Long-run neutrality of money supply for food prices in Germany with policy effects

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Abstract:

Using a modified Fisher-Seater model with consideration of policy impacts, this paper attempts to tests the long-run neutrality of money supply on food prices in Germany after the launching of the Eurozone. The main findings include: (1) we can not reject the super neutrality of money for aggregated food prices; (2) However, staple food and its derived products – meat- are very sensitive to money supply, and their prices can increase to be much higher than money growth rate, perhaps due to speculative effects and demand effects; (3) Fresh or perishable products are usually less sensitive to money growth; (4) Most products decreased their prices after the launching of decoupling policy in Europe in 2003. The results can explain the links between money supply and food prices in a long run and also give insightful implications for the ongoing reform of CAP (Common Agricultural Policy) in Europe.

Key Words: money supply, German food prices , CAP

1 Introduction

Since Fisher and Seater (1993) (FS) developed an approach to test the long-run neutrality of money for other economic variables in an ARIMA framework, the approach has been extended and widely applied in a lot of contexts, such as price changes, Bullard (1999) is comprehensive review. Prices are a key issue in agricultural policy, as food prices are strongly linked to both producers' and consumers' welfare. So far, a large bulk of literature has mainly focused on the prices within agricultural products, particularly price transmissions between different products or across different regions. For instance, Meyer and Cramon-Taubadel have a good survey on it. Without exception, macroeconomic variables,such as monetary supply , of course can impact prices of agricultural products, and the research on the long-run impact of monetary supply on food prices is only conducted in a very limited way. Adopting FS approach, we will shed the light on the long-run impact of money supply on agricultural prices.

Agricultural prices are a very complicated system and the shock of money supply on agricultural prices hence are also quite complicated. Changes in money supply would result in different impacts on producers and consumers respectively. If food prices are inelastic, an increase in money supply could push up food prices dramatically in a short run due to demand effect or speculation, or vice versa. For instance, the food crisis caused by high world food prices could be driven by the over-supply of money. On the other hand, over-supply of the money could pump a lot of liquidity into production, which eventually increases the supply in a long-run and possibly reduces the prices. The aggregate effect of money supply on food prices in a long run is ambiguous and might be different for different products.

Particularly, agricultural prices in European countries are very dynamic in an era of integration. The launching of Euro zone makes the impact of monetary supply heterogeneous within each member due to economic unbalance. For instance, the supply of money in European Central Bank may have different impact on wheat prices in France and Germany. In order to estimate the long-run effects of money supply on food prices , we should look into each individual country separately.

In addition, European countries are experiencing a transition of agricultural policies from coupled price policies to decoupled price policies, and the breaking point is 2003. Because policy targets of the CAP (Common Agricultural Policies) include increasing productivity and farmer income, stabilizing market, securing supply and providing consumers with reasonable prices, it makes the policy impacts on prices more complicated and even unpredictable in a long run. Nevertheless, we should involve the policy effects in analyzing the long-run impact of money supply on food prices.

Even though the literature measuring the impact of changes in the money supply on agriculture has a long tradition, and the mainstream is measuring the influence on the income of farmers for the US, such as Tweeten (1980),

Chambers and Just (1982), Chambers (1984), Orden (1986), Orden and Fackler (1989) and Dorfman and Lastrapes (1996), the analysis of long-run impact specifically for European countries, has been conducted only in a very limited way, even such an analysis is of particular importance for European countries.

In this paper, we will employ monthly data of money supply and food prices from January 1998 through May 2010 in Germany to empirically study the long run impacts of money supply and policy reforms. In particular, we will test if the money supply is long-run neutral for food prices.Germany is the largest economy in the Euro zone and one of the largest producer of agricultural products, so the results may have very important policy implications for the whole Euro zone.

The structure of the paper is outlined as follows: Section 2 will first introduce the models which is a Modified Fisher-Seater Approach with consideration of policy effects; Section 3 describes the data , which is followed by Section 4 discussing the empirical results, and finally Section 5 draws conclusions and gives policy implications.

2 Adjusted Fisher and Seater Methodology

The theoretical foundation for the test of long-run neutrality and super neutrality was first introduced by Fisher and Seater (1993) and it was used to measure the long-run (super) neutrality of nominal money supply, which is defined as a permanent and exogenous change of the level (first difference) of a variable on the level of another variable. Fisher and Seater defined neutrality as nominal money supply having no influence on the variables, such as income, in terms of real values or having an equiproportionate in terms of nominal values.

Similar with FS, we define the variables responding to the shock as neutrality variable (x), and the variable experiencing exogenous and permanent changes as impact variable (y).

