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Yijue Diao April 12, 2016

How Does Keqiang Index Work for the Economy of China?

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Abstract

How Does Keqiang Index Work for the Economy of China?
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How to keep track of Chinese economy? I address this question by comparing Keqiang Index with GDP and analyzing movements of different components from 2000 to 2014. I find that Keqiang Index is more consistent with GDP in areas which second industry has a heavier share among all economics activities. I also consider that the indicator, Loan Disbursed by Bank, will distort Keqiang Index and generate gaps between Keqiang Index and GDP. I find that cargo volume by rail is not representative enough for every region, for example, Tianjin and Sichuan. I also notice that the volatility of Keqiang Index is much larger than GDP, by comparing the standard deviation of each.

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How Does Keqiang Index Work for the Economy of China?

Yijue Diao

PART I.

INTRODUCTION

After the Cultural Revolution, China was like a lion just woke up, swiftly jumped onto the stage of world economy. China, uses its own way of socialism with Chinese characteristics to create a unique path that has surmounted every country except the United States, to become the second place in the world, in terms of total GDP. Furthermore, China is even estimated by IMF to be the largest economy in terms of GDP by PPP. [1]

However, there are claims or "rumors" saying that Chinese economy is inflated. Scholars have continuously questioned the accuracy of Chinese GDP statistics. For example, the summation of GDP of all thirty-one provinces in China is 10% more than total GDP of China in 2013. However, theoretically, these two amounts should be equal to each other.

Such skepticism even has consensus with the prominent leaders in China. Mr. Li Keqiang, the premier of China, the previous party secretary of Liaoning Province has the same qualms. In a meeting with the American Ambassador in 2007, Mr. Li pointed out that he did not "pay much heed to the figures provincial officials feed him," as the data has been suspected to overestimate or overstate the growth of provincial economy. [2] He also

considered that GDP are man-made and not reliable, and in his words, “GDP statistics are for reference only.” And indeed, under any circumstance, measuring the exact amount of Chinese GDP would be difficult.

Instead, Mr. Li himself, would like to use three alternative indicators to analysis the economy situation of his province: 1) electricity consumption, 2) the cargo volume on the province's railways, and 3) loans disbursed by banks. Later, in a passage of The Economist wrote in 2010, the editor created a term called “Keqiang Index”, in Mr. Li Keqiang’s honor. [3] Later, when Mr. Li took office as the national premier in 2013, the “Keqiang Index” immediately become a popular “invention” to reveal the amazing intelligence of our premier. Enormous compliments towards this index rapidly appeared on headlines of newspapers. Soon, Keqiang Index became a popular measurement to capture Chinese economy.

There are very few scientific researches on the topic of Keqiang Index. Even on Google Scholar, there are no more than ten essays with key words “Keqiang Index,” let along find essays demonstrating the credibility of Keqiang Index or even just analyzing how it works. Therefore, in my project, I will have an insightful observance of “Li Keqiang Index.”

In this paper, I am going to test Keqiang Index, as an alternative measurement of Chinese economy and catch the connection and interaction between Keqiang Index and GDP. Specifically, I calculate the Keqiang Index for China other nine provinces. These data are

from the official statistical bureau, ensuring the accuracy of the calculation for Keqiang Index. I compare the movements of growth rate of Keqiang Index to GDP growth rate, as well as look at each alternative indicator solely. I start to examine the Keqiang Index on national level, and then for three different provinces (municipality) representing three different economy situations within China.

According to the empirical method I have used, I have four major findings throughout the research process. By noticing the deviation of Keqiang Index and GDP, I find that loan disbursed by bank will distort Keqiang Index and create gaps between Keqiang Index and GDP. By figuring out the correlation of cargo by rail with Keqiang Index and GDP, I obtain the conclusion that cargo by rail is not a widely fitted indicator of capturing economy. By comparing the standard deviation of Keqiang Index, three components of Keqiang Index, and GDP, I think Keqiang Index is more volatile than GDP. Finally, I find that Keqiang Index matches better with GDP in areas with heavy second industry.

PART II.

LITERATURE REVIEW

There are mainly three ways to calculate GDP, gross domestic products. In China, since 2000, the national statistical bureau has used the expenditure approach, which has been widely used among western developed countries, including the United States. Under this

method, national income is considered from output side. Symbolically, GDP is counted by the sum of the final uses of goods and services (excepts intermediate consumptions.) In reality, we calculate GDP by adding consumption, investment, government spending, and net exports.

On account of the claim that Chinese economy is murky, it is a challenge to evaluate the accuracy and quality of GDP statistics. Holz et al (2013) specifically wrote an essay evaluating Chinese GDP statistics in four stages. He found that "the supposed evidence for GDP data falsification is not compelling," while "manipulations of nominal and real data would be virtually undetectable." GDP statistics were also tested by Benford's Law for credibility, however, "exhibit few statistical anomalies." [4]

Another approach to assess the quality of Chinese GDP statistics, according to Fernald et al (2015), is to "find an independent benchmark to compare with reported data." [5] Henderson et al (2012) use satellite data on night-lights to compare with official income growth and other economic activities for sub- and super-national regions. He mentions that official data are likely to augment the real growth by up to three percent, including China. [6]

In another paper, Nakamura et al (2014) estimate Engel curves by using household consumption data. By noticing the unexpected smooth of Engel curves, they find that official

data of aggregate consumption cast doubt of being accurate comparing with the implication of household spending patterns. [7]

PART III.

