Seasonal Variation Analysis of Human Resource Supply and Demand Based on Long-Term Trends Decomposition

Yirui Deng

China University of Petroleum,
Qingdao 266555, Shandong, China

Jiangwei Si

China University of Petroleum,
Qingdao 266555, Shandong, China

Abstract
Based on the statistical data of the human resource supply and demand index of the national construction industry in January 2010 to May 2014, we determine its long-term trends, calculate the value of long-term trends and decompose the long-term trends from the raw data. The economic phenomenon hidden in the change of the human resource supply and demand index is discussed by using the average method in the month (season) to analyze the related data, calculate the seasonal index and draw the seasonal variation diagram.
Key words: HUMAN RESOURCE SUPPLY AND DEMAND INDEX, LONG-TERM TRENDS DECOMPOSITION, SEASONAL VARIATION

1. Introduction

Based on the time series data of human resource statistics in the month, quarter as the unit, seasonal variation analyzes the human resource phenomenon has periodic variation law that takes the year as a cycle and happens with the seasons change in statistical analysis of human resource.

Human resource demand forecasting methods of research started in the West. Brown Box and Jenkins, respectively discusses the autoregressive model prediction method and Bartholomew and Forties, they went a step further to discuss the autoregressive model prediction method in the application of the human resource demand forecasting [1]. Van Winkel proposed that human demand forecasting model can be divided into two categories, one is based on the human trend extrapolation model; another one is related to the agency and the human demand model and the situation of the environment [2].Wen-fu wang's study of Enterprise Human Resource Forecasting and Planning, according to the real situation of China's enterprises, illustrates the enterprise human resources comprehensive control balance [3]. Zhang Li in the Human Resource Demand Forecasting Model Based on Grey Prediction GM Research, forecasts a specific enterprise personnel quantity that the enterprise human resources demand forecast model is set up, the prediction results and the accuracy of the test show-

ing that model conforms to the secondary accuracy, which can be long-term forecasts [4]. To conclude, research on manpower supply and demand forecasting method is still in developing , the research content is rich and varied, but for the talent supply and demand cycle issues, especially on seasonal, is not comprehensive yet.

The purpose of the analysis of the seasonal variation is to ensure the work of human resource and human resource to meet the needs of economic and social development preferably. For this purpose, we study the regularity of the human resource phenomenon in the past to make the forecast and decision. In the dynamic time series data of human resource statistics, besides the existence of long-term trends,

there is still a seasonal variation, such as the change of the supply and demand index of the human resource market [5]. We should decompose long-term trends firstly.

2. Basic concepts and Methods

2.1. Human resource supply and demand index

Human resource supply and demand index, also known as human resource supply and requirement index, referred SDI, is a relative number in dynamic that reflects the changes and developments in the supply and demand of human resource [6-7]. With the human resource supply and demand rate during the reporting period and that during the base period compared to the SDI, that is,

$$\text{SDI} = \frac{\text{Talent supply and demand rate during the reporting period}}{\text{Talent supply and demand rate during the base period}} \times 100\% \qquad (1)$$

where

$$\text{Talent supply and demand rate} = \frac{\text{Supply of talent}}{\text{Demand of talent}} \times 100\% \qquad (2)$$

The human resource supply and demand rate reflects the dynamic changes in human resource supply and demand conditions [8].

Studying the human resource supply and demand index can help countries, regions, organizations and individuals to understand the development trend of human resource supply and demand. It not only provides the basis for the regulation of the job market, but also provides authoritative reference in implementation and adjustment of organizational human resource strategy and searching personal job. To compile this index, we need to get the supply of human resource and the demand of human resource in the report period and the base period. In view of it has not been readily available information in this regard at the present stage in our country, these data can be acquired through certain market survey and estimates at present.

2.2. Long-term trends decomposition

Long-term trends decomposition eliminates the impact of long-term trends firstly to calculate seasonal variation. The calculation is as follows:

Determination of the model of the long-term trends;

By the model, calculate T, which is the value of long-term trends. That is:

$$T = \hat{Y} ;$$

Decompose long-term trends from the raw data. Decompose by division for multiplicative models. If the results were without cycle variations, the decomposed data should be

$$Y / T = SI ;$$

(4) Apply the Monthly average method to Y / T, calculate the seasonal index and draw the seasonal variation diagram.

3. Application and Analysis

800HR China Human resource Supply And Demand Index(referred SDI), is a human resource supply and demand index compiled by 800hr.com company (http://www.800hr.com) which comprehensively and real-timely observes the condition of job posting of various industries and individual job searching through china's network recruitment data. In the dimension of the major areas, major cities, hot post, etc. SDI provides four industries' supply and demand index, including construction, pharmaceuticals, chemicals, machinery, to comprehensively reflect the status and trends of the ratio of human resource supply and recruitment needs [7-8].800hr.com company has published SDI for the community monthly since January 2010.If SDI were greater than 100, it could mean that human resource supply and demand rate(the ratio of supply and demand is the ratio of the number of people apply for a job through the online recruitment platform and the number of posts published by enterprises)is greater than the reference level(the level in the reference period is the ratio of supply and demand in May 2009). The greater SDI is, the more the supply of human resource becomes, or the demand of posts is relatively small, or both change simultaneously. If SDI were smaller than 100, it could mean that human resource supply and demand rate is smaller than

the reference level. The smaller SDI is, the less the supply of human resource becomes, or the demand of posts is relatively numerous, or both change simultaneously.

