Forecast research on China's crude steel output in the new period

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Keywords: output of crude steel; mid or long term forecast; GDP; the crude steel production of each RMB ten thousand Yuan GDP; structural transformation

Abstract: Chinese economic growth is clearly slower than the early stage. Crude steel output of China falls after 34 years continuous increase. In this paper, forecast the crude steel outputs of China in the next five years to provide quantitative basis for development strategy adjustment of iron and steel industry in the future. In this paper, study the relationship between two indicators of the crude steel production of each RMB ten thousand Yuan GDP and GDP, and find a stable correlation function between them. Forecast those indicators, which can calculate the crude steel output of China after this round of economy development pattern change. It points that the crude steel output data fall in the range from 804 million tons to 841 million tons. That means after China's economic growth downward adjustment, the growth of crude steel output of China will fall, but the total quantity is still huge.

Introduction

It is the 19th times that China get the top one of the crude steel output all over the world, in 2014. China's crude steel production accounted for global increase year by year, from less than 0.1% in the early days of new China to 49.97% in 2014, as show in figure.1(from wind info). Because the advancement of domestic industrialization, the demand for steel consumption growing rapidly, thus stimulate the rapid development of China's steel industry [1], then crude steel production increased year after year. The invest inertia, the fixed asset investment of the iron and steel industry continues to increase, which established a huge of excess capacity [2]. However, China economic growth rate declining and economic transition lead its development to a stable period, so the steel consumption has decreased since 2014, and the production of crude steel has been reduced since 2015. The excess capacity leads a series social issue in China. The accurate prediction of the crude steel output could provide data information for reducing steel capacity, and could provide reliable evidence for global iron ore commerce and price trend, and it could be theoretical foundation to the relative industries policy adjustment [3].

Steel consumption is relative to economic growth, but the GDP growth is faster than the crude steel output's from 2000 to 2104 comparing Fig.1 to Fig.2. The latest data show that the crude steel output has declined in 2015, but the data of GDP continues to rise [4], so the relation between the crude steel output and GDP need to further verified. After compared with many groups data and analyzed them, we found that the index of the crude steel production of each RMB ten thousand Yuan GDP could reflect our country's rhythm of economic structure adjustment more clearly [5].

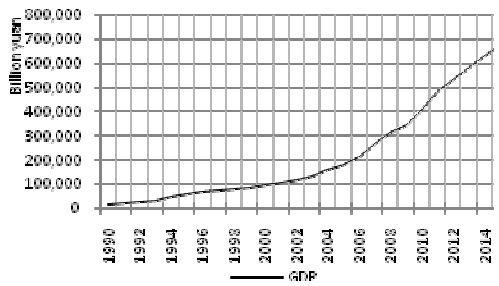

Figure 1. China's GDP curve

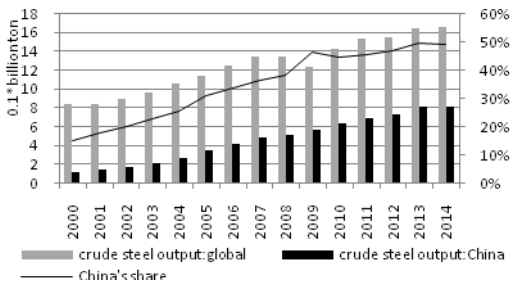

Figure 2. China's the crude steel output of China and global/ share of global

Materials and Methods

A. Correlation analysis between crude steel output and GDP

Before establish the crude steel output model we need to analyze the correlation between the crude steel output (sign as OUTPUT) and GDP, as show in Fig.1 and Fig.2. Take the correlation coefficient r=0.977124 between OUTPUT and GDP (show as table1), and draw them with scatter diagram (show as Fig.3), then we can get the conclusion that there is highly correlated between them.

Calculate the long term crude steel production. After confirmed the high degree linear relation between OUTPUT and GDP, use the LS (least square) fitting to estimate, then building regression equation: OUTPUT=a0+a1*GDP.

Among them: OUTPUT is crude steel production; GDP is Gross Domestic Product; the estimated result show in table2.

