

Study on the Decoupling of Cultivated Land Occupation by Construction from Economic Growth in Chengdu City

Chen Xu

Department of Economic Management, Sichuan Agricultural University
211 Hui Min Road, Wenjiang District, Chengdu 611130, Sichuan, China
Tel: 86-155-2074-2811 E-mail: azure_1231@163.com

Wenxiu Zhang (Corresponding author)

Department of Economic Management, Sichuan Agricultural University
211 Hui Min Road, Wenjiang District, Chengdu 611130, Sichuan, China
Tel: 86-186-2813-6673 E-mail: cndzwx@163.com

Received: March 15, 2011 Accepted: July 12, 2011 doi:10.5539/jms.v1n1p56

Abstract

This paper uses the decoupling analysis method to analyze the status, degrees and causes of decoupling of cultivated land occupation by construction from economic growth in the period of 1993 to 2006 in Chengdu city, and hopes to provide the government with relevant measures of the decoupling of cultivated land occupation by construction from economic development. The results are as follows: 1) Relative decoupling and absolute decoupling of cultivated land occupation by construction from economic growth occurred at 57.14 percent in the research period. However, the degrees of decoupling had obvious variations in the temporal scale; 2) The elasticity values of the decoupling exhibited an inverted “V” shaped curve; 3) The additional investment of capital and labor, the implementation of government policy and measures, the pattern transformation in the economic growth will help accelerate decoupling. Therefore, the quantity of cultivated land occupation by construction should be under the control of Chengdu government, meanwhile, the government need to speeding up the transformation of economic development models and optimizing the structure of industry so that cultivated land conservation and economic growth are not a dilemma.

Keywords: Economic growth, Cultivated land occupation by construction, Chengdu city

1. Introduction

With high-speed development of economic and continual population growth, sharply decline of the amount of cultivated land will become one of the important factors which will constraint on China's future agricultural development and food supply. The main reasons for reduction of cultivated land in Chengdu were agricultural structure adjustment, disasters damages, ecological restoration and construction. Despite the cultivated land loss induced by agricultural structure adjustment had happened with a high frequency in the past time, it contributed a little to cultivated land decrease recently and may not be the main cause in the future because of food security (Chen & Du, 2006). It could be understood that: The cultivated land loss resulted from disasters damages decreased stably, but could not be reined by human beings completely. The cultivated land loss arisen by ecological restoration is an important driving force to the cultivated land decrease recently while the total quantity of its needs to be adjusted is limited. The cultivated land loss caused by construction was the most important driving force to the cultivated land decrease, and was an important contributor to economic growth. So cultivated land occupation by construction (CLOC) which caused by economic growth was the greatest menace to cultivated land loss permanently. Therefore, further studies on the relationship between CLOC and economic growth will help us understand the rules among the two factors, so that to provide the government with relevant measures of cultivated land protection and Economic development policy adjustment.

In recent years, the researches of the correlations between CLOC and economic growth in China are mainly concentrating on the two areas which are the main factor that affects occupation of cultivated land and the variation of cultivated land and the manifestation of economic growth. In the area of the main factors affecting

CLOC, some scholars believed that the economic growth was the main factor to affect the variation of cultivated land and the urbanization also gave some relief on the reduction of cultivated land (Zhu & Huang, 2007); also some scholars suggested that urban construction, rural construction, factory construction and transportation construction were the main cause losing of cultivated land (Tan et al., 2005). In the area of the variation of cultivated land and the manifestation of economic growth, the existing research suggested that correlations between their exhibited an exponential curve (Li & Yang, 2007) or the Kuznets curve (Qu & Wu, 2004). However, the existing research findings were difficult to analyze, monitor and predict the dynamic changes of relationship between CLOC and economic growth. While decoupling analysis method, which emphasize on the process of dynamic change of relationship between CLOC and economic growth, is more helpful to monitor dynamically and evaluate the possibility of influence factors of production factors, technological progress and other factors in the promotion of the decoupling in economic growth process. This paper takes Chengdu city as an example, uses the decoupling analysis method as a tool to analyze the status, degrees and causes of decoupling of CLOC from economic growth from 1993 to 2006, and hopes to provide the government with relevant measures of the decoupling of CLOC from economic growth.

