CHINA'S INDUSTRIAL STRUCTURE UPGRADE IN THE “NEW NORMAL”: EMPIRICAL TEST AND DETERMINANTS

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This paper measures the index of industrial structure upgrade nationally, regionally and provincially by employing angle cosine method. The results show that China's industrial structure has upgraded and the East is higher than the Northeast and the Midwest. The paper presents an empirical study to examine the effect of variables including demand-side factors, New Normal as a dummy variable and supply-side factors on industrial structure upgrading. It implies that New Normal is not significant, while consumption, investment, technology improvement and labor supply significantly facilitate the upgrade. It highlights policy suggestions designed to adopt innovation-driven strategy and regional economy development strategy.

Keywords: New normal; industrial structure; index of upgrade; demand-side factors; supply-side factors.

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1. Introduction

Reform and opening up has provided an impetus for China's economy growth. Its GDP has risen from 365.02 billion Yuan in 1978 to 67.6708 trillion Yuan in 2015, a sharp increase of 184 times, maintaining a high average annual growth rate of 8–10%. China has also significantly upgraded its industry structure. The composition of primary, secondary and tertiary industry has shifted from 27.9:47.6:24.5 in 1978 to 9.0:40.5:50.5 in 2015, which showed that the proportion of tertiary industry had risen continuously and even exceeded 50% in 2015. China's industrial structure adjustment is consistent with the

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general industrial optimization mode with an evolution from “primary, secondary, tertiary”; “secondary, tertiary, primary” to “tertiary, secondary, primary”.

Currently China's economy has entered the New Normal era of “structural adjustment and methods transformation”, with the characteristics of retardant economic growth, the difficulties of industrial structure adjustment and tasks of resolving the consequence of pre-stimulus policy. Broadly speaking, China's New Normal will present new features with respect to economic growth, economic structure, economic quality, growth momentum, wealth distribution and institutional environment (Wu, 2015). Since 2012, China's economic growth has showed a declining trend, with a growth rate of 7.7% in 2012, nearly year-on-year decrease of 2%, and in 2015 it even dropped below 7%. Traditional theory suggests that economic development will definitely lead to industrial upgrading and structural optimization, which gives rise to the research how China's industrial structure will develop under the New Normal. This paper will measure the China's industrial structure upgrading index at both the provincial and regional level to figure out how industrial structure developed in the 10-year rapid economic growth, examine the determinants and mechanism of industrial structure upgrading by demand-side and supply-side, and empirically explore the impact of New Normal on industrial structure upgrading.

The paper is organized as follows: Section 2 reviews the researches on the upgrade of industrial structure and New Normal. Section 3 measures the index of industrial structure upgrading by angle cosine method. Section 4 examines the determinants of industrial structure upgrade by the approaches of demand-supply. Section 5 is the empirical study in which New Normal is included as a dummy in the model. Conclusion is given in Section 6.

2. Literature Review

Industrial structure upgrade refers to the quality and benefit of industrial structure evolving to higher levels on a reasonable and coordinated basis, reflecting the dynamic development process of industrial structure from low level to high level, simplicity to complexity, small scale to large scale, and a rigid structure to a flexible structure (Zhou *et al.*, 1978; Bah and Brada, 2009; Fatas and Mihov, 2005). Industrial restructuring is fundamentally the flow and allocation of production resources and the transfer from low-productivity industries to high-productivity industries, laying the theoretical basis of “economic development is bound to promote industrial upgrading” (Petty, 1662; Porter, 1990). Clark (1957), Kuznets (1971), Chenery (1987), Hoffmann *et al.* (1958) carried out extensive researches on industrial structure optimization, presenting a universal path for industrial structure upgrading and optimization, which stated that, both in developed and developing countries, industrial structure upgrade is required to undergo the process from composition of “primary, secondary, tertiary” to “secondary, tertiary, primary” and ultimately to “tertiary, secondary, primary”.

