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# Effects of the Development of Township Enterprises on the Urban-Rural Dual Economic Structure Based on Cointegration Theory

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**Abstract** The gross output value of township enterprises (*XGDP*) is used as a variable of township enterprises development. And *CXEY* is a variable of urban-rural dual economic structure. According to the 1986–2006 *Statistical Yearbook of Chinese Township Enterprises* and the 2006 *China Statistical Yearbook*, effects of the development of township enterprises on the urban-rural dual economic structure are studied by the cointegration analysis. Result shows that without considering other influencing factors, township enterprise development in the years 1979–2005 is the key factor to improve the dual economic structure in urban and rural areas in China.

**Key words** Urban and rural areas, Dual economy, Township enterprises, Cointegration analysis, China

The reform and opening up has promoted the liberation of productive forces in rural areas. When rural areas implement the household contract responsibility system, township enterprises have made considerable progress. On the one hand, township enterprises have already become an important part of the economy and the pillar of economic growth in China in the 1990s. On the other hand, township enterprises have promoted the transition to a modern society in rural China from the aspects of economy, society and even way of life; and the transformation of urban-rural dual economic structure is an important part of it. At present, with the reform and opening up and the development of market economy, urban-rural dual economic structure has achieved certain improvement, but the effects are not significant. Dual economic structure in China shows certain characteristics of inflexibility, such as low agricultural productivity, slow agricultural economic development, low development of non-agricultural industries in rural areas, little technology content, lack of competitiveness, blocked transfer of rural surplus labor force, slow process of urbanization, and further expansion of the urban-rural gap. Both domestic and foreign scholars have researched on the development and influencing factors of urban-rural dual economic structure in China by different methods and from different aspects. But there are few researches on the effects of the development of township enterprises on the urban-rural dual economic structure in China. Thus, based on the existing research results, we study on the effects of the development of township enterprises on the urban-rural dual economic structure in China by using the cointegration theory and other empirical methods.

## 1 Research method and data source

**1.1 Research method** Cointegration analysis theory is a powerful tool to deal with the long-term equilibrium relationship

and short-term fluctuation of the non-stationary economic time series. Its fundamental idea is that if two or more time series variables are non-stationary and a certain linear combination of them is stationary, we can conclude that there exists long-term stable equilibrium relationship among these variables (cointegration relationship). The economic meaning of cointegration analysis is that if two or more variables with their own long-term fluctuation laws have cointegration relationship, they also have a long-term equilibrium relationship. On the contrary, if the two or more variables have no cointegration relationship, there is no long-term equilibrium relationship among them. The error correction model based on cointegration theory can reflect the deviation degree from equilibrium state within the system in short term. In other words, long-term equilibrium error is taken as the correction term of short-term fluctuation, so as to obtain the adjustment information about deviation degree. For these reasons, we establish the impulse response function and variance decomposition by using cointegration analysis method based on *VAR* model in order to study on the effects of the development of township enterprises on the urban-rural dual economic structure in China<sup>[1]</sup>.

**1.2 Data source and explanation** Growth rate of the gross output value of township enterprises (*XGDP*) is used as a developing variable of township enterprises. Dual contrast coefficient is taken as the variable of urban-rural dual economic structure. Dual contrast coefficient is the ratio of agricultural to industrial comparative labor productivity in urban-rural dual economic structure in China, that is, dual contrast coefficient = Comparative labor productivity of primary industry/Comparative labor productivity of secondary and tertiary industries<sup>[2]</sup>. Since comparative labor productivity properly reflects the labor productivity and labor usage of a department, the dualization of economy can be reflected by comparing the comparative labor productivity of agriculture with that of industry. Dual contrast coefficient changes in the opposite direction of the dual eco-

economic structure. In other words, greater dual contrast coefficient indicates smaller differences of two departments, and *vice versa*. Therefore, it is obvious that smaller dual contrast coefficient leads to more significant urban-rural dual economic structure. Theoretically, value of dual contrast coefficient is within 0 – 1 and is usually less than 1. When the coefficient is 0, the comparative labor productivity of agriculture is 0, indicating the most significant dualization of economy. When the coefficient is 1, comparative labor productivity of agriculture is equal to that of industry and the dual economy turns into single economy.

Thus, dualization of economy disappears. Dual contrast coefficient of developing countries is usually in the range of 0.31 – 0.45, while that of developed countries is in the range of 0.52 – 0.86<sup>[3]</sup>. In this research, we use "CXEY" as the variable of urban-rural dual economic structure. Data of the economic indices motioned above are within the years 1979 – 2005. The original data of the gross output value of township enterprises are from the 1986 – 2006 *Statistical Yearbook of Chinese Township Enterprises*<sup>[4]</sup>; and the data of dual contrast coefficients are from the 2006 *China Statistical Yearbook*<sup>[5]</sup>.