2. Methods and Data

2.1 Conception of Decoupling

The term of “decoupling”, which derived from physics, was used to describe the process of breaking the link between “environmental bads” and “economic goods” (Organization for Economic Cooperation and Development, 2002). Similarly, the concept was also introduced when analyzing the relationship between agricultural policies and international trade distortion (OECD, 2002). Chinese scholars such as Chen and Du (2006) use it as a tool in the field of assessment of Soil erosion and land resource management. Decoupling of CLOC from economic growth in this paper means breaking the link between “CLOC” and “economic growth” (Considering CLOC makes a mainly contribution to the increase in the industrial sector output and service sector output, so in this paper, the economic growth is taking the change of non-agricultural GDP into account).

Decoupling can be divided into two forms, relative decoupling and absolute decoupling. When economy increases, total quantity of CLOC increases at certain lower rate separately, this is called “relative decoupling”. Absolute decoupling can be described as: with economic increases, the growth rates of CLOC decrease even though the gross use of CLOC becomes increasingly huge. In contrast with decoupling, negative decoupling which is the non-ideal relationship is described like: with a high-speed growth of economic, total quantity of CLOC increases at a higher rate separately. One could argue that, negative decoupling means the growth of economic is dependent on the addition of CLOC.

Then a simple measurement named decoupling factor which is used to measure whether the decoupling had occurred or not (Li et al., 2010) is defined as:

$$R_d = \frac{(EP_{iend} - EP_{istart}) / EP_{istart}}{(DF_{iend} - DF_{istart}) / DF_{istart}} \quad (1)$$

$$F_d = 1 - R_d \quad (2)$$

From the formula above, R_d stands for values of the decoupling elasticity, EP_{iend} on behalfs of environmental pressure in the end of period i , EP_{istart} stands for environmental pressure in the start of period i , DF_{iend} uses as economic driving forces in the end of period i , DF_{istart} represents as environmental pressure in the start of period i , F_d stands for decoupling factor. When $F_d < 0$, there is no decoupling occurred; when $1 > F_d \geq 0$, relative decoupling occurred during the period; when $F_d \geq 1$, the status of decoupling is absolute decoupling.

Based on the work by OECD and other authors, Tapio (2005) used an elasticity index to distinguish the decoupling degrees, and then all the possible results were divided into strong decoupling and other decoupling degrees. It could be understood that detailed dividing on degrees of decoupling, makes agriculture and environmental policies as well as measures been made more easily in the near future.

2.2 Selection of Decoupling Factor and Optimization of Decoupling Model

In order to recognize decoupling more directly, the paper takes the quantity of CLOC as environmental pressure (EP) and selects the change of non-agricultural GDP as economic driving force (DF). The addition of non-agricultural GDP affected by the government policy and other factors assumes a fluctuation and this fluctuation presents an obvious hysteretic nature. According to Dong and Zou's (2006) study, this lag phase of affect was generally about 3-4 years. By considering Chengdu as the provincial capital city of Sichuan province and CLOC in this city was used for infrastructure construction and real estate development in the process of

urbanization. The paper sets up the lag phase of influences on the addition of non-agricultural GDP for 3 years, so non-agricultural GDP data that later 3 years than CLOC data as DF has been adopted. The decoupling model can be showed as in (3) and (4) below:

$$R_{d(n+1)} = \frac{(EP_{n+1} - EP_n) / EP_n}{(DF_{n+4} - DF_{n+3}) / DF_{n+3}} \quad (3)$$

$$F_{d(n+1)} = 1 - R_{d(n+1)} \quad (4)$$

Here, $R_{d(n+1)}$ stands for elasticity values of the decoupling in the $n+1$ year, EP_{n+1} uses as amount of CLOC in the $n+1$ year, EP_n represents as amount of CLOC in the n year, DF_{n+4} stands for output value of non-agricultural GDP in the $n+4$ year, DF_{n+3} on behalfs of output value of non-agricultural GDP in the $n+3$ year, $F_{d(n+1)}$ stands for decoupling factor in the $n+1$ year.