After nearly four decades of reform and opening up, China's rapid economic development and continuous industrial structure adjustment (Xu, 2011) have formed the industrial structure led by tertiary industry (Cheng, 2011). Currently, China's economy has entered the New Normal era, which is a trend and an irreversible development state as well

as the objective reconsideration and active rethinking of China's growth progress, trend and power (Jin, 2015; Liu, 2015; Li and Zhang, 2015), while the industrial structure upgrade is the top priority of China's economy in the New Normal (Zhang and Wang, 2015). Huang *et al.* (2015) proposed the industrial structure upgrade index to measure the industrial structure adjustment of regions in China, reporting that China's industrial structure upgrade level had been obviously deepened while technological improvement was the key driving factor in the upgrade of industrial structure. Thus, in the New Normal, China's industrial structure upgrade shall accelerate factors allocation, and cultivate advanced manufacturing industries, etc. (Guo and Li, 2016), especially focus on the important role of innovation driver for the industrial structure optimization (Zweimuller and Brunner, 2005; Acemoglu, 2009; Acemoglu and Guerrieri, 2008; Fuceri, 2010).

Scholars have had lots of informative discussions on the factors influencing industrial structure upgrade with respects of technological improvement (Duarte and Restuccia, 2009), environmental regulation (Berkowitz *et al.*, 2006), foreign investment (Chen *et al.*, 2011; Mao and Yao, 2012) and financial development (Ali, 2005). Gao *et al.* (2015), Ma and Guan (2015) made empirical analysis of China's industrial structure upgrade from the factors of social needs, R&D input, labor input, etc., agreeing that technological progress is the core element in driving industry structure upgrade. Lahorgue and Cunha (2004), Wang (2006), Fu *et al.* (2013) also proved that innovation can lead to the optimization of regional industrial structure. Wang *et al.* (2016) proved that foreign direct investment was conducive to regional industrial structure upgrade; Lanoie *et al.* (2008), Brunnermeier and Cohen (2003), Domazlicky and Weber (2004), Lee and Yu (2010), Capello (2013) believed that environmental regulations will not significantly reduce enterprise productivity, but standardize enterprise production behaviors and patterns, and promote industrial structure optimization. Song and Lin (2015) and Song (2015) indicated that financial development can obviously promote industrial structure upgrade.

Numerous theoretical and empirical studies show that with economic development, industrial structure will continue to be optimized to realize upgrade and it is propelled by core factors like technological advancement and innovation (Zhao *et al.*, 2010). In the New Normal, China's economic industrial structure upgrade is urgent to make effective breakthroughs in aspects like resource allocations, advantages cultivation, etc. Previous researches have laid a solid foundation for this paper, but still left room for improvement in the following aspects: First, the existing researches measured the industrial structure upgrade from the national level and the regional level of Eastern, Central and Western China, but due to the enormous differences of the current economic development in China's provinces, few studies measured the industrial structure upgrade from the provincial level; secondly, numerous studies show that the New Normal will influence the industrial structure optimization greatly, but these studies are basically qualitative analysis, lacking an appropriate empirical test. Accordingly, this paper will calculate China's industrial structure upgrade index at the national level, regional level and provincial level, select influencing factors from the demand and supply level to conduct the empirical test on China's industry structure upgrade, and especially introduce the New Normal as a dummy variable to study the impact of the New Normal on industrial structure upgrade.

The paper will use angle cosine method and 2003–2015 data to measure China's industrial structure upgrade indexes at the national, regional and provincial level; and explore the demand-side and supply-side determinants of industrial structure upgrade in which New Normal has been introduced to extend the extant researches on China's industrial structure upgrade and New Normal. The index of New Normal is measured by the initially declining economic growth rate of provincial level, rather than 2014 when it was first proposed.

3. China's Industrial Structure Upgrade Index

The existing studies mainly adopt three methods to measure China's industrial structure: the static comparative method to study industrial structure upgrade level by measuring the proportion of industries and comparing the proportion with that of developed countries; the dynamic comparative method, by constructing some certain quantitative indicators including the structural similarity coefficient method, the correlation coefficient method and the distance discrimination method to distinguish industrial structure upgrade; the index method, by constructing one-level or multi-level index to distinguish industrial structure upgrade level (Gao *et al.*, 2015).