Table1 the correlation between Crude steel production (the OUTPUT) and the GDP

	GDP	OUTPUT
GDP	1.000000	0.977124
OUTPUT	0.977124	1.000000

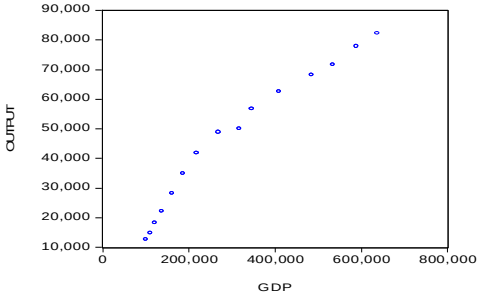

Table2 The least squares fitting results between Crude steel production (the OUTPUT) and the GDP

Dependent Variable: OUTPUT				
Method: Least Squares				
Date: 09/04/15 Time: 18:13				
Sample: 2000 2014				
Included observations: 15				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7602.184	2684.821	2.831542	0.0141
GDP	0.125216	0.007559	16.56602	0.0000
R-squared	0.954772	Mean dependent var		46117.94
Adjusted R-squared	0.951293	S.D. dependent var		23562.05
S.E. of regression	5200.064	Akaike info criterion		20.07430
Sum squared resid	3.52E+08	Schwarz criterion		20.16870
Log likelihood	-148.5572	Hannan-Quinn criter.		20.07329
F-statistic	274.4332	Durbin-Watson stat		0.296417
Prob(F-statistic)	0.000000			

The t statistics of the Constant coefficient a0 (that is c) and a1 in Crude steel output prediction model are obvious. The probability value of c: Prob=0.0141 means at least under the confidence level of 95%, the constant term is not zero significantly. The probability value of coefficient a1: Prob=0.0000 means at least under the confidence level of 99%, the coefficient of GDP is not zero significantly. R-squared: R^2 =0.954772,and Adjusted R-squared: $\overline{R}^2 = 0.951293$ are similarly equal 1, that means that model's fitting effect is very good. The coefficient of GDP is 0.125216，that means GDP increase RMB 100 million Yuan, while crude steel production increases 1252.16 tons.

The crude steel output forecast model is shown as follow: that is regression equation (1)

$$OUTPUT=7602.184+0.125216GDP \quad (1)$$

GDP and crude steel output are highly correlated after 2000, and the crude steel output model has fitted the two series data. But using this model to forecast the crude steel output, we found the result obviously deviated from our actual expectation. Because economic structure is adjusting, China transfers the force to drive economic growth from investment to extensive growth mode of consumption [6], so the highly correlated between GDP and crude steel output is not suitable to our recent develop model. After compared with many groups data and analyzed them, we found that the index of the crude steel production of each RMB ten thousand Yuan GDP could reflect our country's rhythm of economic structure adjustment more clearly.

So-called "the crude steel production of each RMB ten thousand Yuan GDP" means increases each RMB ten thousand Yuan GDP could cause how many crude steel production, we use formula (2) to show and use ρ to indicate it:

$$\rho = \text{crude steel production/GDP(RMB ten thousand Yuan)} \quad (2)$$

The curve of crude steel production of each RMB ten thousand Yuan GDP in China is shown in fig 4.

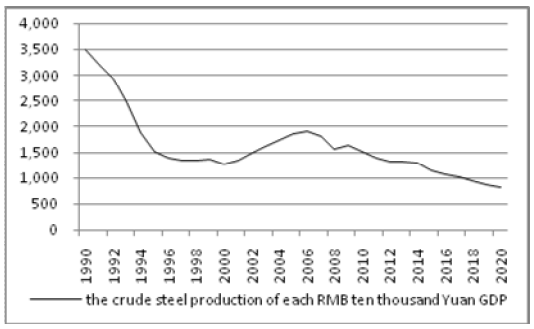

Figure 4 the crude steel production of each RMB ten thousand Yuan GDP

Table3 GDP forecast result from 2015 to 2020

	GDP forecast(RMB billion Yuan)
2015	67724.415
2016	72126.502
2017	76814.725
2018	81807.682
2019	87125.181
2020	92788.318