2.3 Redefinition of the Coordinate Graph of Decoupling Degrees

In order to define the degree of decoupling in an accurate way, the research selected 0.8 and 1.2 as partitioning standard which introduced by Tapio (2005) and Li et al. (2006), then set up the coordinate graph of decoupling degrees of CLOC from economic growth (see Fig.1).

As Fig.1 shown, when the non-agricultural GDP grows ($\Delta DF > 0$), the quantity of CLOC decreases oppositely ($\Delta EP < 0$), and decoupling elasticity $R_d \leq 0$, strong decoupling occurs in the period of research (see the area I). It can be seen from this that it is the most ideal relationship between the CLOC and economic growth. However, when the non-agricultural GDP decreases ($\Delta DF < 0$), the quantity of CLOC increases oppositely ($\Delta EP > 0$), and decoupling elasticity $R_d \leq 0$, decoupling degree is strong negative decoupling (see the area V). It is clear that under this circumstance is the most non-ideal relationship between the CLOC and economic growth. In accordance with critical value of decoupling elasticity (0.8 and 1.2) and the change of ΔDF , the quadrant 1 and 3 are subdivided into 6 status as weak decoupling (see the area II), expansive coupling (see the area III), expansive negative coupling (see the area IV), weak negative decoupling (see the area VI), recessive coupling (see the area VII) and recessive decoupling (see the area VIII).

2.4 Data

This paper mainly depends on the publication data from << Statistical Yearbook of Sichuan province >> (1993-2010) and << Statistical Yearbook of Chengdu city >> (1993-2010). In order to eliminate the inflation effect on the addition of non-agricultural GDP and the addition of social fixed assets investment, this paper regards 1992 as base period, calculates the actual output value of non-agricultural GDP from 1996 to 2009, as well as the actual amount of social fixed assets investment from 1996 to 2009 by using consumer price index and fixed assets investment index separately.

2.5 Study Area

Chengdu, as the provincial capital city of Sichuan province and located in the eastern of Chengdu Plain. She has the total area of 0.121 million hm^2 and population of 11.396 million, comprises 19 districts (including cities and counties). Since 1992, Chengdu's economic has grown rapidly, the level of economic development has come to the 1st in the provincial capital city in Western China. Compared with the output value of GDP about 292.56×10^8 RMB in 1992, the whole city's GDP reached 4502.6 billion RMB in 2009 with an annual increase of 17.45 percent. However, rapid economic development makes the area of cultivated land decreased from 45.83×10^4 hm^2 in 1992 to 33.47×10^4 hm^2 in 2009, with an annual decrease of 1.83 percent. The past data shows that the area of CLOC was 89747 hm^2 , accounting for 61.72 percent of the total area of cultivated land loss. One could argue that the CLOC was the main reason for reduction of cultivated land in Chengdu.

3. Results and Discussion

With the data of CLOC from 1992 to 2006 and the statistics of non-agricultural GDP from 1995 to 2009 (which has been referred to related non-agricultural GDP), the variable quantity of CLOC and variable output value of related non-agricultural GDP can be calculated. According to the formula (3) and (4), the decoupling factor and the decoupling elasticity can be obtained. Based on them, the status can be defined and degrees of decoupling can be divided by the coordinate graph of decoupling degrees (see the Table 1).

As Table 1 shows, the status of decoupling of CLOC from economic growth, which mainly presented a repeated fluctuations of decoupling - negative decoupling - decoupling, showed the status instability from 1993 to 2006 in Chengdu. It is clear from the table that decoupling occurred 8 times, accounting for 57.14 percent in the period of research. The occurrence times of negative decoupling, absolute decoupling and relative decoupling were 6 times, 7 times and 1 times respectively, accounting for 42.86 percent, 50 percent and 7.14 percent in the

research period. Taking the degrees of decoupling of CLOC from economic growth into consideration, they were strong decoupling (7 times), expansive negative coupling (6 times) and weak decoupling (1 time), accounting for 42.86 percent, 50 percent and 7.14 percent separately in the period of research. While Fig.2 shows the elasticity values of the decoupling exhibited an inverted “V” shaped curve from 1993 to 2006 in Chengdu.

