The Study on the Effects of Agricultural Policies to the Stock Price of Agricultural Companies of China

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Abstract: This paper attempts to use the intervention analysis model to study the impact of the release of the central Number 1 Documents on the stock price fluctuation of listed agricultural companies in China, and get the intervention value of the policy event on the stock return rate while separating the influence of the policy event. The results of the empirical study on the data of the study showed that the effect of the intervention on the results of the intervention was based on the publication of the "Number 1 Documents" in 2012 ~ 2013 as the intervention event. The results of the empirical study on the significance of biological breeding index and land transfer index (data from 2013) Intervention model, is consistent with the interpretation of the "Number 1 Documents".

Keywords: Agricultural policy; Number 1 document; Intervention analysis

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DOI: http://dx.doi.org/10.26549/jfr.v1i1.600

1. Introduction

Agriculture as an important basic industry in China is not only affected by the impact of natural factors, but also by the relevant national policies. Can the stock returns of agricultural companies reflect the relevant policy changes in a timely, effective and accurate manner? On the other hand, what impacts will the national agricultural policies have on the stocks of agricultural companies? This paper intends to use the pre-model to conduct quantitative analysis and explores the relationship between China's major agricultural policy and the stock returns of agricultural companies.

2. Intervention Model and Its Parameter Description

The ideas and steps of modeling the intervention model include: Firstly, fitting a time series model with data that is not affected by the intervention event, and then use the model to predict a number that is separated from intervention event as the predicting number. Secondly, using the actual time series data to minus the predicting number obtained in the previous step to obtain the intervention number of the intervention event, and the parameters of the pre-intervention model will be obtained by using these intervention numbers. Thirdly, use all the data that is separated from the influence of the intervention event, to identify and estimate the time series model. Fourthly, the time series model obtained in step 3 is added to the intervention model to obtain the total intervention analysis model containing the effect of intervention.

The basic variables of the intervention model are intervention variables, with two basic forms. One is a transient intervention variable:

$$S_t^T = \begin{cases} 0 & t<T \\ 1 & t \geq T \end{cases} \quad (1)$$

The other is a persistent intervention variable;

$$P_t^T = \begin{cases} 0 & t=T \\ 1 & t \neq T \end{cases} \quad (2)$$

In it t is the time variable and T is the node where the intervention event occurs.

The intervention event is in a variety of forms, overall it can be summarized as the following four types:

The impact of the intervention event will suddenly begin and continue for a long time. This type of model is $Y_t=\omega S_t^T$, ω is the intensity of the effect of the intervention. If the Yt requires a difference to be a stationary sequence, the intervention model will be adjusted to (1-B) Y_t=wS. If the intervention event has a certain lag, the intervention model can be further adjusted to (1-B) $Y_t=\omega B^b S_t^T$, where B is the hysteresis operator.

The impact of intervention events gradually begins and become a long-term sustainability, the model is:

$$Y_t=\frac{\omega}{1-\delta B}S_t^T \quad 0<\delta<1 \tag{3}$$

The more general model is:

$$Y_t=\frac{\omega B^b}{1-\delta_1\ldots\delta_t B^r}S_t^T \tag{4}$$

Intervention suddenly starts but the time of effect is short, the model is:

$$Y_t=\frac{\omega B^b}{1-\delta B}P_t^T \quad 0<\delta<1 \tag{5}$$

Intervention suddenly begin to have temporary effects. The Intervention model is:

$$Y_t=\frac{\omega_0}{1-\delta_1\ldots\delta_t B^r}P_t^T \quad 2\le r \tag{6}$$

No matter how complicated the intervention event can be, we can generally use the above four types or their units to describe it, and use these models to stimulate the effect of intervention event.

2.1 The Time Series Model Measuring Methods of the Intervention Model

The time series model under the influence of no intervention can be analyzed by Autoregressive Integrated Moving Average (ARIMA). Bokes and Jenkins firstly proposed this model in the early 1970s as a method of predicting time series. The modeling idea of it is to treat the data of the time series to be predicted over time as a random sequence process and approximately describe the time series in mathematical models. Once the model is identified, the historical numbers of the time series can be used to predict future numbers.

In this model, AR is autoregressive, MA is moving average, p is the number of autoregressive terms, q is the moving average term, and d is the difference number of times when the time series is stationary.

