

An application of Shift-Share model to economic analysis of county*

Wei Chen , Jiuping Xu[†]

Uncertainty Decision-Making Laboratory
School of Business and Administration, Sichuan University, Chengdu 610064, P. R. CHINA

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Abstract. Shift-share analysis is a useful method to examine whether a productive sector in one region is energetic. The purpose of this paper is to explain changes in different sectors in study region which are measured by competitive and structural component of the shift-share model (SSM). This is done by applying the shift-share model to each productive sector in study region and using time series data as the basis of analysis. County scale economy is very important to developing countries but many counties of them, despite a persistent growth rate and development, still can't keep a good balance between three aggregate industrial sectors due to the reasons of history, geographic and environment, so it is very important to assess the performance of certain county's industries and find out the real problems to make an economic adjustment. This paper will show us how shift-share method could handle this work.

Keywords: shift-share method, county economy, aggregate assessment

1 Introduction

The economy of Many developing countries has achieved remarkable success and attracted increasing attentions of the world in recent years, and their rapid development not only make for improving comprehensive national powers themselves but also play a important role in world economy. However, comparing with developed countries, their relatively weak industrial structure and inadequate industrial infrastructure are still big challenges to make sure the healthy development of their economy^[2], so how to maintain a sustained and coordinated economic development is becoming a more and more important research topic. County is many developing countries' basic administrative districts, and also the most important one. A reasonable adjustment in county scale industries would be a fundamental guarantee for the entire country's economic development. This paper's focus is mainly on the assessment and optimization of county scale industrial structure. The most common and effective modeling tools for industry evaluation should be the method based on Input-Output Table. But for most county in developing country the preparation of Input-Output Table may be too hard to achieve because the requirements of funds and workload are far beyond their affordability. So we need to choose another effective method to achieve our goal. Had been examined and proved in many fields and many country, the Shift-Share Method (SSM) can be used to quantify the relative efficiency and the industrial structure level of various industries in a certain region's economic growth, here we choose this model as the most compatible method for our research. The rest of this paper will discuss how shift-share method can be applied in analysis of county economy in detail.

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[†] Corresponding author. Tel.:+86-28-85418522; fax:+86-28-85400222.
E-mail address: xujiuping@openmba.com, beyondchenw@163.com.

We organize this paper as follow. In section 2, the shift-share model and its basic formulation of county scale analysis are summarized. In section 3, an empirical analysis is made and the results of the analysis are presented and discussed. Finally we conclude this paper with a summary in section 4.

2 Model explanation

Shift-Share Method (SSM) is a standardized and useful analytical tool for economic and spatial analysis. Since it was first developed by *Dunn* (1960) and *Perloff* et al, it has been widely used in many domains. It continues to be popular among planners, geographers and regional researchers. It has been utilized in structural political economy^[10, 12], retail analysis^[11], migration analysis^[11, 15], and neoclassical analysis of regional growth^[3, 4], regional employment. Additionally, policy-makers who often have need of quick, inexpensive analysis tools that are neither mathematically complex nor data intensive also utilize shift-share extensively. All these features are just suitable to the conditions of county scale economic research.

In order to make sense of what is to follow, it is first necessary to briefly review economic shift-share model. As we know, the level and variety of industries are two of the most important factors affecting the economy growth of a certain area^[6] (In this article we discuss county scale economy). Some industries grow (or decline) because they partake in the overall growth (decline) being experienced by all regions (include the region we discuss) across the bigger area such as nation, province (and the bigger area is chosen as a reference benchmark). This is some times called the regions national component of growth, let N_{ij} denotes the j -th industry's national growth component in the region i . Some regions grow because they enjoy an above-average concentration of industries that happen to be growing rapidly across the nation (province). This is called the regions industry mix, proportional, or structural component of growth, let P_{ij} denotes the j -th industry's structural component of region i . Finally, other regions grow not because they enjoy this cluster of rapidly growing industries but because of competitively driven changes in the locations of industries. As a result, economy in some industries may grow faster in one region than in others, irrespective of whether those particular industries are ones that are growing or declining across the nation (province). This is called the regions competitive or differential component of growth, let D_{ij} denotes the j -th industry's competitive component of region i . The total economy growth in region i 's j -th industry (let G_{ij} denotes it) is therefore comprised of three separate components: N_{ij} , P_{ij} and D_{ij} ^[7]. The identification and measurement of these three effects is called shift-share analysis.