In order to analyze whether decoupling of CLOC from economic growth happened or not, research on decoupling from 1993 to 2006 can be generally divided into four stages according to the fluctuation of elasticity values of the decoupling and the detailed decoupling degrees.

3.1 The First Stage (1993 - 1994)

Compared with strong decoupling of CLOC from economic growth in 1993, decoupling degrees changed into expansive negative coupling in 1994 and presented an ideal-non-ideal transition. It is believed that the pressure of CLOC increased between 1993 and 1994.

In general, the annual average quantity of CLOC was 2043 hm² in this stage and the output of annual average addition of related non-agricultural GDP was 72.33×10^8 RMB. In comparison with the economic indicators in 1992, the quantity of CLOC decreased by 44.94 percent while the output of related of non-agricultural GDP increased by 12.6 percent in 1993 (see Fig.3). Fig 4 shows related non-agricultural GDP grew 10^8 RMB when quantity of CLOC decreased 15.02 hm². However, related non-agricultural GDP grew 10^8 RMB when quantity of CLOC increased 13.29 hm² accordingly in 1994. Combined with the historical situation of social development in 1994, Chengdu strengthened “Taiwan industrial development zone”; in addition, other industrials development zone's infrastructure in Chengdu hugely influenced by the upsurge of industrial development zone's Infrastructure across the whole country. Meanwhile, Pengxian county, Qionglai county and Chongzhou county in Chengdu were changed into Pengxian city, Qionglai city and Chongzhou city respectively, the new cities had strengthen transportation infrastructure dynamics such as roads construction, making the amount of CLOC increased by 69 percent this year compared with 1993 and obviously, the pressure of CLOC increased.

3.2 The Second Stage (1995 - 1998)

As the Table 1 shown, decoupling degrees of CLOC from economic growth in the period of 1995 to 1998 appeared as: strong decoupling - strong decoupling - expansive negative coupling - expansive negative coupling. From this it is clear that the pressure of CLOC decreased firstly and then increased.

Compared with the first stage, the quantity of CLOC which was 2043 hm² in this stage increased by 29.83 percent, and annual average addition of related non-agricultural GDP which was 90.92×10^8 RMB increased by 25.70 percent. Furthermore, the annual average addition of social fixed assets investment which was higher than the annual average addition of related non-agricultural GDP, so that the annual average the variable quantity of CLOC increased by 51.11 percent in Chengdu in this stage. As annual average rate of quantity of CLOC was higher than annual average rate of addition of related non-agricultural GDP, it shows that the pattern of economic growth was extension of expanded reproduction in this stage, and economic growth was mainly rely on increment of quantity of CLOC and large scale input of capital and other production factors. This was supported by Song et al. (2009), who pointed out the CLOC would effectively increase inputs of land, labor and capital in the process of economic growth, as a result, the CLOC had a closely relationship with economic growth.

When related non-agricultural GDP grew 10^8 RMB in 1995 and 1996, quantity of CLOC decreased 4.44 hm² and 5.17 hm² respectively, decoupling degrees of CLOC from economic growth all presented as strong decoupling. By carrying out <<Regulations on the Protection of Basic Farmland>>, the quantity of CLOC showed a decreasing trend and the pressure of CLOC increased. However, this trend disappeared between 1997 and 1998, where related non-agricultural GDP grew 10^8 RMB in 1997 and 1998, quantity of CLOC increased 6.79 hm² and 9.14 hm² respectively, and one could argue that the pressure of CLOC increased at that time. Considering the changes of social and economic development in Chengdu during 1997-1998, urban and rural economic grew fairly quickly and housing market showed signs of upsurge, huge amount of land which contained high quality of cultivated land around the city were taken up for building houses.

3.3 The Third Stage (1999 - 2002)

The same situation as the second stage, the decoupling degrees of CLOC from economic growth in this stage appeared as: strong decoupling - strong decoupling - expansive negative coupling - expansive negative coupling. So the conclusion is pressure of CLOC decreased firstly and then increased.