DATA AND METHODOLOGY

In accordance with the constitution of Keqiang Index, I use 1) electricity consumption, 2) he cargo volume on the province's railways, and 3) loans disbursed by banks as my sole source to calculate Keqiang Index. I extract the weight of three indicators from Citibank's version of Keqiang Index. Specifically, electricity consumption weighs 40% in the Index, cargo volume by rails shares 25%, the rest 35% belongs to loan disbursed by bank. [8]

I collect all of data from the official websites of national and respective provincial statistic bureaus. Notice that except GDP growth rate, data for three indicators are not tallied by statistic bureau directly. These data are from corresponding departments, the Bureau of Energy, China Railways Corporation, and the Central Bank. And each data set is strongly associated with other data and department performances. Such facts will improve the quality of data. Notice that according to the access of the data in different regions, the time span of my data varies, but at least an eight-years length is guaranteed for each region I have included.

Beyond calculating Keqiang Index, I calculate the mean, and standard deviation of each data. I also calculate the correlation coefficient of Keqiang Index and GDP, three indicators and GDP etc., and make linear regressions model in need of further analysis of data.

PART IV.

SAMPLE RESULTS OF KEQIANG INDEX

In this section, "Keqiang Index" on national level will be provided at first. I also calculated Keqiang Index on provincial levels for nine provinces and three municipalities. Among nine provincial level examples, I will give three examples, with three different perspectives. To be more specific, each of perspective represents a different level on the path of economic development.

First of all, I run a regression on GDP growth rate by using growth rate electricity consumption, cargo volume by rail, and loans disbursed by bank as a reference. According to the regression result, we have the formula:

GDP growth rate = 8.176 + 0.296 * electricity – 0.0246 cargo + 0.0485 * loans

Each regressor is significant and p-values are below 10% level. From the result, I assume that cargo volume by rail and loans disbursed by bank can be insignificant in the model and electricity consumption matches the pattern of GDP.

4.1 NATIONAL LEVELS

According to the comprehensive data set on the website of National Statistical Bureau, I have the opportunity to calculated Keqiang Index from the year of 2000 to 2013 and are shown on the table below.

On national level, nine out of fourteen years we have chosen, the Index growth rate surpassed GDP growth rate. The correlation coefficient of these two growth rates is 0.5667, which I would like to consider being effective. Moreover, we can also find that from 2005 to 2008, the two growth rates match perfectly, with differences shrinking below 1% level. From the graph, it will take extra effort to find the difference between two curves and actually from 2007 to 2008, the two curves are parallel, with a very subtle difference of 0.5%.

However, on the graph, we observe that, from 2001 to 2004 and from 2009 to 2011, the two growth rates mismatch, with two huge gaps existed. In the first gap, both two curves have the upward trends, and it has the biggest gap in 2003, saying that 6.0%. Later in the second gap, both two curves have downwards slopes, and in 2009, the difference is the largest, at 5.0% level.

4.2 PROVINCIAL LEVELS

After calculating Keqiang Index of nine provinces (municipalities,) I depict a scatter diagram to show the relationship between Keqiang Index and GDP. On the graph, it reveals that those regions can be divided into three groups.

The first group, located in the lower left corner, has lower GPD growth rate and Index growth rate, representing eastern coastal provinces (municipalities.) This is the most developed area in China, with highest GDP capita, HDI, and income. Most regions in this area are experiencing a transition from second industry to tertiary industry. Shanghai is an example in this area. The second group is at the upper left corner in the graph. It is a combination of central and northeastern provinces. They are the second most developed areas in China. The similarity of those provinces is that they all have a solid basis of second industry. Liaoning is a good representative among those provinces. The last group is in the right part of the scatter diagram. Typically, provinces (municipality) in that part have the highest GDP growth rates among all areas of China. But they are the least developed part of China, located in western China. They are at the starting point of industrialization and modernization. I would like to take Sichuan as an example.

4.2.1 LIAONING PROVINCE

Due to the lack of the loan data prior to 2006 and the slow process of uploading new data of 2015, Keqiang Index of Liaoning is only calculated from the year of 2006 to 2013.

We observe that two growth rates are consistent, and in fact, with a correlation coefficient of 0.7125, which is higher than national level. This fact gives us a good support of using Keqiang Index to portray the economic behavior in the province of Liaoning. The growth rate Keqiang Index is lower than GPD growth rate in seven years out eights years. It seems that if GDP growth rate is overestimated, growth rate of Keqiang Index is better to represent the economy growth. The exception, where Index growth rate is higher, is the year of 2009. In the previous year, the difference is -5.8%, and one year later the difference jumps to 1.4%.

4.2.2 SHANGHAI MUNICIPALITY

The Keqiang Index of Shanghai is calculated from the year of 2001 to 2013, as data prior to 2000 are not completed to calculate Keqiang Index.

The correlation between the two growth rates is 0.4153. Generally, they have the weakest correlation so far, but they are still in the same trend of downwards sloping. In the details for each year, the small trends and data vary. For example, in the year of 2003, 2006, and 2013, the GDP growth rate increased comparing with previous year, but the growth rate of Index decreased in respective year. Also, we find that the growth rate of Index is much more volatile than GDP growth rate, even dropping to negative values. But, in general, like Liaoning province, excepting the year of 2002, 2009, and 2010, the Index growth rate is smaller than GDP growth rate on a big scale.

4.2.3 SICHUAN PROVINCE

I have calculated Keqing Index of Sichuan province from 2006 to 2014.

For Sichuan province, the correlation of two growth rates is 0.7803, highest among three regions I have chosen. The GDP growth rate of Sichuan is above 10%, except 2014. Index growth rate maintains beyond 10%, with exceptions in 2006, 2013, and 2014. Like Liaoning and Shanghai, the Index growth rate is smaller than GDP growth rate except the year of 2009. I also notice that in last two years, Index growth rate drops much faster than GDP growth rate. Though I do not have data for 2015, but I expect the trend to continue.

PART V.