This paper adopts the angle cosine method put forward by Fu (2010) to measure industrial structure upgrade level. First, divide the GDP into three parts of primary, secondary and tertiary industry; the proportion of the added value of each part in GDP serves as a component of the space vector, thereby forming a set of three-dimensional vector $X_0 = (x_{1,0}, x_{2,0}, x_{3,0})$. Next, respectively calculate the angles $\theta_1, \theta_2, \theta_3$ of vector X_0 and the industrial vectors X_1, X_2, X_3 , which are arranged from low level to high level:

$$\theta_j = \arccos \frac{\sum_{i=1}^3 (x_{i,j} \cdot x_{i,0})}{\left(\sum_{i=1}^3 x_{i,j}^2\right)^{\frac{1}{2}} \cdot \left(\sum_{i=1}^3 x_{i,0}^2\right)^{\frac{1}{2}}}, \quad (i = 1, 2, 3; j = 1, 2, 3) \quad (1)$$

where $X_1 = (1, 0, 0)$, $X_2 = (0, 1, 0)$ and $X_3 = (0, 0, 1)$.

Thus, the calculation formula to define industrial structure upgrade index (UPG) is as follows:

$$UPG = \sum_{k=1}^3 \sum_{j=1}^k \theta_j. \quad (2)$$

Higher UPG means a higher level of industrial structure upgrade. Based on industrial structure data in 2003–2014, the paper measures China's industrial structure upgrade level at national, regional and provincial levels, and the data are sourced from the 2004–2015 *China Statistical Yearbook* and the *Statistics Yearbook* of different provinces and cities. Nationally, China's industrial structure upgrade index shows a clear upward trend, indicating that China's industry is in a better and faster “quality improving and speed accelerating” period (see Figure 1). In this decade, China's economy was in a “golden phase” of fast development, and the dominant economic development model has been continuously

Table 1. Industrial Structure Upgrade Indexes in the Four Regions

Year	The Eastern Region	The Northeast Region	The Central Region	The Western Region
2003	6.56	6.34	6.23	6.24
2004	6.54	6.32	6.25	6.21
2005	6.61	6.37	6.31	6.35
2006	6.63	6.39	6.33	6.37
2007	6.66	6.38	6.32	6.28
2008	6.66	6.37	6.34	6.35
2009	6.74	6.44	6.36	6.44
2010	6.75	6.43	6.36	6.42
2011	6.76	6.41	6.38	6.44
2012	6.79	6.42	6.41	6.38
2013	6.81	6.42	6.46	6.46
2014	6.84	6.49	6.50	6.53
Mean	6.70	6.40	6.35	6.37

adjusted from factor-driven, investment-driven to technology-driven model, which is directly manifested by industrial structure transformation and upgrade. In 2004, the industrial structure upgrade index declined to some extent, but since then it has been on the increase, which was closely related to the national implementation of programs like the Western Development and the Development of Old Industrial Base of the Northeast, because the industrial structure of the Western and old industrial bases in Northeast China was dominated by traditional industries such as steel industry, and these programs mainly served to solve traditional industrial transformation and output capacity, etc., thus the industrial structure upgrade index declined. With economic development strategy continuing to transform to scientific development and sustainable development, more importance has been attached to the development of strategic emerging industry, modern service industry, advanced manufacturing industry and other high-end industries, therefore, industrial structure upgrade index rises unceasingly.

National Bureau of Statistics of China divided China's economic region into Eastern region, NorthEastern region, Central region and Western region.¹ This paper calculates four economic regions' industry structure upgrade with results shown in Table 1. In 2003–2014, industrial structure upgrade index in the four regions rose constantly; the industrial structure also showed rapid growth. Among the four regions, industrial structure upgrade index in Eastern region was the highest, indicating its industrial structure was the most reasonable, which corresponded to its development level. Since the reform and opening-up, the Eastern region has opened up first due to its advantageous geographic location,

¹ With limitation of the data, this paper removed those of Hong Kong, Macao and Taiwan regions; the Eastern region includes: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan; the northeast region includes: Liaoning, Jilin, Heilongjiang; the central region includes: Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan; the Western region includes: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia and Xinjiang.