The theoretical foundation of the FS approach relies on the framework of integration, and the variables are separated by their order of integration. Especially the neutrality variable has to be at least order 1, otherwise there are no permanent changes. The illustration here is restricted to the analysis of super neutrality, because the neutrality variable is integrated order two (see data section) and the impact variables are integrated order one. For the test of long-run neutrality the variables must have the same level of integration.

FS use a stationary and bivariate ARIMA framework for the explanation of their idea:

$$a(L)\Delta x_t = b(L)\Delta y_t + u_t \qquad (1)$$
$$d(L)\Delta y_t = c(L)\Delta x_t + w_t$$

u_t and w_t are assumed to be independently and identically distributed and the covariates are zero, which are necessary for the identification. a_0 and d_0 are normalized to one. Δ means the first-order difference which is necessary to make the time series stationary.

Super neutrality implies that a permanent and exogenous change captured in u is influencing y in the long-run. This can be measured by the long-run derivative (LRD) of these two variables:

$$LRD_{y,x} = \lim_{k\to\infty} \frac{\partial y_{t+k}/\partial u_t}{\partial \Delta x_{t+k}/\partial\, u_t} \qquad (2)$$

LRD is undefined when there are no permanent, exogenous shocks in the neutrality variable ($\lim_{k\to\infty} \partial\Delta x_{t+k}/\partial\, u_t = 0$). Equation (2) reveals that the result can be interpreted as the long-run semi-elasticity, when the variables x is integrated of rank two and y of one.

In the next step we make use of the impulse-response representation to calculate the LRD:

$$\Delta x_t = \Delta^{-1}(\alpha(L)u_t + \beta(1L)w_t) \qquad (3)$$
$$y_t = \Delta^{-1}(\gamma(L)u_t + \lambda(L)w_t)$$

where α and γ are abbreviations for:

$$\alpha(L) = d(L)/(a(L)d(L) - b(L)c(L)) \qquad (4)$$
$$\gamma(L) = c(L)/(a(L)c(L) - b(L)c(L))$$

The impulse-response representation can be derived by u_t also for the case when k goes to infinity:

$$\lim_{k\to\infty} \partial\Delta x_{t+k}/\partial\, u_t = \gamma(L) \qquad (5)$$
$$\lim_{k\to\infty} \partial y_{t+k}/\partial\, u_t = \alpha(L)$$

which can be composed to the LRD:

$$LRD_{\Delta x,y} = \frac{\gamma(1)}{\alpha(1)} = \frac{c(1)}{d(1)} \qquad (6)$$

A test for super neutrality is defined by Fisher and Seater if LRD is 0 or 1 when the variables are real or nominal values respectively. In order to calculate the test, the Bartlett estimator can be used for $c(1)/d(1)$, which is the frequency-zero regression coefficient. The coefficients b_k of the following regression

$$(y_t - y_{t-k-1}) = a_0 \qquad (7)$$
$$+b_k(\Delta x_t - \Delta x_{t-k-1}) + p + e_{kt}$$

can be interpreted as $\lim_{k\to\infty} b_k$. In the testing procedure coefficients up to k=30 are estimated and tested if they are statistically different of 0 or 1. The confidence intervals are corrected by the procedure of Newey and West (1987).

In equation (7), we include a variable p_t, measuring the long-run policy impacts. This is a dynamic dummy variable with zero before the policy change and following a time trend or a quadratic trend afterwards. Thus we can measure the impact of a policy change.

3 Data

As aforementioned, the observations cover the time period from January 1998 to May 2010, after Germany adopted Euros.

The neutrality variable in our analysis is the real money supply and the impact variables are price indices for different agricultural products in Germany, so that we can test the long-run impact of monetary supply on different agricultural products separately.

The real money supply is defined as the Money-supply-to-Real-GDP-ratio. Particularly, the money aggregate used in this study is the contribution of Germany to the monthly M2 time series of the European Central bank. The series of money supply are seasonally adjusted and standardized to the first month of 2005. GDP (seasonal adjusted) in Germany is taken form the Eurostat database and is only reported quarterly. We assume that in all three months the same output is produced in the economy.

The final Money-supply-to-GDP-ratio is reported in Figure 1 a, and the time span includes the food crisis of 2007 as well as the financial crisis of 2008. Note that at the end of 2008 and beginning 2009 , money supply is relatively faster than GDP, as European Central Bank took monetary policies to incentivize economies.