We choose GDP as the indicator of regional economic change in this article, let b_{ij0} denote the beginning research period's GDP of j -th industry in region i , and b_{ijt} denotes the end period's GDP of j -th industry in region i . This region's growth rate r_{ij} in this period could be written as

$$r_{ij} = (b_{ijt} - b_{ij0})/b_{ij0} \quad (1)$$

Let B_{j0} denotes the beginning period's GDP of j -th industry in benchmark area (nationwide often), and B_{jst} denote the end period's GDP of j -th industry in benchmark area. This area's growth rate R_{ij} in this period could be written as

$$R_j = (B_{jt} - B_{j0})/B_{j0} \quad (2)$$

Then we define variable b_{sj} as the standardized GDP value of the j -th industry in region i

$$b_{sj} = b_{i0} \times B_{j0}/B_0 \quad (3)$$

where B_0 is the benchmark area's total GDP in the beginning period, b_{i0} is region i 's GDP.

As explain above, we can now get the main shift-share equation of j -th industry's growth in region i as

$$G_{ij} = N_{ij} + P_{ij} + D_{ij} \quad (4)$$

each component is defined as follows

$$\begin{aligned}
 N_{ij} &= b_{sj} \times R_{ij} \\
 P_{ij} &= (b_{ij0} - b_{sj}) \times R_{ij} \\
 D_{ij} &= b_{ij0} \times (r_{ij} - R_{ij})
 \end{aligned}
 \tag{5}$$

Then enter the original data into the formulation above and figure out the value of P_{ij} and D_{ij} . As to structural component P_{ij} , its value represents the structural superiority of j -th industry in region i over the benchmark region's counterpart. As to competitive component D_{ij} , its value represents the developing speed superiority of j -th industry in region i over the benchmark region's counterpart.

Therefore, we could choose the value of P_{ij} as ordinate and the value of D_{ij} as abscissa, then the point where region i 's j -th industry is located will show us how j -th industry perform in the study period comparing the j -th sector of benchmark area. Fig. 1 will show us The meaning of the mix-value's location. The shift-share method will provides a more accurate assessment and analysis in the research region.

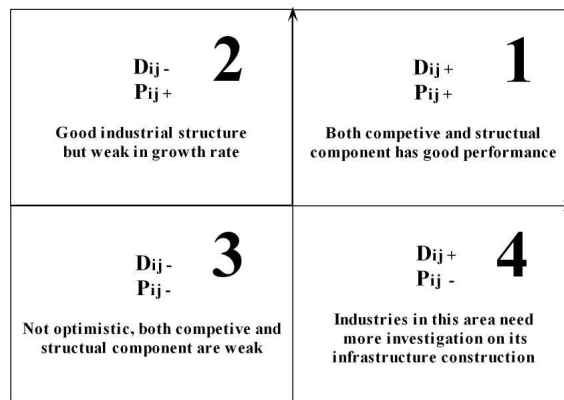


Fig. 1. Meanings of different value location

Although traditional shift-share method is useful and conventionally on the analysis of county economy, it is still far from perfect^[16]. Most application of shift-share method to regional analysis have used a study period of several years and have examined situations only at the beginning and the end years, they doesn't take the continuous change in economy of certain region into account over the study period^[5].

One reason that shift-share was not used time-series analysis in the early years is due to the difficulty of gaining annual economic data. This reason is not a burden today, most administrative districts's statistic bureau in most countries provide efficient economic and social data annually. This do give us a great help to complete the time-series shift-share analysis. A second limitation is the time and effort required to compute and analyze the shift-share effects, especially a comprehensive and particular analysis which contains a large number of industries. Micro-computer are widely used today, and the statistical softwares are easy to understand and good at calculating. In this paper, we calculate each industry's industry mix component and competitive component on an annual basis, draw these points and then use arrows connect them. Obviously, this will not only give a trend of various industries's performance, but also provide us a more accurate view of it, and make a deeper analysis possible. So it's really necessary to introduce the time-series concept to the traditional shift-share method.

