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Research Article

An Improved Empirical Model for Evaluating the Influence of Agricultural Supply Chain on Food Processing Enterprise Performance

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Abstract: Agriculture supply chain has much economic benefits, it can promote the product circulation, provide cooperation opportunity for both the upstream and downstream enterprises. In order to analyze how the agriculture supply chain effect on the business performance in food processing industry, we make a statistical analysis about the effect of agriculture supply chain on food processing industry by using data from 1990 to 2013. The result shows that: First, Agriculture supply chain development will promote the food processing industry's performance in short time, but this effect will reduce gradually in the long time. Second, agriculture supply chain is the granger reason to the business performance of food processing industry and there exist a long-term equilibrium relationship between them. On this basis, we put forward the related suggestions.

Keywords: Agriculture supply chain, business performance, food processing industry, granger test

INTRODUCTION

Today's society, with the flourishing development of agriculture supply chain industry is showing a trend of any related the development of supply chain, rural products business, the construction of the rural area, commercial trend of village culture is spreading every corner of society (Zhou, 2007). Leisure is closely related to everyone's life, with the continuous improvement of people's living standard and the increase in leisure time, a suitable public agriculture supply chain era is coming and a new industry, Agriculture supply chain industry have emerged (Li and Geoffrey, 2008; Ning *et al*., 2013). Agriculture supply chain is the product of human social development, is a sign of progress of human society (Aliza and Anat, 2005). The agriculture supply chain industry development in China's not so long, with the constantly improving standard of people's material and cultural consumption, leisure has become an important requirement in people's spiritual and material life, especially on how to give an impetus to the economic development in recent years, making an important contribution to enrich people's leisure life. Agriculture supply chain and its related problem research are more and more important, by the people from all walks of life (Li, 2014; Pesonen and Komppula, 2010; Zhou and Chen, 2012). Particularly in terms of food consumption in Agriculture supply chain, as a result of the Agriculture supply chain has such characters as green, leisure, Agriculture supply chain at the same time promote the agricultural and sideline products, especially the rural characteristics of food production and consumption (Donald and Jack, 2000).

Agriculture supply chain is the use of rural infrastructure and space, the field of agricultural production, agricultural products, agricultural activities, natural ecology, agriculture and rural human resources, natural environment through planning and design, to play to the agricultural and agriculture supply chain function, enhance the experience of people in rural areas and agriculture, enhance the quality of tourism and improve farmers' income, promote rural development of a new model (Zhou and Qing, 2014; Su, 2011). At the same time, agriculture supply chain is based on agriculture, for the purpose of leisure, by means of service, leisure travelers, for the service object, through scientific planning and development in the countryside, for rural tourists provide leisure, sightseeing, recreation, travel demand management experience, fitness, etc., (Li, 2011). Agriculture supply chain including rural products, services and activities provided also has four characteristics of agriculture supply chain industry commodity: invisibility, perishable, heterogeneity, inseparable.

Gregory and Stephen (2011) pointed out that agriculture supply chain can increase the farmers' income channels, increase the income of the farmers, rural prosperity and meet the needs of tourists on rural food needs. Erick and Holly (2009) said that the agriculture supply chain has the economic protection function. Agriculture supply chain can improve the natural resources, maintaining ecological balance; improve the quality of living environment (Arie and Oded, 2000). Filippo and Romei (2014) find out that agriculture supply chain has social function, rural agriculture can promote the exchanges between urban and rural areas, to increase employment opportunities

for farmers, promote the development of rural society, narrowing the gap between urban and rural areas. Park *et al*. (2014) said that agriculture supply chain can provide entertainment for visitors to places and services. Li and Ning (2012) pointed out that the agriculture supply chain has the function of education. Agriculture supply chain can educate visitors learn agricultural knowledge, let visitors understanding the agricultural production activities and help visitors participate into the outdoor natural classroom. Sharpley and Deborah (2011) pointed out that agriculture supply chain has medical function, unique leisure agriculture area of the natural environment and living environment can ease the visitor's work, learning and life pressure, physical and mental relaxation is health care places. Lin and Kuo (2013) find out that the agriculture supply chain has the function of cultural inheritance, Agriculture supply chain saves and passing on rural folk culture, it can promote the countryside culture promote spread.

