Assessing China's Potential Surge on Demand for Grain Sorghum

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Abstract

China is one of the world's fastest growing economies showing an impressive growth on consumption of animal protein which has resulted on a rapidly increasing derived demand for feed grains. Corn is the key feed crop for China, however, the government policies have boosted domestic corn prices above international levels. Some important facts signal that China is becoming a large market of feed grain where sorghum is a close and cheaper substitute for corn. This paper used a derived demand model to estimate the parameters of China's sorghum feed domestic consumption. Results of this paper will be an important reference for international sorghum trading countries, especially for United States, which is one of the largest sorghum producing and exporting countries.

Key Words: China, Sorghum, Demand, Feed

Introduction

In the United States, South America, and Australia sorghum is used primarily as a feed grain for livestock. However, corn has become the main substitute for sorghum as animal feed in recent years. The relatively lower prices and increased level of productivity of corn are reasons that the demand of sorghum as feed in the United States has been steadily declining overtime. In addition, some sorghum varieties and hybrids are less palatable due to tannins and phenolic compounds in the seed.

Sorghum has been used as food in China for long time before 1980s as well as primarily used for liquor production. The use for sorghum as animal feed is negligible compare to the same use of corn. Even though China has the 95% self-sufficiency policy, the import of corn as feed grain is increasing annually.

However, the fact that corn has been used as the dominant feed grain in China is slowly being changed since August, 2013 when China for the first time purchased large

quantity of sorghum from United States for feed use. This news made a lot of media and experts speculate about whether China will continue importing sorghum as a substitute of corn for feed use and if China will import larger quantities of sorghum from United States or other sorghum export countries in the future.

China is one of the world fastest growing economy. The growth of income and transition to modern urban lifestyles are boosting the Chinese's demand for all food, especially the demand of meat consumption. China produces nearly half of the world's pork and also is the world's second largest poultry producer. The meat production is expected to grow further to supply China's growing appetite for meat.

Undoubtedly, with the sharp increase in demand for meat, the feed grain use for meat production is also increasing. As the rise in corn prices and the issues related to GMO, looking for corn substitutes for feed grain is a trend that cannot be ignored. Sorghum seems to be a perfect and cheaper substitute for corn.

Since China has not used sorghum as mainly feed grain before and 2013 was the first year China start import large quantity of sorghum for feed use from the United States, there are few studies focused on the China domestic sorghum demand. This study use a derived demand model to estimate the parameters which have effect on Chinese domestic sorghum feed consumption demand. Official data from 1991-2011 have been used for the analysis. Results of this study will help sorghum export countries such as United States to have insights about the Chinese domestic sorghum demand.

Literature Review

The use of sorghum for animal feed in China is still small compared to the use of corn. Several studies have been published projecting the future trends in China's grain imports but little research focused on China's sorghum feed grain market and its domestic demand. The purpose of this literature review is to provide an understanding of the China's feed grain market and China's potential demand for feed grain. In addition, this literature review also summarizing the methods that previous studies used for analyzing feed grain demand.

China feed grain market

In recent decades, China has shown sustained economic growth and urbanization, which are changing consumption patterns towards increased demand for meat and dairy products. The expanded consumption of livestock products in turn has generated a growing demand for feed grains. Several studies (e.g. Crook and Colby, 1996, Crompton and Phillips, 1993) indicate that China is going to import either meat or feed grains in the long-term. As the USDA projections show that China's import grain needs (USDA definition of grain includes wheat, rice, corn, sorghum, millet, barley, and oats) will reach from 207 million tons to 369 million tons by 2030.

Coarse grains are the mainly ingredient of China's feed grains, and corn is the major cereal crop used as feed in China. As the State Statistical Bureau of China (SSB) reported that more than 90% of the coarse grain output is corn. The official statistic shows that the yields of coarse grains have improved significantly since 1980. Chinese

government has assisted research and extension of new technologies in coarse grain production to ensure an appropriate growth of feed grain supply.