Figure 1. China's Industrial Structure Upgrade Index

boosting the economy to grow in a geometric manner and driving industrial structure upgrade, so that its industrial structure upgrade index was significantly higher than that of the remaining three regions. But in view of the index, the rising speed of industrial structure upgrade index in the Western region was the most obvious, rising by 0.29 from 2003 to 2014. On the one hand, West Development Strategy, supporting fund and preferential treatment propelled the economic development and industrial structure adjustment of the Western region; on the other hand, because of the risen labor cost and shortage of land resources, etc. in the Eastern region, labor-intensive industries were transferred to the Western region, which drove the upgrading of industrial structure in the Western region.

Provincially, although industrial structure upgrade index in each province showed a different trend of fluctuations, the industrial structures were in constant evolution in general. Industrial structure upgrade index in 2003–2014 showed an obvious rising trend (see Figures 2–5), especially in the Eastern and Western regions, indicating a significant adjustment of these two regional industrial structure. But in terms of each city and each province, since 2012, industrial structure upgrade index in Jiangsu Province has showed a “cliff-style” mainly because after financial crisis China greatly developed the strategic emerging industries, upon which Jiangsu Province was the first to try to make extra efforts to support the photovoltaic industry, etc., and in 2011–2012, the photovoltaic industry represented by Wuxi Suntech was faced with bankruptcy because of overcapacity, affecting the industrial restructuring of Jiangsu in a large-scale. In Northeastern region, industrial upgrade indexes of three provinces were all rising, but Liaoning and Heilongjiang’s indexes were in volatility. As the strategy of Revitalizing the Old Industrial Bases in Northeast China was putting forward, the labor and resource intensive industries would be taken place by new industries, so the industrial structure were in volatility. In central region and Western region, every province’s industrial upgrade index, but some provinces’ industrial structure was changing very fast, such as Tibet and Qinghai. Like Northeastern region, Chinese government put forward stimulus package for the economy of Western region. Among these, the most important was Western development, which leads to the result that the industrial structure in

Figure 2. Industrial Structure Upgrade Indexes of the Eastern Provinces

Figure 3. Industrial Structure Upgrade Indexes of the Northeast Provinces

Figure 4. Industrial Structure Upgrade Indexes of the Central Provinces

Figure 5. Industrial Structure Upgrade Indexes of the Western Provinces

Tibet and Qinghai upgrade from agriculture to manufacture. So from the calculation, the index is fluctuating.

4. Industrial Structure Upgrade Determinants and Model Specification

4.1. Selection of determinants

According to the traditional industrial structure optimization theory, the industrial structure optimization is not only influenced by national revenue and other demand-side factors, but also labor input and other supply-side factors as well. Now China is in the New Normal, in order to stimulate economic growth, optimize industrial structure, China has introduced a supply-side structural reform, while effective management of the demand-side is also necessary to advance industrial structure upgrade. Accordingly, this paper will analyze the determinants from both demand and supply sides (Figure 6).

On the demand side, factors influencing industrial structure upgrade are consumption demand, investment demand and export demand. Consumption demand refers to the consumption wishes of residents, which has consequent correlation with national revenue. With the increase of national revenue, the residents’ wishes for high-end industry consumption has become more urgent, promoting domestic industrial restructuring, and effectively pulling industrial structure upgrade. Investment demand includes domestic investment demand which can be divided into private investment, government investment and foreign investment demand, all of which can promote industrial structure upgrade. As the Chinese economy has entered the New Normal, private investment dominated by private enterprises will more spontaneously increase investment in research and development, change production patterns and continue to strengthen innovation, thus increasing the technological content and added value of industries to promote industrial structure upgrade. On the other hand, rising business cost, shortage of land and other resources,

