Chapter 132
Trend Analysis of the Labor Supply and Demand in China's Construction Industry: 2016–2025

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132.1 Introduction

With the continuous expansion of industrial scale, known as a labor-intensive industry, the construction industry requires more labor force. Because of its features—large market demand, low technological threshold, relatively higher income, a large number of rural surplus labor are absorbed into the construction industry. But in recent years, China's demographic dividend definitely disappears and the rural surplus labor force continues to decrease, which causes a "partial" labor shortage, leads the construction industry to lose the comparative advantage of low labor costs, and creates the market environment of carrying out construction industrialization.

The theory of labor supply and demand started early and is relatively well-developed. Freeman (1987) argued that the number of labor supply depends on the size and composition of the population, the proportion of workers who are willing to work, as well as the factors of education, skill level and so on. After analyzing the above factors, Hoffman (1989) and other scholars reached a conclusion that labor participation rate and the actual working hours are main factors that influence the number of labor supply. Malthus (1959) proposed that labor supply will be in the infinite elastic situation in a certain time period. Lewis (1954) argued that there were a large number of zero marginal productivity of labor in the developing countries, and people in the agriculture industry were confronted with "insufficient employment" and unlimited supply of "surplus labor". Thus, the supply of labor was unlimited in some years.

At present, the academic research for the number of labor in the construction industry mainly focused on descriptive analysis, which is that, in a stable macroeconomic background, though the demand for the construction industry labor

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will continue to expand in the future, with the decline of rural labor force and the intensification of the aging phenomenon, future labor supply to the construction industry will reduce, so that labor shortage appears. Wen et al. (2005) put forward that, construction safety and work environment problems in some degree hindered the transfer of rural surplus labor force to the construction industry, leading to migrant workers who want to engage in the construction industry gradually reduce. Xiaolin and Ningyu (2014) believed that China's urbanization would slowly increase the labor demand of the construction industry. Zhongfu and Shiqing (2015) thought that the main reasons of the shortage of labor in the construction industry of migrant workers were gradually decreasing growth of migrant workers engaged in the construction industry, the prominent aging problem of construction workers, and the deviation of migrant workers' occupation tendency from the traditional construction industry. With the "partial" labor shortage increasing, and Chinese construction labor market becoming unsteady, scholars started to do quantitative research about labor force in the construction industry. Dai (2013) proposed that 2012–2016 labor demand in Construction was at an average annual growth rate of 0.97%, and Liu (2015) found that the balance time of construction labor supply and demand by considering the low effective labor supply of the elderly is 2014.

To effectively solve the problem of shortage of labor in the construction industry, Tharmaratnam and Shaw (1985) argued that construction industrialization had more advantages in scale economy, construction cycle and low impact on the environment. Ye and Guo (2004) believed that China's construction industry must take the road of construction industrialization to achieve intensive production. Wu et al. (2013) analyzed the correlation between the construction industrialization and the labor cost, and it was considered that compared with the traditional construction methods, the labor productivity of construction industrialization had been greatly improved.

As an emerging research point, the prediction model of the labor supply and demand in the construction industry and its impact on the construction industry are still in the exploratory stage. Therefore, this paper focuses on two issues: firstly, how the demand and supply number of construction labor will change in the future; secondly, how the future demand and supply situation will effect on construction industrialization.

132.2 Analysis of the Labor Supply in China's Construction Industry

China's Construction labor force consists of about 95% of the rural labor force and 5% of the urban labor force, and the main cause of the shortage of migrant workers taken into account is that the rural labor cannot continue unlimited supply (Dai 2013). Therefore, this paper studies the supply of migrant workers in the construction industry to replace the supply of labor force in the construction industry.

Based on the existing research, this paper puts forward the prediction model of the future supply of migrant workers in the construction industry, as follows:

Set i as the year, S_i as the number of migrant workers in the construction industry of i year, T_i as retirement rate of i year, M_i as the rural surplus labor force of i year, N_i as the ratio of rural surplus labor force engaged in the construction of i year, then:

$$S_{i+1} = S_i * 1 - T_i + M_i * N_i \qquad (132.1.1)$$

The Eq. (132.1.1) shows, there are four influencing factors in the future supply of the construction industry (Fig. 132.1).

This paper calculates the number of actual demand for labor in agriculture and the number of rural surplus labor in 2000–2014 by adopting the method of the estimation of the rural surplus labor force (Li 2012; Xinghua 2013).

This paper predicts the number of migrant workers engaged in the construction industry in 2009–2015 with the use of the Eq. (132.1.1).

