Monetary Easing Policy and Long-Run Food Prices: Evidence from China

Xiaohua Yu

Professor of Agricultural Economics in Developing and Transition Countries

Courant Research Centre 'Poverty Equity and growth'

University of Göttingen

Wilhelm-Weber-Str. 2

37073, Göttingen, Germany

xyu@gwdg.de

+49-551-39-10678

Please Cite:

Yu. X. (2014): Monetary Easing Policy and Long-Run Food Prices in China, Forthcoming in Economic Modelling. DOI: 10.1016/j.econmod.2014.03.029

Mar. 17, 2014

This paper is selected for presentation in the 2013 Annual Meeting of Chinese Economists Society in Chengdu, China, in June 7-9. I am very grateful to Dr. Wenhong Kou for his assistance in data collection, and to Dr. Wei Chen of Shanghai University of Finance and Economics, Dr. David Abler of Penn State University, and two anonymous reviewers for their fruitful comments. Ms. Larissa Wood provided helpful research assistance. Support from the project of RTG 1666 of German Research Foundation (DFG), and the National Natural Science Foundation of China (Project ID: 70903039 and 71273006) are acknowledged.

Monetary Easing Policy and Long-Run Food Prices: Evidence from China

Abstract:

The money easing policy in the past decade incurred a significant impact on food prices through channels of both demand and supply, and leads to a problem of welfare distribution in China. Through the construction of a theoretical model, this paper empirically studies the impact of money supply on 7 major food products in China. We find that except for the price of rice which is stable and the price of wheat flour which slightly increases, all other food prices including soybean oil, poultry meat, pork, beef and mutton, decline in response to money expansion. This mainly results from a relatively larger stimulating effect of money expansion on supply to that on demand. The governments should make precautionary policies to protect farmers from welfare loss.

Key Words: Money Easing Policy, Food Price, Long-Run, China.

JEL: E31, Q18

1. Introduction

In company with rapid economic growth, money supply expands speedily in China. Particularly, the expansionary speed of money supply has reached a record level in the past decade. Money supply, measured by the broad definition M2, increased by more than 10 folds from 8.85 trillion yuan in December 1999 to a historical record of 103.6 trillion yuan in March 2013, which is now the largest in the world. In contrast, food Consumer Price Index (CPI) only increased by 87%. Surprisingly, the monetary easing policy in China has not triggered large inflation in food prices, and this could largely be explained by the rapid economic growth. Table 1 demonstrates the changes in money supply and prices in China from 1999 through 2012.

Doubtlessly, money expansion policy has impact on food prices, either actively or passively, and changes in food prices would have substantial welfare impact. If food price is positively affected by money supply, consumers suffer from welfare loss (Ferreira et al. 2013; Yu 2014). However, if food price is negatively affected, producers would incur welfare loss. Unfortunately, such a relationship has not been well studied in the context of China.

The current literature on domestic food price analysis mainly focuses on the effects of pass-through from international market, rising oil prices, increasing biofuel demands, and changes in stocks (Headey and Fan 2008; Anderson and Nelgen 2012; Meyer and Yu 2013; Wright 2011). Chinese governments regard food security as one of the most sensitive policy issues, so that the domestic food market is heavily intervened (Yang et al. 2008; Yu and Zhao 2009; Yu and Jensen 2010). Table 2 shows that the self-sufficient rates for major food products (except for soybeans) are very high, which is mainly due to the food security of Chinese government. China endeavors to keep high self-sufficient rates for the main cereals. Consequently, the pass-through effect from the international market is very limited (Yang et al. 2008; Anderson and Nelgen 2012).

[Insert Table 1 and Table 2]

Major changes in money supply have both short- and long-run impacts on commodity prices. Several models have theoretically explained these effects. Sims (2003) explains a real short-run effect of money supply with imperfect information. In contrast to that, Golosov and Lucas (2007) argue that sticky prices are responsible for the impact, and Mackowiak and Wiederholt (2009) combine both attempts to explain the phenomena.

On the other hand, long-run effects could depend on the market structure because an increasing money supply could trigger both demand and supply shifts due to rising incomes and investments, respectively. There are two different streams of literature: The Structuralist Approach and the Monetarist Approach, depending on whether money takes an active or

passive role in the inflation process (Barnett et al. 1983). The structuralists conjecture that the money supply is passive and the inflation originates from real shocks (Olivera, 1970). On the other hand, the monetarists suggest that money supply can generate aggregate demand, which can only change relative prices between commodities but not the overall price level, so that money supply is a cause of inflation.

Given the nature of the modern quantitative easing policy, monetary authorities often take active roles to shock the economic system and try to correct the economic unbalance and create employment. A good example is the Economic Stimulating Package implemented by the Chinese government in 2009 after the world Financial Crisis, in which Chinese state owned banks lent out more than 4 trillion yuan loans to stimulate the weak economy.

To some extent, money supply is therefore viewed as a causal shock rather than a passive result in the modern toolbox of policy makers. In contrast to the impact of money supply on overall price level, we are more interested in the disaggregated markets. Lastrapes (2006) found that the real effects on disaggregated prices do last in the long run. Bordo (1980) believes that the contract length between producers and consumers is vital for the transmission speed of the impact of money supply on market prices.

The effects of expansionary monetary policies on agricultural prices have already been studied to some context. However, most studies, such as those of Chambers and Just (1982), Barnett et al. (1983), Awokuse (2005), and Gilbert (2010), only focus on the short-run impact. The results are quite mixed, as some scholars have confirmed the existence of an impact while others have rejected it.

Several theoretical models have been developed to explain the short-run impact of money supply on food prices. An important one is the overshooting model proposed by Frankel (1986). It divides an economy into two sectors: The agricultural sector with flexible prices and the manufacturing sector with sticky prices. It predicts that agricultural prices

overshoot shortly after a money supply shock occurs. Saghaian et al. (2002) extended the model and tested it empirically. Another theoretical model developed by Lapp (1990) attributes a short-run money supply impact on agricultural prices under imperfect information.

The impact of money supply on food prices could last for a very long time. Neglect of the long-run effect could lead to significant economic welfare loss, so that it has important policy implications to shed light on the long-run impact. The main stream of the literature uses the cointegration tests to identify equilibrium, which is explained as a long-run impact. For instance, Robertson and Orden (1990), Choe and Koo (1993), Kaabia and Gil (2000) and Westerlund and Constantini (2009) have conducted cross-country analyses to look at its impact on aggregate agricultural prices. The results are contradictory. Some of the papers confirm the test and others reject it. Uniquely, Dorfman and Lastrape's (1996) tested the impact of money supply shocks on segregated food prices, which were disaggregated into livestock and crop prices, and find that the impact is different for different commodities. However, the main problem for the cointegration-style test is that rejection of cointegration does not necessarily imply no long-run impacts occur.

Even though the impact of money supply on food prices is known to be an important topic in the policy arena for China, the research is only conducted in a very limited way, mainly due to data availability and technical difficulties.

As exogenous money supply could have stimulating impacts both on demand and on supply, it is heavily hinged upon welfare distribution between producers and consumers. In this paper, we first develop a theoretical framework based on the market equilibrium to examine the mechanism of the impact of money supply on commodity prices through the channels of demand and supply. It is speculated that the final impact is determined by the relative scales of the two impacts. If the stimulating effect on demand is larger than that on supply, one can expect that the price would increase. In this case, consumers suffer from

welfare loss. However, if the stimulating effect on demand is smaller than that on supply, it is even possible that the price could decrease, and then the farmers incur welfare loss.

We then develop an econometric model based on a bivariate ARIMA model, to empirically study the long-run impact of money supply on food prices with use of the retail food prices for 7 major food products: rice, wheat flour, soybean oil, poultry food, pork, beef and mutton.

In addition to methodological contribution, this research could also add significant policy contributions to the literature, as the empirical results could offer policy implications for producers as well as policy makers.