Table 1 shows that the statistics about national Building Supply And Demand Index (referred B-SDI) in January 2010 to May 2014.

Table 1. National Building Supply and Demand Index

Time	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
2010	58.92	83.27	126.95	91.98	79.9	79.16	96	97	70	78	89	83
2011	65	146	143	93	88	93	127	109	101	117	129	111
2012	109	422	364	259	250	274	372	281	224	249	242	190
2013	109	204	328	159	166	181	222	199	180	196	178	133
2014	185	523	474	278	231	—	—	—	—	—	—	—

It shows that there is an obvious seasonal variation on the national B-SDI from January to May 2014 from this time series data. The busy season of human resource supply is in February and March, the off-season of human resource supply is in September and October.

If we don't consider the long-term trend of the time series, the actual monthly index is calculated in the following table.

Table 2. The Monthly Index of National Building Supply And Demand

Time	2010	2011	2012	2013	2014	Monthly	Monthly
Jan	58.92	65	109	109	185	105.384	59.30%
Feb	83.27	146	422	204	523	275.654	155.12%
Mar	126.95	143	364	328	474	287.19	161.61%
Apr	91.98	93	259	159	278	176.196	99.15%
May	79.9	88	250	166	231	162.98	91.71%
Jun	79.16	93	274	181	—	156.79	88.23%
Jul	96	127	372	222	—	204.25	114.94%
Aug	97	109	281	199	—	171.5	96.51%
Sep	70	101	224	180	—	143.75	80.89%
Oct	78	117	249	196	—	160	90.04%
Nov	89	129	242	178	—	159.5	89.76%
Dec	83	111	190	133	—	129.25	72.73%

From the data of table 2, it shows that data in the same month of different years have growth trend year by year. So it doesn't inappropriate to directly calculate the human resource supply and demand monthly index ignoring the long-term trend of the time series. I draw the national B-SDI folding time series diagram (as shown in picture 1) to determine whether the index above have the long-term trend. I conclude that SDI has the growth trend year by year from 2010 to 2014(only a slight decrease in 2013) seen from the picture. And the index has no significant cross among different years. It can be considered that the national B-SDI is a time series which both has two characteristics of long-term trend and seasonal variation.
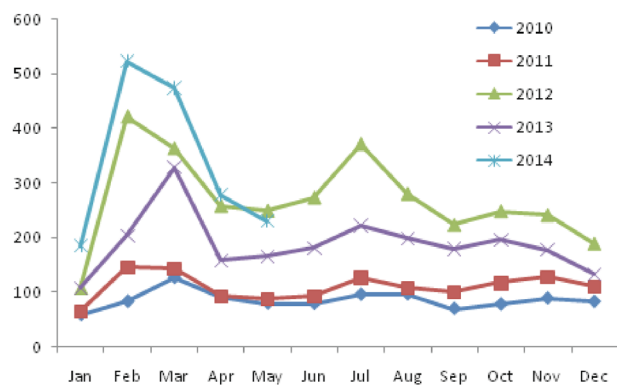

Figure 1. Folded Annual Time Series Plot

We construct the correlation coefficient table to determine the linear trend equation of time series. With

the correlation coefficients, $b = 4.30$, $b = 4.30$.

Therefore the linear trend equation is as follows:

$$\hat{Y}_t = 63.85 + 4.30t$$

According to the linear trend equation, we can get

the estimation of the long-term trend, that is $T = \hat{Y}$. We exclude long-term trend T to get the new series Y/T, as shown in Table 3. The calculation of the monthly index as shown in Table 4:

Table 3. Decomposition of Long-term Trend

Time ID t	Y	T	Y/T	Time ID t		T	Y/T
1	58.92	68.15	0.86	28	259	184.25	1.41
2	83.27	72.45	1.15	29	250	188.55	1.33
3	126.95	76.75	1.65	30	274	192.85	1.42
4	91.98	81.05	1.13	31	372	197.15	1.89
5	79.9	85.35	0.94	32	281	201.45	1.39
6	79.16	89.65	0.88	33	224	205.75	1.09
7	96	93.95	1.02	34	249	210.05	1.19
8	97	98.25	0.99	35	242	214.35	1.13
9	70	102.55	0.68	36	190	218.65	0.87
10	78	106.85	0.73	37	109	222.95	0.49
11	89	111.15	0.80	38	204	227.25	0.90
12	83	115.45	0.72	39	328	231.55	1.42
13	65	119.75	0.54	40	159	235.85	0.67
14	146	124.05	1.18	41	166	240.15	0.69
15	143	128.35	1.11	42	181	244.45	0.74
16	93	132.65	0.70	43	222	248.75	0.89
17	88	136.95	0.64	44	199	253.05	0.79
18	93	141.25	0.66	45	180	257.35	0.70
19	127	145.55	0.87	46	196	261.65	0.75
20	109	149.85	0.73	47	178	265.95	0.67
21	101	154.15	0.66	48	133	270.25	0.49
22	117	158.45	0.74	49	185	274.55	0.67
23	129	162.75	0.79	50	523	278.85	1.88
24	111	167.05	0.66	51	474	283.15	1.67
25	109	171.35	0.64	52	278	287.45	0.97
26	422	175.65	2.40	53	231	291.75	0.79
27	364	179.95	2.02	—	—	—	—