From the analysis of Fig. 132.2, it is found that the actual number of migrant workers in the construction industry is almost in the same trend with the predicted number. The correlation coefficient is 0.92, which shows that the model has certain rationality and feasibility.
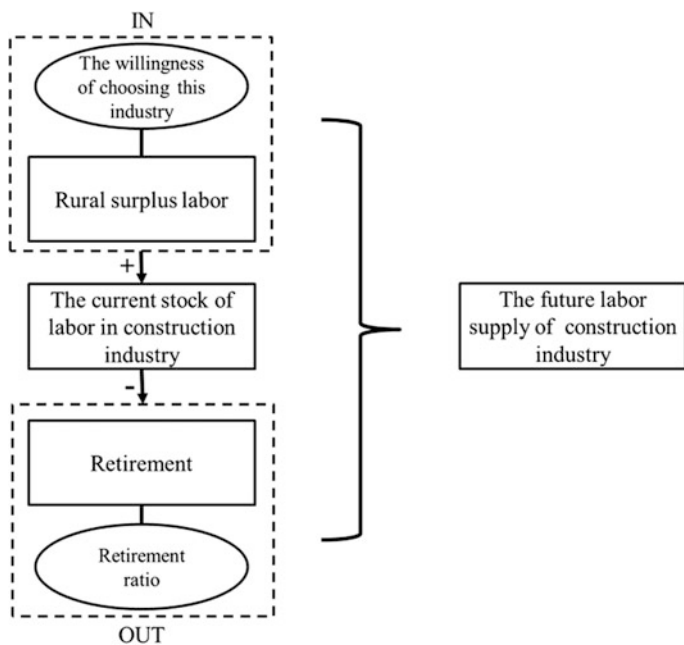
Fig. 132.1 Impact factors for the future labor supply in construction industry. *Note* Due to data availability, the model used in this paper does not consider cross-industry labor mobility
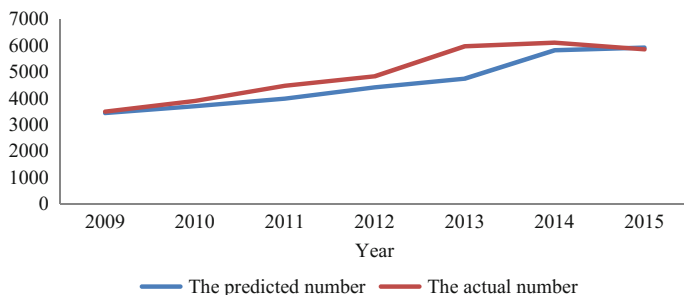
Fig. 132.2 Comparison of the actual and predicted number of migrant workers: 2009–2015 (10 thousand)

Table 132.1 Predicted number of surplus rural labor: 2015–2025 (10 thousand)

Year	Rural surplus labor force	Year	Rural surplus labor force
2015	422	2021	111
2016	337	2022	88
2017	270	2023	71
2018	216	2024	57
2019	173	2025	45
2020	138	–	–

The rural surplus labor force in 2015–2025 is predicted by using the grey model (Table 132.1).

This paper makes two hypotheses based on the current situation and possible future changes, and calculates them with Eq. (132.1.1) (Table 132.2):

Hypothesis I: According to *the Chinese Human Resources* and *Social Security Almanac* of 1990–2012 and *the Chinese Statistical Almanac of 1990–2015*, the average annual retirement rate in 1990–2012 is 4.7%, and the rural labor's age structure in 2011–2015 is relatively stable, and the Chinese labor population ratio in 2001–2014 stabilizes at 62%. Therefore, the average annual retirement rate of 2016–2025 is assumed as 4.7%.

Table 132.2 Predicted labor supply of China's construction industry: 2016–2025 (10 thousand)

Year	The future labor supply of the construction industry		Year	The future labor supply of the construction industry	
	Hypothesis I	Hypothesis II		Hypothesis I	Hypothesis II
2016	5718	5909	2021	4646	5588
2017	5507	5874	2022	4438	5496
2018	5291	5820	2023	4235	5400
2019	5074	5752	2024	4039	5301
2020	4858	5674	2025	3849	5200

Based on *the 2015 Migrant Workers Monitoring Report*, the proportion of migrant workers engaged in the construction industry stabilizes at 22% in 2013–2015, so let's assume that the average annual rate of migrant workers engaged in the construction industry in 2016–2025 is 22%.

Hypothesis II: Taking into account the new retirement scheme proposed in 2016, the average retirement age will be prolonged from 55 years old to 60 years old, so it is assumed that the annual average retirement rate of 2016–2025 is 2.2%.