2.Theoretical Framework

Barnett et al. (1983) suggest that money supply could affect commodity prices through the channels of both supply and demand. Monetary easing policies usually could lead to proliferation of credits in an economy. On the one hand, indirect wage effect of credit easing (Fischer 1977), or direct changes in the market credit conditions, could lead to an increase in demand, which could push up food prices. On the other hand, producers could obtain credits more easily, which would eventually increase supply and would put down commodity prices. The final impact of money supply on the market prices depends on the aggregate effects of demand and supply in response to money supply. The short-run aggregate effect hence could be unstable across the time horizon. The policy implications derived from the short-run effect would be non-robust.

In contrast, it is important to look into the long-run effect when the monetary shock approaches a long-run stable equilibrium. Money supply often has a permanent shock and the market has a long run memory for it. It could be mirrored by a non-stationary process, which

will be empirically tested later. The impact of money supply could last for a very long period, while the short-run effect is elusive and difficult to be captured. Hence, in this study we focus on the long-run impact rather than the short-run.

Suppose both market demand D_t and supply S_t are determined by money supply m_t and nominal food price p_t,

$$\begin{aligned} D_t &= D(m_t, p_t) \\ S_t &= S(m_t, p_t) \end{aligned} \quad (1)$$

Even though Equation (1) is a static model, it could still capture the full impact of a money supply on food price, which is exactly the long-run effect. Total differentiation of Equation (1) yields

$$\begin{aligned} dD_t &= \frac{\partial D_t}{\partial m_t} dm_t + \frac{\partial D_t}{\partial p_t} dp_t \\ dS_t &= \frac{\partial S_t}{\partial m_t} dm_t + \frac{\partial S_t}{\partial p_t} dp_t \end{aligned} \quad (2).$$

The condition of market equilibrium condition ($dD_t = dS_t$) yields,

$$\frac{dp_t}{dm_t} = \frac{\frac{\partial D_t}{\partial m_t} - \frac{\partial S_t}{\partial m_t}}{\frac{\partial S_t}{\partial p_t} - \frac{\partial D_t}{\partial p_t}}. \quad (3)$$

Rewriting Equation (3) could lead to the food price elasticity (η) with respect to money supply:

$$\eta_{p,m} = \frac{dp_t}{dm_t}\frac{m_t}{p_t} = \frac{\frac{\partial D_t}{\partial m_t}\frac{m_t}{D_t} - \frac{\partial S_t}{\partial m_t}\frac{m_t}{S_t}}{\frac{\partial S_t}{p_t}\frac{p_t}{S_t} - \frac{\partial D_t}{p_t}\frac{p_t}{D_t}} = \frac{\varepsilon_{D,m} - \varepsilon_{S,m}}{\varepsilon_{S,p} - \varepsilon_{D,p}} \quad (4)$$

where $\varepsilon_{S,m}$ and $\varepsilon_{D,m}$ are respectively supply and demand elasticities with regard to money supply; while $\varepsilon_{S,p}$ and $\varepsilon_{D,p}$ are respectively supply and demand elasticities with regard to food prices.

Economic theory proposes that the supply and demand elasticities with respect to prices are usually positive and negative, respectively. Consequently, the denominator of equation (4) is always positive. In particular, both $\varepsilon_{S,p}$ and $\varepsilon_{D,p}$ are independent of money supply, so that $\varepsilon_{S,p} - \varepsilon_{D,p}$ is presumed to be a positive constant.

The numerator of Equation (4) is the difference between the demand and supply elasticities with respect to money supply. As aforementioned, money supply could be a proxy for market credit condition, and both supply and demand could be positively affected by money supply due to stimulating effects.

The impact of money supply on food prices is determined by the scale difference between the responses of supply and demand to money supply. If $\varepsilon_{D,m} > \varepsilon_{S,m}$, the stimulating effect on demand is larger than that on supply, $\eta_{p,m} > 0$, which implies that the food price increases in money supply. If $\varepsilon_{D,m} = \varepsilon_{S,m}$, the stimulating effect on demand is offset by that on supply, $\eta_{p,m} = 0$, which implies that the food price will keep stable; If $\varepsilon_{D,m} < \varepsilon_{S,m}$, the stimulating effect on demand is smaller than that on supply, $\eta_{p,m} < 0$, which implies that the food price decreases in money supply.

As income increases in China, income elasticities of demand become less sensitive for main food products, such as cereals and meats, the main study objects in this research, so that the stimulating effect on the demand side could be very limited (Yu and Abler 2009). On the other hand, except for the production of cereals, limited by land, other products, such as

poultry and pork, are very standardized and can be produced in a large scale in current times. This implies that the stimulating effect on these products could be very large.

Considering both effects, the impact of money supply on food prices could be negative, particularly for the standardized products. In this case, the welfare of farmers could be negatively affected. Governments should make policies to protect farmers from welfare loss, such as subsidies or provision of market information to guide farm production.

The next section will develop an econometric model to empirically study the impact of money supply on food prices in China

3.Econometric Model

Given the market prices and money supply information, we could start with a bivariate ARIMA model to demonstrate the relationship between real money supply and food prices:

$$a(L)\Delta^{\langle m\rangle}\overline{m}_t = b(L)\Delta^{\langle p\rangle}\overline{p}_t + u_t$$

$$c(L)\Delta^{\langle p\rangle}\overline{p}_t = d(L)\Delta^{\langle m\rangle}\overline{m}_t + v_t \quad (5)$$

Where $\overline{m}_t$ and $\overline{p}_t$ are respectively the logarithmic forms of real money supply and nominal food prices. The values $\langle m\rangle$ and $\langle p\rangle$ indicate the corresponding variable´s order of integration. The error terms u and v are independently and identically distributed with mean zero, variances σ_{uu} and σ_{vv} , respectively, and covariance σ_{uv} . Thus u denotes the exogenous changes in the real money supply series.

Corresponding to the definition of the food price elasticity (η) with respect to money supply in Equation (4), which is exactly the long-run impact of money supply on food prices, we have:

(6) $$\eta_{p,m} = \lim_{k\to\infty} \frac{\partial \Delta \overline{p}_{t+k}}{\partial \Delta \overline{m}_{t+k}}.$$

Given that the money supply is exogenous, Equation (6) could be rewritten by dividing ∂u_t both in the numerator and in the denominator as:

(6.A) $$\eta_{p,m} = \lim_{k\to\infty} \frac{\partial \Delta \overline{p}_{t+k} / \partial u_t}{\partial \Delta \overline{m}_{t+k} / \partial u_t}.$$

Equation (6.A) is defined by Long-Run Derivative in Fisher and Seater (1993). It is determined by the analyzed time series' order of integration.

Existence of a long run impact on food prices requires both $\langle m \rangle \geq 1$ and $\langle m \rangle \leq \langle p \rangle + 1$. When $\langle m \rangle < 1$, there are no permanent and exogenous changes in the level of money supply. When $\langle m \rangle \geq \langle p \rangle + 1 \geq 0$, the order of money is higher than that of food prices and the long-run impact of on food prices can be rejected.

When the long-run impact exists, we could transform Equation (5) into its impulse response representations:

$$\Delta^{\langle m \rangle} \overline{m}_t = \frac{c(L)}{a(L)c(L) - b(L)d(L)} u_t + \frac{b(L)}{a(L)c(L) - b(L)d(L)} v_t = \alpha(L)u_t + \beta(L)v_t$$

(7) $$\Delta^{\langle p \rangle} \overline{p}_t = \frac{d(L)}{a(L)c(L) - b(L)d(L)} u_t + \frac{a(L)}{a(L)c(L) - b(L)d(L)} v_t = \gamma(L)u_t + \delta(L)v_t$$

Substituting equations (7) into equation (6.A), yields the long-run elasticity of interest:

(8) $$\eta_{p,m} = d(1) / c(1).$$

Consequently, estimation of the long-run elasticity is possible and the parameters can be obtained directly from the second equation (5). The parameters can be identified by

assuming that the exogenous shocks are uncorrelated ($\sigma_{u,v}=0$) and that the money supply is predetermined ($b_0=0$).