Figure 6. Path Diagram of Determinants of China’s Industrial Structure Upgrade in the New Normal

saturated market capacity in the Eastern region make the Eastern private investment gradually spread to the central and Western regions. Compared with the existing industrial structure in central and Western China, the marginal industries transferred may still be regarded as high-end industries, thus upgrading the industrial structures in the central and Western regions, driving industrial structure upgrade nationwide. Meanwhile, the current government investment goes more to the modern services industries like medical treatment, finance, education and advanced manufacturing industry like aviation, so that strategic emerging industry can benefit industrial structure upgrade. Although labor-intensive industries are always targeted by foreign investment whose technological spillover effect can improve industrial production method and enterprise management mode, thus propelling industrial upgrade. With the unceasing development of China's economy, foreign investment focuses on strategic emerging industry to optimize industrial outputs. Export demand affects domestic industrial structure optimization conversely and the demands of foreign consumers always lead the enterprises to adopt advanced technologies to produce high-quality products, while foreign high-standard trade barrier, etc. will also "force" the enterprises to change production patterns, thus urging the domestic industrial structure optimization.

On the supply side, industrial structure upgrade is influenced by technological, labor and institutional supplies. Technological improvement is the core driving force for industrial structure optimization, which can improve productivity and quality through production pattern transformation and other approaches; especially in the New Normal, it is difficult to sustain the traditional element-driven, investment-driven patterns, therefore, industrial structure adjustment and optimization can only be achieved by accelerating core technological advantages cultivation. Thus, currently, the Chinese government vigorously promotes "Internet+" strategy, Made-in-China 2025 strategy, etc., which, in essence, are to achieve structural reform on the supply side through technological advancement. The scale of labor force can directly influence industrial development and structure optimization and for which high technicians gathering is of great importance. Institutional supply lays the environmental basis for industrial structure optimization. Environmental basis is provided by institutional supply for industrial structure upgrade and optimization and which is firmly guaranteed by perfect system arrangement. On the one hand, institutional supply influences resource allocation direction, for a sound market system can make factors of production flow to high-end industry, thus boosting the rapid development of high-end industry, accelerating industrial structure upgrade. On the contrary, bad institutional arrangement will constrain resource flow, resulting in industrial upgrade stagnation. On the other hand, institutional supply affects the direction of industrial structure optimization. Emerging industries' development needs a large amount of fund and inputs of other factor, and is highly risky, thus is in need of governmental fund subsidy, policies support and other institutional guarantees. Good institutional supply can guarantee the development direction of emerging industry, and actively guide the investment of private capital, thus propelling industrial structure optimization.

4.2. Model specification and data sources

Resident consumption, domestic investment, foreign investment, export demand, technological R&D, labor supply, institutional arrangement, etc. deeply influence China's industrial structure upgrade. Accordingly, the paper constructs a linear model as follows:

$$\begin{aligned} \text{UPG}_{it} = & \beta_0 + \beta_1 \text{PGDP}_{it} + \beta_2 \text{DI}_{it} + \beta_3 \text{FDI}_{it} + \beta_4 \text{EXP}_{it} + \beta_5 \text{TECH}_{it} \\ & + \beta_6 \text{LAB}_{it} + \beta_7 \text{INS}_{it} + \mu_{it}, \end{aligned} \quad (3)$$

where UPG_{it} refers to industrial structure upgrade index of Province i during the period of t ; PGDP_{it} refers to resident consumption demand in Province i during the period of t , manifested by GDP, and the higher the GDP, the higher the disposable income of the residents. DI_{it} is the domestic investment demand of Province i during the period of t , represented by the entire fixed investment in each province or city deducting the part of foreign investment; FDI_{it} is the foreign investment demand of Province i during the period of t , represented by the actual utilized foreign direct investment of each province; EXP_{it} is the export demand of Province i during the period of t , represented by the export volume of each province; TECH_{it} is the technological supply of Province i during the period of t , represented by the proportion of the quantity of inventions and practical patents granted to each province or city in the total patent granting amount so that it can better reflect the level of the regional technological advancement; LAB_{it} is the labor supply of Province i during the period of t , measured by the unemployment rate of each province or city due to limitation of the data, and the lower the unemployment rate, the higher the level of the labor supply of the region; INS_{it} is the institutional supply of Province i during the period of t , measured by the proportion of non-state owned investment in social investment, and the higher the proportion of the non-state owned investment, the higher the degree of economic marketization, the more the institution is inclined to perfection; μ_{it} is the stochastic variable.

