

A Brief Analysis on the Influence of ICT Change on China's Labor Market

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I. Introduction

China's information and communication technologies (ICT) reform began in the mid-1990s which was about 30 years later than that of the U.S., and it had a profound impact on the labor market. This paper analyzes the influence of ICT on China's labor market from three aspects: employment structure transformation, employment contradiction, and wage inequality. The results show as follows. (1) The rise and development of ICT significantly promoted the employment of related industries, and increased the coordination of industrial structure and employment structure. (2) The rapid development of ICT has led to the structural contradiction between "recruitment difficulty" and "employment difficulty." Jobs closely related to ICT is in short supply, while employment in traditional industries is oversupplied. (3) The wage gap in industries is increasing, which shows that an obvious increase in the industries closely related to ICT and that the wage gap with the traditional industries is increasing.

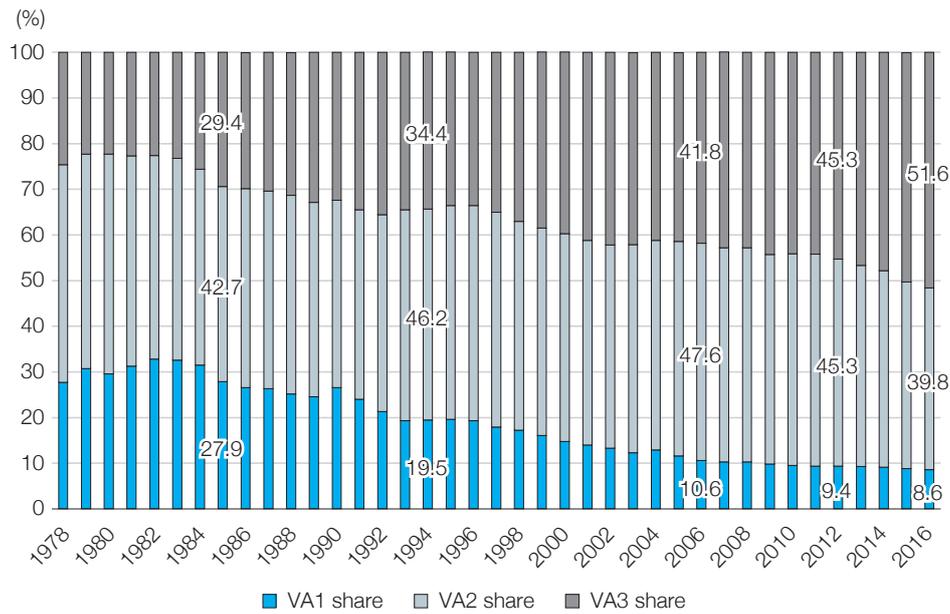
Facing the employment structural contradictions and the widening wage gap, the Chinese government has issued relevant policies accordingly, for example, from the educational aspect to set up the shortage of specialty and strengthen the cooperation between schools and enterprises to provide financial and technical support to encourage entrepreneurship, to take reform of personal income tax and to raise minimum wage.

II. ICT increases the coordination of industrial structure and employment structure

1. The evolution of industrial structures and employment structures

In 1978-1994, the share of China's tertiary industry increased whereas the share of the primary industry decreased, and the employment ratio also showed the same change. However, the employment structure is far behind the optimization and upgrading of the industrial structure. In 1985, when the share of the tertiary industry increased to 29.4% which was the first time exceeded 27.9% in the primary industry (Figure 1), the employment ratio of the tertiary industry was only 16.8% which was far below 62.4% in the primary industry (Figure 2). The primary industry absorbed so many labor force. The comparative labor productivity was as low as 0.4 in the primary industry (Figure 3). While the absorptive capacity of the secondary and the tertiary industries was relatively low, the comparative labor productivity was up to 2.1 and 1.8 respectively.