The relative parameter in Equation (8) can be directly estimated in the frequency domain (Fisher and Seater 1993). A calculation of the covariance matrix of the sequences $(\Delta^{\langle m\rangle}\overline{m}_t \quad \Delta^{\langle p\rangle}\overline{p}_t)$ is necessary:

$$Cov\begin{pmatrix}\Delta^{\langle m\rangle}\overline{m}_t\\ \Delta^{\langle p\rangle}\overline{p}_t\end{pmatrix}=\begin{bmatrix}\alpha(L) & \beta(L)\\ \gamma(L) & \delta(L)\end{bmatrix}\begin{bmatrix}\sigma_{uu} & \sigma_{uv}\\ \sigma_{uv} & \sigma_{vv}\end{bmatrix}\begin{bmatrix}\alpha(L) & \gamma(L)\\ \beta(L) & \delta(L)\end{bmatrix} \tag{9}$$

Additionally assuming the long-run exogeneity (b(1)=0), the parameter of a zero-frequency regression of the differenced prices on the differenced money supply, corresponds to the long-run elasticity:

$$\frac{Cov\left(\Delta^{\langle m\rangle}\overline{m}_t,\Delta^{\langle p\rangle}\overline{p}_t\right)}{Var\left(\Delta^{\langle m\rangle}\overline{m}_t\right)}=\frac{\gamma(1)}{\alpha(1)}=\frac{d(1)}{c(1)} \tag{10}$$

Fisher and Seater (1993) also propose a Bartlett estimator for Equation (8). We could use the limit regression of moving averages of money supply on agricultural prices:

$$\sum_{i=0}^{k}\Delta\overline{p}_{t-i}=\mu_k+\theta_k\sum_{i=0}^{k}\Delta\overline{m}_{t-i}+e_{kt} \tag{11}$$

Where μ_k is the intercept and e_{kt} is a random variable following a normal distribution. When $k\to\infty$ is defined as a long run, equation (11) can be consistently estimated for the case that both money supply and agricultural prices are integrated by order one in the following OLS regression:

$$(\overline{p}_t-\overline{p}_{t-k-1})=\alpha_k+\theta_k(\overline{m}_t-\overline{m}_{t-k-1})+e_{kt} \tag{12}$$

We can estimate the parameter θ_k for different length of k, and thus $\eta_{p,m} = \lim_{k\to\infty} \theta_k$. In practice, the length of k depends on the definition of a long run.

In comparison, the current literature mainly uses the cointegration test to identify the long-run relation between money supply and food prices. The above model suggests that existence of a cointegration implies there is a long-run equilibrium between the two series, but doesn't necessarily imply a long-run impact. In contrast, our model indicates when money supply is non-stationary and has a long-run memory, there is a possible long-run impact on food prices. Later, we will show that (1) if money supply is stationary, there is no long-run impact, because there is no permanent shock in money supply; (2) if food price is stationary, the long-run impact could be rejected. The former case indicates no impact, and the latter implies an insignificant impact.

4.Data Sources and Structure

4.1 Data Sources

In order to carry out the abovementioned research in the context of China, the information of food prices and money supply should be provided. We collect these data from different sources.

Unlike most of the existing empirical research analyzing the impact of monetary policy, we use excess money supply series, rather than nominal money supply, to test the impact of the monetary policy on food prices, because the influence of over- or under-supply of money on the markets might be persisting. Qayyum (2006) points out that excess money supply has a strong impact on inflation. In a country with rapid economic growth, nominal money supply should be deflated by real GDP to measure real or excess money supply.

The monthly reported M2 by the People's Bank of China (the central bank of China) is used to measure the nominal money supply. However, GDP is only reported by the National Statistical Bureau of China (NBSC) quarterly or yearly. Due to a strong seasonality, quarterly reported GDP might not be so ideal for deflating purpose. In this research, we specifically use the yearly GDP instead. The nominal yearly GDP is first deflated by CPI into the price in1999 to obtain the real GDP, which is then transferred to a monthly GDP series by assuming constant growth rates within each year.

We collected monthly retail prices for rice, wheat flour, soybean oil, poultry meat, pork, beef and mutton from different sources. According the statistics of the NBSC, cereal and meat are the two main products in food expenditure in China[1](Yu and Abler 2009).

The detailed data structure and sources are reported in Table 3. The retail prices for rice, wheat flour, soybean oil and poultry meat, which are the national averages for both rural and urban areas, are reported weekly by the Ministry of Commerce in China and then they are converted to monthly data by averaging. The prices for pork, beef and mutton, which are the average price for 36 Chinese major cities, are reported monthly by the Nation Development and Reform Commission.

The trends of these variables are shown in Figure 1. Even though it shows that the food prices have been substantially increasing in the research period, the increasing scales are heterogeneous.

Particularly, the price increases for rice and wheat flour are larger than those for soybean oil and meat products. In general, the scales of food price increase lag behind money supply. This would result in a significant welfare distribution effect. Specifically, it could

[1] Urban Data is reported in *China Urban Life and Price Yearbook* (2012), and rural data in China Yearbook of Rural Household Survey (2011).

imply that the producers would suffer from welfare loss due to the monetary easing policy in China.

[Insert Table 3 and Figure 1]

4.2 Seasonality

Money supply and food prices often demonstrate strong seasonality, as is indicated in Figure 1. We use the procedure of Holt-Winters seasonal smoothing to remove it (Holt 2004) from all variables.

4.3 Stationary Tests

Our econometric model points out that the existence of long-run impact heavily depends on the integration level of the time series. We know that (1) if money supply is stationary, there is no long-run impact, because there is no permanent shock in money supply; (2) if food price is stationary, the long-run impact could be rejected. The former case indicates no impact, and the latter implies an insignificant impact.

Even though there are many tests for stationarity, the Augmented Dicky-Fuller (ADF) test and KPSS test are two most popular ones. The null hypothesis for the ADF test is that the time series has a unit root which implies non-stationary; while the null hypothesis for the KPSS test is that the time series is stationary.

The test results are reported in Table 4, which shows that the results are very consistent.

[Insert Table 4]

The ADF test cannot reject the null hypothesis for all level variables, but can for the first-order difference of all variables. In contrast, the KPSS test can reject the null hypothesis

for all level variables, but cannot for the first-order difference of all variables. The results indicate that all variables, including money supply and all 7 food price series, are I(1) processes. It evidences that the time series of money supply has a long-run memory, and there are long-run impacts on food prices. The assumptions of our econometric model are satisfied.

4.4 Cointegration tests

The current literature mainly uses the cointegration test for studying the long-run impact of money supply on food prices. We have pointed out that rejection of cointegration does not sufficiently imply there is no long-run impact. In order to demonstrate this point, we use the trace test of Johansen (1995) to test the cointegrations between food prices and money supply for the purpose of comparison. Table 5 reports the cointegration tests.

[Insert Table 5]

Unfortunately, we cannot find any cointegration between food price and money supply. This implies there is no long-run equilibrium between food prices and money supply, but does not imply no long-run impact of money supply on food prices, because all variables are non-stationary and I(1) processes. The results of the cointegration tests indicate that we need an alternative approach to tackle this problem.

5. Estimation Results and Discussions

5.1 Estimation

In order to estimate the long-run elasticity of food price with respect to money supply in Equation (11), we first need to define the “long run”. The length of the long run is quite ambiguous in the current literature. For instance, Fisher and Seater (1993) use 30 months and

Olekalns (1996) 25 months. Following their studies, we use 36 months as the long run, slightly longer than that of Fisher and Seater (1993).

In addition, the usual OLS estimation will result in the problem of serial correlations in error terms. In order to correct the error terms, which are important for estimation of the confidence intervals of the long-run elasticities, we adopt the well-known Newey-West procedure (Newey and West 1987) with a lag of 5 months.