To better research on the influence of the New Normal on China's industrial structure upgrade, the paper introduces a dummy variable (NEW_{it}) to the model; once the economy enters the New Normal, the NEW_{it} is marked with 1, otherwise with 0. Though "the New Normal" was first proposed by President Xi Jinping on a Central Economic Working Conference in December 2013, the most typical feature of the New Normal is economic growth slowdown. And before 2013, some provinces and cities had showed declines of economic growth. Therefore, when setting the New Normal as a dummy variable, the paper does not impose uniformity on all cases by marking the economy after 2013 as New Normal, but examines the economic growth speed of each province after the financial crisis. The year in which the growth speed declined is considered that the province entered the New Normal, and the dummy variable NEW_{it} was marked with 1. It shows that most of the provinces have initially witnessed declining economic growth rate since 2011, which is a manifestation of New Normal, while the remaining provinces have entered the New Normal since 2012.² The

²The provinces entered New Normal since 2011 include Beijing, Tianjin, Hebei, Inner Mongolia, Liaoning, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, Guangxi, Hainan, Chongqing, Shanxi, Qinghai, Ningxia; The provinces entered New Normal since 2012 include Shanxi, Jilin, Heilongjiang, Sichuan, Guizhou, Yunnan, Tibet, Gansu, Xinjiang.

model introduced with dummy variable is as follows:

$$\begin{aligned} \text{UPG}_{it} = & \beta_0 + \beta_1 \text{PGDP}_{it} + \beta_2 \text{DI}_{it} + \beta_3 \text{FDI}_{it} + \beta_4 \text{EXP}_{it} + \beta_5 \text{TECH}_{it} \\ & + \beta_6 \text{LAB}_{it} + \beta_7 \text{INS}_{it} + \beta_8 \text{NEW}_{it} + \mu_{it}. \end{aligned} \quad (4)$$

The time span of the research is from 2003 to 2014, 31 provinces, municipalities, autonomous regions are selected, while Hong Kong, Macau and Taiwan are excluded. The source of the above variables is as follow: UPG_{it} is calculated according to *China Statistical Yearbook* and *Statistic Yearbook Data* of each province; the data of DI_{it} , FDI_{it} , EXP_{it} , TECH_{it} , LAB_{it} and INS_{it} are from *China Statistical Yearbook*, *Statistic Yearbook* of each province and DRCNet Statistical Database. The descriptive statistics of each variable are as Table 2.

5. Empirical Analysis of China's Industrial Structure Upgrading in the New Normal

5.1. Empirical analysis on a national level

To avoid spurious regression caused by non-stationary data, the paper first conducts a panel data stationary test. Table 2 gives an account to unit root test results of Levin, Lin&Chu t , showing that at 10% significance level, in the circumstance of first difference the data can deny the hypothesis of the existence of unit root, indicating that the data is stationary in first order (see Table 3). On this basis, the paper uses Kao's panel data co-integration test method to conduct co-integration analysis on each variable, which showed that at 1% significance level, it can deny the null hypothesis of the absence of co-integration relation, indicating that there is co-integration relation among the variables, so regression model is applicable (see Table 4).