The annual average quantity of CLOC was 8596.75hm² and was 224.10 percent higher than the second stage; the annual average addition of related non-agricultural GDP which was 233.81×10^8 , was 157.15 percent higher than the second stage. Compared with the second stage, the annual average addition of social fixed assets investment

increased by 125.3 percent in the third stage, and was lower than annual average addition of related non-agricultural GDP as well as annual average the variable quantity of CLOC. Moreover, the annual average addition of non-agricultural employees was 166.21 percent higher than the second stage, but it was lower than annual average rate of quantity of CLOC and was higher than annual average addition of related non-agricultural GDP. It showed that the pattern of economic growth was still extension of expanded reproduction in this stage.

The related non-agricultural GDP grew 10^8 RMB when quantity of CLOC decreased 2.84 hm^2 in 1999 and 4.04 hm^2 in 2000. Pressures of CLOC decreased which is affected by the policies of cultivated land protection in the latter second stage, and decoupling degrees of CLOC from economic growth were strong decoupling between 1999 and 2000. The values of the decoupling elasticity changed dramatically from 2001 to 2002, where related non-agricultural GDP grew 10^8 RMB in 2001 and 2002, the quantity of CLOC increased 5 hm^2 and 68.22 hm^2 respectively. Meanwhile, quantity of CLOC in 2002 reached the max value in the research period. It could be supposed that the main reason was that Chengdu government had accelerated the urban and rural construction scale, which was affected by the 'Western Development Strategy' in 2000. As a result, small towns in rural area developed quickly in 2001, for example, Wenjiang county and Xindu county were changed into Wenjiang city and Xindu city respectively. It is clear from the third stage that the number of cultivated land occupation by infrastructure construction increased and the pressure of CLOC increased.

3.4 The Fourth Stage (2003 - 2006)

The decoupling degrees of CLOC from economic growth from 2003 to 2006 appeared as: strong decoupling - strong decoupling - expansive negative coupling - weak decoupling; so the pressure of CLOC presented as: decrease - increase - decrease.

Compared with the third stage, although annual average addition of related non-agricultural GDP which was 450.84×10^8 RMB increased by 92.83 percent in the fourth stage, the quantity of CLOC which was 6099 hm^2 in this stage decreased by 29.06 percent. Moreover, the annual average addition of social fixed assets investment which was higher than the annual average addition of related non-agricultural GDP, and the annual average the variable quantity of CLOC in the same stage increased by 125.3 percent. Furthermore, the annual average addition of non-agricultural employees was 75.84 percent higher than the third stage. In comparison with the third stage, it is clear that although the quantity of CLOC decreased in this stage, the greater number of capital and labor input had taken a good substitution to accelerate economic grow. As for the pattern of economic growth, it is believed that Chengdu was at its primary stages of economic development process.

When the related non-agricultural GDP grew 10^8 RMB, the quantity of CLOC decreased 44.5 hm^2 in 2003 and 7.73 hm^2 in 2004. The CLOC for independent public ore, logistics and real estate were main bodies of new construction land in 2005, making the pressure of CLOC increased. When related non-agricultural GDP grew 10^8 RMB in 2006, quantity of CLOC increased 6.79 hm^2 , the decoupling degrees of CLOC was weak decoupling from expansive negative coupling. Several effective measures had been implemented, scientific and rational urban planning had been carried out in Chengdu for cultivated land protection in 2005, which successfully increased the intensity of land consolidation and controlled the quantity of CLOC. As a result, the effect of cultivated land protection was obvious and the pressure of CLOC decreased.

