449	-139	-2316	19895	23889
	2005	3510	514	4	26590	30618	260	672	8611	396	9939	3250	-158	-8607	26194	20679
	2006	584	719	65	28237	29605	1114	1237	3070	379	5801	-530	-518	-3005	27858	23805
	2007	83	472	35	30817	31408	2337	1326	4916	456	9035	-2253	-853	-4881	30360	22372
	2008	32	296	49	37436	37813	126	969	253	465	1813	-94	-674	-203	36971	36000
	2009	894	338	84	42552	43866	8	784	130	347	1268	885	-446	-46	42205	42598
	2010	1219	366	1572	54798	57955	0	619	127	164	910	1219	-253	1445	54634	57045
	2011	1249	578	1753	52453	56033	40	515	136	208	900	1209	63	1617	52245	55133
	2012	3689	279	5207	58383	67557	0	279	257	320	856	3689	0	4950	58063	66701
Value (million USD)	2000	147	113	0	2270	2531	0	561	1052	64	1677	147	-448	-1051	2206	854
	2001	121	99	5	2810	3035	47	329	626	77	1079	75	-230	-621	2732	1956
	2002	103	80	2	2483	2667	70	380	1167	77	1694	33	-301	-1166	2406	972
	2003	77	97	0	5417	5590	265	495	1767	87	2613	-188	-398	-1766	5330	2977
	2004	1640	252	1	6979	8872	112	233	324	145	814	1528	19	-323	6834	8058
	2005	762	196	1	7778	8738	37	225	1097	170	1527	725	-29	-1095	7609	7210
	2006	108	288	12	7489	7897	161	409	412	146	1128	-53	-120	-400	7343	6769
	2007	21	218	7	11473	11718	481	478	874	196	2030	-460	-261	-868	11277	9688
	2008	7	183	12	21815	22018	31	481	73	351	937	-23	-298	-61	21464	21082
	2009	205	201	20	18787	19214	2	524	32	237	795	202	-322	-11	18550	18419
	2010	309	253	367	25093	26023	0	416	33	118	568	309	-163	334	24975	25455
	2011	418	387	578	29726	31108	17	427	47	162	652	401	-40	531	29565	30456
	2012	1101	1126	1689	34977	38892	0	272	101	279	652	1101	854	1588	34698	38240

Note: Wheat refers to HS Code 1001; rice: 1006; maize: 1005; soybean: 1201. Source: UN Comtrade database. http://comtrade.un.org/data/

Table 3. Balances of Main Meat Products in China from 2000-2011

	Pork			Beef			Mutton			Poultry		
	Supply (1000 tons)	Of which: (%)		Supply (1000 tons)	Of which: (%)		Supply (1000 tons)	Of which: (%)		Supply (1000 tons)	Of which: (%)	
		Import	Production		Import	Production		Import	Production		Import	Production
2000	37100	1.4	99.2	5111	3.3	98.1	2695	1.7	98.5	13356	14.8	95.0
2001	37204	1.2	99.6	5189	3.2	98.4	2735	1.9	98.2	12970	13.1	96.6
2002	38083	1.4	99.6	5350	3.6	98.0	2867	2.4	97.8	13075	11.1	97.4
2003	39992	1.5	99.8	5570	3.7	97.8	3101	2.1	98.3	13636	10.8	96.3
2004	40261	1.3	100.3	5714	3.2	98.4	3328	2.0	98.7	13543	6.0	97.7
2005	41644	1.0	100.5	5773	3.5	98.8	3501	2.2	98.6	14442	7.0	97.3
2006	43424	1.1	100.4	5860	3.8	98.8	3630	2.0	98.9	14888	8.7	96.0
2007	44054	1.4	99.7	6236	4.1	98.7	3835	2.1	98.5	15980	9.8	94.9
2008	46577	2.8	98.3	6278	4.6	97.9	3829	2.4	98.0	17002	10.6	94.1
2009	48358	1.8	99.1	6562	5.1	97.1	3931	2.6	97.7	17615	10.7	94.3
2010	50009	1.9	99.1	6820	5.4	96.1	4076	2.6	97.9	17978	10.4	96.4
2011	50292	2.7	98.2	6742	5.7	96.3	4055	3.1	97.1	17933	11.1	97.2
% change 2000-11	35.6	96.8	-0.9	31.9	70.8	-1.9	50.5	78.7	-1.3	34.3	-24.7	2.3
% AGR 2000-11	2.8	6.3	-0.1	2.6	5.0	-0.2	3.8	5.4	-0.1	2.7	-2.5	0.2