For the income of agriculture supply chain channel of economic benefits, the development of agriculture supply chain can fully utilize rural natural resources, optimizing the agricultural structure and expanding agricultural function (Qing and Li, 2013). At the same time, it can extend the agricultural industrial chain, also the development of agriculture supply chain service industry will promote the transfer of farmers employment, increase the income of farmers and create a good economic foundation for the new construction (Leiper, 1990; Zhou, 2013). Therefore, in this study, we try to test the effect through the development of agriculture supply chain research for the characteristics of food production and consumption in rural areas and analyze the Agriculture supply chain for the food processing industry, especially the impact of agricultural and sideline food processing industry.

MATERIALS AND METHODS

Data collection: In order to analyze how the agriculture supply chain effect on the food processing industry, we use STATA 12.0 software and make a statistical analysis of growth of agriculture supply chain and food processing industry data from the year of 1990 to 2013. All data was collected from China statistical yearbook and Chinese tourism bureau website. We use the first letter to represent the variable as Agriculture Supply Chain (ASC) and Food Processing Industry (FPI) and then we undertook log processing to all the data and noted them as LnASC and LnFPI.

Nonlinear VAR model: We assume the VAR (Q) model as following:

$$\begin{bmatrix} y_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} \beta_1 \\ \gamma_1 \end{bmatrix} + \begin{bmatrix} \alpha_1 & \alpha_2 \\ \varphi_1 & \varphi_2 \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \ldots + \begin{bmatrix} e_1 \\ e_2 \end{bmatrix} \quad (1)$$

In this formula, Q is the lag augmentation of VAR model. We consider now that coefficients that determine causal relationships in the VAR (α_{2q} and φ_{1q}) are not stable but change over time following a logistic smooth transition functional form as:

$$\alpha_{2q} = a_{2q}^{*} + a_{2q}^{**} F\left(\lambda_{1q}, c_{1q}; \tau\right) \quad (2)$$

$$\alpha_{1q} = \varphi_{1q}^{*} + \varphi_{1q}^{**} F\left(\theta_{1q}, g_{1q}; \tau\right) \quad (3)$$

As the transition variable is time, c_{1q} and g_{1q} are interpreted as the timing of the transition midpoint. The midpoint break date would simply be equal to (c_{1q} T+T/2) or (g_{1q} T+T/2). These timing coefficients can be determined endogenously through a grid search procedure, as will be discussed later on, so the researcher does not need to know the break point a priori.

An attractive feature of the VAR model (formula 1) under definition (formula 2, 3) is that it allows us to test a situation where a structural break has occurred in the causal relationships between the variables involved possibly due to a permanent shift in the data to a new regime induced by, for instance, a policy or a structural change in the economy. The transition towards the new regime may not be immediate but a smooth function whose speed of transition can be estimated. This is a plausible situation when the covariates' predictive power before the occurrence of a structural break is different from that after the break, but this change in predictive power takes time to occur. Ignoring the fact that the casual relationships are not stable over time but might change as a result of some structural breaks could lead to erroneous inferences.

We test for nonlinear granger causality from x_t to y_t using two different hypotheses:

$$H_0^1 : \alpha_{21}^{*} = \alpha_{22}^{*} = \ldots = \alpha_{2Q}^{*} = 0 \quad (4)$$

$$H_0^2 : \alpha_{21}^{*} + \alpha_{21}^{**} = \alpha_{22}^{*} + \alpha_{22}^{**} = \ldots = \alpha_{2Q}^{*} + \alpha_{2Q}^{**} = 0 \quad (5)$$

Equally, testing for granger causality from y_t to x_t, then we would have:

$$H_0^1 : \varphi_{11}^{*} = \varphi_{12}^{*} = \ldots = \varphi_{1Q}^{*} = 0 \quad (6)$$

$$H_0^2 : \varphi_{11}^{*} + \varphi_{11}^{**} = \varphi_{12}^{*} + \varphi_{12}^{**} = \ldots = \varphi_{1Q}^{*} + \varphi_{1Q}^{**} = 0 \quad (7)$$

The alternative in all these tests is that the sums of the coefficients are different from zero. Hypotheses H_{01} (formula 4 and 6) and H_{02} (formula 5 and 7) are tests for granger causality before and after the break, respectively. The combination of these two tests allows us to address causality issues and analyze whether

causal patterns have changed after the break. An advantage of these tests is that, for a given set of estimated parameters of the transition function, they can be carried out using standard F statistics. In practice, as will be discussed below, these tests take the form of F statistic. However, note that, under the null hypothesis H_{02}, the parameters of the transition function are not identified. Testing these hypotheses would only make sense if a smooth break exists. These identification issues are discussed in the next section.