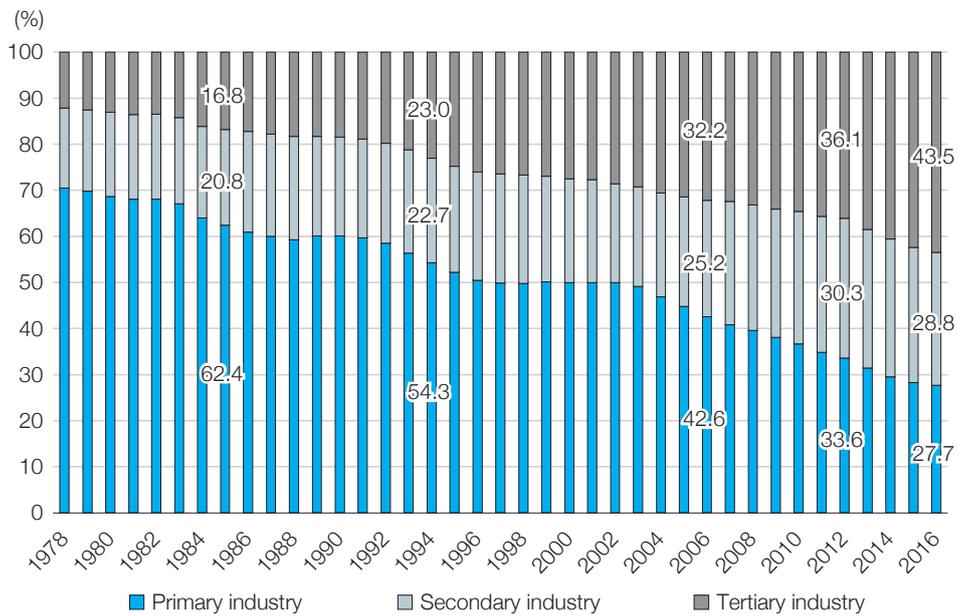
Since 1993, with the rise of the internet in China, the industrial structure and employment structure have been optimized and transformed from the primary industry to the tertiary industry. The employment absorption capacity of the tertiary industry had been enhanced obviously. With the share of the tertiary industry increased, the employment ratio showed a faster growth. In 1994, when the employment ratio of the tertiary industry increased to 23% which was the first time exceeded 22.7% in the secondary industry, the share of the tertiary industry was 34.4% which was far below 46.2% in the secondary industry. The labor productivity of the tertiary industry reduced to 1.5 which showed obviously pulling effect on the employment of labor force, while the



Source: CEInet Statistics Database.

Note: VA stands for value added.

Figure 1. Changes in industrial structure during 1978-2016

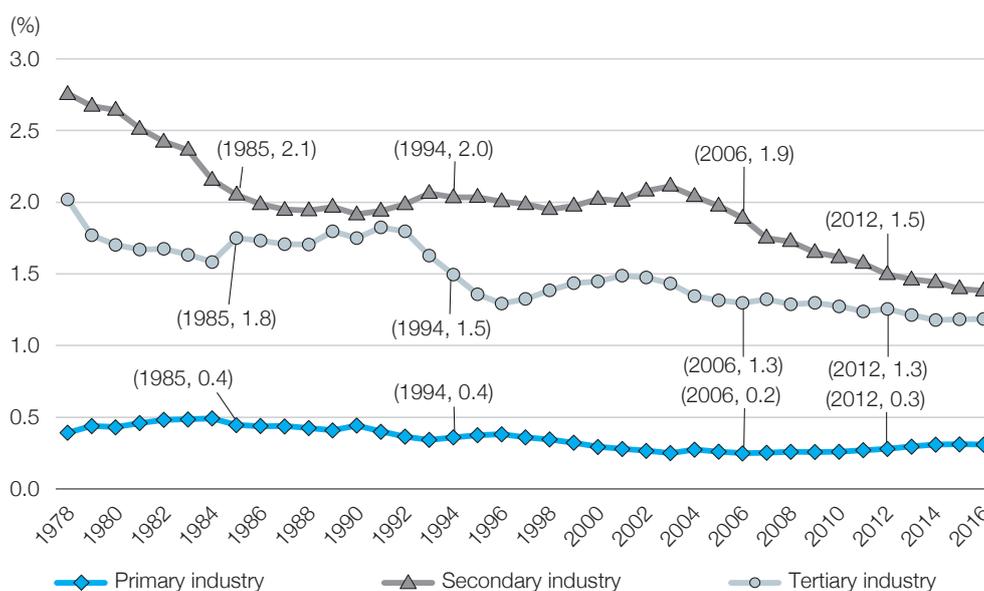


Source: CEInet Statistics Database.