The paper uses F -test and Hausman test to determine the selection of the fixed effect model or the random effect model. F -test shows that fixed model regression was applicable, while Hausman test denies the null hypothesis and points out that it should be fixed effects model regression (the results shown in Table 5). Accordingly, the paper eventually chooses the fixed effects regression model, and explores according to the mechanism of influencing factors selection. First, carry out regression of the demand-side determinants,

Table 2. Descriptive Statistics of Variables

	Sample Size	Average	Median	Maximum	Minimum	Standard Deviation
UPG_{it}	372	6.474	6.411	7.561	5.681	0.304
PGDP_{it}	372	111.630	111.800	123.800	103.800	2.681
DI_{it}	372	7213.708	4937.680	42152.680	133.960	7253.950
FDI_{it}	372	754.122	271.350	7181.310	3.000	1189.311
EXP_{it}	372	448.620	92.962	6460.870	1.213	922.277
TECH_{it}	372	69.406	73.358	91.627	16.096	15.468
LAB_{it}	372	3.652	3.725	6.500	1.210	0.689
INS_{it}	372	92.214	94.645	99.339	23.861	11.383

Table 3. Stationary Test of Each Variable

Variable	Levin, Lin&Chu		Variable	Levin, Lin&Chu	
	<i>t</i> -Test Value	<i>P</i> Value		<i>t</i> -Test Value	<i>P</i> Value
UPG _{it}	9.68950	1	d(UPG _{it})	−15.3728	0.0000
PGDP _{it}	0.32026	0.6256	d(PGDP _{it})	−15.2704	0.0000
DI _{it}	30.2501	1.0000	d(DI _{it})	−1.62612	0.0520
FDI _{it}	8.29609	1.0000	d(FDI _{it})	−7.66976	0.0000
EXP _{it}	7.84515	1.0000	d(EXP _{it})	−9.81513	0.0000
TECH _{it}	4.91951	1.0000	d(TECH _{it})	−17.4595	0.0000
LAB _{it}	1.56416	0.9411	d(LAB _{it})	−13.9048	0.0000
INS _{it}	−0.44496	0.3282	d(INS _{it})	−18.4175	0.0000

Table 4. Cointegration Test of Each Variable

Test Method	ADF Statistic Magnitude	<i>P</i> Value
Kao	−4.513847	0.0000

Table 5. *F*-Test and Hausman Test

Test Method	ADF Statistic Magnitude	<i>P</i> Value
<i>F</i> -Test	54.987878	0.0000
Hausman Test	22.303726	0.0044

then carry out regression of the supply-side determinants. Finally, remove insignificant variables and introduce the dummy variable of the New Normal to make regression, thus investigating determinants of China’s industrial structure upgrade in the New Normal (results shown in Table 6).

From Regression (1), demand-side factors of per capita income and domestic investment have a significant impact on China’s industrial structure upgrade, as we have expected, that increasing domestic investment can boost industrial structure upgrade. However, per capita income and industrial structure upgrade show a negative correlation, mainly because the speed of industrial structure adjustment speed couldn’t match the residents’ income growth rate. Thanks to the rapid development of China’s economy in 2003–2014, the per capita income grew by leaps and bounds, but the industrial structure was still in the traditional low-end industry that cannot match the increase of per capita income, which led to the oversea household consumption, aiming at international market to conduct cross-border purchase or “cross-border online shopping” after the increase of per capita income, thus showing a negative correlation between the two. For both foreign investment and exports are concentrated in low-end labor-intensive industries, foreign

Table 6. Regression Result on National Level

Variable	Regression (1) Demand-side Factors	Regression (2) Supply-side Factors	Regression (3) Introducing Dummy Variable of the New Normal
C	7.212464*** (22.93278)	7.016745*** (27.58587)	7.083853*** (20.71031)
$PGDP_{it}$	-0.007249*** (-2.621167)		-0.005507** (-1.933377)
DI_{it}	8.31E-06*** (6.066432)		6.55E-06*** (4.527489)
FDI_{it}	8.74E-06 (0.392685)		
EXP_{it}	9.98E-06 (0.400631)		
$TECH_{it}$		0.002287*** (3.390295)	0.001164** (1.780637)
LAB_{it}		-0.096294*** (-5.856438)	-0.035281** (-2.007948)
INS_{it}		-0.003791 (-1.492510)	
NEW_{it}			0.019448 (0.986881)
F -Statistic Magnitude	86.17124	76.61073	87.26577
R^2	0.896842	0.882072	0.900894

Note: ***, **, * respectively refer to the significant test on 1%, 5%, and 10% level; the t in the bracket refers to statistic magnitude.

investment, export demand and China's industrial structure upgrade are not tightly related, thus the increase in foreign investment and export demand could not actually promote the industrial structure optimization. On the other hand, due to the lack of provincial and municipal high-tech products export data, the export data of this paper are the total exports of each province and city, which cannot truly reflect the proportion of hi-tech industries in export industries, partly resulting in the uncorrelated relation between export demand and the industrial structure upgrade.