**Table 1 Dual economic structure in urban and rural areas and the growth speed of township enterprises**

Year	Proportion of primary industry//%	Proportion of the output values of secondary and tertiary industries//%	Employment proportion of primary industry//%	Employment proportion of secondary and tertiary industries//%	Comparative labor productivity of primary industry	Comparative labor productivity of secondary and tertiary industries	Dual contrast coefficient//%	Growth speed of township enterprises//%
1979	31.17	68.83	69.8	30.2	0.45	2.27	19.82	9.01
1980	30.09	69.91	68.7	31.3	0.44	2.23	19.73	20.97
1981	31.79	68.21	68.1	31.9	0.47	2.14	21.96	13.11
1982	33.27	66.73	68.1	31.9	0.49	2.09	23.44	16.3
1983	33.04	66.96	67.1	32.9	0.49	2.04	24.02	14.23
1984	32.01	67.99	64.0	36.0	0.50	1.89	26.46	39.39
1985	28.35	71.65	62.4	37.6	0.45	1.91	23.56	92.03
1986	27.09	72.91	60.9	39.1	0.44	1.86	23.66	36.24
1987	26.79	73.21	60.0	40.0	0.45	1.83	24.59	35.99
1988	25.66	74.34	59.4	40.6	0.43	1.83	23.50	48.42
1989	25.00	75.00	60.0	40.0	0.42	1.88	22.4	11.99
1990	26.98	73.02	60.1	39.9	0.45	1.83	24.59	16.41
1991	24.41	75.59	59.7	40.3	0.41	1.88	21.81	20.76
1992	21.76	78.24	58.5	41.5	0.37	1.89	19.58	51.39
1993	19.91	80.09	56.4	43.6	0.35	1.84	19.02	79.71
1994	20.26	79.74	54.3	45.7	0.37	1.74	21.26	43.54
1995	20.86	79.14	52.2	47.8	0.40	1.66	24.10	50.83
1996	20.71	79.29	50.5	49.5	0.41	1.60	25.63	10.36
1997	19.43	80.57	49.9	50.1	0.39	1.61	24.22	17.09
1998	18.91	81.09	49.8	50.2	0.38	1.62	23.46	7.56
1999	17.96	82.04	50.1	49.9	0.36	1.64	21.95	12.13
2000	16.58	83.42	50.0	50.0	0.33	1.67	19.76	7.12
2001	15.49	84.51	50.0	50.0	0.31	1.69	18.34	8.52
2002	15.40	84.60	50.0	50.0	0.31	1.692	18.20	11.41
2003	14.60	85.40	49.1	50.9	0.30	1.68	17.86	8.49
2004	13.10	86.90	46.9	53.1	0.28	1.64	17.07	13.23
2005	12.60	87.40	44.8	55.2	0.28	1.58	17.72	26.26

## 2 Result and analysis

Considering the heteroscedasticity in the data eliminated,  $\ln CXEY$  and  $\ln XGDP$  are the natural logarithms of the variable of urban-rural dual economic structure and the variable of township enterprises development, which are two new variable sequences.

**2.1 Unit root test** Unit root test is a process to test the stability of variables. And the premise for establishing the VAR model and for the cointegration and causality relationships of variables is that all the variables shall obey the unit root at the same order. Therefore, before cointegration analysis, it is necessary to use ADF unit root test to carry out stationary test on the differential sequence of  $\ln CXEY$  and  $\ln XGDP$ . And ADF unit root test on variable sequences are conducted by Eviews3.1 software. According to the test result in Table 2, level values of  $\ln CXEY$  and  $\ln XGDP$  are stable at second-order difference un-

der 1% significance level. Therefore, cointegration method can be used to carry out cointegration test on the variable of urban-rural dual economic structure and the variable of township enterprises development.

**2.2 Result of cointegration test** To obtain sound the appropriate conclusions about cointegration relationship, Maximum likelihood statistics put forward by Johansen and Juselius (1990) are used to test the cointegration relationship between the two variables. Johansen cointegration test is a test method based on vector autoregression model. Before carrying out cointegration test, structure of VAR model should be determined. According to the features of data processing, VAR models with both intercept term and time trend term and the lag order of which is 1 are selected. Table 3 reports the result of cointegration test on variables by Johansen cointegration test.