Even though the long run is defined as 36 months, we estimate the long-run elasticities for different k and $k = 1, 2, 3 \cdots, 36$ for each food product. The estimated elasticities and the corresponding confidence intervals are reported in the Figure 2.

For comparison, we also reported the estimated long-run elasticities and their standard errors respectively for $k = 12$, 24, and 36 in Table 6.

[Insert Table 6]

5.2 Discussions

Fisher and Seater (1993) proposed a definition of "Long-Run Neutrality" for the case of an equal-proportion change of food prices in response to money supply change. It equivalently tests $\theta_k = 1$. However, our results indicate that we can reject the hypothesis $\theta_k \geq 1$ for any length of k and for any food products in China. This implies that the percentage of food price change is smaller than that of money supply change, and hence the neutrality for food prices can be rejected.

Then we will test the hypothesis $\theta_k = 0$, which means that food prices do not significantly react to money supply.

First, we find that the price of rice is quite stable, and does not significantly react to money supply. The point estimator of the long-run elasticity is 0.038 and is not significantly different from zero. Rice is the main food in China and Chinese governments often takes active policies to stabilize the price (Yang et al. 2008).

Second, the results indicate that the long-run elasticity for wheat flour is 0.195 and statistically significantly different from zero. This implies that wheat flour price increases in money supply. If the real money supply increases by 1%, wheat flour price will increase by 0.2%. According to our theoretical framework, it is plausible that the stimulating effect of monetary supply on the demand side is larger than that on the supply side, particularly given the fact that the production of wheat is limited by land acreage and seasonal factors in China, and the import of wheat is strictly controlled by Chinese government (Table 2) (Yang et al. 2008).

Third, interestingly, all long-run elasticities for soybean oil and all meat products are negative and statistically significant from zero, as shown in Table 6. Table 2 indicates that more than 50% of domestic soybeans have been imported since 2002. First, this implies that the supply of soybeans is not constrained by the domestic producers, so that the stimulating effect on supply of soybeans could be very large. Second, the soymeal is mainly used as feed for the industry of animal husbandry, so that the meat production is not constrained by the domestic resource limitations in China (Yu and Abler 2014). Third, these products are highly standardized and less restricted by land and seasonal factors, so that they can be easily and massively produced if the credit conditions are not very strict. Hence, the stimulating effect of money supply on food supply could possibly be larger than that on demand. Consequently, monetary easing policy could put down these prices.

Specifically, the elasticities for soybean oil, poultry meat, pork, beef and mutton respectively are: -1.34, -0.37, -1.76, -3.46 and -0.55, all negative and statistically significant.

Particularly, the negative impact on soybean oil, pork and beef are relatively large, perhaps because these products are more relied on soymeal feeds. Our econometric results implies that, with a 1% increase in excessive money supply, the prices for soybean oil, poultry, pork, beef and mutton will respectively decrease by 1.34%, 0.37%, 1.76%, 3.46% and 0.55% in the long-run which is defined as three years.

5.3 Policy Implications

The results indicate that the monetary easing policies in China in the past decade have significant impacts on food prices. Amongst the seven main food products which we are interested in we find that, except for rice which has no significant response and wheat flour which has a small-scale positive response, soybean oil and meat products react negatively to money supply. This is possibly due to a larger stimulating effect on supply than that on demand because China opened these markets to the world either directly or indirectly through feed market (Yu and Abler 2014), while rice and wheat are separated from the international market due to food security concerns (Yang et al. 2008; Yu and Jensen 2010). Furthermore, these findings are consistent with the diagram in Figure 1 and our theoretical expectations.

Price changes usually have a significant welfare distribution effect. Even though the price decrease resulting from monetary easing could increase the welfare of consumers, it does harm farmer welfare. Given the fact that around half of the population still live in rural areas, such a distribution effect could be very extensive.

The governments should make policies to protect farmers from such a negative impact. Possible policies could include subsidies, increasing minimum purchase price, and government guidance of production. The Chinese government has realized this problem since, and is taking active subsidy policies, such as direct subsidy, to improve farmers' income (Yu and Jensen 2010; Huang, Wang and Rozelle 2013).

6. Conclusions

In the past decade, the money supply in China has been expanding rapidly and much faster than GDP growth. Such a monetary easing policy has had serious impact on food prices. In general, we find that the scale of food price increase is smaller than money supply increase, which results in a significant welfare distribution effect. In addition, the impact is heterogeneous for different products.

Money supply has a significant stimulating effect both on demand and on supply, as it could change the market credit condition. We set up a theoretical framework to explain the relationship between food prices and money supply, and find that the final price change is determined by the relative scale of the stimulation effects between demand and supply. If the effect on demand is larger, food price increases; otherwise, food price could decrease in the long run.

We also set up an econometric model and use monthly reported retail prices for 7 main food products (rice, wheat flour, soybean oil, poultry, pork, beef, and mutton) from different sources, to empirically estimate the long-run elasticity of food prices with respect to money supply. The empirical evidence shows that the long-run elasticities of food prices with respect to money supply are smaller than 1, which implies that the scale in food price change is generally smaller than that in money supply.

Specifically, we find that the price is stable for rice and has a smaller positive increase for wheat flours in response to money supply increase. It is possible that the production of these products is limited by land acreage and seasonal factors in China, and hence the stimulating effect on demand is larger than that on supply, which results in price stability or a small increase in price.

However, the price for soybean oil and all meat products including poultry, pork, beef and mutton react negatively to money supply increase. These products are linked to soybean supply and more than 50% of domestic supply in China is imported due to less trade restrictions. In addition, they are highly standardized in the current agricultural production system and less restricted by land and seasonal factors. Market credit easing could make it much easier for the producer to increase the production scale. We speculate that the stimulating effect of money expansion on food supply finally could exceed the effect on food demand in the long run, which is defined as three years in this research. Consequently, money supply puts down these food prices. Our econometric model indicates that the prices for soybean oil, poultry, pork, beef and mutton will respectively decrease by 1.34%, 0.37%, 1.76%, 3.46% and 0.55% in the long run, with a 1% increase in excessive money supply.

Price change has a significant distribution effect on national welfare. Even though food price decline could increase consumer welfare, it harms producers' welfare as around half of the population still lives in rural areas and their livelihood depends on food production. Governments should make policies to protect farmers from such a negative impact. The possible policies could include subsidies, increasing minimum purchase price, and government guidance for production. The Chinese government may have realized this problem, and is hence taking active subsidy policies to improve farmers' income (Huang, Wang and Rozelle 2013).

The mainstream of the literature uses the cointegration test to identify the long-run impact of monetary supply on food price, which however does not sufficiently identify the long-run impact. It is clear that if the money supply has long-run memories, its impact exists no matter whether the impact is significant or not. This paper hence adapts a different but more general test to study this issue. In an era of global monetary easing, the theoretical framework and

econometric method proposed in this research could be easily extended to the studies in other countries.

References:

Anderson, K. and S. Nelgen (2012). "Trade Barrier Volatility and Agricultural Price Stabilization." *World Development* 40(1): 36-48.

Awokuse, T.O. 2005. “Impact of Macroeconomic Policies on Agricultural Prices.” *Agricultural and Resource Economics Review* 34:226-237.

Barnett, B. J. 2000. “The U.S. Farm Financial Crisis of the 1980s.” *Agricultural History* 74:366-380.

Barnett, B, J. et al. 1983,”The Money Supply and Nominal Agricultural Prices” *American Journal of Agricultural Economics*, 65:303-307

Bordo, M.D. 1980. “The Effects of Monetary Change on Relative Commodity Prices and the Role of Long-Term Contracts.” *Journal of Political Economy* 88:1088-1109.

Bullard, J. 1999. “Testing Long-Run Monetary Neutrality Propositions: Lessons From the Recent Research.” *Federal Reserve Bank of St. Louis Review*, November, pp. 57- 78.

Chambers, R.G. and R.E. Just. 1982. “An investigation of the effect of monetary factors on agriculture.” *Journal of Monetary Economics* 9:235-247.