FINDINGS ON AGGREGATE LEVEL

5.1 GAP AND BANK LOAN

The year of 2009 is a special year for Keqiang Index. No matter how differently each region behaves in the past year, in 2009 for every region, the growth rate of Keqiang Index increases comparing with last year and surpasses GDP growth rate. It is a very interesting phenomenon, since in 2009, the world was suffering from the global financial crisis. Economic development was severely delayed or even retrograded and China was not the exception.

Therefore, I check each of three components of Keqiang Index and assume that the problem is from the indicator, loans disbursed by bank. I find that each time when the gap between Index growth rate and GDP growth rate becomes larger, the growth rate of bank loans is at high levels. To test the assumption, I draw a scatter diagram to show the relationship between the gap (difference) of two growth rates and growth rate of loans disbursed. Not to my surprise, there is a positive relationship between the two terms as the points aggregate on a line from lower left corner to upper right corner, very few outliers exist.

Then I make a linear regression. The results show that as the growth rate of bank loans increases by 1%, the gap between Index growth rate and GDP growth rate will have extra 0.3311% difference. The R-square of this regression is 0.4735. This low R-square is understandable since we only have one regressor in this regression and it is significant that bank loans can explain over 40% of the gap. According to diagram and linear regression, I conclude that bank loans distort Keqiang Index and generate gaps between Keqiang Index and GDP.

5.2 LIMITATION OF CARGO VOLUME BY RAIL

According to our regression data, cargo volume by rail does not seem to have a strong relation with GDP. And intuitively, I think that cargo volume by rail is not representative in every area. Four examples are listed below.

In Sichuan province, there are about 2000 miles of rail tracks, making up the sparse rail network in this large western province. Though, 2000-mile tracks seem to be long enough, it is only two thirds of the length of rail tracks in Shandong province, while Sichuan is actually three times bigger than Shandong. Tianjin is the third largest seaport in China. Taking advantages from that, only 10% of cargo in Tianjin is shipped through railway. Unlike last two examples, Jiangsu has a long and dense rail system, but it also has the most developed river and highway system in China. According to such facts, railway is not a popular choice in Jiangsu. The last example is Beijing. As Chinese capital, Beijing is the railway center in China, connecting most high-speed rails in China. However, as Beijing is political center of China, with the restriction of noise, pollution, and public safety, most of tracks in Beijing are for passenger transportation. Also, Beijing is only 50 miles away from Tianjin, thus cargo volume by rail has small share in total cargo transportation.

I calculate the correlation of cargo volume by rail and two growth rates for a detailed analysis. I find that the correlations of cargo volume by rail and GDP are all very low in each of four examples I choose. The highest correlation coefficient is merely 0.3182 in Jiangsu, and Beijing even has a negative correlation coefficient of -0.1621. From this case, I know that cargo by rail, in areas I choose, does not have strong association with GDP.

While comparing with correlation between cargo volume by rail and Keqiang Index, the four examples deviate into two cases. For Sichuan province, the correlation of cargo by rail

and GDP and Index are both low. In this case, we can say that cargo by rail is not in accordance with economic activities. For the remaining three examples, Tianjin, Jiangsu, and Beijing, cargo by rail has a low correlation with GDP, but a much higher correlation with Keqiang Index. With current data I have, I cannot tell which correlation is more accurate and effective. Thus I cannot conclude that cargo by rail is a significant indicator in all areas.

5.3 KEQIANG INDEX IS MORE VOLATIRE

While depicting the curves of Keqiang Index and GDP for different regions, I find that curves of GDP are often flatter than curves of Keqiang Index. I calculate the standard deviation of GDP, Keqiang Index, and three indicators of Keqiang Index for numerical analysis.

In every region I have covered, GDP has the lowest standard deviation. Even the largest standard deviation of GDP, which is 2.65 of Guangdong, is smaller than the smallest standard deviation between Keqiang Index and three other indicators. On average levels, I find that loans disbursed by bank and cargo volume by rail have the highest standard deviation (9.04 and 8.30), about three time larger than average standard deviation of GDP. Thus, due to the high standard deviation of three indicators, Keqiang Index also has a high standard deviation of 4.70, doubling the standard deviation of GDP. From the Evidence above, I prove that Keqiang Index has more volatility than GDP has.

PART VI.

OTHER FINDINGS

While looking at the components of Keqiang Index, I discovered that electricity consumption and cargo by rail are strongly associated with the performance on second industry. Such information, together with the different correlation coefficients arouse a question: is that true that the more the second industry weighs, the better Keqiang Index matches?

To answer this question, I first calculate the ratio of second industry and tertiary industry. If the ratio is higher, it means that in that region, second industry is more important. Among nine regions, Beijing has the lowest ratio of 0.28, and Anhui has the highest ratio of 1.54. I match the ratio and the correlation of Keqiang Index and GDP into pairs and draw a scatter diagram.

For next step, I do a linear regression in order to find the mathematic relation of all points. I obtain a positive relationship of from the regression, with coefficient of regressor of 0.4133. The R-square is 0.4111. It is not high, but there are three outliers that significantly differ from other points. Later, I drop three outliers and do the regression again. This time, it remains to have the positive relationship, but the R-square amazingly jumps to 0.9690. This

model almost explains every thing behind the scene. From the regression result, I am glad to state that Keqiang Index fits better in areas with higher share of second industry.

PART VII.

CONCLUSION AND FURTHER STEPS

According to my research, I have four major findings: Bank loans will distort Keqiang Index and generate gap between Keqiang Index and GDP; Cargo volume by Rail is not representative enough to fit every region; Keqiang Index is more volatile than GDP because its three components have high volatility; Last, I have found that Keqiang Index has more correlation with GDP in areas with heavy second Industry.

It is a very creative idea to use Keqiang Index to scale the economy of China. It gives us more transparency as three indicators are collected from three independent departments that statistical bureau has no right to intervene. It also provides us with a more dynamic tool than GDP to analyze the economy because the data of three indicators in Keqiang Index are published on a monthly basis. GDP is only published quarterly.