2.2 AR (P) (P-Order Autoregressive Model)

Y_t represents the economic variable of period t, Y_t's model can be written as:

$$Y_t-\delta=\alpha_1 Y_{t-1}-\delta+\mu_t$$

μ_t is an irrelevant random error term (white noise sequence) with zero mean and invariant variance, then Yt follows a stochastic process of first order autoregressive, and the p-order autoregressive function form is:

$$Y_t-\delta=\alpha_1 Y_{t-1}-\delta+\alpha_2 Y_{t-2}-\delta+\alpha_3 Y_{t-3}-\delta+\ldots\alpha_p Y_{t-p}-\delta+\mu_t$$

2.3 MA (q) (Q-Order Moving Average Model)

Sometimes the AR process may not be able to predict the time series very well, we can usually use the moving average process, that is, the model of Y_t. And it can be written as:

$$Y_t=\alpha+\beta_0\mu_t+\beta_1\mu_{t-1}$$

α is the mean constant term, u is the random error term for white noise? The Y of the t period is equal to a constant plus a moving average of the past and the current error term, that is, Y follows a first order moving average process, which can be abbreviated as MA (1). The q-order moving average process can be recorded as:

$$Y_t=\alpha+\beta_0\mu_t+\beta_1\mu_{t-1}+\beta_2\mu_{t-2}+\ldots+\beta_q\mu_{t-q}$$

2.4 ARMA (p, q) (Autoregressive Moving Average Process)

When Y_t has the characteristics of AR and MA, it will be the ARMA process, and Y_t can be written as:

$$Y_t=\theta+\alpha_1 Y_{t-1}+\beta_0\mu_t+\beta_1\mu_{t-1}$$

It includes an autoregressive term and a moving average term. θ is a constant term and can be recorded as ARMA (1,1). When there is p autoregressive and q moving averages in the model:

$$Y_t=\theta+\alpha_1 Y_{t-1}+\alpha_2 Y_{t-2}+\ldots\alpha_p Y_{t-p}+\mu_t+\beta_0\mu_t+\beta_1\mu_{t-1}+\beta_2\mu_{t-2}+\ldots+\beta_q\mu_{t-q}$$

3. An Empirical Analysis of the Impact of Agricultural Policy Release on Agricultural Stock Companies' Stock Prices

3.1 Agricultural Industry Policy and Sample Data Selections

In this paper, the policy event is the release of 2012 ~ 2013 "No. 1 document", according to the past study on the agricultural industry stock research and policy, biological

breeding and land transfer related stocks have the highest market attention. This paper examines the impact of policy documents on the corresponding share price through the grasp of keywords in the first document.

Table 1. Policy File Keywords Selection

	Biological breeding	land transfer
Policy keywords	transgenic, food security, grain production, seed law, farming capacity, agricultural science and technology innovation system	land transfer, land right, agricultural modernization

This paper mainly studies the impact of the 2012 ~ 2013 "No. 1 document" on the corresponding concept stock, mainly considering the conceptual stock of two kinds: biological breeding and land circulation. Therefore, we adopt the 2012-2013 Wind Concept Index: the Biological Breeding Index (884062.WI), and the Land circulation Index (884139.WI), both of which were compiled by Wind and these two were started at December 31, 2009.

3.2 The Selection Between Estimation Interval and Event Interval

Definition of event interval and estimated interval. In the case of the event class analysis method, it is necessary to decide the to-be-studied event interval and the estimated interval, and analyze the response of the agricultural listed company's stock price to the policy event in the event interval. The time of the policy events and policy events that lead to changes of the stock price is the event interval, while the period before the event window period that is not affected by the policy event is called estimation interval.

As is shown in chart 8, the estimated interval's BCI and LTI in 2012 can get a better fitting effect using ARIMA(2,0,2)、ARIMA(9,1,0) respectively.

The simulated result of biological breeding index in 2012 is:

BCI_t=-0.00129+0.375BCI_{t-1}-0.842BCI_{t-2}-0.289u_t+0.738u_{t-1}:

The simulated result of land rights transformation index in 2012 is:

d-LTI_t=-0.0000297-0.861d-LTI_{t-1}-0.809d-LTI_{t-2}-0.802d-LTI_{t-3}-0.760d-LTI_{t-4}-0.629d-LTI_{t-5}-0.525d-LTI_{t-6}-0.398d-LTI_{t-7}-0.283d-LTI_{t-8}-0.142d-LTI_{t-9}

The simulated result of biological breeding index in 2013 is (the parameter result in this year is not shown):

BCI_t=-0.000288-0.836BCI_{t-1}+0.741BCI_{t-2}+1.363BCI_{t-3}+0.588BCI_{t-4}-0.904BCI_{t-5}-0.833BCI_{t-6}-0.990u_t-0.754u_{t-1}-0.990u_t-1.030u_{t-1}

The simulated result of land rights transformation index in 2013 is:

LTI_t=0.000936+0.684LTI_{t-1}-0.703LTI_{t-2}-0.850LTI_{t-3}-1.70d-LTI_{t-4}-0.581u_t+0.529u_{t-1}-0.696u_{t-2}

3.3 Build an Intervention Analysis Model

The ARIMA model can be extrapolated to get the estimated daily return when event interval is not affected by intervention, and then the value of policy intervention can be got by using the actual value minus the estimated value.