Note: AGR refers to annual growth rate. Source: FAO, http://faostat3.fao.org/faostat-gateway/go/to/download/FB/BC/E, released July 9th, 2014

Table 4. Balances and Utilities of Main Grain Products in China from 2000-2011

	Supply (1000 tons)	Of which: (%)		Utility (%)			Supply (1000 tons)	Of which: (%)		Utility (%)		
		Import	Production	Food	Feed	Processing		Import	Production	Food	Feed	Processing
	Wheat						Rice (Milled Equivalent)					
2000	113016	2.3	88.2	84.9	3.6	0.0	128691986	0.5	98.4	79.3	10.4	0.0
2001	112087	2.0	83.8	84.5	5.0	0.0	130902678	0.5	91.4	78.0	11.8	0.1
2002	109902	2.1	82.2	84.4	5.5	0.0	130168878	0.6	90.4	78.4	11.4	0.1
2003	108149	2.1	80.0	84.7	5.1	0.0	126755584	0.6	85.4	80.0	9.6	0.1
2004	105264	8.5	87.4	86.8	2.4	0.0	123449127	1.1	97.5	82.2	8.2	0.0
2005	105216	5.1	92.6	86.5	3.7	0.0	121313580	0.8	100.1	84.2	6.7	0.0
2006	105921	2.1	102.4	86.1	5.3	0.0	124951130	1.0	97.8	82.1	8.2	0.1
2007	106261	1.9	102.9	84.8	6.5	0.0	124754744	0.8	100.2	82.3	8.2	0.0
2008	105592	1.6	106.5	83.6	6.9	0.0	128809855	0.6	100.1	82.2	8.2	0.1
2009	107233	2.5	107.4	80.0	10.3	0.0	131178331	0.6	100.0	81.4	9.1	0.0
2010	111344	2.7	103.5	78.0	12.6	0.1	131892080	0.7	99.7	81.8	8.8	0.0
2011	125602	2.6	93.5	70.2	21.3	0.1	135701022	0.8	99.6	81.7	8.6	0.0
	Maize						Soybean					
2000	123127	4.1	86.2	6.8	76.3	0.5	27012	47.3	57.1	20.0	7.4	65.8
2001	123326	4.4	92.6	7.0	74.8	0.5	30772	53.4	50.1	17.4	8.6	68.1
2002	127661	4.1	95.2	7.0	73.7	0.6	31554	44.0	52.3	15.1	6.0	72.6
2003	129108	4.0	89.8	7.1	73.6	1.2	37124	62.6	41.5	13.5	7.8	73.8
2004	134336	3.7	97.1	6.8	72.1	1.5	39525	56.4	44.0	12.9	9.1	72.9
2005	138153	3.8	101.0	6.8	72.0	1.3	43224	67.3	37.8	12.8	7.0	75.9
2006	141084	3.8	107.5	6.4	69.2	1.7	45767	67.1	33.9	11.9	7.0	77.2
2007	147172	3.2	103.6	6.1	67.9	3.2	47396	70.0	26.8	11.2	7.2	77.8
2008	160721	2.7	103.3	6.1	68.5	3.1	50367	78.6	30.9	10.7	7.2	78.6
2009	162187	2.9	101.2	5.9	67.9	3.2	56332	79.8	26.6	9.9	8.6	78.4
2010	175132	3.9	101.4	5.8	68.2	3.0	67688	84.8	22.3	8.6	13.3	75.5
2011	190428	3.2	101.3	5.4	67.7	3.5	69377	79.1	20.9	7.9	8.7	80.9

Source: FAO, http://faostat3.fao.org/faostat-gateway/go/to/download/FB/BC/E, released July 9th, 2014.