Finally, to appraise the overall regional economy's performance, we introduce some variables. Using equation (1) to (5), total regional economic change G_i can be written as

$$\begin{aligned}
G_i &= \sum_{j=1}^n G_{ij} = N_i + P_i + D_i \\
N_i &= \sum_{j=1}^n (b_{sj} \times R_{ij}) = \sum_{j=1}^n N_{ij} \\
P_i &= \sum_{j=1}^n [(b_{ij0} - b_{sj}) \times R_{ij}] = \sum_{j=1}^n P_{ij} \\
D_i &= \sum_{j=1}^n [b_{ij0} \times (r_{ij} - R_{ij})] = \sum_{j=1}^n D_{ij}
\end{aligned} \tag{6}$$

where N_j , P_j , D_j denotes region i 's overall national growth effect, overall industry mix effect, overall competitive effect respectively, thus we can find out the total shift between region i and the benchmark area.

Let L_i denotes regional coefficient^[17] in region i , it simply compares the growth rate between region i and benchmark area

$$L_i = (b_{it}/b_{i0})/(B_t/B_0) \tag{7}$$

and defines the proportion j -th industry in region i takes of the benchmark area counterpart's GDP in the beginning period and end period as K_{ij0} and K_{ijt}

$$K_{ij0} = b_{ij0}/B_{j0} \quad K_{ijt} = b_{ijt}/B_{jt} \tag{8}$$

then L_i can be explained as follows

$$L_i = \frac{b_{it}/B_t}{b_{i0}/B_0} = \frac{\sum_{j=1}^n K_{ijt} \times B_{jt}}{\sum_{j=1}^n K_{ij0} \times B_{j0}} \bigg/ \frac{\sum_{j=1}^n B_{jt}}{\sum_{j=1}^n B_{j0}} = W_i \times U_i \tag{9}$$

where

$$W_i = \frac{\sum_{j=1}^n K_{ij0} \times B_{jt}}{\sum_{j=1}^n K_{ij0} \times B_{j0}} \bigg/ \frac{\sum_{j=1}^n B_{jt}}{\sum_{j=1}^n B_{j0}} \quad U_i = \frac{\sum_{j=1}^n B_{jt}}{\sum_{j=1}^n B_{j0}} \tag{10}$$

As shown in equation (9), the variant W_i and U_i has the ability to assess the level of region i 's total structural effect and total competitive effect respectively. If $W_i > 1$, region i 's aggregate industrial structure is good, in which healthy industries take a large share; If $U_i > 1$, most industries in region i develop actively and have a good growth rate. As to L_i , it provides us the information that whether region i upgrade its economic status in the benchmark area.

3 Empirical analysis

In empirical analysis sector, we choose Yanbian county as region i to test the county economy based shift-share method. Yanbian county is in south of Sichuan province, China. Yanbian county has experienced unprecedented fast economic growth^[18]. Gross Domestic Product (GDP) of Yanbian grew about 10% per year in recent years. But comparing with the prosperous eastern coastal provinces, its economic situation is, especially the industrial structure, still not optimistic yet. Unbalanced industrial structure is a common problem in many areas in many developing countries including China, and a healthy economic development can't be

achieved without a concordant industrial structure. Our empirical analysis will focus on the assessment of industrial structure.

Yanbian county is full of geographic advantages such as mine resource, waterpower resource, these resources provides good elements for the development of excavating industry and manufacturing industry. The modernization of industry could help Yanbian get rid of the predominant role of agriculture. Meanwhile, various sectors in a region shouldn't be regarded as homogeneous, and it's important to realize which industry is more appropriate for local economy, which industry is more efficient than other regions due to local advantages. We will analyze Yanbian's situation by shift-share method in the rest of this paper.

We choose Sichuan province as the reference benchmark region because there are a lot of common characteristics between Yanbian county and Sicuan province such as climate, development level, geography, etc. Another consideration is that Sichuan province is just right in size to our research. The calculation results of an overview in Yanbian county is listed on Tab. 3, and the Fig. 2 which gives us a direct impression of Yanbian macro-economy. We will analyze them respectively.