RESULTS

ADF unit root test: Data stable is the premise of establishing VAR model, an Augmented Dickey-Fuller test (ADF) is a test for a unit root in a time series sample. We use ADF unit root test to inspect LnASC and LnFPI, the result as is shown in Table 1. Through the test results we can see that LnASC and LnFPI are non-stationary and then we test on d.LnASC and d.LnFPI and demonstrate that they are stable, so we can build the VAR model and use granger test and cointegration test.

VAR model: In VAR model, lag length selection have great influence for VAR model, if we establish two models, it is unable to determine the relationship between variables without the lag length. Therefore, the structure of VAR model is determined by the variables and lag length. I use STATA to measure the lag length; the result is shown in Table 2.

In this study, I use AIC, SC criterion to identify the lag length. From Table 2, we can get that the minimum AIC is -9.62135 in lag 2, so we choose 2 lag as the lag length. According to the analysis above, we construct the VAR regression model of LnASC and LnFPI and choose lag length as 2. Through the STATA 12.0, we get the VAR model as Table 3 and 4.

From the Table 4, we can get the formula of VAR model, as:

$$LnFPI = -0.192 + 0.128LnASC_{t-1} + 0.22LnASC_{t-2} + 0.28LnFPI_{t-1} - 0.04LnFPI_{t-2} \quad (8)$$

Table 1: Augmented Dickey-Fuller test (ADF)

Variable	Test statistic	1% critical value	5% critical value	10% critical value	Result
LnASC	-2.657	-3.750	-3.000	-2.630	Unstable
LnFPI	-1.789	-3.750	-3.000	-2.630	Unstable
D.LnASC	-3.241	-3.750	-3.000	-2.630	Stable
D.LnFPI	-4.063	-3.750	-3.000	-2.630	Stable

Table 2: Selection-order criteria of VAR model

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	36.5359				0.00009	-3.63520	-3.61840	-3.53585
1	89.5991	106.1300	4	0.000	2.3e-07	-8.79991	-8.74943	-8.50167
2	101.4030	23.6070	4	0.022	1.9e-07*	-9.62135*	-9.53723	-9.12428*
3	104.6570	6.5083	4	0.164	2.6e-07	-9.54284	-9.42506	-8.84694
4	112.7380	16.1620*	4	0.003	5.2e-07	-9.47243	-9.82100*	-9.07770