**Table 2** Test results of ADF unit roots of  $\ln CXEY$  and  $\ln XGDP$ 

Variable	ADF Test	Type of test	Lag order	Significant level	Conclusion
$\ln CXEY$	-3.170 6	Having constant term and linear trend	1	-3.236 7 **	Unstable
$\ln XGDP$	2.149 9	Having constant term and linear trend	1	-3.236 7 **	Unstable
$\Delta \ln CXEY$	3.411 6	Having constant term and linear trend	1	-3.241 8 **	Stable
$\Delta \ln XGDP$	3.112 2	Having constant term and linear trend	1	-3.241 8 **	Unstable
$\Delta^2 \ln CXEY$	5.087 1	Having constant term and linear trend	1	-4.416 7 *	Stable
$\Delta^2 \ln XGDP$	5.304 7	Having constant term and linear trend	1	-4.416 7 *	Stable

Note:  $\Delta$  and  $\Delta^2$  are the first order difference and second order difference; \* and \*\* mean significance at 1% and 10% levels, respectively.

**Table 3** Co-integration test of  $\ln CXEY$  and  $\ln XGDP$ 

Assumed cointegration number	Eigenvalue	Maximum likelihood statistics	5% critical value	1% critical value	Lag order
0 cointegration vector	0.399 8	15.760 990	15.41	20.04	1
At least 1 cointegration vector	0.113 0	2.998 569	3.76	6.65	1

According to the test result in Table 3, a normalization cointegration equation is obtained:

$$\ln XGDP = 1.259 6 - 0.165 3 \ln CXEY + EC \quad (1)$$

where  $EC$  is the error correction term. And ADF unit root test is used to test on the error correction term. Test statistics show that  $EC$  is stationary series at level condition under the 5% significance level. Therefore, it can be concluded that  $\ln XGDP$  and  $\ln CXEY$ , that is the urban-rural dual economic structure and the township enterprises development, have certain stable and equilibrium relationship.

**2.3 Determination of error correction model VEC** Result of cointegration test shows that there are stable and equilibrium relationships between the township enterprises development and the urban-rural dual economic structure. But whether there is causality in this equilibrium relationship or not still needs further validation. According to the Granger theorem, error correction model VEC is established to carry out causality tests on variables. Vector error correction model is constructed by  $\ln CXEY$  and  $\ln XGDP$ . And the VEC model with intercept form of cointegration equation but without time trend of sequence use has a third lag order. Estimation result of parameters by Eviews3.1 software is:

$$\begin{aligned} D[\ln XGDP] = & -0.323 9 vecm + 0.133 8d[\ln XGDP(-1)] + \\ & 0.140 0d[\ln XGDP(-2)] + 0.155 6d[\ln XGDP(-3)] - \end{aligned}$$

**Table 4** Granger causality of  $\ln CXEY$  and  $\ln XGDP$ 

Null hypothesis	Lag phase	Sample number	F statistics	P value
$\ln XGDP$ is not the Granger causality of $\ln CXEY$	2	25	4.357 4	0.026 9
$\ln CXEY$ is not the Granger causality of $\ln XGDP$	2	25	0.011 9	0.988 2

Table 4 shows that the  $P$  value of " $\ln XGDP$  is not the Granger causality of  $\ln CXEY$ " is only 0.026 9, indicating that there is high probability that township enterprises development is the Granger causality of the improvement of urban-rural dual economic structure under 2 lag phases. And its economic implication is that under 2 lag phases, development of township enterprises can greatly promote the improvement of urban-rural dual economic structure. The  $P$  value of " $\ln CXEY$  is not the Granger causality of  $\ln XGDP$ " is as high as 0.988 2, indicating that there is low probability that township enterprises development is the Granger causality of the improvement of urban-rural dual economic structure under 2 lag phases. And its economic

$$0.063 3d[\ln CXEY(-1)] + 0.003 9d[\ln CXEY(-2)] + 0.025 2d[\ln CXEY(-3)] - 0.009 6 \quad (2)$$

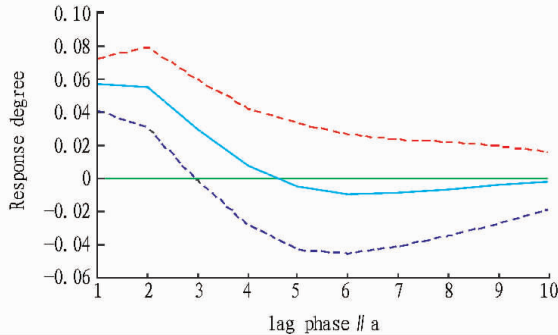
Goodness of fit  $R$  of equation (2) is 0.56, which is a general fitting degree. Overall test results of VEC model shows that the logarithm likelihood function value of model is 16.38, which is relatively great and indicates that the model has certain overall explanatory power. The  $vecm$  coefficient reflects the adjustment of the deviation of long-term equilibrium. And the  $vecm$  coefficient in equation (2) is -0.323 9, which is relatively great and indicates that the adjustment speed of long-term equilibrium is 32.39% and is consistent with the reverse correction principle. And its in-depth economic implication is that the long-term stable relationship between the urban-rural dual economic structure and the township enterprises development restricts the change of the two variables and promotes the trend equilibrium.