Figure 2. Changes in employment structure during 1978-2016

comparative labor productivity of the primary industry and the secondary industry was 0.4 and 2.0 and their employment capacity were basically unchanged.

Since 2006, industrial structure has shifted from the secondary industry to the tertiary industry. The employment capacity of the secondary and the tertiary industries is obviously enhanced. By 2012, the share of



Source: CEInet Statistics Database.

Figure 3. Comparative labor productivity during 1978-2016

the tertiary industry added up to 45.3% which was equal to that of the secondary industry, and the employment ratios of the secondary and the tertiary industries were 36.1% and 30.3% respectively. The comparative labor productivity had already dropped to 1.5 and 1.3.

To sum up, since the reform and opening up the optimization and upgrading of the industrial structure had led to the continuous adjustment and improvement of the employment structure in China. Especially since the rise of the internet in 1993 the employment absorption capacity of the tertiary industry has been significantly enhanced. However, until now the coordination of the industrial structure and the employment structure remains to be further improved, and there still retains a lot of labor force in the primary industry.

By 2016, the share of the three industries in China was 8.6%, 39.8% and 51.6% respectively, and the corresponding employment ratios were 27.7%, 28.8% and 43.5% respectively. The comparative labor productivity of the secondary and the tertiary industries was 1.4 and 1.2 respectively, while that of the primary industry was as low as 0.3 which showed that a large number of labor need to be transferred from the primary industry to the secondary or tertiary industries.

In addition, the speed of China's industrial structure and employment structure adjustment is very fast, especially in recent ten years: the share of the tertiary industry had increased from 41.8% in 2006 to 51.6% in 2016 with an increase of 9.8 percentage points, and its employment ratio had increased from 32.2% in 2006 to 43.5% in 2016 with an increase of nearly 11.3 percentage points. The share of the secondary industry was reduced by 7.8 percentage points, and its employment ratio increased by 3.6 percentage points in the same period. While the share of the primary industry is reduced by 2 percentage points and the employment ratio is reduced by 14.9 percentage points in the same period.

2. The transition of industry structure and employment structure in the tertiary industry

In the tertiary industry, the sectors which are closely related to ICT, such as finance and IT, have significantly improved their industry contribution rates. The share of the financial sector to the tertiary industry increased from 10.6% in 2004 to 16.9% in 2015 with an increase of 6.3 percentage points, and its employment ratio also increased from 6.0% to 6.8% accordingly. The share of leasing and business services to the tertiary industry

Table 1. The VA share and employment ratio of major sectors in the tertiary industry

Year	Transport, Storage and Post		Accommodation and Catering		Wholesale and Retail		Finance		IT services ¹		Leasing and Business services		Scientific research and Technical service	
	share	ratio	share	ratio	share	ratio	share	ratio	share	ratio	share	ratio	share	ratio
2004	14.8	10.6	5.6	3.0	19.3	9.9	10.6	6.0	6.3	2.1	3.9	3.3	2.6	3.7
2005	14.0	10.2	5.5	3.0	18.3	9.1	9.8	6.0	6.4	2.2	4.1	3.6	2.8	3.8
2006	13.4	10.0	5.4	3.0	19.1	8.4	10.6	6.0	6.3	2.3	4.2	3.9	3.0	3.9
2007	13.0	10.0	5.1	3.0	19.8	8.1	11.5	6.2	5.9	2.4	4.1	4.0	3.0	3.9
2008	12.6	9.8	5.1	3.0	20.8	8.0	11.6	6.5	5.8	2.5	4.2	4.3	3.0	4.0
2009	11.9	9.5	4.8	3.0	21.2	7.8	12.4	6.7	5.3	2.6	4.1	4.4	3.1	4.1
2010	10.5	9.1	4.3	3.0	20.1	7.8	14.4	6.8	5.0	2.7	4.2	4.5	3.2	4.2
2011	10.5	9.1	4.1	3.3	20.5	8.9	14.1	6.9	4.8	2.9	4.4	3.9	3.7	4.1
2012	10.2	8.7	4.0	3.5	20.9	9.3	14.2	6.9	4.9	2.9	4.6	3.8	3.9	4.3
2013	10.1	9.8	3.9	3.5	21.2	10.4	14.4	6.3	5.0	3.8	4.8	4.9	4.0	4.5
2014	9.9	9.8	3.8	3.3	21.6	10.1	14.7	6.4	5.2	3.8	5.0	5.1	4.0	4.6
2015	8.9	9.5	3.5	3.1	19.3	9.8	16.9	6.8	5.4	3.9	5.0	5.3	3.9	4.6