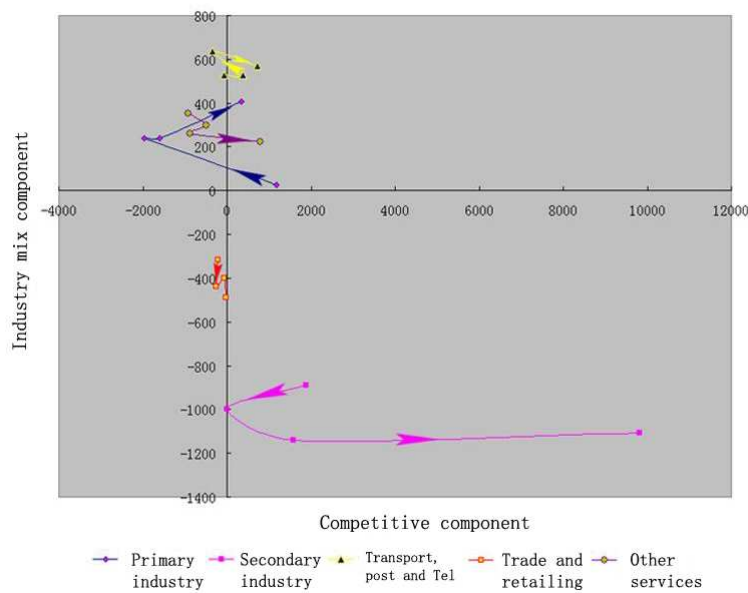


Fig. 2. SSM analysis of Yanbian's macro-economy

3.1 Primary industry

Concluding from Fig. 2, the structural mix of Yanbian primary industry has been making progress in recent years. The value of P_{ij} is always above the average level of Sichuan, mainly because Yanbian's agriculture-depending history has lasted for hundred years.. But on the other hand, the growth rate of primary industry was fluctuating through the study periods, which should be the weakness of agriculture infrastructure construction in Yanbian. Our suggestion is to take full advantage of Yanbian's climate condition and light-heat energy, and to develop the characteristic plants such as mango, loquat, tea, silkworm, etc.

3.1.1 Agriculture

Analyzing Fig. 3, we can see that Yanbian's agriculture is more competitive than average level of Sichuan province and shares the similar agriculture proportion. Agriculture provides most job opportunity for farmers in Yanbian, paying more attention to it will bring farmers to a affluent life and, following this, the large amount of wealthy farmers could form a huge consumption market which would impulse the whole region's economy forward.

Table 1. SSM data of aggregate analysis in Yanbian

Industry		2000	2001	2002	2003
Primary industry	r_{i1}	-0.07137	0.015301	0.015119	0.146961
Secondary industry	r_{i2}	0.925842	0.795435	0.273323	0.246409
Transportation,post and telecommunication	r_{i3}	0.082361	0.616237	0.070343	0.195168
Trade and retailing	r_{i4}	0.046552	0.044716	0.072314	-0.04097
Other services	r_{i5}	0.068117	0.393961	0.070916	0.126257
Primary industry	R_1	0.004846	0.038178	0.046797	0.098276
Secondary industry	R_2	0.095562	0.111592	0.1284	0.143066
Transportation,post and telecommunication	R_3	0.124436	0.115107	0.111543	0.093096
Trade and retailing	R_4	0.100015	0.112885	0.094084	0.107169
Other services	R_5	0.125082	0.152662	0.114201	0.108796
Primary industry	b_{i1}	29407.36	40792.77	46980.79	56972.02
Secondary industry	b_{i2}	49152.93	73004.63	90633.3	114390.3
Transportation,post and telecommunication	b_{i3}	8751.175	13038.83	15945.54	19245.43
Trade and retailing	b_{i4}	13268.11	19729.44	23748.7	29032.45
Other services	b_{i5}	24138.43	37176.32	45572.67	55793.82
Primary industry	N_{i1}	109.2107	1122.703	1908.993	4617.066
Secondary industry	N_{i2}	3301.708	5485.073	9373.761	12966.55
Transportation,post and telecommunication	N_{i3}	745.7941	1007.323	1454.391	1484.465
Trade and retailing	N_{i4}	929.0094	1497.767	1856.219	2545.124
Other services	N_{i5}	2066.621	3685.016	4245.576	4958.123
Primary industry	P_{i1}	26.33111	239.4085	241.0769	406.9342
Secondary industry	P_{i2}	-891.254	-998.812	-1139.95	-1107.7
Transportation,post and telecommunication	P_{i3}	528.4123	529.7016	636.0586	570.1288
Trade and retailing	P_{i4}	-317.718	-436.836	-401.633	-488.662
Other services	P_{i5}	353.0939	297.324	261.8825	221.6666
Primary industry	D_{i1}	1174.686	-1959.58	-1611.36	351.1102
Secondary industry	D_{i2}	1875.41	-3.93005	1581.965	9813.824
Transportation,post and telecommunication	D_{i3}	-64.7816	378.8131	-336.336	725.2002
Trade and retailing	D_{i4}	-211.155	-252.867	-70.94	-16.4653
Other services	D_{i5}	-929.704	-499.264	-866.34	789.4691