The food prices or the impact variables are the producer price indices published monthly by the German Statistical Bureau (Statistisches Bundesamt) which are in real values. For the purpose of the analysis, we adjust the indices to the nominal prices by CPI from the same source. Figure 1.b reports a general aggregated price index (API) for all agricultural products. Because agricultural price indices usually demonstrate a strong seasonality, they are adjusted by the loess smoother (Cleveland et. al (1990)).

As mentioned before, the function form by which we estimate super neutrality depends on the data structure of neutrality variables, particularly orders of integration for neutrality variables. If it is a I(2) process, we should take second order differences, otherwise, we should take first-order differences . The results of the ADF and KPSS test for Integration order (2) are reported in table 1. Basically KPSS tests reject the null-hypothesis of order 1 and accept the alternative hypothesis of order 2. Therefore, the following analysis will be based on the second-order differences. In addition, the time series of prices all have an integration order one.

4 Empirical results

Table 2 presents the estimated long-run semi-elasticities for different agricultural prices. An overall price index and several important sub-aggregated groups (crops, vegetables, plants, flowers, fruits, animal products and livestock) or specific products (wheat, corn, potatoes, milk, eggs, cattle, pork and fatted poultry) are reported.

We present the results of the slope coefficients with lags of 6, 12, 18 and 24. Because the values zero and one are important for the interpretations, we additionally apply a t-test to check if the parameters are significantly distinguishable from zero or one. If the slope is equal to zero, it implies the prices are inelastic with

respect to money supply, and if it equals to 1, it implies that the product is neutral with equal proportion ration of money growth.

In General, the money supply has a positive impact on food prices in a long run except for cattle.

In the first row of table 2, the parameters for the aggregated price index (shown in figure 1 b) is reported. The effect is positive and increasing to long-run super neutrality in the last two observations. We can not reject the null hypothesis of super neutrality of money supply for agricultural prices as a whole basket.

Now we will briefly discuss long-run impacts of monetary on different agricultural products, as different products may have different impacts.

The most important category in the German agriculture is the grain production. The grains group is at first zero and then keeps increasing to more than 1, and significantly higher than 1. It implies that grain group is very sensitive to money supply. Similar results can be found specifically for wheat and corn. Other sensitive products include animal products, milk, eggs, livestocks, hogs, and poultry. These basically are staple food or products based on staple food as feed. Because the price elasticity of staple food is very small, an increase in money supply could push the price to a very high due to speculation.

Table 1 also indicates that vegetables, potatoes, flowers, plants, and fruits are mainly fresh and perishable products, and the life cycles are very short. It is very difficult to conduct speculative investment in a long run, so that the shocks of money supply on these products are less sensitive. Their elasticities with respect to money supply are positive but lower than 1 in a long run.

Table 3 reports the impacts of CAP reform in Germany in a long run. As Germany adopted the decoupling agricultural policy in 2003, so that we included a policy variable starting with the year 2003. The results are quite interesting, basically, most products except for AAP, vegetables, Flowers, and hogs are negative and statistically significant. That means the decoupling reduced food prices in Germany, which is consistent with the common wise of 2003 CAP reform.

5 Conclusions

Even though there is a large volume of literature analzing the impact of macroeconomic variables, such as money supply, on food prices, most of them just focus on the short-run effect. The long-run impact of money supply on food prices has been well studied. Using a modified Fisher-Seater model with considering policy impacts, this paper attempts to study the long run impact of money supply on food prices in Germany which will give some insightful policy implication for the ongoing CAP reform in Europe.

Changes in money supply results in complicated effects on producers and consumers respectively. If food prices are inelasticitic, an increase in money supply could push up food prices dramatically in a short run due to demand effect, and vice versa. On the other hand, over-supply of money also could pump a lot of money into production, which eventually increases the supply in a long-run and possibly reduces the prices. In aggregation and in a long run, the impacts could be ambiguous.

The results of this study indicate that: (1) Most agricultural prices increase in money supply, and we can not reject the super neutrality of money for aggregated food prices; (2) The different agricultural sections may have different impacts. Staple food and its derived products- meat are very sensitive to money supply, and their prices can increase to be much higher than money growth rate, perhaps due to speculative effects and demand effects; (3) Fresh or perishable products are usually less sensitive to money growth; (4) Most products did decrease their prices after the launching of decoupling policy in Europe in 2003. These findings can explain the links between money supply and food prices in a long run and also give insightful implications for the ongoing reform of CAP (Common Agricultural Policy) in Europe.