Source: CEInet Statistics Database.

increased from 3.9% in 2004 to 5.0% in 2015, as to scientific research and technology services the share rose from 2.6% to 3.9%. Their employment ratio went up from 3.3% to 5.3% (leasing and business services) and 3.7% to 4.6% (scientific research and technology services). The share of IT services to the tertiary industry decreased by 1.3 percentage points in 2004-2010, and began to increase in 2013, while its employment ratio increased significantly from 2.1% in 2004 to 3.9% in 2015 (Table 1).

In addition, the rise of ICT revolution has enabled e-commerce mode to enter the wholesale and retail industry which make a huge effect. The online platforms, such as Taobao and Jingdong, have greatly reduced the trade costs, increased the efficiency and vitality of the market. In recent years, the share of the wholesale and retail industry has increased on the whole, and its employment ratio has also increased.

However, the share of industries, which are not highly correlated with ICT, decreased significantly. For example, the share of transport, storage and post industry dropped significantly from 14.8% in 2004 to 8.9% in 2015 with a decrease of 5.9 percentage points, its employment ratio decreased from 10.6% to 9.5%. And the share of accommodation and catering trade was also reduced from 5.6% to 3.5%, while the employment ratio changed little.

Thus, we can see that the optimization and upgrading of China's industrial structure and employment structure in recent years is mainly derived from the promotion of ICT technology.

III. ICT makes “difficult employment” and “job difficulty” coexist

1. Employment is reducing in traditional industries while increasing in emerging industries

The rapid adjustment of industrial structure driven by ICT technology has greatly changed the structure of employment demand. In the labor market, the demand of traditional industries has declined, while in emerging industries it is booming. As shown in Table 2, the employment growth rates in mining industry, manufacturing

1. IT represents for information transmission, software and information technology.

Table 2. Employment growth rate of the traditional and emerging industries during 2014-2016

(%)

Year	Mining	Manufacturing	Transport, Storage and Post	Finance	IT	Leasing and Business services
2014	-6.3	-0.3	1.8	5.3	2.7	6.5
2015	-8.5	-3.3	-0.8	7.2	4.0	5.5
2016	-10.1	-3.4	-0.6	9.6	4.1	3.0

industry, transportation, storage and post industry, which are less associated with ICT, were significantly negative during 2014-2016. While the employment growth rates of the finance, IT, and the leasing and the business services, which are closely related to ICT, are obviously increased.

Because the restructuring of the supply of talents in China is slower than the upgrading of the industrial structure, there exists serious imbalance in the proportion of supply and demand in the labor market which has caused the contradiction of structural employment to become increasingly prominent. The problem of “recruitment difficulty” and “employment difficulty” are becoming more and more acute. The talents for the jobs, which are closely related to ICT industry, are in short supply, while the jobs that are less related to ICT industry are oversupplied.

2. The talents for emerging industries that are closely related to ICT, are in short supply

As the talents for the emerging industries that are closely related to ICT, are in short, the Chinese government is taking active measures to increase talents supply, by strengthening professional construction and setting up related specialties, seeking college-enterprise cooperation, standardizing the social training and so on. As China is a centralized country which make decisions with high efficiency, the shortage of talent will soon be relieved.