B. The analysis of the crude steel production of each RMB ten thousand Yuan GDP

1) China's industry structure development process after the reform and opening-up policy

a) The first stage

China had begun to major industrialized strategy adjustment since 1978[7]. Give up the pure idea of heavy industry development, and turn to industrialization strategy of that improve people's life, industrial comprehensive development, opening to the outside world, and multiple economic elements common development. This phase is divided into dominated by agricultural products as raw materials for light industry growth period, and dominated by non-farm products as raw materials for light industry growth period [8], so the proportion of light industry in GDP increased rapidly in this period, characterized by light industry production value of each RMB ten thousand Yuan GDP rising, and crude steel production of each ten thousand Yuan GDP declined.

b) The second stage

The Chinese government adjusted economic development strategy again in 1996, then the fixed asset investment turn to the main means of the development of economy. China has entered the heavy industry period and high degree of machining period again. In this period Chinese has already ended the "shortage economy", they began to pursue the durable consumer goods demand such as cars, houses. China's real estate investment growth was from 0.9% in 1997 to 31% in 2004, and infrastructure investment growth was from 4.2% to 34.6% in 2003. There was a large change from the policy level, which urged the crude steel production of each RMB ten thousand Yuan GDP continuously increasing for 10 years.

c) The third stage

Some drawbacks of the excessive growth of the fixed asset investment appeared gradually [9], which manifested as the urban real estate market investment scale is too large, house prices rising too fast in some city, economic development structure too straightforward, and per unit of GDP energy consumption is too high in the whole country. The government work report has clearly pointed out that "appropriately control the scale of fixed assets investment, rationally adjust the relationship between investment and consumption, reduce the issuance of construction treasury bonds" since 2004. In order to expand domestic demand as the long-term strategy and the basic foothold to China's economic development, and abundantly exert the basis function of consumption and the key role of investment. The contribution rate of tertiary industry to GDP increased gradually and exceeded the secondary industry in 2013, so "the crude steel production of each RMB ten thousand Yuan GDP" has decreased obviously, continuously, and significantly since 2007.

2) The forecast of crude steel production of each RMB ten thousand Yuan GDP in China

a) GDP forecast

From international experience, after twenty or thirty years high speed growth, the growth rate of most countries have reduced significantly from the third decade, then most countries entered into a period of less than 4% growth in the fourth decade. At present, China is in the critical period of economic transformation and industrial structure adjustment, and China's economic growth maybe experience a slowly decreasing process. China's GDP growth is 6.9% in 2015, and China's economic development growth is expected to remain in slightly lower than the past 10 years during "the thirteen 5 years", so this paper assumes that China's GDP growth will remain fluctuation around 6.5% in 2015-2020, then in term of formula (3) to forecast each year's GDP in 2015-2020, and the forecast result were shown in table 3.

$$GDP_t = GDP_{t-1}(1+\sigma) \quad (3)$$

Where $t \in [2015, 2016, 2020]$ $\sigma = 0.065$

Table4 The least squares estimated result from OUTPUTGDP

Dependent Variable: OUTPUTGDP				
Method: Least Squares				
Date: 01/19/16 Time: 15:44				
Sample (adjusted): 2006 2014				
Included observations: 9 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1936.118	48.28519	40.09755	0.0000
X	-78.85864	8.580504	-9.190444	0.0000
R-squared	0.923467	Mean dependent var		1541.824
Adjusted R-squared	0.912534	S.D. dependent var		224.7342
S.E. of regression	66.46430	Akaike info criterion		11.42434
Sum squared resid	30922.52	Schwarz criterion		11.46816
Log likelihood	-49.40952	Hannan-Quinn criter.		11.32976
F-statistic	84.46426	Durbin-Watson stat		1.849843
Prob(F-statistic)	0.000037			