**2.4 Granger Causality Test** Other influencing factors are neglected in this research, because we mainly discuss the effects of township enterprises development on the urban-rural dual economic structure. Thus, Granger Causality Test is used to investigate the long-term effects mechanism of township enterprises development on the urban-rural dual economic structure. Table 4 reports the concrete Granger Causality Test of  $\ln CXEY$  and  $\ln XGDP$ .

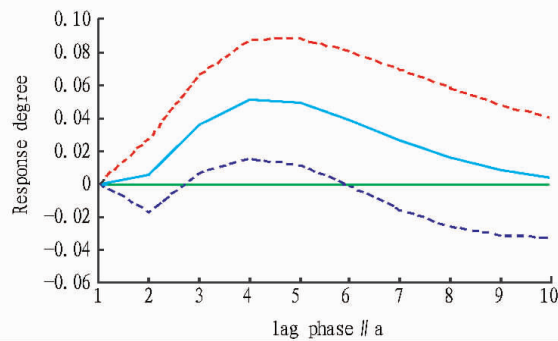
implication is that under 2 lag phases, development of township enterprises has little promoting effect on the improvement of urban-rural dual economic structure.

**2.5 Variance decomposition and impulse response function based on VAR Model** Since there are various interactions among variables, it is difficult to accurately describe all of the effects only by model analysis. Therefore, we have to conduct the long-term impulse response analysis from the system point of view. Reaction ability of the urban-rural dual economic structure to the impulse of township enterprises development is analyzed, as well as the reaction ability of the urban-rural dual economic structure to the impulse of its own improvement.

Fig.1 and 2 illustrate the impulse response function curves based on VAR model. The horizontal axis is the lag phase of impulse response function; the longitudinal axis is the response degree of dependent variable; and the curve is the response function of impulse. The lag phase is designed as 10 years.



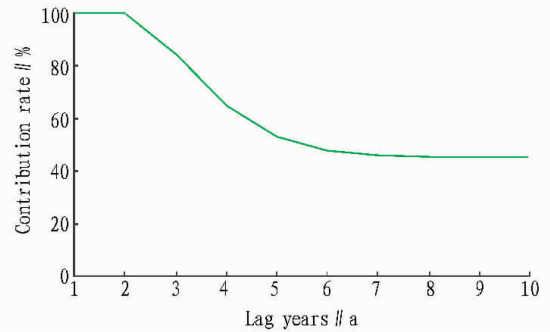
**Fig.1** Response curve of the urban-rural dual economic structure caused by the improvement of itself



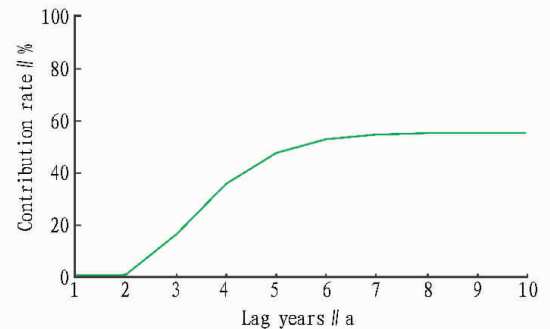
**Fig.2** Response curve of the urban-rural dual economic structure caused by the development of township enterprises

Fig.1 shows that if giving a positive standard deviation impact to the urban-rural dual economic structure, the reaction ability of the urban-rural dual economic structure to the improvement of itself shows a downward trend in the lag phase of 1–4 years, within the range of 0.06–0. However, after the lag phase of 5 years, the reaction ability slowly decreases and then slowly increases within the range of negative value and is still below 0 at the lag phase of 10 years. Fig.2 indicates that the reaction ability of the urban-rural dual economic structure to the development of township enterprises shows a sharp rise and then a downward trend, and reaches its maximum value at the lag phase of 4 years (more than 0.04). Based on the comparison between Fig.1 and 2, the reaction ability of the urban-rural dual economic structure to the improvement of itself fluctuates from  $-0.02$  to  $0.06$ , and that to the development of township enterprises fluctuates above 0. Therefore, it can be concluded that under a positive standard deviation impact, improvement of urban-rural dual economic structure has relatively significant reaction ability to the development of township enterprises, showing that the development of township enterprises can help to improve the urban-rural dual economic structure to some extent.