4. Conclusions

According to the decoupling models and the coordinate graph of decoupling degrees has been redefined in this paper, the status, degrees and causes of decoupling of CLOC from economic growth has been explored. Study on the relationship between CLOC and economic growth helps to understand the rule between the two factors, and provides the government with relevant measures of cultivated land protection and Economic development policy adjustment. In this paper, Chengdu regarded as an example to be analyzed. The results for the status, degrees and causes of decoupling of CLOC from economic growth in the period of 1993 to 2006 are shown as follows:

(1) Relative and absolute decoupling of CLOC from economic growth occurred at 57.14 percent in the period of research. However, the degrees of decoupling had obvious variations in the temporal scale. The decoupling degrees from 1993 to 1994 appeared as: strong decoupling - expansive negative coupling, so the pressure of CLOC increased. From 1995 to 1998, the decoupling degrees presented as: strong decoupling - strong decoupling - expansive negative coupling - expansive negative coupling, which shows the pressure of CLOC decreased firstly and then increased. The decoupling degrees from 1999 to 2002 were the same as the decoupling degrees from 1995 to 1998, and the pressure of CLOC decreased firstly and then increased. The decoupling degrees from 2003 to 2006 appeared as: strong decoupling - strong decoupling - expansive negative coupling - weak decoupling, the pressure of CLOC presented as: decrease - increase - decrease.

(2) The status of decoupling of CLOC from economic growth, which mainly presented a repeated fluctuations of decoupling - negative decoupling - decoupling, showed status instability from 1993 to 2006 in Chengdu, while the elasticity values of the decoupling exhibited an inverted “V” shaped curve.

(3) The additional investment of capital and labor, the implementation of policy measures and the transformation in the pattern of economic growth will help accelerate decoupling of CLOC from economic growth. Therefore, <<Regulations on the Protection of Basic Farmland>> should be executed strictly and the quantity of cultivated land occupation by construction should be under the control of Chengdu government. Meanwhile, the government should speeding up the transformation of economic development models and optimizing the structure of industry, so that economic can grow healthily through improving quality production and making benefit which caused by technical progress and scientific management. In this way, the changes of production factors input which caused by CLOC can affect weakly on economic growth, cultivated land will gradually decoupled from economic growth and economic will grow continuously even if the quality of CLOC is 0. Then, cultivated land conservation and economic growth are not a dilemma.

References

- Chen, B.M., & Du, H.L. (2006). Analyzing decoupling relationship between arable land occupation and GDP growth. *Resources Science*, 28(5), 36-42
- Dong, G.X., & Zou, J. (2006). The positive analysis of contribution of arable land loss to economic development: A study of Zhejiang. *Journal of South China Agricultural University: Social Science Edition*, 5, 41-47.
- Li, J.M., Sun, Y.L., & Zhuang, M.F. (2006). Establishment and evaluation of decoupling index about CO₂ emission in Taiwan. *Taiwan Economic Forum*, 4(3), 1-24
- Li, X.K., & Wei, J. (2010). Decoupling between economic growth and resource–environmental pressures: a case study of the Chongqing Metropolitan area. *Journal of Chongqing Normal University(Natural Science)*, 27(1), 28-35. doi:10.3969/j.issn.1672-6693.2010.01.007, <http://dx.doi.org/10.3969/j.issn.1672-6693.2010.01.007>
- Li, Z.F., & Yang, G.S.(2007). Correlation analysis of cultivated land change and economic development in Huzhou City. *Chinese Journal of Eco-agriculture*, 15(3),146-2149
- OECD. (2002). Sustainable development: indicators to measure decoupling of environmental pressure from economic growth. [Online] Available: <http://www.oil.oecd.org/olis/2002doc.nsf> (2002)
- Qu, F.T., & Wu, L.M. (2004). Hypothesis and validation on the Kuznets Curves of economic growth and farmland conversion. *Resources Science*, 26(5), 61-67
- Song, W., Chen, B.M., & Chen, X.W. (2009). Decoupling Evaluation between Cultivated Land Occupation and Economic Growth in Changshu City. *Journal of Natural Resources*, 24(9), 1532-1540
- Tan, M.H., et al. (2005).Urban land expansion and arable land loss in China: A case study of Beijing - Tianjin -Hebei region. *Land Use Policy*, 22(3), 187-196. doi:10.1016/j.landusepol.2004.03.003, <http://dx.doi.org/10.1016/j.landusepol.2004.03.003>
- Tapio, P. (2005). Towards a theory of decoupling: degrees of decoupling in the EU and case of road traffic in Finland between 1970 and 2001. *Transport Policy*, 12(2005), 137-151. doi:10.1016/j.tranpol.2005.01.001, <http://dx.doi.org/10.1016/j.tranpol.2005.01.001>
- Zhu, L.F., & Huang, J.K. (2007). Urbanization and cultivated land changes in China. *Economic Research Journal*, 2, 137-145