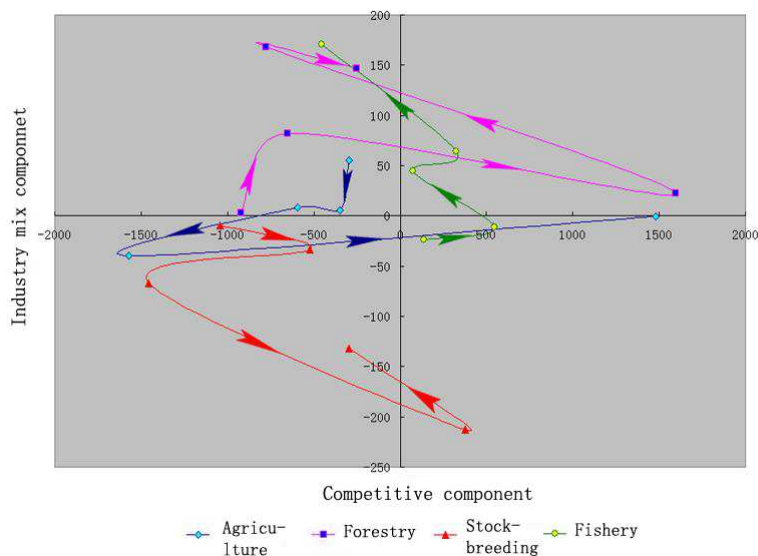


Fig. 3. SSM analysis of Yanbian's primary industry

Table 2. SSM data of Yanbian's primary industry

Industry		1999	2000	2001	2002	2003
Agriculture	r_{i1a}	-0.05218	-0.02766	-0.0517	-0.04094	0.088417
Forestry	r_{i1b}	-0.28276	-0.21155	0.906011	-0.1488	0.000337
Stockbreeding	r_{i1c}	-0.04	0.030094	-0.00327	0.132221	0.100214
Fishery	r_{i1d}	0.334559	0.847107	0.155108	0.320852	-0.0523
Agriculture	b_{i1a}	19592.66	18915.86	18357.22	18435.86	18747.74
Forestry	b_{i1b}	1135.326	1183.31	1212.371	1246.669	1375.5
Stockbreeding	b_{i1c}	14151.54	14734.41	16048.12	16985.52	19319.67
Fishery	b_{i1d}	842.4744	897.4177	977.5261	1040.946	1238.089
Agriculture	N_{i1a}	-808.936	-183.619	-371.395	893.6019	6.164847
Forestry	N_{i1b}	1.831355	78.83524	41.42669	89.40787	106.4007
Stockbreeding	N_{i1c}	483.4778	967.0291	1477.391	1688.259	2019.102
Fishery	N_{i1d}	69.06826	78.34097	90.07896	109.4352	176.9539
Agriculture	P_{i1a}	55.75537	5.385595	8.322076	-39.976	-0.541
Forestry	P_{i1b}	3.106949	82.33129	22.64007	167.8193	146.9975
Stockbreeding	P_{i1c}	-9.06388	-33.794	-66.82	-213.147	-131.891
Fishery	P_{i1d}	-23.4034	-10.8309	44.5249	63.9772	170.8526
Agriculture	D_{i1a}	-293.82	-347.766	-592.927	-1571.63	1481.376
Forestry	D_{i1b}	-919.938	-652.167	1593.933	-776.227	-252.398
Stockbreeding	D_{i1c}	-1043.41	-522.235	-1456.57	378.8881	-296.21
Fishery	D_{i1d}	136.3351	547.4899	73.39614	323.5876	-454.807
Agriculture	R_{1a}	0.064194	0.031946	-0.03754	-0.00937	-0.01963
Forestry	R_{1b}	0.070762	0.110385	0.001526	0.069438	0.035009
Stockbreeding	R_{1c}	0.143675	0.050322	0.033348	0.068334	0.100268
Fishery	R_{1d}	0.162218	0.111307	0.083943	0.092989	0.100376