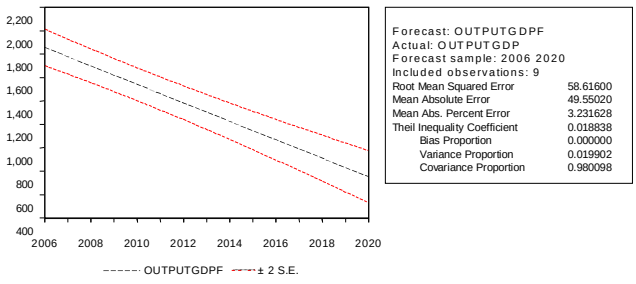

Figure 5 forecast result of crude steel production of each RMB ten thousand Yuan GDP from 2015 to 2020

b) C

rude steel production of each RMB ten thousand Yuan GDP

Based on historical data to calculate the crude steel production of each RMB ten thousand Yuan GDP from 1990 to 2014(show in fig.4), according to the operating rules select data from 2006-2014 as sample, then use the LS (least square) fitting to estimate by EVIEWS software and building regression equation (4). The estimated result is shown in table 4.

$$outputgdp = 1936.118 - 78.8586\ x \quad (4)$$

Regression equation (4) , that is the t statistics of crude steel production of each RMB ten thousand Yuan GDP， forecast model are obvious. The probability value of the constant

coefficient c and the coefficient of variable X: Prob=0.0000 means at least under the confidence level of 99%, they are not zero significantly. R-squared: R^2=0.923467, and Adjusted R-squared: $\overline{R}^2 = 0.912534$ are similarly to 1, which means that model's fitting effect is very good. The coefficient of X is -78.85864，that means each RMB ten thousand Yuan GDP increase one unit while the crude steel out would decrease 78.85864 tons, which is consistent to the development mode of China at present stage.

Then according to the results of the fitting to forecast crude steel production of each RMB ten industrial structure adjustment and increase the proportion of the tertiary industry at present stage in China. The forecast results of crude steel production of each RMB ten thousand Yuan GDP from 2015 to 2020 are shown in fig 5.

The forecast result of crude steel production of each RMB ten thousand Yuan GDP multiply by the forecast result of GDP, then we can get the crude steel production from 2015 to 2020. According to actual data of crude steel production in 2015 is 806 million ton to adjustment forecast data of crude steel production in last step, ultimately gain the forecast data is 806, 820, 840, 830, 838, 841 million ton respectively (shown in table 5).

Therefore, China's steel industry experiences the mid a downward adjustment still can be a better future, just growth will fall in the previous stage, but China will remain the world's most important iron and steel production base and export power in the future for a long time. China's crude steel output will be 8.06-841 million tons between 2015 and 2020, which value would be about to 841 million ton in 2020.

No matter in the long or the short term, China's steel consumption is closing or has reached to its peak [10], so it is undeniable that growth will continue to slow in the future. Combined with China's national conditions and a lot of strong method of investment and government policy such as infrastructure investment plan, "Made in China 2025" , and "One Belt and One Road", even if the steel consumption reaches peak, China's steel production will not fell sharply and will continue to fluctuate in the peak interval for many years.

Table5 forecast results of Crude steel output

	GDP (RMB 0.1 billion Yuan)	Crude steel production of each RMB ten thousand Yuan(10 thousand ton)	Crude steel output (un-adjusted) (10 thousand ton)	Crude steel output (adjusted) (10 thousand ton)
2015	677833	15830	1072982	8.06
2016	721892	15131	1092331	8.21
2017	768815	14549	1118561	8.40
2018	818788	13497	1105077	8.30
2019	872009	12795	1115758	8.38
2020	928690	12062	1120143	8.41

CONCLUSIONS

Because China's economic structure transformation, the original high correlation between China's crude steel output and GDP cannot accurately describe the development trend of China's crude steel production for the next stage, so this paper chose a new indicator that is crude steel output of each RMB ten thousand Yuan GDP to analyze its operation rule, and then forecast the value from 2015 to 2020. According to the results of the new indicator and GDP, we can gain a forecast result of crude steel output. According to actual data of crude steel production in 2015 is 806 million ton to adjustment forecast data of crude steel production in last step, ultimately gain the forecast data. More accurately predict China's crude steel output in the future, there is important practical significance to China's iron and steel industry development, which will help government to make proper industrial adjustment policy in current severe overcapacity, and adjust

the industrial structure distribution. At the same time, quantitative prediction of crude steel production could provide some references for the design and adjustment China's iron ore supply security policy, and avoid unnecessary economic risk. This paper has more practical reference value.

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