Results of Granger Causality Test can only explain the causality among variables, but can not explicate the strength of



**Fig.3** Contribution rate of the urban-rural dual economic structure to the improvement of itself



**Fig.4** Contribution rate of development of township enterprises to the improvement of the urban-rural dual economic structure

causality. Variance decomposition is a kind of causality test outside the sample period, which can find out the relative important information among random information. Variance decomposition decomposes the fluctuation of each endogenous variable within system into several components related to the equation information, so as to obtain the relative importance of information to the endogenous variable of model. Moreover, variance decomposition can also decompose the unit increment of each variable into the contribution to other variables and a certain percentage of their own reasons. Variances of the forecasting errors of the township enterprises development and the urban-rural dual economic structure in different forecasting periods are decomposed by using the method of variance decomposition. Fig.3 illustrates the contribution rate of the urban-rural dual economic structure to the improvement of itself; and Fig.4 illustrates the contribution rate of development of township enterprises to the improvement of the urban-rural dual economic structure based on VAR model. The horizontal axis is the lag phase; the longitudinal axis is the contribution rate; and the lag phase is designed as 10 years.

Fig.3 indicates that the contribution rate of the urban-rural dual economic structure to the improvement of itself shows a downward trend in the lag phase of 10 years, and slowly decreases after the lag phase of 5 years. Fig.4 indicates that the contribution rate of development of township enterprises to the improvement of the urban-rural dual economic structure has an upward trend in the lag phase of 10 years, and shows a sharply

(To page 8)

A long-term mechanism of new countryside construction should be established with the participation of farmers, so as to form the atmosphere of the common maintenance and management, and to gather the ideas of farmers to the maximum extent.

On the one hand, government should publicize the measures, experiences and work developments of building new countryside, tell farmers the benefits and interests brought by the new countryside construction, and gain the support of farmers. Based on this, various propagandas close to the life of farmers and reflecting the trends of rural areas should be carried out. Close contacts and communication with the farmers should be carried out by conducting entertainment program and introducing the policy, key points and construction process of new countryside, which can stimulate enthusiasm of farmers for participating in the new countryside construction. On the other hand, based on consolidating the grassroots organizations, government should actively promote the construction of rural social groups and organizations, accelerate the democratization process of the management of new countryside construction, and ensure the basic rights and interests of farmers who participate in the construction and management of new countryside construction. For instance, the Village Council, or the Village Community Volunteers Association, can be taken as a platform to encourage the members and the village leaders to make a long-term mechanism of the public management affairs. Through carrying out the appraisal activities, we can guide the farmers to protect public facilities, to participate in the public management affairs, and to maintain a good village appearance.

**3.4 Fully integrating project funds; constructing the socialist new countryside** The objective of new countryside construction is to realize the coordinated development of rural culture, economy, politics and society. According to the experiences of different areas, it is necessary to integrate the funds of new countryside construction, in order to effectively promote the construction of new countryside. At present, each new countryside site only get about 100 thousand yuan, which is far

(From page 4)

increase within the lag phase of 2 – 6 years. Therefore, it can be concluded that development of township enterprises can help to improve the urban-rural dual economic structure to some extent.

### 3 Conclusion

Dual contrast coefficient reaches its maximum value in the 1990s, although the urban-rural dual economic structure in China further deteriorated in early 21st Century and the township enterprises lost their glories of the 1990s. This is a period that urban-rural dual economic structure achieves its greatest improvement in China. Result of cointegration empirical analysis shows that without the influence of other factors, development of township enterprises is the key to improve the urban-rural dual economic structure in China in the years 1979 –

from enough to build a standardized new countryside. Therefore, to effectively promote the construction, we should fully integrate the project funds, and motivate all sectors of society to construct the socialist new countryside.

On the one hand, the agriculture-related project funds obtained should be used for the new countryside construction according to the actual needs, in order to ensure the scale of construction. On the other hand, government should develop various preferential policies and measures, attract the funds of all sectors of society to invest in the new countryside. For instance, attract the investment of wealthy businessmen by tax preference, project attraction and other means; and attract the high-level talented person by handsomely-paid jobs. On the other hand, during the construction of the projects, government should strengthen the coordination and management of various departments, concentrate all forces on a major task, and motivate all sectors of society to support the development of new countryside construction<sup>[3]</sup>.

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2005, which is consistent with the original intention of the policy makers in China who want to promote the urban-rural dual economic structure by the development of township enterprises.

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