(1) AI field

As the rise of ICT technology has made the artificial intelligence (AI) flourishing, the demand for AI talents in many industries and fields, such as internet, finance, automobile and manufacturing, has surged. The number of AI positions released only through the LinkedIn platform has soared from 50 thousand to 440 thousand, increased by about eight times during 2014-2016.² According to the big data of China intelligence association, the demand for AI talents in the third quarter of 2017 increased by 179% compared with the first quarter of 2016. On the other hand, the development of education and training system is lagging behind, resulting in an AI supply and demand ratio to be only 1:10. There exists a serious imbalance between supply and demand. From the subdivision level, such as algorithm, machine learning, GPU, smart chip, show a more significant talent gap compared with the application technology.³

In order to increase the talents supply, our country plans to set up AI specialty and seeks the cooperation between schools and enterprises to cultivate the reserve force. *The New Generation of Artificial Intelligence Development Plan*, issued by the State Council recently, pointed out that we should improve the layout of artificial intelligence, set up artificial intelligence specialty, and promote the construction of the first level discipline in the field of AI. Besides strengthening professional construction, the government also plans to cultivate AI talents by college-enterprise cooperation which can enrich the form of AI education and promotes the development of AI education.

(2) Internet finance

As an emerging field, the internet finance also encounters structural imbalance, and there exists a huge talent

2. From the 21st Century Business Herald, http://www.21jingji.com/2017/7-25/xOMDEzNzlfMTQxNDIxOA_2.html.

3. From Chinanews, <http://www.chinanews.com/it/2017/07-06/8270299.shtml>.

gap. At present, the contradiction between enterprises and talents is mainly reflected in the rapid development of the industry, which leads to a general lack of understanding of the internet financial industry and inadequate knowledge and skills, making it difficult for enterprises to acquire high-quality talents in the short term. It is expected that the gap of internet financial talents will exceed three million people during 2017-2019,⁴ and the huge gap of talent has become the bottleneck of the internet financial enterprises in China.

In order to increase the supply of internet financial talents, our country is actively seeking cooperation between schools and enterprises and strengthening the skill training. The internet financial leaders, represented by Luo Mingxiong and other internet financial leaders, have already joined in alliance with the heads of relevant universities, such as the Central University of Finance and Economics and University of International Business and Economics, to establish the internet finance course in order to develop systematic internet financial knowledge and skills for students in schools and make them meet the talent needs of internet financial enterprises.

(3) Big data

The emergence of the big data industry has made data analysts the most demanding jobs, while the supply of talents lags far behind the industry development. The supply index is only 0.05. In the future, the gap between China's basic data analysis and talent analysis will be as high as 14 million times, according to the data analysis of the China Commercial Federation.

At present, there are two main aspects of the implementation of talent measures. First, to add related specialties and increase the supply of talents. In February 2016, the Ministry of Education first approved to set up the specialty of "data science and big data technology" in three universities i.e., Peking University, University of International Business and Economics, and Central South University. In March 2017, the Ministry of Education had announced that 32 universities can set up this specialty. Up to now, 35 universities in China have been approved for the major. Second, to standardize the social training and cultivate professional talents. In order to rectify the training errors of training institutions for big data talents, Specialized Committee⁵ joins forces with 87 experts to co-draft "*Standards for the Training System for Large Data Talents in China.*"

3. The talents for the jobs that are less related to ICT industry, are oversupplied

In recent years, as economic growth is no longer driven by investment, the traditional fields like steel and coal sectors are facing overcapacity and serious loss, and the employment absorptive capacity has also been reduced. Since 2016, in the iron and steel industry and the coal industry, 1,300 thousand and 500 thousand respectively of the workers are facing to be laid off, accounting for more than 20% of employment in these industries.⁶ For this part of the laid-off workers, our government has launched an employment support plan, taking a series of measures in the occupation training, occupation introduction and occupation guidance to help the workers to get employment or start a business as soon as possible. At the same time, for workers who are unable to carry out employment in the market, the government will set up public service jobs for them.⁷ Although it is not easy as expected, the government is doing it actively and expecting that there will be significant results by 2020.