One problem I have found that is both GDP and Keqiang Index do not reflect the welfare conditions under the growth of economy. As the economy grows fast in China, the lives of Chinese have earth-shaking changes. Thirty year ago, when the western countries were

suffering from the oil crisis, the Chinese were still managing to solving the problem of food and clothes. But today, the Chinese are buying everything they can buy worldwide. This is the benefit that the growth of economy of China, but in both GDP and Keqiang Index, we cannot see this significant change. I hope to modify the Keqiang Index in the future, possibly adding one factor that can represent the welfare changes. Also, I consider changing one or two other factors in the Index, which can include tertiary industry.

On an even further scale, I want to create an index that not only match the economics patterns of China, but also predict the economy of China. I hope this indicator can offer prospective trends of economy, can include large economics transformations in China. And, more important, it should be more representative than GDP, covering every area of national economy.

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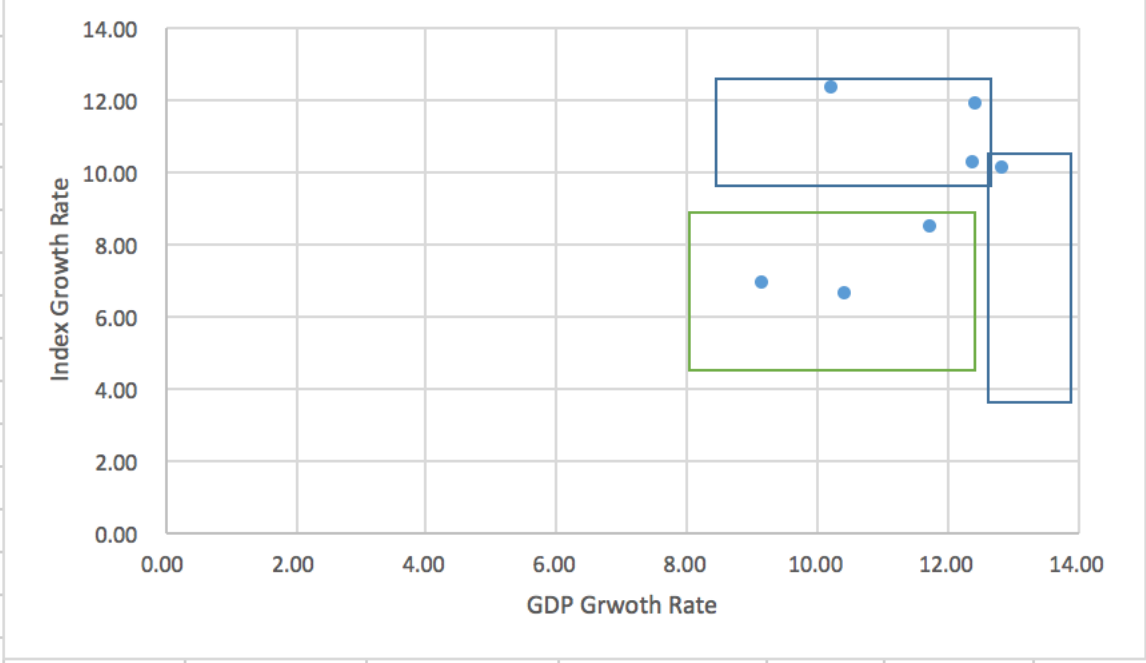
Appendix

Regression of GDP growth rate with three indicators of Keqiang Index

VARIABLES	(1) gdp
electricity	0.296***
	(0.0378)
cargo	-0.0248
	(0.0200)
loanpercentage	0.0485*
	(0.0264)
Constant	8.176***
	(0.565)
Observations	113
R-squared	0.309

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

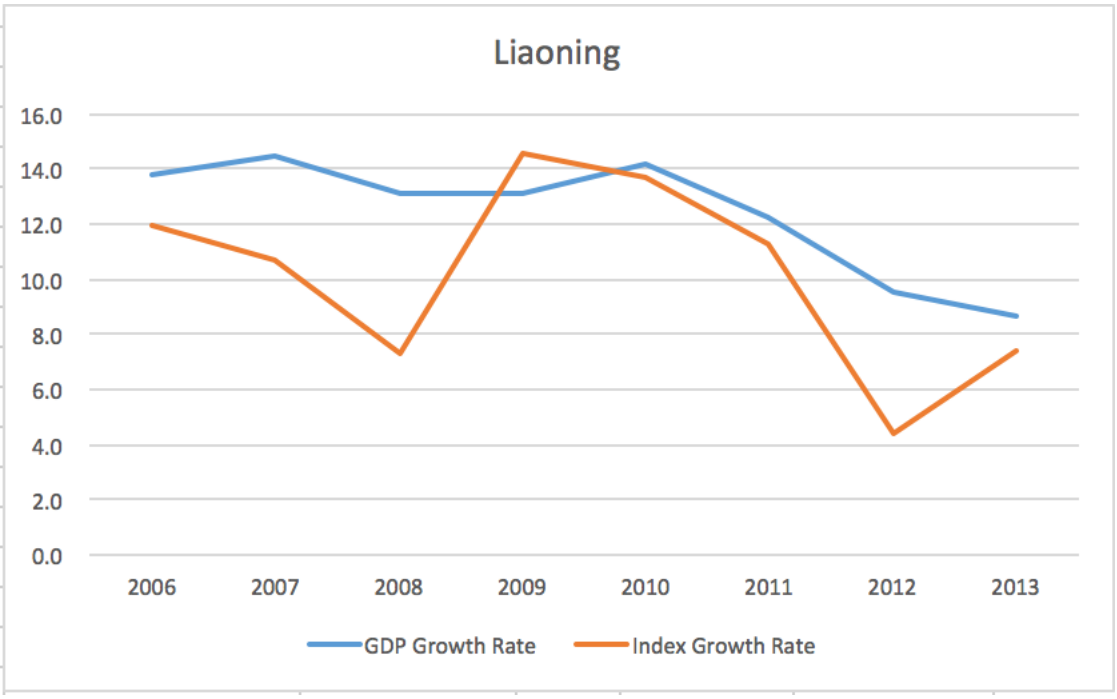
Scatter diagram of growth rate of GDP and Keqiang Index for provinces