Table 1. The decoupling status and degrees between OLCO and non-agricultural GDP in Chengdu city from 1993 to 2006

Time	The variable quantity of CLOC (hm ²)	The addition of related non-agricultural GDP (1 × 10 ⁸ RMB)	F _d	R _d	The status of decoupling	The degrees of decoupling
1993	-1110	73.92	4.57	-3.57	absolute	strong decoupling
1994	940	70.74	-5.45	6.45	negative	expansive negative coupling
1995	-170	38.26	2.41	-1.41	absolute	strong decoupling
1996	-300	58.01	2.87	-1.87	absolute	strong decoupling
1997	770	113.34	-2.07	3.07	negative	expansive negative coupling
1998	1450	154.05	-2.41	3.41	negative	expansive negative coupling
1999	-346	119.45	1.78	-0.78	absolute	strong decoupling
2000	-932	230.70	2.32	-1.32	absolute	strong decoupling
2001	1510	301.73	-1.60	2.60	negative	expansive negative coupling
2002	19347	283.34	-26.86	27.86	negative	expansive negative coupling
2003	-15023	337.57	4.82	-3.82	absolute	strong decoupling
2004	-4668	603.79	3.12	-2.12	absolute	strong decoupling
2005	1969	494.52	-2.00	3.00	negative	expansive negative coupling
2006	39	367.49	0.94	0.06	relative	weak decoupling

Note: The CLOC data and the non-agricultural GDP data were selected from << Statistical Yearbook of Sichuan province>> (1993-2010) and << Statistical Yearbook of Chengdu city>> (1993-2010). In order to eliminate the inflation effect on the addition of non-agricultural GDP, this paper regards 1992 as base period, calculates the actual output value of non-agricultural GDP from 1996 to 2009 by using consumer price index.