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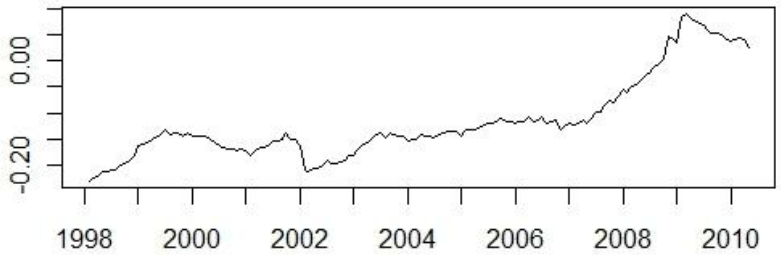
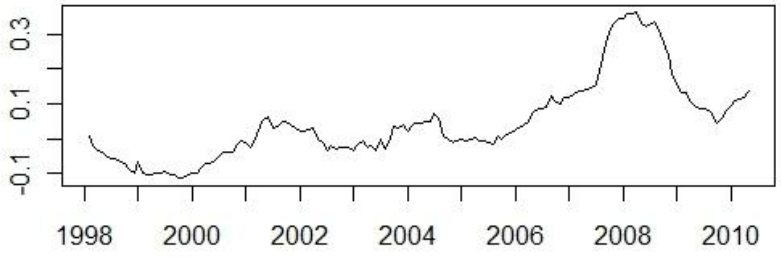


a) Index of real money supply (in logarithms)



b) Index of aggregated Agricultural Prices (in logarithms)

Table 1: Real money supply and the aggregated agricultural prices (January 1998 to May 2010)

Table 1: The Tests of Integration Orders for the Real Money Supply in Germany

	Level	Lag 1	Lag 2
ADF	-1.65	-3.00	-3.85**
KPSS	0.83**	0.12*	0.027

Note: **, * means significance level of 5% and 10%, respectively

Table 2: Coefficients of a long-horizon regression of real money supply on aggregated and disaggregated price indices and the results of t-tests

		k=6	k=12	k=18	k=24
API		0.17	0.62	1.05	0.97
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**		
Cereals		-0.07	1.22	3.27	4.01
	$b_k = 0$		**	**	**
	$b_k = 1$	**		**	**
Wheat		-0.76	1.74	5.77	7.16
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**		**	**
Corn		0.15	4.15	8.02	8.12
	$b_k = 0$		**	**	**
	$b_k = 1$	**	**	**	**
Vegetables		0.64	0.5	0.37	0.25
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Potatoes		0.12	0.23	0.36	0.21
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Flowers		0.26	0.5	0.53	0.58
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Plants		0.37	1.12	0.65	0.82
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Fruits		0.44	0.49	0.65	0.27
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Animal Products		4.4	4.69	10.12	12.33
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Milk		0.38	1.41	2.11	1.67
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Eggs		1.11	1.98	3.64	3.55
	$b_k = 0$	**	**	**	**
	$b_k = 1$		**	**	**
Livestock		0.61	1.32	1.95	1.37
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**
Cattle		0.48	1.08	0.74	-0.64
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**		**	**
Hogs		0.96	0.05	1.43	1.33
	$b_k = 0$	**		**	**
	$b_k = 1$		**	**	**
Fattened Poultry		0.5	1.2	1.77	1.44
	$b_k = 0$	**	**	**	**
	$b_k = 1$	**	**	**	**

Note: ** and * denote significance level of 5% and 10%, respectively

Table 3: Impact of the policy variable for the decoupling of the agricultural subsidies

	k=6	k=12	k=18	k=24
API	-7.00E-04	-1.00E-04	0.0015	0.0031**
Cereals	-0.0026	-0.0055	-0.0065*	-0.0035
Wheat	-0.0057	-0.0097	-0.0126	-0.0036
Corn	-0.0105*	-0.0173*	-0.0218*	-0.016
Vegetables	4.00E-04	-0.0016	-0.0013	-0.0028
Flowers	0.0013	0.0028	0.0047	0.006
Plants	-1.00E-04	-3.00E-04**	-2.00E-04**	-0.0012**
Potatoes	-0.0025**	-0.0089**	-0.0138**	-0.0212**
Fruits	0.0027	0.0053	0.0082**	0.0101**
Animal Products	-0.0011	-0.0212*	-0.0164	-0.0185
Milk	0.0011	0.0039	0.0071*	0.0123**
Eggs	-0.0016	-0.0082	-0.0144**	-0.0127**
Livestock	-0.001	-0.0042	-0.0081**	-0.006
Cattle	-4.00E-04	-0.0017**	-0.0029	1.00E-04
Hogs	-0.0017	-0.0049	-0.0076**	-0.0086**
Fattened Poultry	0.004**	0.0091**	0.0143**	0.0196**

Note: **, * denote significance level of 5% and 10%, respectively