For college graduates who have difficulty in employment, the government encourages them to carry out their own business. Since 2011, the state has vigorously introduced a number of preferential policies for entrepreneurship, mainly in the following six aspects:⁸ (1) Reduce the entrepreneurship barriers. To simplify the formalities of starting, examining and approving the project which opens up a green channel for college

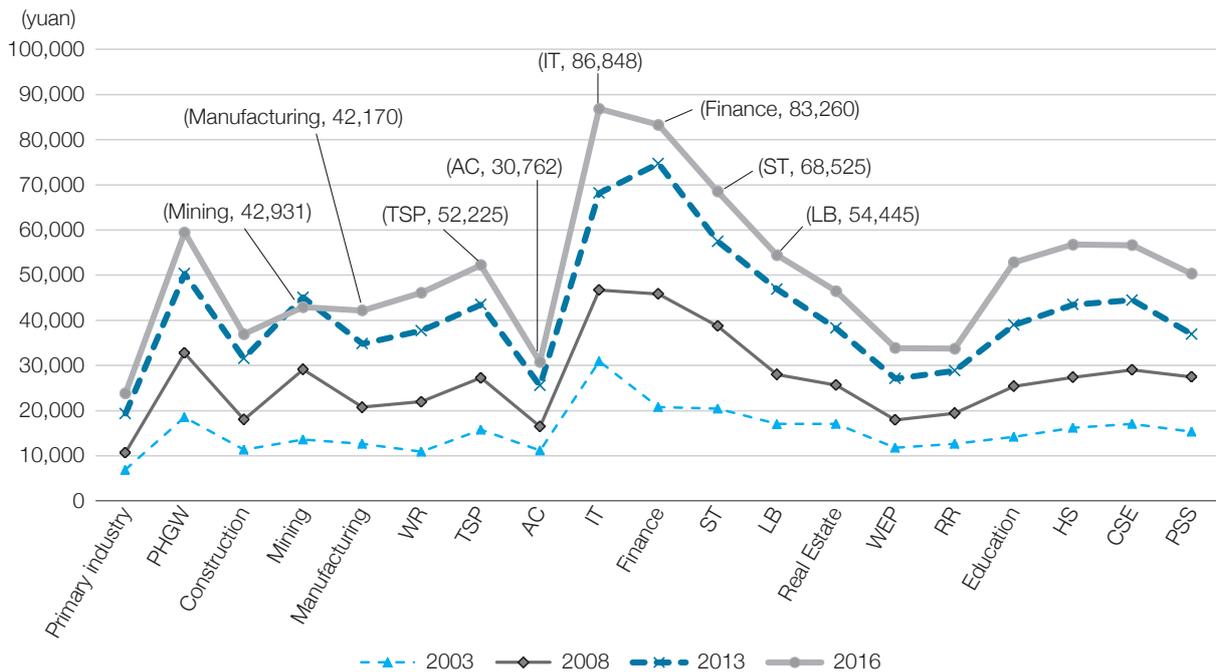
4. From People's Daily Online, <http://js.people.com.cn/n2/2016/1216/c360301-29474761.html>.

5. Specialized Committee is short for China Commercial Federation Data Analysis Specialized Committee.

6. From People's Daily Online, <http://energy.people.com.cn/n1/2016/0301/c71661-28160325.html>.

7. From Ministry of Land and Resources of the People's Republic of China, http://www.mlr.gov.cn/xwdt/jrxw/201605/t20160519_1405783.htm.

8. From People's Daily Online, <http://finance.people.com.cn/n/2015/1027/c1004-27745092.html>.



Source: CEInet Statistics Database.

Note: PHGW is short for Power, Heat, Gas and Water Production and Supply; likewise, WR: Wholesale and Retail; TSP: Transport, Storage and Post; AC: Accommodation and Catering; LB: Leasing and Business services; ST: Scientific research and Technical services; WEP: Water, Environmental and Public facilities management; RRR: Residents' services, Repairs and other services; HS: Health and Social work; CSE: Culture, Sports and Entertainment; PSS: Public administration, Social security and Social organization.