According to the new requirements of the construction industry of China, the future work environment of the construction industry will be greatly improved. Because the working environment of the construction industry is the primary factor for migrant workers to choose jobs, it is assumed that the ratio of migrant workers engaged in the construction industry in 2016–2025 is 28%.

132.3 Analysis of the Labor Demand in China's Construction Industry

This paper adopts the future labor demand prediction model of the construction industry (Dai 2013), verifies it and modifies the parameters as following:

Set i as the year, D_i as the average number of construction workers of i year, O_i as the total output value in construction industry of i year, P_i as the labor productivity in construction industry of i year, $R_{O(i+1)}$ as the increasing rate over the previous year of the total output value in construction industry of $i + 1$ year, $R_{L(i+1)}$ as the increasing rate over the previous year of the labor productivity in construction industry of $i + 1$ year, then:

$$D_{i+1} = D_i\left(1 + R_{O(i+1)}\right)/(1 + R_{Li+1}) \qquad (132.2.1)$$

From the analysis of Fig. 132.3, the trend of GDP is similar to the trend of the total output value of construction industry, and the correlation coefficient is 0.997, showing the development trend of GDP is highly correlated to the development trend of total output value of construction industry. Therefore, this paper estimates the average annual growth rate of total output value of construction industry by the average annual growth rate of GDP, then:

$$B_{i+1} = \frac{D_{i+1}}{G_i} * C_i \qquad (132.2.2)$$

Set i as the current five-year plan, G_i as the average annual actual growth rate of GDP in current five-year plan, D_{i+1} as the average annual planning growth rate of GDP in the next five-year plan, C_i as the average annual actual growth rate of total
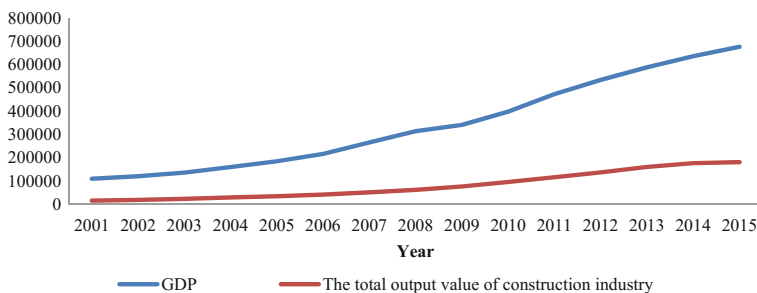
Fig. 132.3 GDP and the total output value of construction industry in 2001–2015 (100 million yuan)

output value of construction industry in current five-year plan, B_{i+1} as the average annual actual growth rate of total output value of construction industry in the next five-year plan.

According to the outline of *the 13th Five-Year Plan*, the rate of urbanization will reach 60% in 2020, 5% higher than that of the 12th Five-Year period. The research of Li and Wei (2005) showed that the construction industry had a strong industrial correlation effect to other industries, but little dependence on other industries. Therefore, the future development trend of China's construction industry can be roughly judged: large development space with growth rate slowed down.

From the calculation with the Eq. (132.2.2), the average annual predicted growth rate of the total output value of the construction industry of *11th Five-Year Plan*, *12th Five-Year Plan* and *13th Five-Year Plan* are obtained, then, then the predicted value and the actual value are compared, leading to the result that the model is reasonable (Table 132.3).

Dai (2013) argued that the growth rate of labor productivity in construction industry would not be changed significantly in the future because the growth rate of technical equipage and the level of construction technology were limited. Thus, this paper uses the average annual growth rate of labor productivity in construction industry of 2011–2015 is 10.1% as prediction parameter of 2016–2025.

Liu (2015) found that the growth tendency of the number of migrant workers in the construction industry were in line with that of the construction workers. Therefore, it can be argued that the annual growth rate of migrant workers in the construction industry was approximately equivalent to the annual growth rate of the construction industry. Meanwhile, this paper believes that the number of migrant workers in the past is on behalf of the demand.