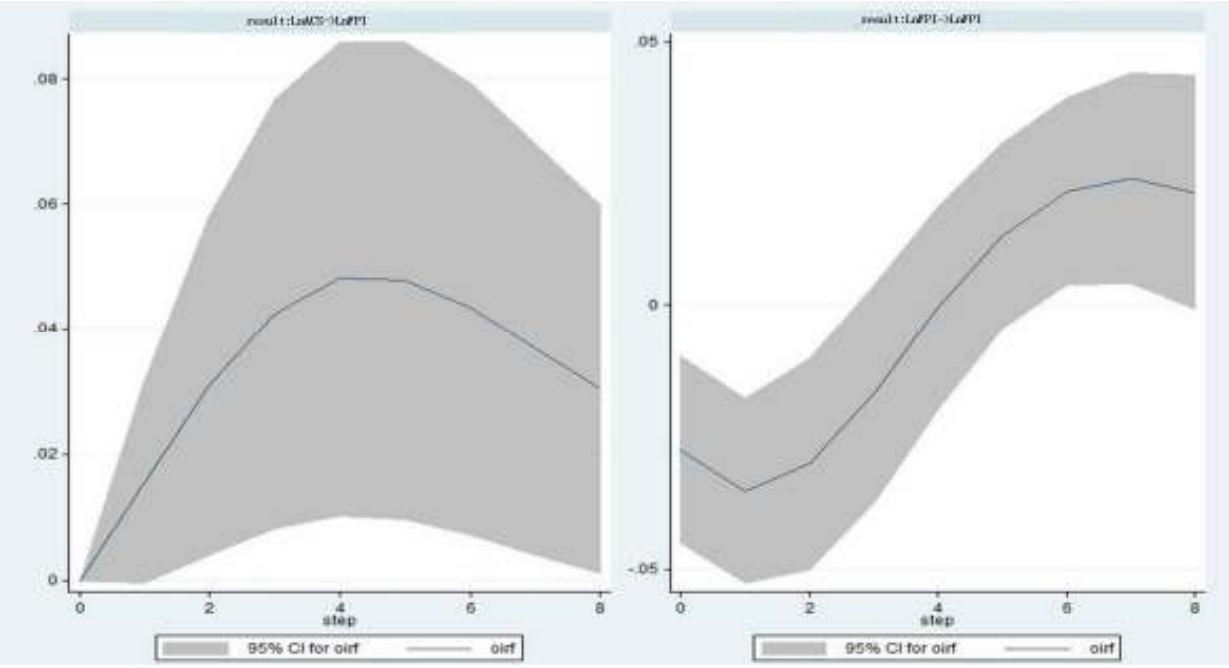

Fig. 1: Impulse-response analysis

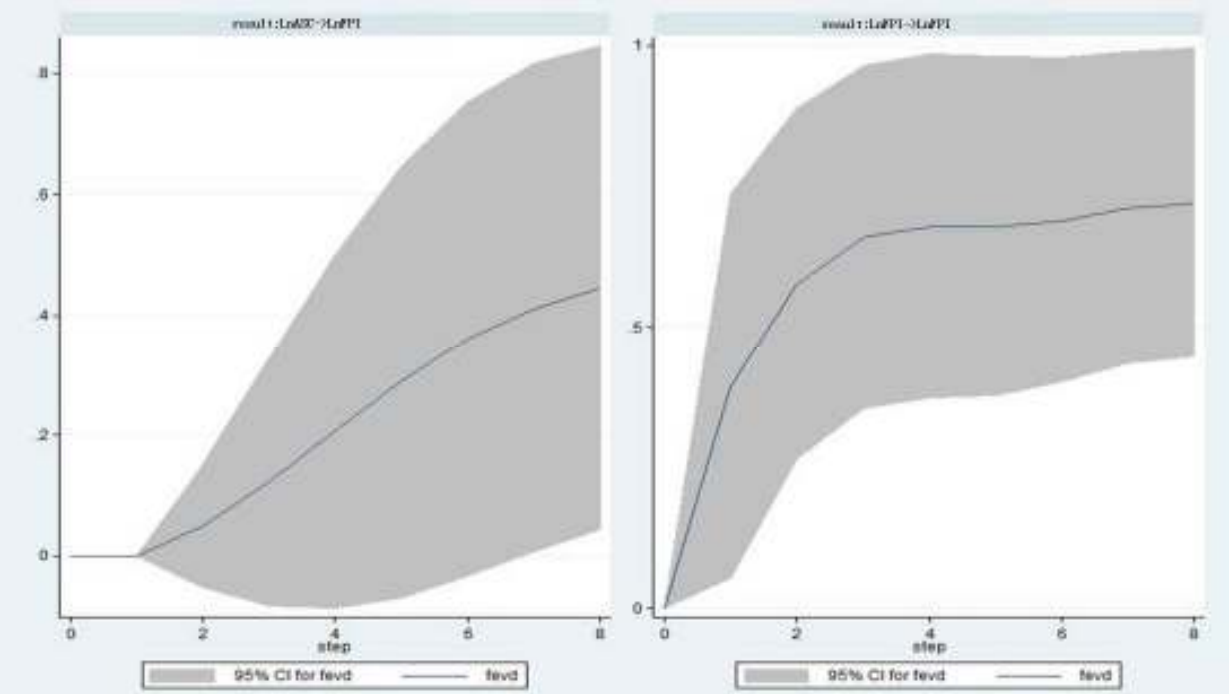

Fig. 2: Cholesky variance decomposition

Table 3: R test of VAR model

Equation	Parms	RMSE	R^2	χ^2	$p>\chi^2$
LnASC	5	0.014806	0.7420	60.39153	0.0000
LnFPI	5	0.027789	0.9962	5508.66600	0.0000

According to this formula, it can be seen that the effect is agriculture supply chain promotes food processing industry growth. LnASC at lag 1 period increased one percentage can drive LnFPI growth by 1.28%, LnASC at lag 2 period increased 1% can drive LnFPI growth by 0.22%, so the effect of agriculture supply chain on food processing industry is obvious. Agriculture supply chain will promote the food processing industry in short time, but this effect will reduce gradually in the long time. Therefore, agriculture supply chain and food processing industry have direct mutual promotion effect.

In order to analyze the relations between agriculture supply chain and food processing industry, we use granger causality test to analyze this VAR model, the result is shown in Table 5. From Table 5, we can get that LnASC is the reason to LnFPI, which means agriculture supply chain is the reason to food processing industry increase. At the same time, LnFPI is not the reason to LnASC, so that food processing industry is not the reason to agriculture supply chain; this is also same to the conclusion above.

According to the results, there exist at least one direct co-integration relationship between agriculture supply chain and food processing industry, which means that there exist a long-term equilibrium relationship between agriculture supply chain and food processing industry.