Table 5. Comparison of China's and International Prices of Main Meats (US$/tons, %)

	Pork			Beef			Mutton			Poultry		
	China	World	Ratio	China	World	Ratio	China	World	Ratio	China	World	Ratio
2004	1072	2071	52	898	2481	36	863	4599	19	960	757	127
2005	920	2161	43	966	2565	38	843	4438	19	923	847	109
2006	982	1986	49	1030	2522	41	997	4036	25	1051	734	143
2007	1734	2117	82	1611	2544	63	1770	4120	43	1168	935	125
2008	2010	2270	89	1982	3040	65	2291	4585	50	1419	997	142
2009	1630	2202	74	2064	2562	81	2192	4276	51	1412	989	143
2010	1744	2454	71	2258	3272	69	2670	5314	50	1595	1032	155
2011	2655	2648	100	2916	3944	74	3591	6631	54	1780	1147	155
2012	2377	2676	89	3884	4176	93	4246	6091	70	1760	1228	143
2004-12 (%)	222	129	-	432	168	-	492	132	-	183	162	-

Note: 1. Ratio= China's prices/World's prices. 2. Pork referred in world price is "USA, pork, frozen product", and related prices data are export unit value from USDA; International beef prices - Australia: Cow 90CL export prices to the USA, FAS from Meat & Livestock, Australia; Mutton -Meat, sheep (New Zealand), frozen whole carcasses Prime Medium (PM) wholesale from USDA; International Poultry price - USA, Broiler cuts, export unit value from US trade exports.

Source: China's grain prices are calculated based on the data from the Compilation of National Costs and Revenues in Agricultural Products in China; World's meat prices except mutton are extracted from http://www.fao.org/economic/est/prices; Mutton prices are from Worldbank pink sheets "Global Economic Monitor (GEM) Commodities", last updated on 07/31/2014.

Table 6. Comparison of China's and International Prices of Main Grains (US$/tons, %)

	Rice			Wheat			Maize			Soybean		
	China	World	Ratio	China	World	Ratio	China	World	Ratio	China	World	Ratio
2004	193	205	94	180	144	125	140	112	125	341	307	111
2005	190	218	87	168	136	124	136	99	137	313	275	114
2006	202	220	92	180	159	113	159	122	131	316	269	117
2007	224	272	82	199	239	83	197	164	120	545	384	142
2008	274	482	57	238	272	88	209	223	94	531	523	101
2009	290	326	89	271	186	145	240	166	145	539	437	123
2010	349	384	91	293	230	127	277	186	149	572	450	127
2011	417	459	91	322	286	113	328	292	113	632	541	117
2012	437	525	83	343	295	116	352	298	118	749	591	127
2000-12 (%)	227	256	-	191	204	-	251	267	-	220	193	-

Note: World's rice prices refer to "Rice (Thailand), 100% broken, A.1 Super from 2006 onwards, government standard, f.o.b. Bangkok; prior to 2006, A1 Special, a slightly lower grade than A1 Super"; Wheat-Wheat (US), no. 2, soft red winter, export price delivered at the US Gulf port for prompt or 30 days shipment; Maize - Maize (US), no. 2, yellow, f.o.b. US Gulf ports; Soybean- Soybean (US), c.i.f. Rotterdam.

Source: China's grain prices are calculated based on the data from the Compilation of National Costs and Revenues in Agricultural Products in China; World's prices are from Worldbank pink sheets "Global Economic Monitor (GEM) Commodities", last updated on 07/31/2014.

Table 7. China's Tariff Rates on Main Meat and Grain Products in 2011 (%)

Commodities	MFN Duty Rate	General Duty Rate
Pork	16	70
Beef	15.5	70
Mutton	17	70
Poultry	19.55	70
Wheat	In-quota Tariff Rate=1 Out-quota Tariff Rate=65	180
Rice	In-quota Tariff Rate=1 Out-quota Tariff Rate=65	180
Maize	In-quota Tariff Rate=1 Out-quota Tariff Rate=42.5	180
Soybean	2.4	180

Note: The duties are calculated using tariff line average method.
Source: Tariff Analysis Online, WTO, http://tariffanalysis.wto.org/report/TariffAverages.aspx, accessed on Sept. 4th. 2014.