Lin (2013) argued that the future growth rate of China's GDP would remain between 6.6–7.8% during 2012–2020, and kept the trend in the long run. Other scholars believed that the future growth rate of China's GDP would be below 6%. Therefore, this paper assumes that the growth rate of GDP in 2016–2025 has three kinds of situations, which are calculated by Eqs. (132.2.1) and (132.2.2) (Table 132.4):

Table 132.3 The comparison of the actual and planned growth rate of GDP and the total output value of construction industry (%)

Five-year plan	Tenth (2001–2005)	Eleventh (2006–2010)	Twelfth (2011–2015)	Thirteenth (2016–2020)	Average
Average annual actual growth rate of GDP	9.6	11.0	7.8	–	9.5
Average annual planned growth rate of GDP	–	7.5	7	6.5	–
Average annual actual growth rate of total output value of construction industry	22.58	22.70	13.69	–	19.65
Average annual predicted growth rate of total output value of construction industry	–	17.6	14.4	11.4	–

Date Source the 10th Five-Year plan, the 11th Five-year plan, the 12th Five-year plan, the 12th Five-year plan, China Statistical Yearbook from 2002 to 2015, the 2015 Construction Development Statistical Analysis Report, the 2015 Statistics Bulletin of the National Economy and Social Development

Table 132.4 Predicted number of demand for migrant workers: 2016–2025 (10 thousand)

Year	Predicted number of demand for migrant workers in the construction industry			Year	Predicted number of demand for migrant workers in the construction industry		
	Hypothesis I	Hypothesis II	Hypothesis III		Hypothesis I	Hypothesis II	Hypothesis III
2016	5861.4	5989.7	5855	2021	5893.7	6710.9	5855
2017	5867.9	6127.4	5855	2022	5900.2	6865.2	5855
2018	5874.3	6268.4	5855	2023	5906.7	7023.2	5855
2019	5880.8	6412.5	5855	2024	5913.2	7184.7	5855
2020	5887.3	6560.0	5855	2025	5919.7	7349.9	5855

Note Average annual growth rate of the labor demand in construction industry is 0.12% in Hypothesis I, 2.3% in Hypothesis II, 0 in Hypothesis III

Hypothesis I: According to the national planning target for the 13th Five-Year growth rate of GDP, it's assumed that average annual growth rate of GDP in 2016–2025 is 6.5%.

Hypothesis II: According to Zhang Lin's research, take the average value of 6.6 and 7.8%, it's assumed that the average annual growth rate of GDP in 2016–2025 is 7.2%.

Hypothesis III: According to other scholars' research, it's assumed that average annual growth rate of GDP in 2016–2025 is 5.8%.

Under the conditions of policy stability and development momentum, it's reasonable to adopt statistical linear prediction method (Dai 2013) and get the corresponding construction labor growth rates of 0, 0.12, and 2.3%.

According to the analysis of the predicted data of labor supply and demand in the construction industry, the labor supply of the construction industry began a downward trend from 2015, while the labor demand keeps a slowly increasing trend, and discussions have been made of six situations, the following two conclusions are obtained:

Scenario I: In the case of the first hypothesis of the supply, which means the stable development in accordance with the status quo of the construction industry, with the future growth rate of China's GDP at more than 5.8%, there will be in short supply in China.

Scenario II: In the case of the second hypothesis of the supply, which means there will be stronger industry attractiveness of the construction industry in the future, when the growth rate of China's GDP are 5.8%, 6.5%, 7.2%, the years when there will be in short supply would be 2018, 2018 and 2016 respectively.

In conclusion, the short supply in the labor force of China's construction industry will occur during 2016–2018.

132.4 Conclusion and Implication

As the labor supply from rural area is continuing to decrease, the supply of labor for the construction industry is also negatively impacted by this tendency. While under the situation, in which the government is promoting the urbanization, it is safe to project that the future of construction industry is promising, that conduces to huge demand for labor in this industry. Based on multi-scenario analysis, the labor demand will be less than its supply in 2016–2018. What is more, the discrepancy between labor demand and supply would enlarge in the upcoming ten years, and the situation of "partial shortage of labor" would downgrade to the "total shortage of labor".

The "total shortage of labor" could deeply impact the whole construction industry. Based on the analysis above, the shortage of labor will give rise to the increasing costs in terms of labor construction, the complete rate of the project, the negative effect on firms' credit, and these will further lead to the harm to the development of the construction industry and the nation's GDP growth. If this vicious cycle continues, there would be none sustainable development in the construction industry. As a new mean of production for the construction industry, the high efficiency of industrialization has already been sufficiently proven by the practice in both China and abroad. To conclude, it is of much necessity for the construction industry to transform and upgrade.

However, if we focus on the other side of the coin, one of the positive aspects of these trend analysis is that this would help to mitigate the cost pressures for while promoting the construction industrialization. Even given substitution effect of industrialization to labor, the shortage of labor supply relative to demand will improve the unit labor cost, which are a good news to some extent for the benefit-cost-analysis of construction industrialization.

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