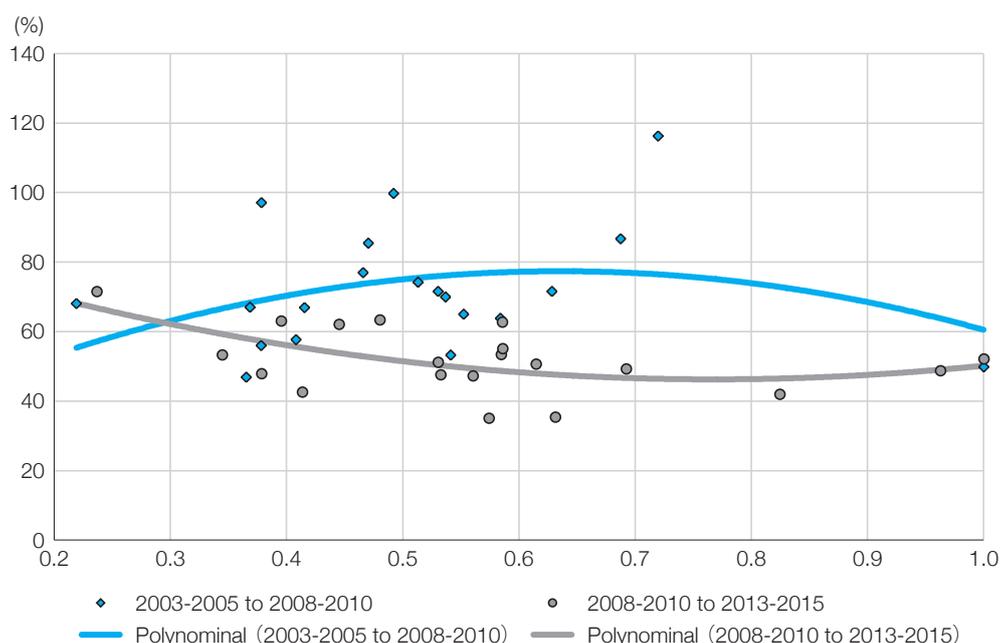
Figure 4. Average real wages across industries in urban areas over the period of 2003-2016

students to start their own business; (2) Strengthen the training of entrepreneurship. To prepare special training programs and to give priority to training resources, which guarantee the students to get their business training; (3) Provide financial support. To provide less than 100 thousand yuan of venture guarantee loan for entrepreneurial college students, and for a partnership or organization the amount will be further increased; (4) Reduce tax and fees for college graduates who engage in self-employed businesses. Although business tax, urban construction and maintenance tax, as well as additional education fee and the personal income tax will be deducted within three years, it is limited to the cases that the amount of relief is not more than 8,000 yuan per year. To exempt from administrative fees about the category of management, registration and evidence; (5) Implement household registration support. To abolish the restrictions on the settlement of college graduates, and to allow them to handle the settlement procedures in the entrepreneurial place; (6) Provide business services. To provide project development, opening guidance, financing service and tracking support service for the college students. In recent years, the scale of college students' participation in entrepreneurship has increased rapidly from 359 thousand in 2013 to 615 thousand in 2016, with an increase of 71.3%.

IV. ICT increases the wage gap in the industry

For more than 10 years, the reward to workers in different industries changed a great deal. Figure 4 shows the change of average real wages of employees in cities and towns in each industry over the period of 2003-2016,⁹ through which we can see the average real wage level of the industries closely related to ICT is far higher than that with low correlation to ICT and the gap between them is increasing.

9. Basis year is 2003.



Source: CEInet Statistics Database.

Figure 5. Changes in real yearly wages over the period of 2003-2015

The average real wage of the productive service industry,¹⁰ closely related to ICT, is in the lead and growing faster during 2003-2016. In 2003, the average real wages per year of IT, Finance, Scientific research and technical services (ST), and Leasing and Business services (LB) were 30.9 thousand yuan, 20.8 thousand yuan, 20.4 thousand yuan and 17.0 thousand yuan respectively, which were far above the whole industry average of only 14.0 thousand yuan a year. By 2016, they were up to 86.8 thousand yuan, 83.3 thousand yuan, 68.5 thousand yuan and 54.4 thousand yuan in turn, and increased by 181.09%, 300.67%, 235.22% and 219.89% respectively compared with those in 2003.

The wage gap in the industry has increased significantly. While the average real wages per year of the primary industry and the wholesale and retail industry were 6.8 thousand yuan and 11.2 thousand yuan respectively, 24.0 thousand yuan and 19.7 thousand yuan less than that of IT industry. By 2016, the average real wages per year of the primary industry and the wholesale and retail industry increased to 23.8 thousand yuan and 30.8 thousand yuan, and the wage gap with the IT industry expanded to 63.0 thousand yuan and 56.1 thousand yuan.