3.1.2 Forestry

With the implementation of returning farmland to forest policy and the increasing need of ecological construction, both economical and environmental value of the Ecological Forest should be considered in the vast western area in China, including Yanbian.

It shows on Fig. 3 that Yanbian's forestry industry goes well on its industrial structure in recent years but, although the trend of growth in the past two years is upward, and it is weak at growth rate. So how to make the best use of Yanbian's mountain environment to enhance plant production is becoming an urgent matter. Our suggestion is to focus on the development of eco-efficient forestry, green barren mountain, and support the development of timber and fruit processing industries.

3.1.3 Stockbreeding

We can get a clear point from Fig. 3 that the stockbreeding sector in Yanbian stands in an obvious weak position with both structural and competitive component, especially the structural one. However, we should't ignore that the stockbreeding industry in Sichuan province has a lot of advantages through nationwide, so there is still much space for further adjustment in Yanbian's stockbreeding industry. On the basis of Making full use of favorable conditions such as climate and light resources, Yanbian government should raise stockbreeding sector's status in primary industry by providing pastoralists with more help such as credit, policy support, etc.

3.1.4 Fishery

Concluding from Fig. 3, we can find that the growth rate of fishery industry in Yanbian is below the average growth rate of Sichuan province. However, the structural component has more superiority than average level. Yanbian is rich in water resources, and the areas of salt water fishing are up to 3.8 million Mu. Readjust fish species will open up a good prospect for fishery industry.

3.2 Secondary industry

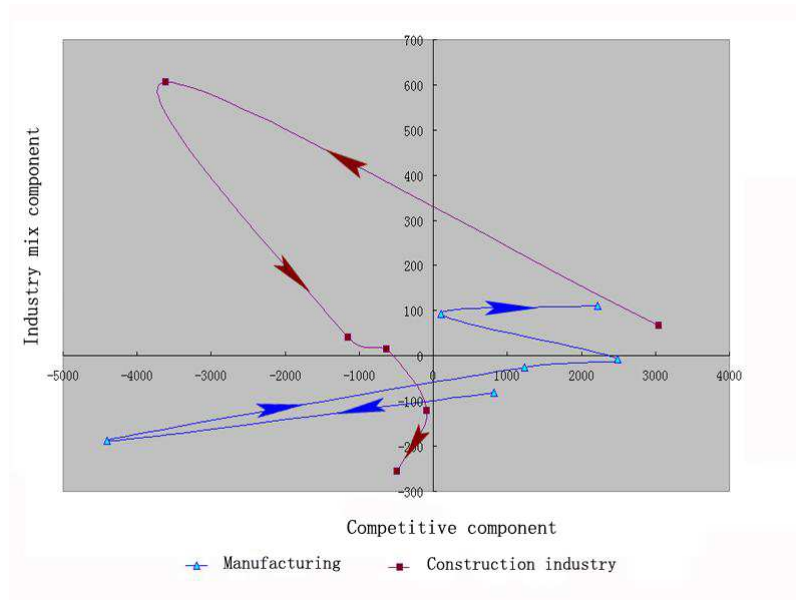


Fig. 4. SSM analysis of Yanbian’s secondary industry

Table 3. SSM data of Yanbian’s secondary industry

Industry		1997	1998	1999	2000	2001	2002
Manufacturing	P_{i2a}	-81.1296	-187.241	-24.4996	-7.46241	93.05698	111.5065
Construction industry	P_{i2b}	66.64252	605.6214	40.83378	15.4194	-122.343	-256.406
Manufacturing	D_{i2a}	824.2992	-4407.51	1231.891	2497.103	111.6136	2216.674
Construction industry	D_{i2b}	3047.915	-3608.26	-1155.45	-629.65	-86.2576	-489.81