Keqiang Index of national level

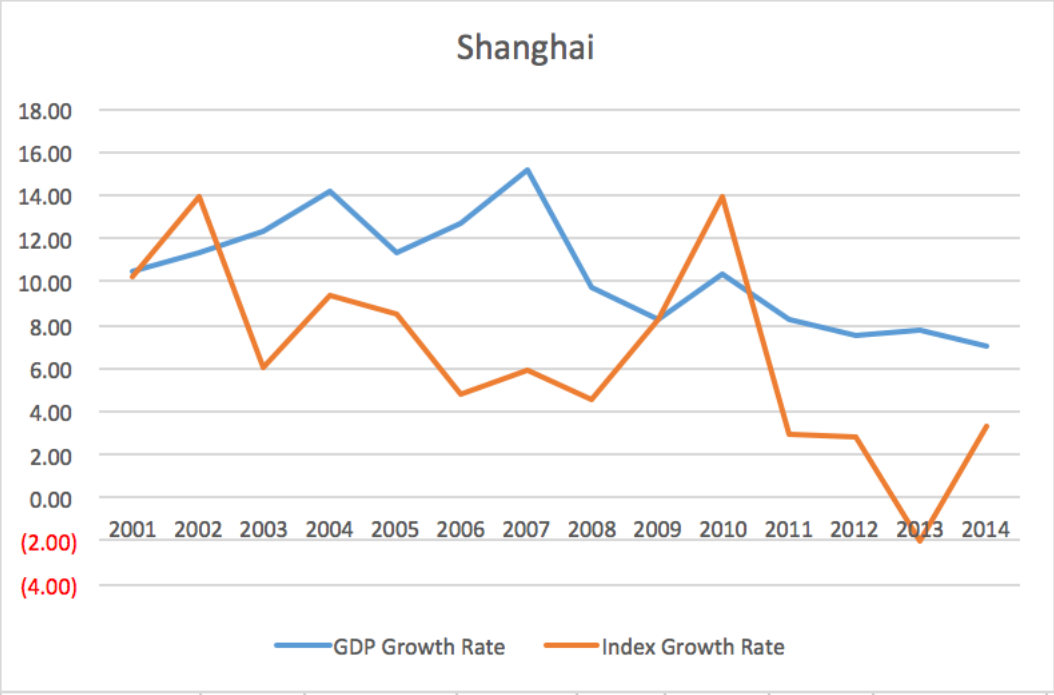
Year	GDP Growth Rate	Index Growth Rate	Diff
2000	8.4	7.6	(0.8)
2001	8.3	10.3	2.0
2002	9.1	12.2	3.1
2003	10.0	16.0	6.0
2004	10.1	13.0	2.9
2005	11.3	10.9	(0.4)
2006	12.7	13.1	0.4
2007	14.2	13.7	(0.5)
2008	9.6	9.1	(0.5)
2009	9.2	14.2	5.0
2010	10.4	14.6	4.2
2011	9.3	11.9	2.6
2012	7.7	7.4	(0.3)
2013	7.7	8.3	0.6
Correlation Coefficient:	0.56668		

Keqiang Index of Liaoning Province



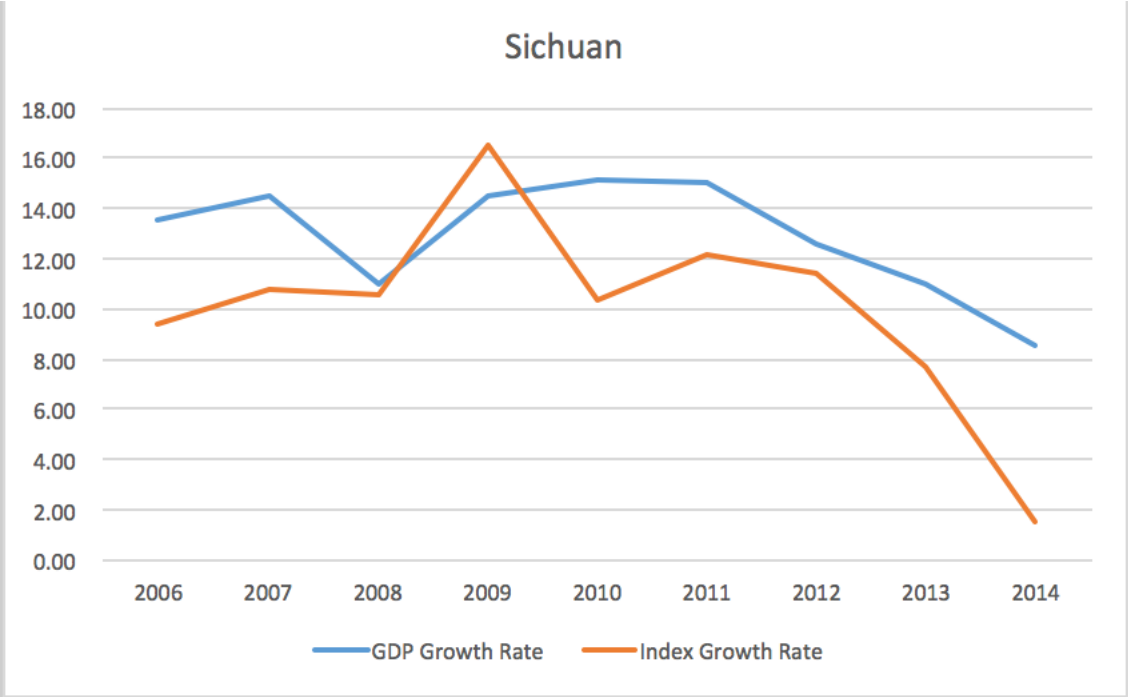
Year	GDP Growth Rate	Index Growth Rate	Difference
2006	13.8	11.93	(1.9)
2007	14.5	10.69	(3.8)
2008	13.1	7.32	(5.8)
2009	13.1	14.54	1.4
2010	14.2	13.68	(0.5)
2011	12.2	11.28	(0.9)
2012	9.5	4.39	(5.1)
2013	8.7	7.44	(1.3)
Correlation Coefficient	0.71246		