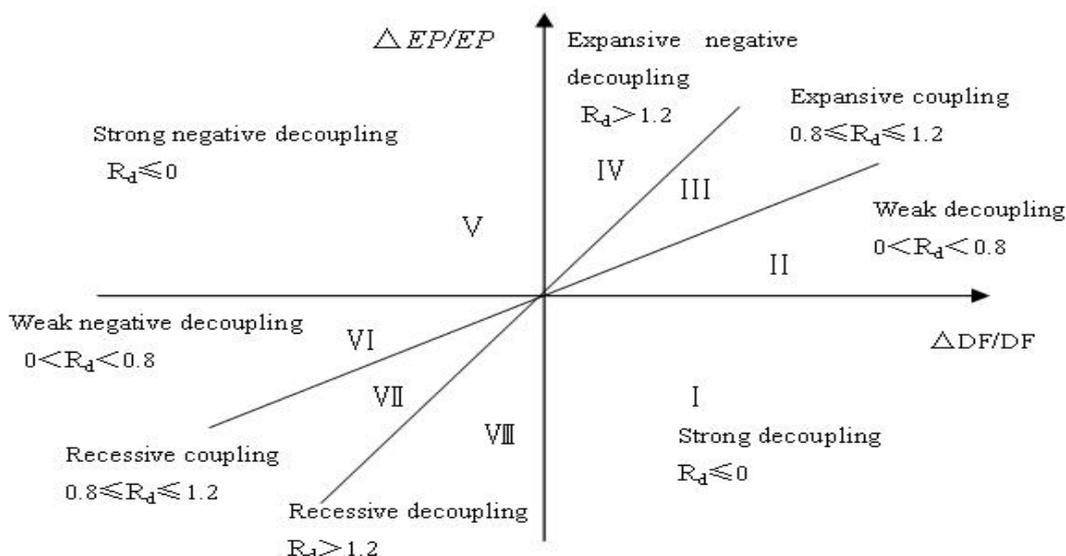


Figure 1. The coordinate graph of decoupling degrees

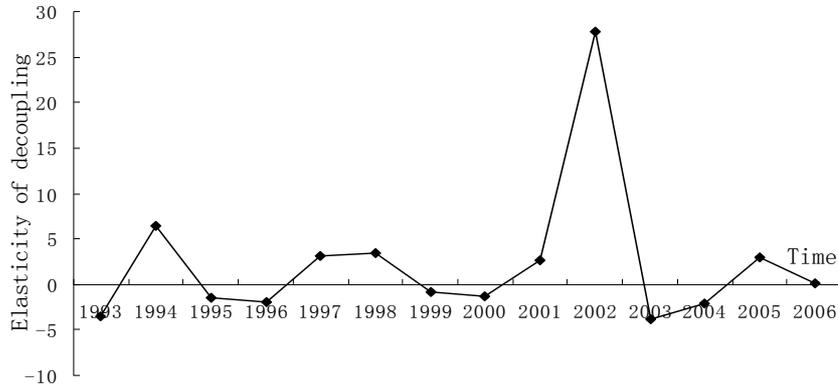


Figure 2. The curve of the elasticity values of decoupling between CLOC and non-agricultural GDP from 1993 to 2006

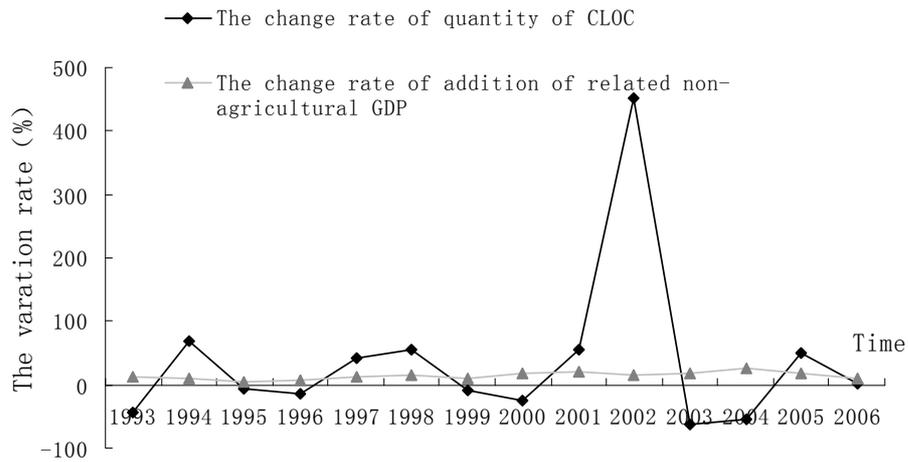


Figure 3. The curves of the change rates of CLOC and related non-agricultural GDP in Chengdu from 1993-2006

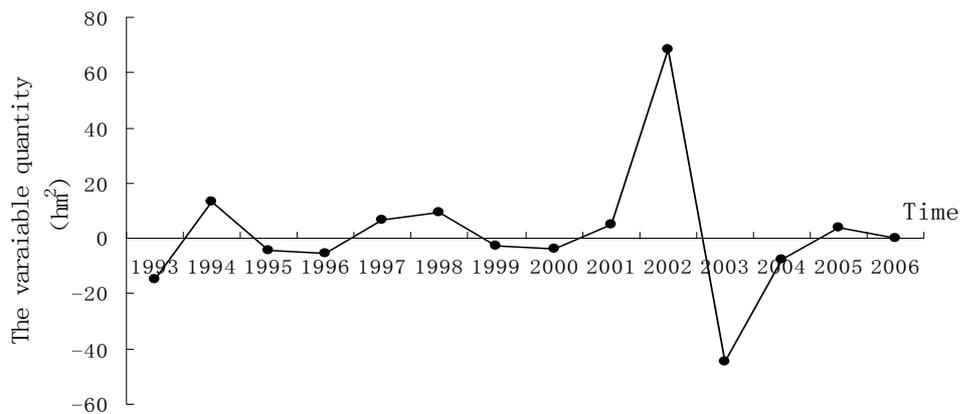


Figure 4. The curve of the variation of CLOC per the variation of non-agricultural GDP in Chengdu from 1993 to 2006