Fig. 2 shows us that the infrastructure of Yanbian secondary industry is weaker than the average level of Sichuan. But the growth rate of secondary industry is faster than provincial average level, especially in recent years. This means that Yanbian’s secondary industry has entered a rapid development track. To achieve the goal of constructing a prosperous society, Yanbian government must implement the new industrialization and recycle economy policy resolutely because promoting the industrialization level not only provides a powerful technical and financial support to the agriculture modernization but also creates a favorable condition for the transfer of surplus labor.

3.2.1 Manufacturing

Analyzing the information comes from Fig. 4, and we can see that both competitive and structural component of Yanbian’s manufacturing have a good trend, both values of them are higher than average level in Sichuan province, especially the competitive component. This means that the manufacturing sector in Yanbian has a clear advantage.

We should realize that relying on the development of mining solely is dangerous, and experiences tells us that the selling raw materials way can’t last long, so what we need to do on manufacturing is to focus on industrial complementarity and to extend industry chains, meanwhile, to increase technological investigation into manufacturing sector to make it become lead role of secondary industry.

3.2.2 Construction industry

Both growth rate and structural mix of the construction industry in Yanbian are below the average level of Sichuan province (see Fig. 4). China government decides to expand housing consumption during the next Five-Year Plan period. It will Obviously stimulate the real estate market, and it is also a good chance for the construction industry in Yanbian.

3.3 Tertiary industry

There is a great development of the tertiary industry in Yanbian county in recent years (see Fig. 2), but the tertiary industry still take low proportion of overall county economy, and its industrial structure is not optimistic yet. The level of tertiary industry marks the economic structure level, there shouldn't be any delay to speed up the tertiary industry development in Yanbian. Let's look back on Fig. 2, we can find that transportation, post and telecommunication sector's structural advantage is higher than provincial level and its growth rate shows us a upward trend since year 2002. Meanwhile, though the retailing and trading industry have been gaining in strength year by year, its competitive and structural component is just up and down around the average level of Sichuan province closely in recent years. Finally, other services industry wanders around average level just like the retailing industry, and it has slender advantage on industrial structure but it was not until 2003 that it caught up the speed of average growth rate of Sichuan province.

Considering the situation that the tertiary industry in Sichuan province is still lagging behind more modernized province such as Zhejiang, Guangdong. These small advantages of Yanbian's tertiary industry is still far from enough. Yanbian needs to do more work on its services industry, and our suggestion is 1, Take full use of the winter sunshine resource of Yanbian which could attract a lot of tourists to develop local tourism industry. 2, Develop the financial and insurance industry 3, Pay more attention on urban community services and intermediary services such as accountancy, pricing, consultant.

Finally, we analyze Yanbian county's aggregate economic performance by using equation (9) and (10) (see results in Tab. 4). The results shows that Yanbian's aggregate economy development is good, and its performance is better than provincial average level in 4 consecutive years ($L_i > 1$, $W_i > 1$, $U_i > 1$), especially on its growth rate. So it is clear that the economic development prospect in Yanbian county is optimistic.

Table 4. Aggregate performance of Yanbian

Variable	2000	2001	2002	2003
L	1.29854603	1.336151	1.100207	1.104155
W	1.001201765	1.003389	1.012553	1.012391
U	1.296987357	1.331638	1.086567	1.09064

4 Conclusion

This paper shows that the shift-share method can be used to analyze regional economy (county scale) on both growth rate and structure aspect. And an introduction of time-series based analysis gives us a more clear understanding on how regional industries performed in a continual time period, and more detail has been revealed by using of this extension of shift-share method. Time-series based analysis really do a lot of help to further analysis.

Through the final results of Yanbian county, we realized that there is diversity and complexity of growth behind the fast growth rate at the regional level, and it's a common phenomenon in county scale economy in many developing countries. We make many suggestions from the analysis of modeling results, and these suggestions should lead to improved policy. Shift-share method is an effective tool for regional economy analysis, and we hope complimentary and extension work could be done to make this method more practical and accurate.

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