Choe, Y.C. and W.W. Koo, 1993. “Monetary Impacts on Prices in the Short and Long Run: Further Results for the United States.” *Journal of Agricultural and Resource Economics* 18:211-224.

Devadoss, S. 1991. “Tests of Monetary Neutrality on Farm Output.” *Western Journal of Agricultural Economics* 16:163-173.

Dorfman, J.H. and W.D. Lastrapes. 1996. “The Dynamic Responses of Crop and Livestock Prices to Money-Supply Shocks: A Bayesian Analysis Using Long Run Identifying Restrictions.” *American Journal of Agricultural Economics* 78:530-541.

Dornbusch, R. 1976. “Expectations and Exchange Rate Dynamics.” *Journal of Political Economy* 84:1161-1176.

Frankel, J. 1986. "Expectations and Commodity Price Dynamics: The Overshooting Model." *American Journal of Agricultural Economics* 68:344-348.

Ferreira F. H. G., A. Fruttero, P. G. Leite and L. R. Lucchetti (2013) “Rising Food Prices and Household Welfare: Evidence from Bbrazil in 2008.” *Journal of Agricultural Economics*, Vol. 64(1):151-176.

Fischer, S., 1977. “Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule.” *The Journal of Political Economy* 85:191-205.

Fisher, M.E. and J.J. Seater. 1993. “Long-Run Neutrality and Superneutrality in an ARIMA Framework.” *American Economic Review* 83:402-415.

Gertler, M. and S. Gilchrist. 1994. „Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms” *Quarterly Journal of Economics* 109:309-340.

Gilbert, L.C. 2010. “How to Understand High Food Prices.” *Journal of Agricultural Economics* 61:398-425.

Golosov, M., and R.E.Jr. Lucas. 2007. “Menu Costs and Phillips Curves.” *Journal of Political Economy* 115:171-199.

Headey, D. and S. Fan (2008). "Anatomy of a Crisis: the Causes and Consequences of Surging Food Prices." *Agricultural Economics* 39: 375-391.

Holt, C. C. 2004. “Forecasting Seasonals and Trends by Exponentially Weighted Moving Averages”. *International Journal of Forecasting* 20: 5–10.

Huang J., X. Wang and S. Rozelle (2013) “ The Subsidization of Farming Households in China’s Agriculture.” *Food Policy*. Vol. 41: 124-132.

Johansen S. 1995. Likelihood-Based Inference in Cointegrated Vector Autoregressive Models. Oxford: Oxford University Press.

Kaabia, M.B. and J.M. Gil. 2000. “Short- and long-run effects of macroeconomic variables on the Spanish agricultural sector.” *European Review of Agricultural Economics* 27:449-471.

Lapp, J.S. 1990. “Relative Agricultural Prices and Monetary Policy.” *American Journal of Agricultural Economics* 72:622-630.

Lastrapes, W.D. 2006. “Inflation and the Distribution of Relative Prices: The Role of Productivity and Money Supply Shocks.” *Journal of Money, Credit and Banking* 38:2159-2198.

Lucas, R.E.Jr. 1972. “Expectations and Neutrality of Money.” *Journal of Economic Theory* 4:103-124.

Mackowiak, B. and M. Wiederholt. 2009. “Optimal Sticky Prices under Rational Inattention.” *American Economic Review* 99:769-803.

Meyer, S. and X. Yu. 2011. “Long-run neutrality of money supply for food prices in Germany with policy effects.” Paper presented at EAAE Congress, Zürich, 30 August- 2 September.

Meyer S. and X.Yu, (2013) "The impacts of production uncertainties on world food prices", *China Agricultural Economic Review*, Vol. 5(4), pp.459 - 472

Newey, W.K. and K.D. West. 1987. “A Simple, Positive Semi-Definite, Heteroscedasticity and Autocorrelation Consistent Covariance Matrix.” *Econometrica* 55:703–708.

Olekalns N. 1996. “Some Further Evidence on the Long-Run Neutrality of Money”. *Economics Letters*, Vol. 50:393-398.

Olivera, J. H. G. 1970. "On Passive Money." *Journal of Political Economy.* 78:805-814.

Orden, D. 2010. “Recent Macroeconomic Dynamics and Agriculture in Historical Perspective.” *Journal of Agricultural and Applied Economics* 42:467-476.

Qayyum, A. 2006. “Money, Inflation and Growth in Pakistan.” *The Pakistan Development Review* 45: 203-212.

Robertson, J.C. and D. Orden. 1990. “Monetary Impacts on Prices in the Short and Long Run: Some Evidence from New Zealand.” *American Journal of Agricultural Economics* 72: 160-171.

Saghaian, S.H., M.R. Reed and M.A. Marchant. 2002. “Monetary Impacts and Overshooting of Agricultural Prices in an Open Economy.” *American Journal of Agricultural Economics* 84:90-103.

Seale, J.Jr., A. Regmi, and J. Bernstein. 2003. “International Evidence on Food Consumption Patterns.“ Washington DC: U.S. Department of Agriculture, ERS Technical Bulletin No 1904, October.

Sims, C.A. 2003. “Implications of Rational Inattention.” *Journal of Monetary Economics* 50:665-690.

Westerlund J. and M. Costantini, 2009. “Panel Cointegration and the Neutrality of Money.” *Empirical Economics*, 36:1–26.

Wright, B. D. (2011). "The Economics of Grain Price Volatility." *Applied Economic Perspectives and Policy* 33(1): 32-58.

Yang, J., et al. (2008). "Fighting global food price rises in the developing world: the response of China and its effect on domestic and world markets." *Agricultural Economics* 39: 453-464.

Yu, W. and H. G. Jensen (2010). "China's Agricultural Policy Transition: Impacts of Recent Reforms and Future Scenarios." *Journal of Agricultural Economics* 61(2): 343-368.

Yu X. (2014) “ Raising Food Prices and Welfare Change: A Simple Calibration”. *Applied Economics Letters*. Vol.21(9):643-645.

Yu X. and D. Abler (2009): "The Demand for Food Quality in Rural China." *American Journal of Agricultural Economics*, Vol. 91(1): 57-69.

Yu X. and D. Abler. (2014): “ Where Have All the Pigs Gone? Inconsistencies in Pork Statistics in China” . Forthcoming in *China Economic Review*. DOI: 10.1016/j.chieco.2014.03.004

Yu X. and G. Zhao (2009): Chinese Agricultural Development in 30 Years: A Literature Review, *Frontiers of Economics in China*, Vol.4 (4):633-648.

Table 1: Changes in GDP, Money Supply and Food Prices (1999-2012)

Year	Nominal GDP	Real GDP	M2	M1	CPI	Food CPI	M2/Nominal GDP	M2/Real GDP
	Trillion Yuan	Trillion Yuan Price in 1999	Trillion Yuan	Trillion Yuan	1999=100	1999=100		
1999	8.85	8.85	11.99	4.58	100.00	100.00	1.36	1.36
2000	9.80	9.76	13.46	5.31	100.42	97.40	1.37	1.38
2001	10.81	10.69	15.83	5.99	101.11	97.40	1.46	1.48
2002	11.91	11.87	18.50	7.09	100.30	96.82	1.55	1.56
2003	13.50	13.32	22.12	8.41	101.50	100.11	1.64	1.66
2004	15.95	15.13	25.41	9.60	105.46	110.02	1.59	1.68
2005	18.36	17.31	29.88	10.73	107.36	113.21	1.63	1.73
2006	21.59	19.96	34.56	12.60	108.98	115.81	1.60	1.73
2007	26.64	23.45	40.34	15.26	114.21	130.06	1.51	1.72
2008	31.60	26.15	47.52	16.62	120.94	148.66	1.50	1.82
2009	34.03	28.60	60.62	22.00	120.08	149.70	1.78	2.12
2010	39.98	32.08	72.59	26.66	124.05	160.47	1.82	2.26
2011	47.21	35.16	85.16	28.98	130.74	179.41	1.80	2.42
2012	51.93	38.71	97.41	30.87	134.14	186.95	1.88	2.52