Table 8. NTMs Notified by China in Meats import after China's WTO accession

	Measures	Quantity	Products Related	Partners	Description
1	Anti-dumping	1	Broiler products	USA	Initiated from 27-09-2009 and been in force 27-09-2010. Anti-dumping duty rate is 51.8% and the duration is 5 years.
2	Countervailing	1	Broiler products	USA	Initiated from 27-09-2009 and been in force 30-08-2010. Countervailing duty rates are 4-12% and 30.3% and the duration is 5 years.
3	SPS emergency	11	Poultry and products, birds and products，swine, wild boar and products etc.	Canada, USA, Japan, Korea, Australia, France, Netherland	Initiated mainly because of the introduction of some viruses in 2002, 2004 and 2009.
4	SPS regular	19	Swine products, poultry meat, fish and so on	All members	Initiation times are mainly on 2002 and 2004 for hygienic standards. There have been no changes in any of the procedures to establish SPS requirements in China since 2010.
5	TBT	1	Poultry Meat	All members	Initiated on 09-08-2002 by forwarding national standards.

Source: WTO, Integrated Trade Intelligence Portal (I-TIP), Extracted on 01/07/2014 16:00.

Table 9. Projected Changes in China's Meat and Grain Outputs, Imports, and Self-sufficiency Ratios in 2030

	% Output Changes		% Change in imports		Self Sufficiency Ratio			Share of World Imports		
	2030 proj	2030 proj meat imports restricted	2030 proj	2030 proj meat imports restricted	2011	2030 proj	2030 proj meat imports restricted	2011	2030 proj	2030 proj meat imports restricted
Wheat	53.7	64.1	199.2	303.5	0.985	0.971	0.965	0.009	0.015	0.02
Maize	60.1	59.5	104.3	115.1	0.963	0.957	0.955	0.027	0.037	0.039
Oilseeds (soybean)	3.0	-1.3	86.9	89.6	0.388	0.282	0.273	0.469	0.498	0.501
Rice	54.2	56.5	16.3	30.6	0.993	0.993	0.991	0.02	0.015	0.017
Cattle Meats	75	101.8	486.9	0	0.948	0.877	0.968	0.04	0.14	0.028
Other Meats	88	106.6	1275.8	0	0.997	0.934	0.992	0.052	0.317	0.033
Dairy	80.9	76.4	149.9	190.3	0.947	0.929	0.917	0.036	0.055	0.063

Source: Simulation results by authors.
Note: All percentage changes results are from 2011 base data, as reported in the version 9 GTAP database.