Keqiang Index of Shanghai Municipality



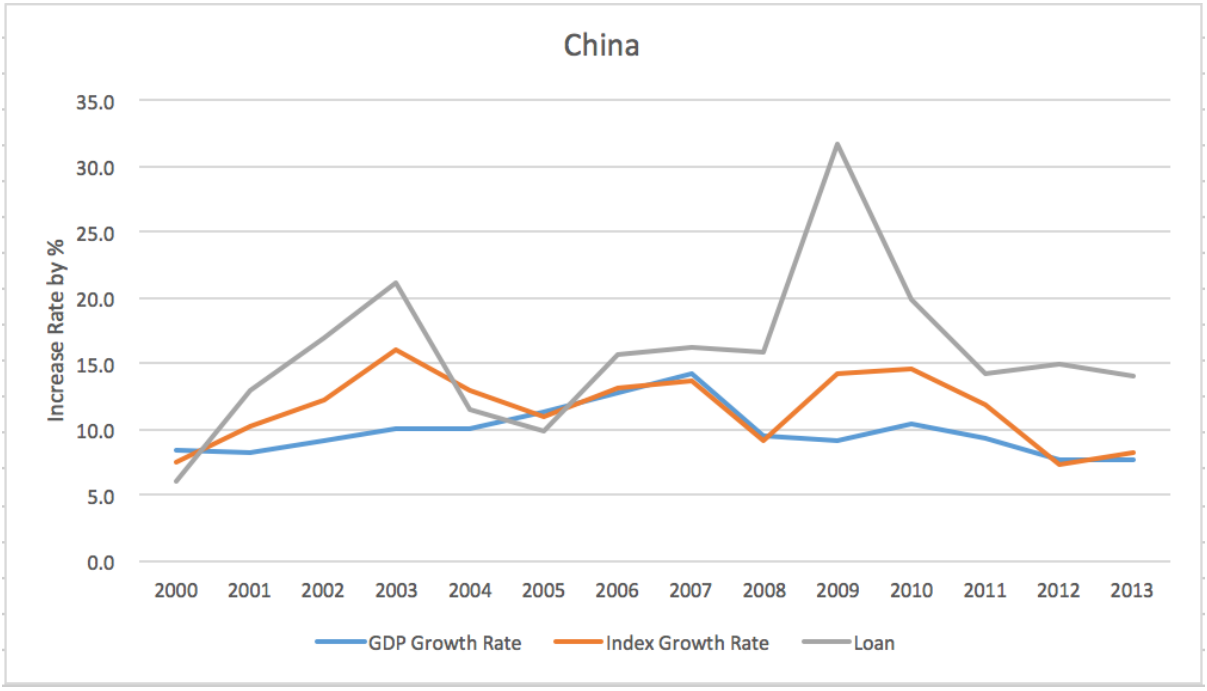
Year	GDP Growth Rate	Index Growth Rate	Difference
2001	10.50	10.21	(0.29)
2002	11.30	13.92	2.62
2003	12.30	6.03	(6.27)
2004	14.20	9.36	(4.84)
2005	11.40	8.52	(2.88)
2006	12.70	4.74	(7.96)
2007	15.20	5.89	(9.31)
2008	9.70	4.59	(5.11)
2009	8.20	8.21	0.01
2010	10.30	13.95	3.65
2011	8.20	2.89	(5.31)
2012	7.50	2.80	(4.70)
2013	7.70	(2.05)	(9.75)
2014	7.00	3.26	(3.74)
Correlation Coffeicient	0.415342102		

Keqiang Index of Sichuan Province



Year	GDP Growth Rate	Index Growth Rate	Difference
2006	13.50	9.39	(4.11)
2007	14.50	10.78	(3.72)
2008	11.00	10.59	(0.41)
2009	14.50	16.53	2.03
2010	15.10	10.34	(4.76)
2011	15.00	12.19	(2.81)
2012	12.60	11.43	(1.17)
2013	11.00	7.71	(3.29)
2014	8.50	1.53	(6.97)
Correlation Coefficient:	0.7803		

Graph of growth rate of GDP, Keqiang Index, and loan disbursed by bank on national level



Scatter Diagram of Loan growth rate and difference between Keqiang Index and GDP, with regression