Data Sources: *China Statistical Yearbook* (Various Edition)

Table 2: Percentage of Import Dependence for Food Products in China (%)

	Beef	Mutton & Goat Meat	Pork	Poultry	Wheat	Rice	Soyabean Oil	Soyabeans
2000	1.9	1.5	0.8	4.7	1.9	-1.9	12.2	46.3
2001	1.6	1.8	0.3	3.4	1.1	-1.0	9.1	52.4
2002	2.0	2.2	0.4	2.4	0.9	-1.0	20.8	42.9
2003	2.2	1.6	0.2	3.3	-0.6	-1.4	28.9	61.7
2004	1.6	1.3	-0.3	2.8	7.0	0.3	35.2	55.4
2005	1.2	1.3	-0.4	2.8	4.1	0.2	21.8	66.2
2006	1.2	1.1	-0.4	3.9	0.1	-0.1	18.9	66.1
2007	1.4	1.5	0.3	4.7	-1.6	-0.3	30.3	71.5
2008	2.1	2.0	1.6	5.9	0.8	-0.2	26.2	69.0
2009	2.9	2.2	0.9	4.7	1.8	0.0	23.2	74.7

Notes: 1,Percentage of Import Dependence =Net Import/ Domestic Supply* 100%

2, Data Source: FAO Database.

Table 3: Data Structure and Sources

Products	Period	Covering Area	Source
Rice	August 2003-June 2012	national average price covering both rural and urban areas	Ministry of Commerce
Wheat Flour	August 2003-June 2012		
Soybean Oil	May 2004-March 2013		
Poultry	January 2004-March 2013		
Pork	April 2005-September 2012	average retail price for 36 Chinese major cities	Nation Development and Reform Commission
Beef	June 2006-September 2012		
Mutton	April 2005-September 2012		

Notes: The Data are taken from the database of *wind*.

Table 4: Stationary Tests

	Augmented Dicky-Fuller test H0: Existence of Unit Roots		KPSS test Ho: Stationarity	
	Level	First-Order Difference	Level	First-Order Difference
Log(M2)	0.560	-15.235***	1.590***	0.163
Log(Rice Price)	0.411	-9.294***	1.310***	0.173
Log(Wheat Flour Price)	-0.744	-11.974***	1.380***	0.063
Log(Soybean Oil Price)	-1.492	-10.020***	1.080***	0.080
Log(Chicken Price)	-1.779	-16.846***	1.340***	0.085
Log (Pork Price)	-1.911	-7.502***	0.861***	0.107
Log(Beef Price)	-2.052	-7.035***	1.020***	0.207
Log(Mutton Price)	-2.384	-14.794***	1.300***	0.087

Table 5: Johansen's Trace Tests for Cointegration between Money Supply and Food Price

	Dicky-Fuller test	
	Rank 0	Rank 1
Log(Rice Price)	10.12	2.24
Log(Wheat Flour Price)	12.47	1.39
Log(Soybean Oil Price)	6.95	0.34
Log(Chicken Price)	8.73	0.25
Log (Pork Price)	5.18	0.68
Log(Beef Price)	7.96	0.07
Log(Mutton Price)	11.77	0.49
5% Critical value	15.41	3.76

Table 6: Estimation of Long-Run Elasticities for 12, 24 and 36 Months

	Lags	12 months	24 months	36 months
Log(Rice Price)	Coefficient	-0.342	-0.125	0.038
	S.E.	0.178*	0.177	0.231
Log(Wheat Flour Price)	Coefficient	-0.283	-0.031	0.195
	S.E.	0.115**	0.125	0.074**
Log(Soybean Oil Price)	Coefficient	-1.873	-1.645	-1.340
	S.E.	0.508***	0.585***	0.430***
Log(Chicken Price)	Coefficient	-0.725	-0.591	-0.346
	S.E.	0.256***	0.218***	0.116***
Log (Pork Price)	Coefficient	-2.974	-3.444	-1.756
	S.E.	0.947***	0.535***	0.468***
Log(Beef Price)	Coefficient	-1.855	-2.221	-3.464
	S.E.	0.451***	0.336***	0.696***
Log(Mutton Price)	Coefficient	-1.002	-1.156	-0.549
	S.E.	0.466**	0.334***	0.241**

Notes: Standard Errors are estimated by Newey-West procedure with a lag of 5 months.