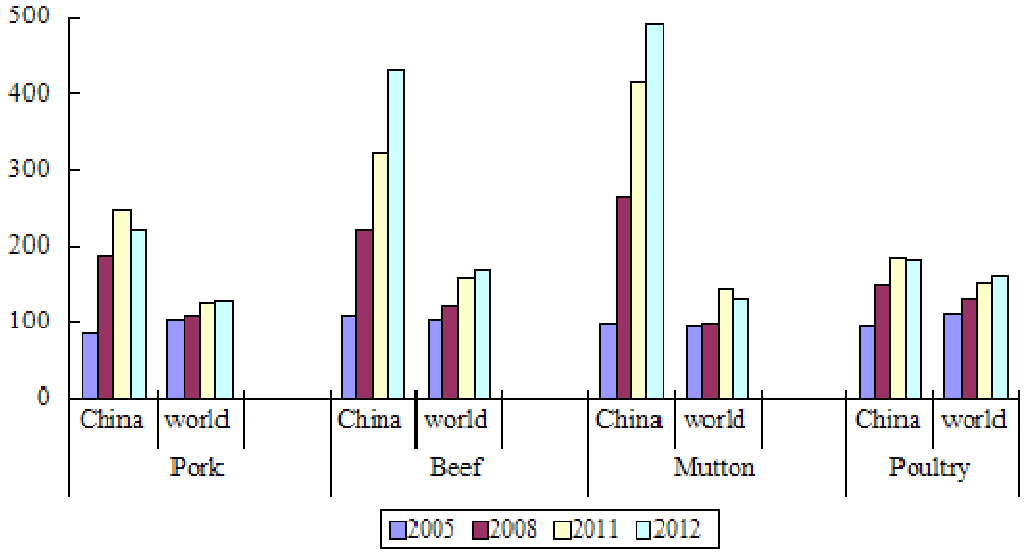

Figure 1. World and China's Meat Price Indices (Base=100, Year 2004)

Note: Pork referred in world price is "USA, pork, frozen product", and related prices data are export unit value from USDA; International beef prices - Australia: Cow 90CL export prices to the USA, FAS from Meat & Livestock, Australia; Mutton -Meat, sheep (New Zealand), frozen whole carcasses Prime Medium (PM) wholesale from USDA; International Poultry price - USA, Broiler cuts, export unit value from US trade exports.
Source: China's grain prices are calculated based on the data from the Compilation of National Costs and Revenues in Agricultural Products in China; World's meat prices except mutton are extracted from http://www.fao.org/economic/est/prices; Mutton prices are from World Bank pink sheets "Global Economic Monitor (GEM) Commodities", last updated on 07/31/2014.

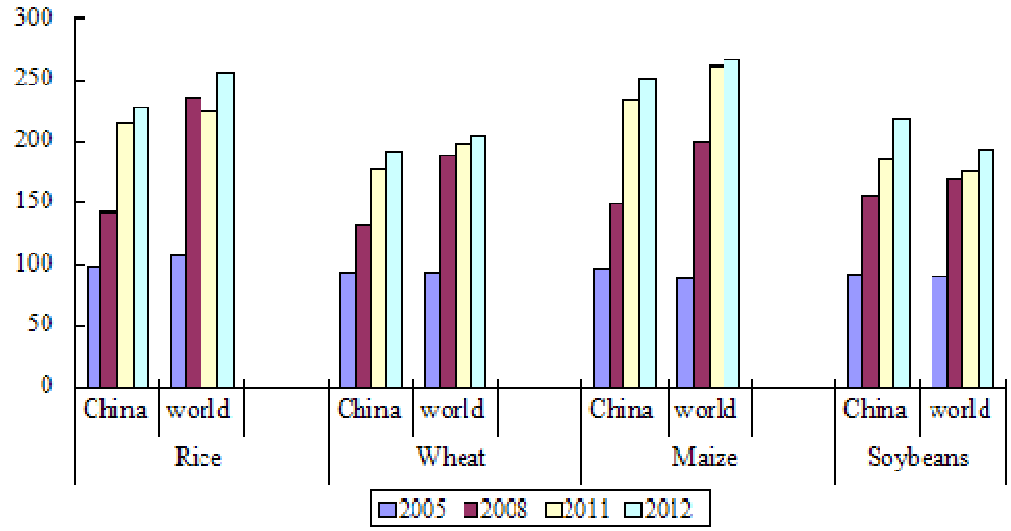

Figure 2. World and China's Grain Price Indices (Base=100, Year 2004)

Note: World's rice prices refer to "Rice (Thailand), 100% broken, A.1 Super from 2006 onwards, government standard, f.o.b. Bangkok; prior to 2006, A1 Special, a slightly lower grade than A1 Super"; Wheat-Wheat (US), no. 2, soft red winter, export price delivered at the US Gulf port for prompt or 30 days shipment; Maize - Maize (US), no. 2, yellow, f.o.b. US Gulf ports; Soybean- Soybean (US), c.i.f. Rotterdam.
Source: China's grain prices are based on Compilation of National Costs and Revenues in Agricultural Products in China; World's prices are from World Bank pink sheets "Global Economic Monitor (GEM) Commodities", accessed on 07/31/2014.