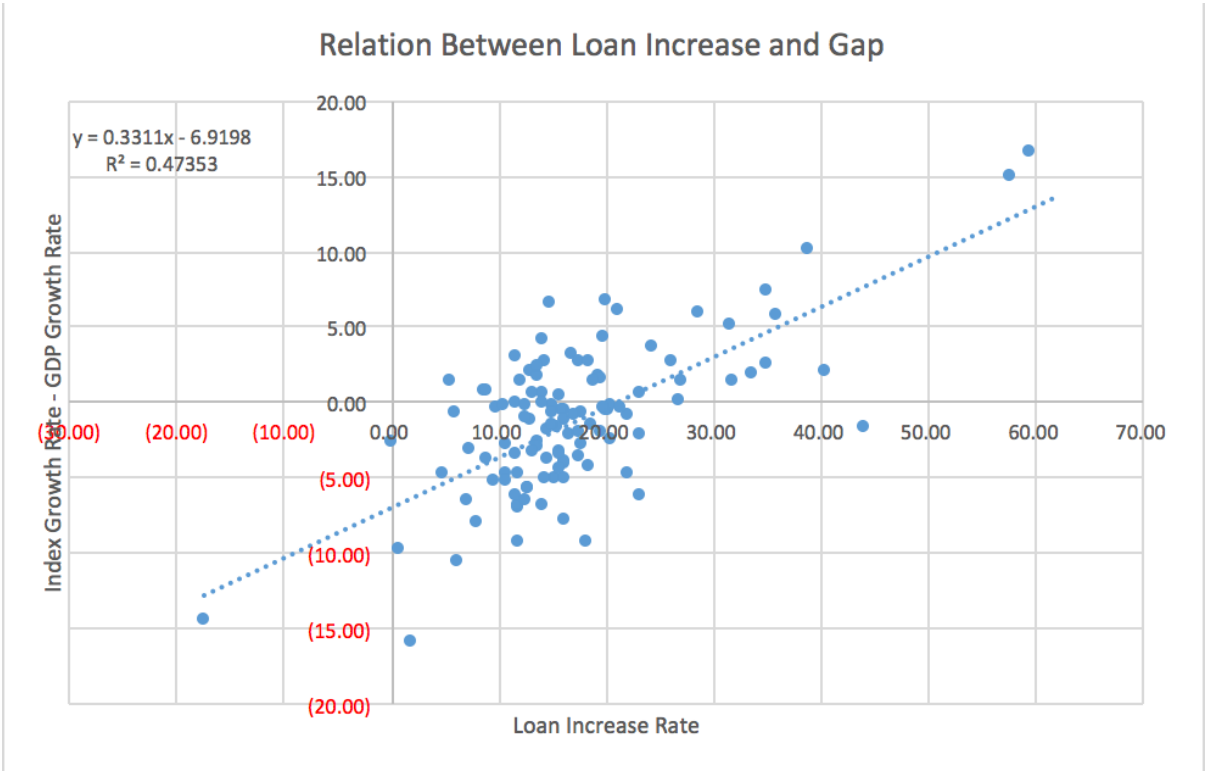
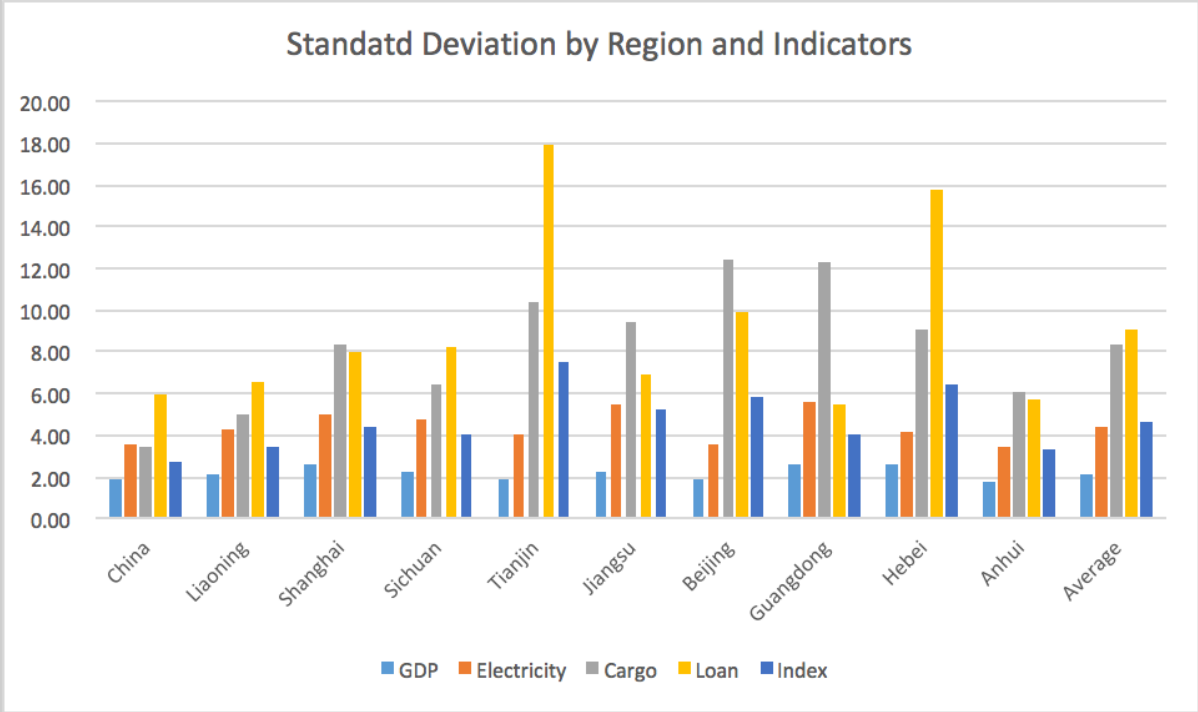


Table of correlation of cargo volume by rail and growth rate of GDP and Keqiang Index