Figure 1: Changes in Money Supply and Food Prices in China

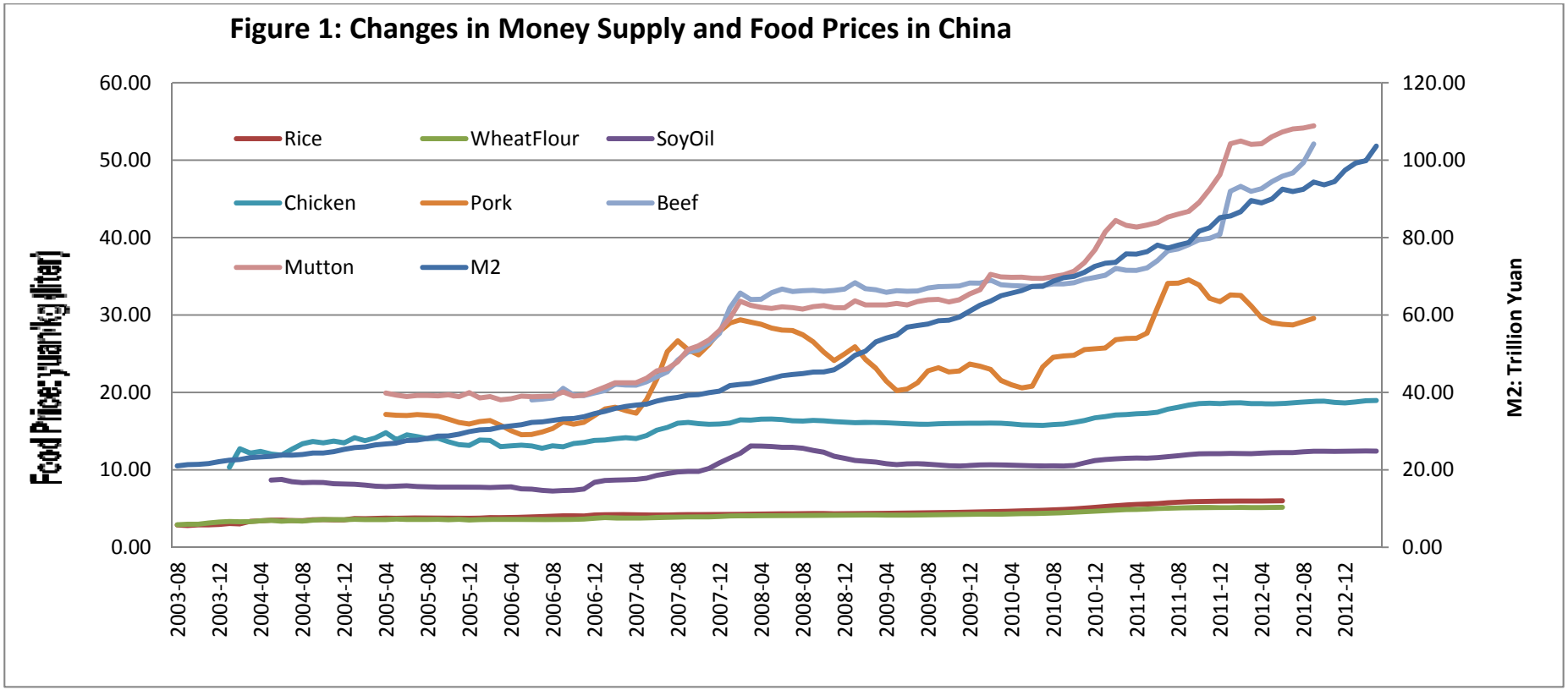
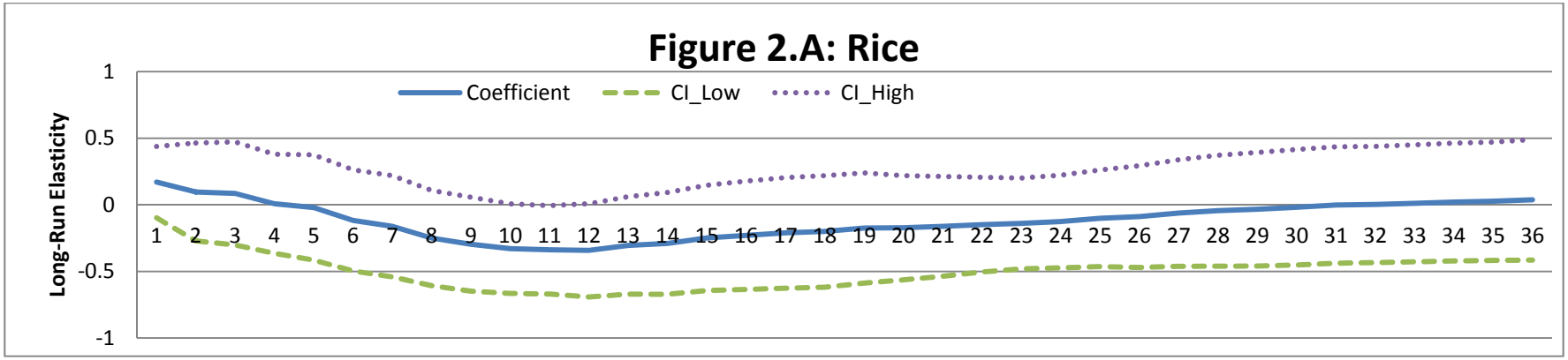
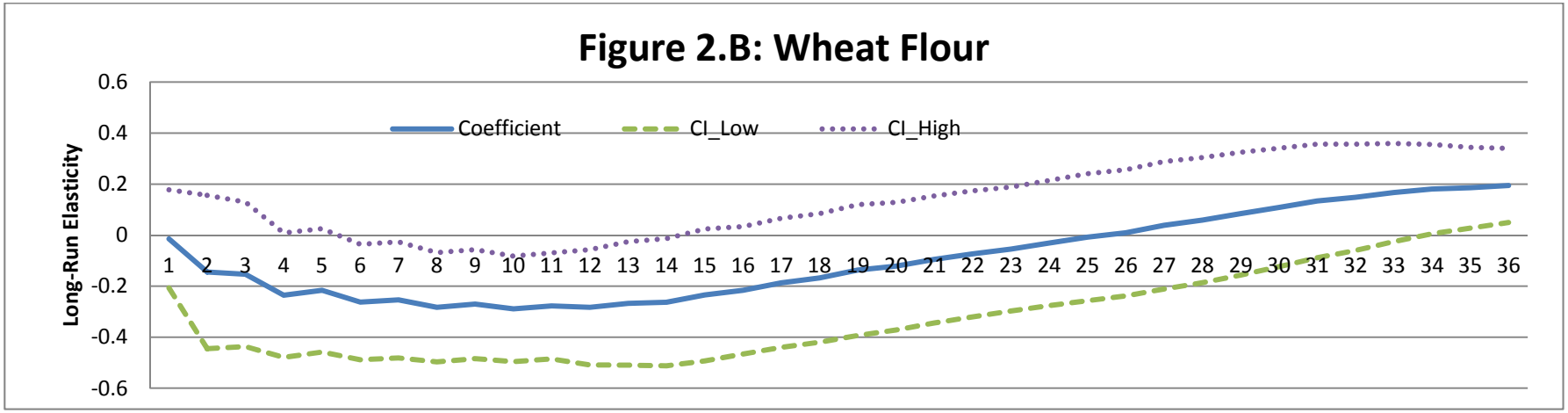


Figure 2: Long-Run Impacts of Money Supply on Different Food Prices





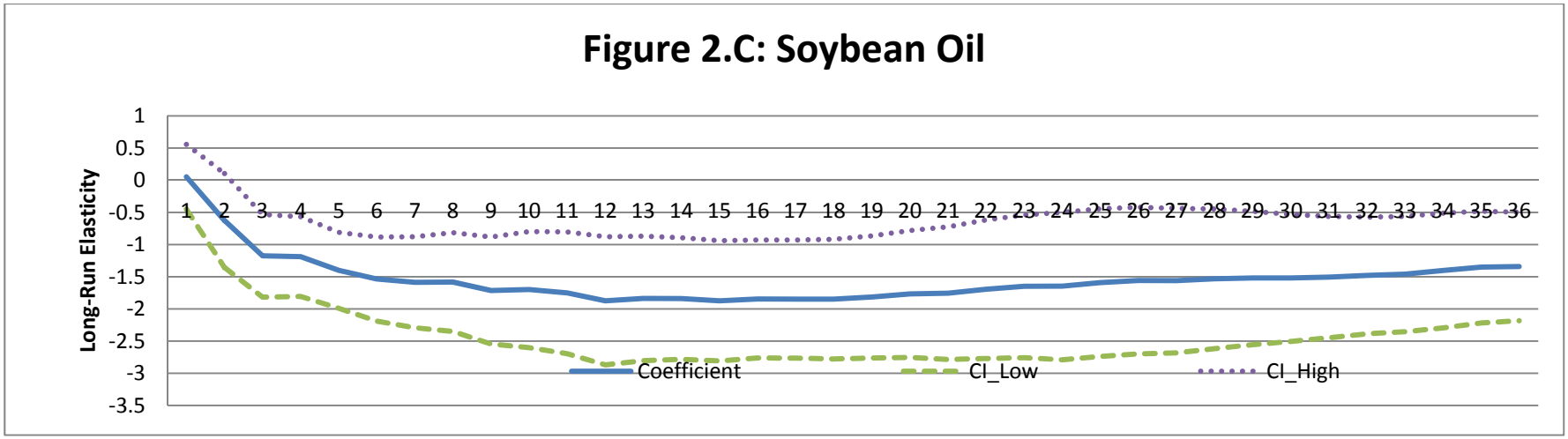


Figure 2.C: Soybean Oil
Long-Run Elasticity
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36
Coefficient
CI_Low
CI_High

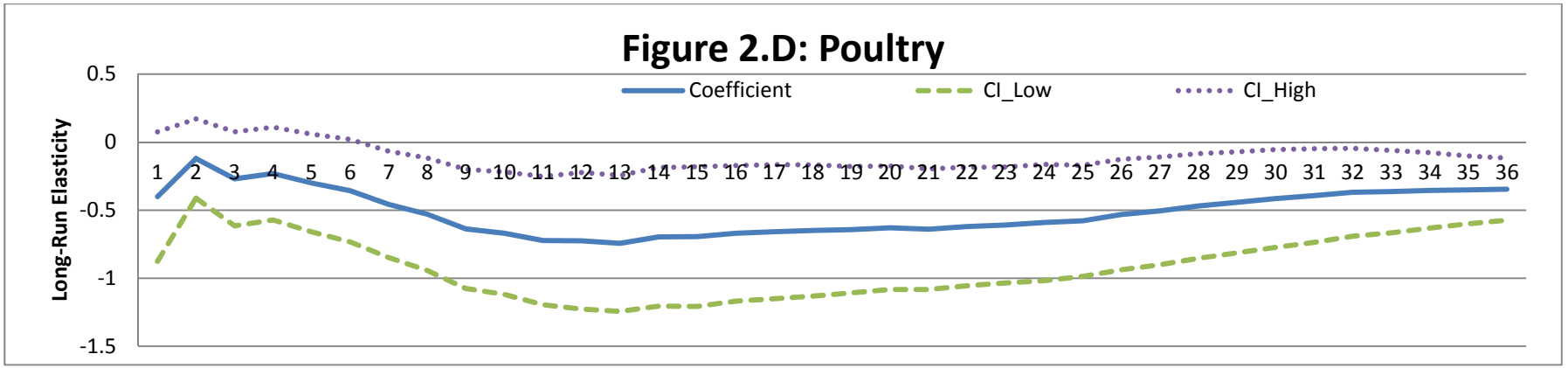


Figure 2.D: Poultry
Long-Run Elasticity
0.5
0
-0.5
-1
-1.5
Coefficient
CI_Low
CI_High
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36