The policy effects' intervention model estimation of Document NO.1 in 2012 is:

Table 2. The Intervention Model Estimated Result in

	(1)	(2)
	z1	z2
VARIABLES	ffd_LTI	zz_BCI
L.ffd_LTI	-0.281	
	(0.339)	
L.zz_BCI		-0.622*
		(0.274)
Constant	-0.00293	0.0129**
	(0.00351)	(0.00400)
Observations	10	10
R-squared	0.079	0.391

Notes: the Robust Std. are in brackets and the SE have been adjusted by heteroscedasticity.

*** p<0.01, ** p<0.05, * p<0.1

It's shown that the intervention effect of policy event to land rights transformation index in 2012 is not remarkable, but the effect to biological breeding index is remarkable. The intervention model is:

$$eBCI = \frac{0.0129}{1+0.622B} S_t^T$$

The final intervention model is:

BCI_t=-0.00129+0.375BCI_{t-1}-0.842BCI_{t-2}-0.289u_t+0.738u_{t-1}+eBCI

In which $S_t^T = \begin{cases} 0 & 2011.3.8\text{-}2012.1.31 \\ 1 & 2012.2.1\text{-}2012.3.1 \end{cases}$

The policy effect's intervention model estimation of Document NO.1 in 2013 is:

Table 3. The Intervention Model Estimated Result in

	(1)	(2)
	b1	b2
VARIABLES	zzBCI	zzLTI
L.zzBCI	-0.418*	
	(0.219)	
L.zzLTI		-0.386*
		(0.217)
Constant	0.000462*	-0.00150
	(0.00379)	(0.00321)
Observations	20	20
R-squared	0.168	0.150

Notes: The Robust Std. are in brackets and the SE have been adjusted by heteroscedasticity.

*** p<0.01, ** p<0.05, * p<0.1

*** p<0.01, ** p<0.05, * p<0.1

It's shown that the intervention effects of policy event to both land rights transformation index and biological breeding index in 2012 are all remarkable. The intervention models are as follows:

$$eBCI = \frac{0.000462}{1+0.418B} S_t^T$$

$$eLTI = \frac{-0.0015}{1+0.386B} S_t^T$$

The final intervention models are:

BCI_t=-0.000288-0.836BCI_{t-1}+0.741BCI_{t-2}+1.363BCI_{t-3}+0.588BCI_{t-4}-0.904BCI_{t-5}-0.833BCI_{t-6}-0.990u_t-0.754u_{t-1}-0.990u_t-1.030u_{t-1}+eBCI

LTI_t=0.000936+0.684LTI_{t-1}-0.703LTI_{t-2}-0.850LTI_{t-3}-1.70d-LTI_{t-4}-0.581u_t+0.529u_{t-1}-0.696u_{t-2}+eLTI

In which $S_t^T = \begin{cases} 0 & 2012.3.1\text{-}2013.1.30 \\ 1 & 2013.2.1\text{-}2013.3.7 \end{cases}$

4. Conclusion

The Document NO.1 in 2012 stressed the importance of improving the capacity in agricultural technological innovation and popularization, putting the key point of agricultural technology on seed cultivation, continuing to implement special science and technology projects such as genetically modified organisms and push the industrialization process of which. But the corresponding expression of land rights transformation just referred to improve the transference market of land contractual management rights. So it's shown that policy in 2012 helped biological breeding stocks. Compared to intervention analysis model's empirical results, in 2012, the biological breeding index is remarkable while the land rights transformation index is not, which are as expected.

The Document NO.1 in 2013 referred to the key science and technology projects such as continue to implement seed industry development and the R&D of fertilizers、pesticides and veterinary drugs efficiently and safely with regard to biological breeding, and referred to encourage and support land transformation to new operating entities such as professional large family、family farms and cooperatives in land rights transformation. It has shown that there is not obvious difference in both aspects concerning policy expressions, but due to the remarkable integrated effects of policy events, the intervention analysis model in this year are remarkable at a lower confidence level, which are as expected.

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