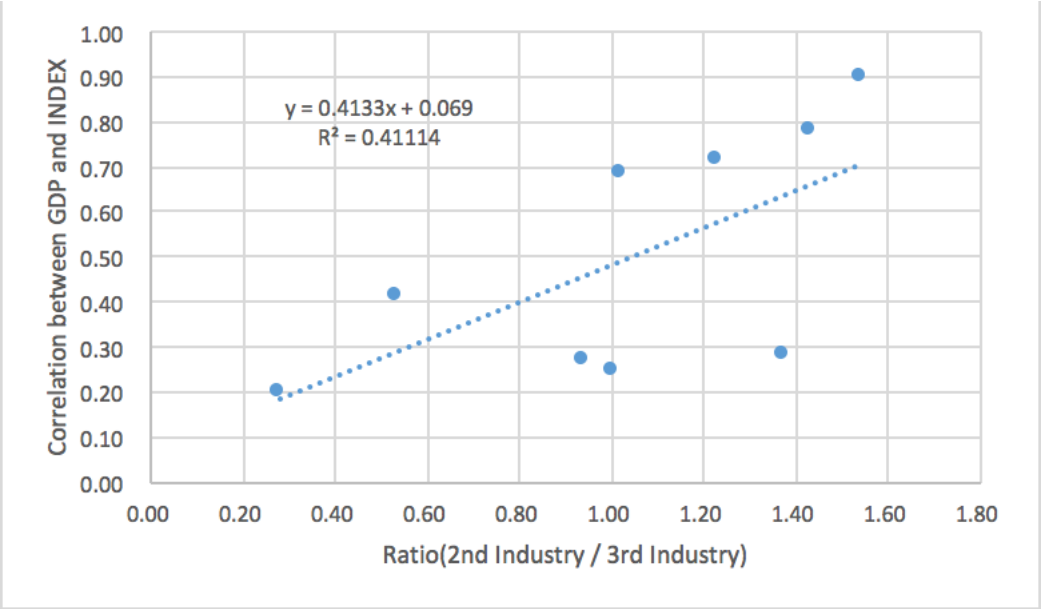
	Corr. With GDP	Corr. With Index	Correlation
Sichuan	0.0765	0.1872	0.7803
Tianjin	0.0550	0.5769	0.2463
Jiangsu	0.3182	0.8600	0.6840
Beijing	(0.1621)	0.6146	0.1995

Standard Deviation of GDP, Keqiang Index, and components of Keqiang Index

	China	Liaoning	Shanghai	Sichuan	Tianjin	Jiangsu	Beijing	Guangdong	Hebei	Anhui	Average
GDP	1.85	2.16	2.57	2.27	1.87	2.21	1.95	2.65	2.59	1.73	2.19
Electricity	3.56	4.32	5.06	4.79	4.04	5.51	3.62	5.60	4.16	3.40	4.41
Cargo	3.51	5.02	8.34	6.42	10.42	9.43	12.36	12.31	9.09	6.05	8.30
Loan	5.96	6.50	7.98	8.29	17.97	6.89	9.87	5.49	15.73	5.67	9.04
Index	2.73	3.48	4.45	4.00	7.50	5.25	5.81	4.10	6.41	3.29	4.70



Scatter diagram of correlation between GDP and Keqiang Index and ratio of second industry to tertiary industry



Scatter diagram after dropping three outliers

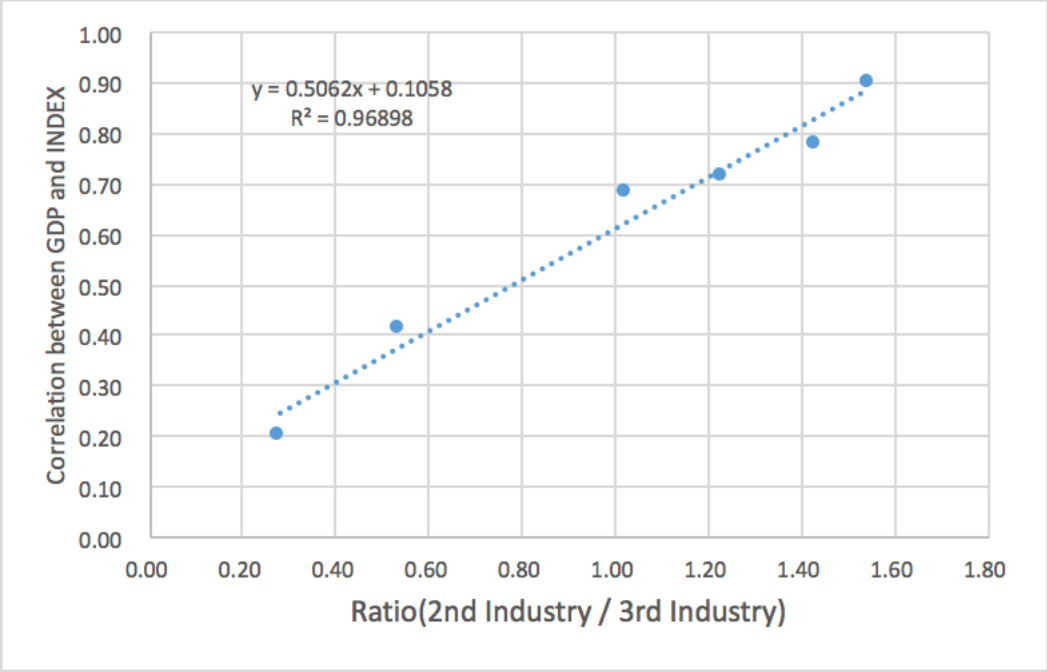


Table of ratio of second industry to tertiary industry

	2nd Industry	3rd Industry	Ratio	Corr.
Liaoning	50.20	40.80	1.23	0.71
Shanghai	34.60	64.80	0.53	0.42
Sichuan	51.30	35.90	1.43	0.78
Tianjing	49.40	49.30	1.00	0.25
Jiangsu	47.70	46.70	1.02	0.68
Beijing	21.70	77.50	0.28	0.20
Guangdong	46.20	49.10	0.94	0.27
Hebei	51.10	37.20	1.37	0.28
Anhui	53.70	34.80	1.54	0.90