Figure 2.E: Pork

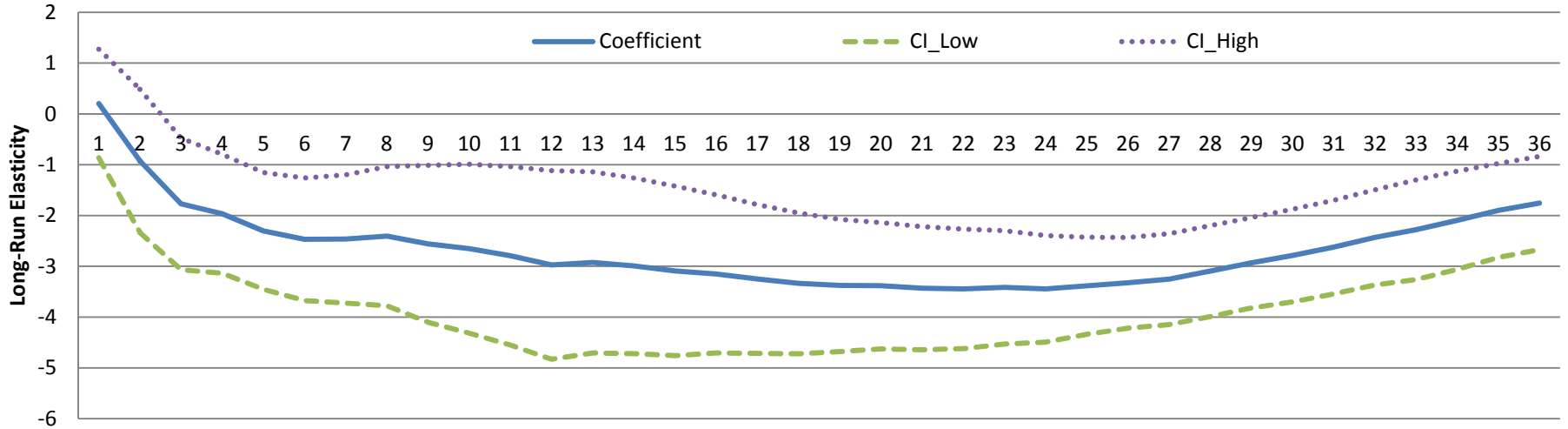
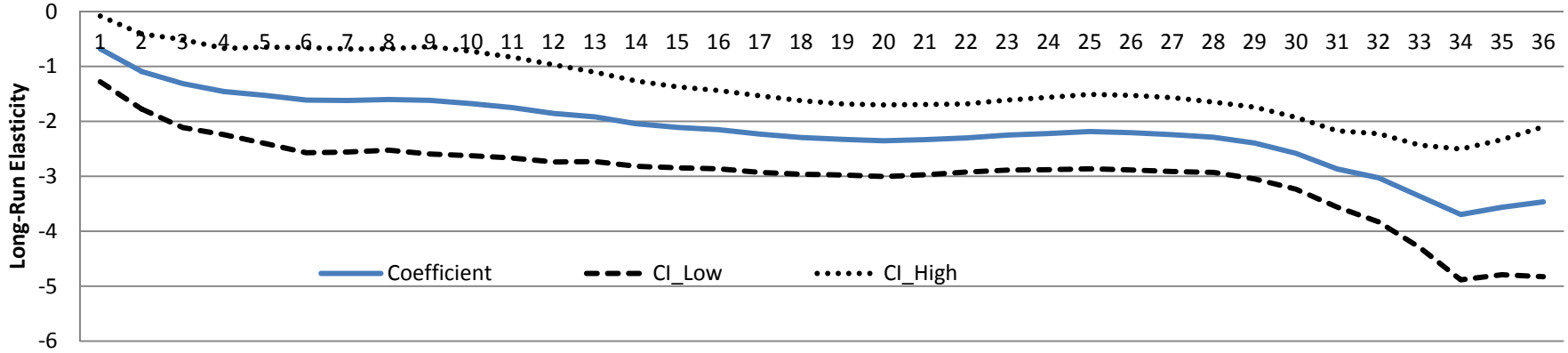


Figure 2.F: Beef



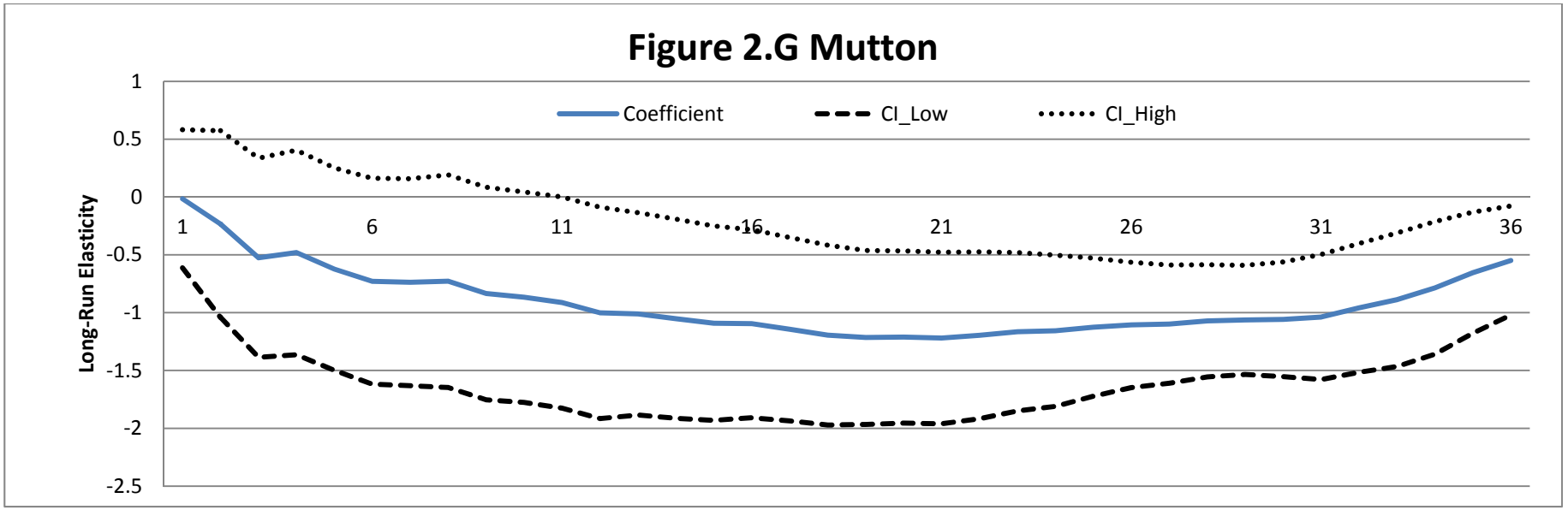


Figure 2.G Mutton
Coefficient
CI_Low
CI_High
Long-Run Elasticity
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
1
6
11
16
21
26
31
36

Vita:

Xiaohua Yu is Professor of Agricultural Economics in Developing and Transition Countries at the Department of Agricultural Economics and Rural Development and the Courant Research Centre ’Poverty, Equity and Growth’ in the University of Göttingen,Germany. He obtained his Ph.D. from the Pennsylvania State University in the U.S. in 2009. His research interests cover agricultural economics, environmental economics, Chinese economy, and applied econometrics. He currently serves as the associate editor for *agricultural economics*, the official journal of International Association of Agricultural Economists (IAAE).