Although the wages of mining and manufacturing industries increased significantly during 2003-2013, they went up from 13.6 thousand yuan and 12.7 thousand yuan to 45.1 thousand yuan and 34.8 thousand yuan respectively, with an increase of 215.05% and 232.80%. However, after entering the year of 2013, with the industrial transformation and upgrading driven by ICT technology revolution, the economic development has entered the new normal. The traditional industries are facing serious overcapacity and large loss, which makes the growth rates of the wage level slow down or even decline. The average actual wages per year in the mining and manufacturing industries in 2016 were 42.9 thousand yuan and 42.2 thousand yuan respectively, increased by -4.79% and 21.13% compared with the year of 2013.

After experiencing the rapid growth of economy driven by investment, the new normal economic growth led by ICT technology has made the wage growth of most industries decrease significantly, especially for

10. Productive service industry includes IT, Finance, Scientific research and technical services, Leasing and Business services.

Table 3. Main conclusion of academic research on personal income tax reform

Literature Sources	Main Conclusion
Tian Zhiwei et al. (2014); Guo Xiaoli (2016)	The average tax rate is small, the adjustment of income distribution is limited.
Xu Jianwei et al. (2013); Hu Wenjun (2017); Liu Yang et al. (2014)	The structure of the tax rate is unreasonable, the income gap is widened.

Table 4. Main conclusion of academic research on minimum wage

Literature Sources	Main Conclusion
Quan Heng and Li Ling (2011); Weng Jie and Xu Sheng (2015); Fu Wenlin (2014)	On the whole, the income gap cannot be narrowed; however, the amount of employment will be reduced.
Zhang Shiwei and Jia Peng (2014)	In the short term, the income gap will be narrowed without employment reduction; in the long run, only if the minimum wage rises within 25%, wage inequity is reduced.
Ye Linxiang et al. (2015)	Only for labor-intensive and Hong Kong and Macao Taiwanese investment enterprises, the minimum wage has a significant impact on the employee's hourly wage.

industries in which the wage level belong to upper-middle class.

Figure 5 shows the growth of average real wages in each sectors during 2008-2010 and 2013-2015 compared with 5 years ago. We can see that the average real wage growth rate of 2008-2010 is generally higher than 2013-2015 in each quantile, and the growth rates of the lower limit of 50% highest incomes are obviously much lower during 2008-2015 than those during 2003-2010.

At the same time, the distribution of wages is more scattered. The number of industries, of which average real wages are in the lower limit of 80% highest, increased from 1 to 3. And the wages of finance and scientific research and technical service move upwards obviously in wage distribution.

In order to cope with the widening of the wage gap among industries, our government has adopted two measures: the individual tax reform and the minimum wage adjustment.

The reform of personal income tax is a common means to adjust the income gap in China. In recent years, the starting point of personal income tax has been adjusted frequently, from the initial 800 yuan in 1980 to 1,600 yuan in 2005, 2,000 yuan in 2007 and 3,500 yuan in 2011. Moreover, in 2011, the tax rate was adjusted so much that the first level tax rate of individual income tax was changed from 5% to 3%. By raising the threshold and reducing the tax rate, the disposable income of the middle and low classes are increased. It is expected that by 2020, our country will raise the tax threshold and reduce the tax rate again. However, according to academic research results, up to now the adjustment of personal income tax does not reduce wage inequality and makes it even larger, thus personal income tax needs further reform (Table 3).

The implementation of the minimum wage policy in China began in recent years. The minimum wage regulation was passed by the end of 2003 and put into effect since March 1, 2004. Due to the great difference of economic development level and living cost, minimum wage standards are different in each provinces and cities. In recent years, the government began to raise the minimum wage frequently, and the minimum wage level and adjustment frequency in the eastern region are obviously higher than those in the central and western regions. By the end of 2017, the minimum wage in Shanghai, Tianjin and Beijing is higher than 19 yuan per hour, while that in the western regions, such as Shanxi, Ningxia and Guangxi, is less than 15 yuan per hour (Table 4).¹¹ According to these academic research, raising minimum wage is not a good way to reduce wage inequality.

11. From People's Political Consultative Conference, <http://www.rmzxb.com.cn/c/2017-12-06/1890536.shtml>.

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