Table 4. Calculation of the monthly index

Time	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2010	0.86	1.15	1.65	1.13	0.94	0.88	1.02	0.99	0.68	0.73	0.80	0.72
2011	0.54	1.18	1.11	0.70	0.64	0.66	0.87	0.73	0.66	0.74	0.79	0.66
2012	0.64	2.40	2.02	1.41	1.33	1.42	1.89	1.39	1.09	1.19	1.13	0.87
2013	0.49	0.90	1.42	0.67	0.69	0.74	0.89	0.79	0.70	0.75	0.67	0.49
2014	0.67	1.88	1.67	0.97	0.79	—	—	—	—	—	—	—
Monthly Average	0.64	1.50	1.58	0.98	0.88	0.93	1.17	0.97	0.78	0.85	0.85	0.69
Monthly Index(%)	65.2	152.5	160.2	99.26	89.19	94.08	118.8	99.00	79.43	86.47	86.18	69.74

We can get seasonal variation diagram of B-SDI through the way converting the data in table 4 and in Figure 2.

4. Discussion and Conclusion

From the calculation results shown in table 4 and picture 2, it can be seen the busy season of human resource supply is in February and March. The reason is that the end of Spring Festival is usually in February and construction workers need to get back to work. So the human resource supply and demand index reached its peak throughout the year and the monthly index reached up to 160.22%. At this time

the supply of human resource reached to the highest level throughout the year and it was also the first annual recruitment peak. After the recruitment peak in the spring, human resource supply and demand index continued to decline in April to May and reached a low level in May. The reason is that the needs of enterprise recruitment continue to rise, however, at this time the supply of other types of human resource reduces in addition to the supply of graduates in part. Because of a large number of graduates entering society in June to July, the supply of human resource continued growth. So the human resource supply and demand in July reached the second peak throughout the year and monthly index reached to 118.76%.Another recruitment peak is in autumn. The monthly index reached to 86.47% in October. The reason is that graduates next year hunting job starts and it leads to a significant growth in the number of human resource supply and a slow growth in the demand of enterprise recruitment. The number of human resource supply and demand decreased significantly in December to next January. The reason is that job seekers' iob wishes declined in the meantime. Due to closing to examination and winter vacation, graduates' job willing decline and the supply of human resource decline significantly.

It should be noted that we need to have more than three years of historical data to eliminate the influence of contingency factors when we apply to the long-term trend decomposition to analyze the seasonal variation of the human resource supply and demand. The more years of data, the more completely contingencies eliminate. When we analyze the data, the time series should be drawn into history graph and we should observe whether the seasonal variations in the same month (season) of different years at first. Secondly, we should exclude the impact of changes in the rest of the factors to determine the regular season change after determining seasonal variation.

Reference:

1. L. Franchini, E. Caillaud, P. Nguyen (2001) Workload control of human resources to improve production management. *International Journal of Production Research,* 39(7), p.p.1385-1103.
2. Kamoche (1996) K.strategic: Human Resource Management within a Resource cability view of the Firm. *Journal of Management studies*, 33(2), p.p.213-233.
3. Han Yu, Han Chunling (2012) Statistical Theory. *Peking University Press.*
4. Zeng Wuyi (2011) Statistics (The Second Edition). *Chinese Finance Press.*
5. Ye Haizhong (2013) New Human resource Science Generalities. *Party Building Readings Press*.
6. Xu Guoxiang, Zhang Miao (1997) Research in Compilation and Application of Human resource Index. *Statistical Research,* No.6, p.p.40-42
7. Bai Wanping (2005) Research in Compilation and Application of Gui Zhou Human resource Index. *Guizhou Finance and Economics College Learned Journal*, No.2, p.p.74-77.
8. G.S. Scherbina, V.P. Radchenko, I.G. (2012) Trigub: Improvement of Precision Management of Rolling Profiles on Medium-Section Mills. *Metallurgical and Mining Industry*, 4(1), p.p. 31-32
9. I.Yu. Kobelyatskiy, V.V. Panchenko, L.M. Solodovnik (2011) Optimization of the Movement of Transfer Points on the Horizons in the Deep Iron Ore Open Pit. *Metallurgical and Mining Industry*, 3(5), p.p. 235-240