Because of the 95% self-sufficient policy for food safety, the market of grains in China has been subject to continuous government intervention (Tian and Chudleigh, 1999). In 2014 USDA (United States Department of Agriculture) Foreign Agricultural Service annual report of China states that Chinese government will continue its temporary reserve program for corn, which has boosted China's domestic corn prices above the international levels. China also maintains a tariff rate quota (TRQ) for corn import, which are 7,200,000 Metric Tons per year. Tariff rates of China's corn import within and out of TRQ are 1% and 65%, respectively. These government policies makes sorghum the better option for China's budget-conscious.

With the restriction on corn import, instead of relying on domestic corn supply at high costs, Chinese feed industries are now importing alternative feed grains, such as U.S. sorghum and dried distiller grains (DDG). USDA estimates that for the market year 2013/14 the consumption of sorghum has raised from 500,000 tons to 5.8 million tons mainly due to increased feed demand in China. Historically, China imports most of its sorghum from Australia for alcohol use. However, the huge increase in demand for coarse grains has prompted China for the first time to expand its feed ratios of sorghum in 2013. It is important to have a better understanding of the factors affecting China's sorghum feed demand to forecast China's potential sorghum demand in the future.

Review of demand model

The International Food Policy Research Institute developed an international model for policy analysis of agricultural commodities and trade (IMPACT) (Rosegran, Ringler, and Msangi, etc, 2008). They define the domestic demand for a commodity as the sum of its demand for food, feed, and other uses. In this IMPACT model, the feed demand is a derived demand determined by the changes in livestock production, feed ratios, and own and cross price effects of feed crops. The derived feed demand model also include a technology parameter that indicates improvements in feeding efficiencies.

Thursby and Thursby (1984) defined a single equation import demand model and stated that the simpler models are preferable to use due to the ease of estimation as long as it yield unbiased or at least consistent elasticity estimates. Variables suggested by the model to use are prices and income or activity variables.

Method and Data

This paper follows the framework of single equation import demand model presented by Thursby and Thursby (1984). The model in this paper is a derived demand where the dependent variable is the China sorghum feed domestic consumption. Since the sorghum feed consumption is determined by the changes in livestock production, the income effect for the derived demand model is considered to be included into the livestock production variables. The swine, poultry, and beef production have been chosen to account for the livestock production because the fact that China is the world largest pork producer, the second largest poultry producer, and its cattle stock volume has increased rapidly. Other factors included in this model are imputed domestic prices of

sorghum and corn. In order to eliminate the colinearity between the price of sorghum and corn, this paper use the price ratio of these two commodities. The model also add one variable to account for the urbanization effect on sorghum feed demand, which is a ratio of China urban population to its total population since the urban population has been doubled from year 1991 to 2011. The log-log form is generally used in the demand analysis since it is easier to estimate and interpret and the coefficient in the model directly provide the elasticity estimates of demand.

Therefore, the sorghum derived feed demand model can be specified as:

$$\ln(SFDC) = f(\ln(PS/PC), \ln(Swine), \ln(Poul), \ln(Beef), \ln(Urb), \varepsilon) \quad (1)$$

where SFDC is sorghum feed domestic consumption in China (in thousand Mton); PS is the imputed sorghum domestic price (in thousand dollars/Mton); PC is the imputed corn domestic price (in thousand dollars/ Mton); Swine, Poul, and Beef are the swine, poultry, and beef production in China (in thousand Mton CWE), respectively. Urb is the percentage of China's urban population to its total population.

Data used in this paper are annual time series data from year 1991 to 2011. China domestic sorghum producer prices were considered to be used in the beginning of the study, but estimations by using the producer prices were not significant. In this study, the prices of sorghum and corn are imputed prices, that is, the sorghum price calculated by dividing China's annual import value of sorghum (in thousand dollars) with annual sorghum import quantity (in Mton). The corn price used the same imputed method. The imputed prices have been used as a proxy for China's domestic market price since almost all the import feed grain will be used by the meat production industries, which are the main consumers of feed grain. Both sorghum and corn import quantity and value are

taken from FAOSTAT. The swine, poultry, and beef production data were obtained from USDA. China urban and total population data also came from FAOSTAT.