Impulse-response analysis: According to the results above, we can get that there exist a long-term equilibrium relationship between agriculture supply chain and food processing industry; and agriculture supply chain is the reason to food processing industry growth, also the VAR model is stable. In order to analyze the VAR model, I use Impulse-response function and cholesky variance decomposition, the results is shown in Fig. 1 and 2.

From Fig. 1, we can get that when LnASC received one unit impact, it will lead LnFPI increase currently, LnFPI will reach the max at t = 4 period and begin to be stable then. It illustrates there is long-term effect between agriculture supply chain and food processing industry. At the same time, when LnFPI received one unit impact, it will lead LnFPI decrease currently and return to the basic situation at t = 4 period. According to the impulse analysis results, we can get that agriculture supply chain will significant influence food processing industry, so that it is important to enhance the development of agriculture supply chain. The cholesky variance decomposition also shows the same result, the contribution degree of LnASC to LnFPI is gradually increased. From Fig. 2, we find the contribution degree of LnASC to LnFPI at t = 1 period is 0 and then increased gradually from step 2, finally increased to 44.2% at t = 8 period. At the same time, the contribution degree of LnFPI to LnFPI is 38.1% at t = 1 period, then increased and become stable from

Table 4: Result of vector auto regression model

LnFPI		Coef	S.E.	z	p>|z|	(95% conf. interval)	
LnASC	L1.	0.4867	0.1895	2.57	0.010	0.1151	0.8583
	L2.	0.2072	0.1788	1.16	0.247	-0.1434	0.5578
LnFPI	L1.	0.3868	0.0938	-3.75	0.000	-0.5361	-0.1680
	L2.	-0.0520	0.0988	3.91	0.000	0.1930	0.5806
_cons		-0.1929	0.1815	-0.67	0.502	-0.4776	0.2339

S.E.: Standard error

Table 5: Granger causality test

Equation	Excluded	χ^2	df	Prob.>χ^2
LnASC	LnFPI	17.716	2	0.213
LnFPI	LnASC	32.897	2	0.002

step 2, the contribution degree in t = 8 period is 73.25%. This means that agriculture supply chain has a important contribution degree to food processing industry and can be used to explain the food processing industry growth.

DISCUSSION

At the present stage, the agriculture supply chain in our country is basically to farmers and rural enterprises independent development, the lack of a reasonable scientific planning, project design generally identical, layout is not reasonable, the function is not perfect, market positioning, in the development and construction on randomness, disorder and blindness exists certain. In addition, although the total amount of agricultural resources in China ranks world front row, but because population is numerous, so the amount of resources per capita, less unequal distribution has become a limiting factor in the development of leisure agriculture. To analyze from the government policy level, one is the financial support is not enough, the financing strength is not strong, is not more than two preferential policies. The country is mostly has not yet been set up special support funds, in taxation, land, health, safety assurance policy also no clear specification. To analyze from the angle of sustainable development of agriculture supply chain, a lot of projects by land, capital and other elements of the "bottleneck" constraints, unable to further expand the scale, improve grades and even midway stranding, resulting in Agriculture supply chain development aftereffect.

CONCLUSION

According to the VAR model, it can be seen that the effect is agriculture supply chain promotes food processing industry growth. LnASC at lag 1 period increased one percentage can drive LnFPI growth by 1.28%, LnASC at lag 2 period increased 1% can drive LnFPI growth by 0.22%, so the effect of agriculture supply chain on food processing industry is obvious. Agriculture supply chain will promote the food processing industry in short time, but this effect will reduce gradually in the long time. Therefore, agriculture supply chain and food processing industry have direct mutual promotion effect.

Above all, there are long-term interaction effects between agriculture supply chain and food processing industry. Agriculture supply chain can promote the growth of food processing industry and they have long-term stability of mutual promotion relationship. Also, agriculture supply chain has a certain lag effect to food processing industry. Considering the importance of agriculture supply chain, it is necessary to pay more attention to the development of agriculture supply chain. On the one hand, agriculture supply chain will first bring including direct economic income and merchandise sales, advertising effect for the food enterprises. On the other hand, the agriculture supply chain development can effectively enhance the local well-known enterprises; create a good corporate image of the company. In today's economy is white hot in the market economic environment, many of the local advantage brand market often be shielding an industry monopoly and extrusion. The development of agriculture supply chain, can make the enterprise products, culture has more direct and comprehensive display to tourists and thus make the enterprise products and cultural communication, thus for the enterprise products, brand communication, expand its visibility and reputation, will also expand the local social influence.

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