Results and Discussion

This paper used the statistical software SAS 9.4 to conduct the econometric estimation of the derived demand model based on annual data over the period 1991-2011 and the estimation results are presented below in Table 1.

Table1. Econometric Results of China's Sorghum Feed Derived Demand Model.

ln(SFDC)=	− 77.8421	−1.7222ln(PS/PC)	+7.1768ln(Swine)	+3.08ln(Poul)	−3.6426ln(Beef)	-11.8849ln(Urb)
	(-2.73)	(-2.07)	(2.41)	(2.45)	(-2.46)	(-4.85)

*t values are in parentheses.

All variables are significant at 90% level. The significance of price ratio variable ln (PS/PC) is 0.0572. The log of swine, poultry, and beef production are significant at 0.0303, 0.0279, and 0.0273 levels, respectively. The variable account for urbanization is significant at 0.0003 level. The test for multicolinearity indicated that there is absence of multicolinearity but the Durbin Watson test showed that there is some autocorrelation. The Cochrane-Orcutt procedure has been used to correct for the autocorrelation.

The significance of the estimated parameters indicated that sorghum-corn price ratio, the meat production, and the urbanization have strong effect on the sorghum feed domestic consumption. The estimation of sorghum-corn price ratio is -1.7222 which indicates that the sorghum feed consumption is elastic with respect to the price ratio and

when the price ratio increase one percent, the sorghum feed consumption will decease more than one percent.

The estimation of swine and poultry production are positive as expected which indicate that one percent increase of the swine and poultry production will increase more than one percent of the sorghum feed consumption which are 7.1768% and 3.08%, respectively. This results consist with the fact that China importing sorghum for feed use from U.S. in recent years due to the domestic large demand of meat.

The model surprisingly shows that beef production and urbanization have a negative effect on sorghum feed domestic consumption. It is hard to precisely explain why the beef production negatively relate to the sorghum feed consumption, and further study will be needed to better interpret this relationship. However, there may be some reasonable explanations to understand this results. Sorghum use for cattle feed is less palatable due to tannin and sorghum may be slightly more efficient feed stock for swine and poultry than cattle in China.

The negative effect on the urbanization can be explained that as there are more people moving from rural areas to the urban areas, the tightening rural labor markets have pushed China away from family farming to larger operations relying on commercial feed. Urban residents may buy more meat from the market directly instead of buying feed grains and feed their own livestock.

Conclusion

This study estimated the effect of sorghum-corn price ratio, meat production, and urbanization on the Chinese sorghum feed domestic consumption. Since rarely previous

studies focused on Chinese domestic sorghum demand, results of this study provide important reference for sorghum export countries, especially the United States which is the world's top exporter of grain sorghum. Results of this study are also a good start to use for future forecasting of China's sorghum domestic feed demand. By using the estimated elasticity, the future sorghum demand can be projected with simulation techniques under different scenarios such as the changing of price ratio and the quantity of meat production.

In December 2013, the Chinese President Xi Jingping announced a new food security strategy at the annual central economic conference that the government will try to maintain self-sufficiency in wheat and rice, but will allow "moderate" grain imports for feed. In a future study, this domestic derive demand model will be combined with China's sorghum domestic supply model and perform a simultaneous equations method to assessing China's future sorghum import demand. To precise forecast China's future sorghum import demand may help both China and United States to justify their feed grain trade policy.

The main limitation of this study was the shortage of observations. In the future, results of this study could be improved by expanding the sample size and use the simultaneous equations method. Due to the lack of information and the time constraint, results such as the negative effect of beef production on sorghum feed domestic consumption has not been explained clearly. Further study may have more precisely interpretation of this results.

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