From Regression (2), the technological progress and labor supply are tightly associated with China's industrial structure upgrade, for technological progress and labor supply increase can promote industrial structure optimization, but there is no correlation between institutional arrangements and industrial structure upgrade. The paper uses the proportion of non-state owned investment in social investment to measure China's institutional arrangements, which fundamentally reflects the marketization level. Although China is constantly advancing market reforms, government investment or policy support still plays a very important role in industrial restructuring. In the New Normal, the government introduced a number of measures to remove zombie enterprises and excess capacity, which

was mainly by government investment, thus to some extent, the policy institutional arrangements like government investment promote the optimization of industrial structure, resulting in an uncorrelated relation between market-oriented institutional arrangement and China’s industrial structure upgrade.

Regression (3) excludes the irrelevant variables to China’s industrial structure upgrade on both demand and supply sides, and introduces the New Normal as a dummy variable to examine its influence on China’s industrial structure upgrade, but the results show that there is no significant correlation between the New Normal and China’s industrial structure upgrade. According to the traditional industrial structure optimization theory, with economic development, the industrial structure will continue to be optimized from “primary, secondary, tertiary” to “secondary, tertiary, primary” and ultimately to “tertiary, secondary, primary”. China’s economy has entered the New Normal, which does not mean a stagnation or retrogression of economic development, but the entrance to a new stage of growth slowdown, and fundamentally, China’s economy is still showing a sustained growth potential, so the industrial structure is also continuously optimizing.

5.2. Empirical analysis on regional level

Based on the empirical analysis on a national level, the paper chooses household consumption, domestic investment, technological advancement, labor supply and the New Normal, etc. as variables, adopted fixed effect model to make empirical analysis on determinants of industrial structure upgrade in the four major regions, with regression results shown in Table 7.

Table 7. Regression Results on Regional Level

Variable	Regression (5) Eastern Region	Regression (6) Northeast Region	Regression (7) Central Region	Regression (8) Western Region
<i>C</i>	8.115724*** (21.70039)	4.743302*** (6.990872)	6.919860*** (12.59756)	6.545584*** (8.726309)
<i>PGDP_{it}</i>	−0.012137*** (−3.765297)	0.007598 (1.409700)	−0.005867 (0.1286)	0.000796 (0.125488)
<i>DI_{it}</i>	2.79E-06** (2.050798)	1.59E-05*** (3.934257)	1.06E-05*** (0.0000)	1.75E-05*** (3.812596)
<i>TECH_{it}</i>	0.002995*** (3.564320)	0.004130*** (2.964598)	−0.001274 (0.3571)	−0.000356 (−0.304484)
<i>LAB_{it}</i>	−0.089182*** (−3.801725)	−0.081021*** (3.438193)	0.022724 (0.5305)	−0.079751* (−1.783405)
<i>NEW_{it}</i>	0.000668 (0.027565)	−0.008577 (−0.219079)	−0.000527 (0.9837)	−0.037633 (−0.819675)
<i>F</i> -Statistic Magnitude	290.3058	21.63878	55.73304	9.939259
<i>R</i> ²	0.974816	0.843986	0.901347	0.555988

Note: ***, **, * respectively refer to the significant test on 1%, 5%, and 10% level; the *t* in the bracket refers to statistic magnitude.

From Table 7, we can see that economic New Normal and industrial structure upgrade of the four regions are not significantly related, which is in line with the regression results on a national level. Since New Normal economy does not mean a recession, but the entrance of economic development into a low-speed stage, comparing with developed countries, the economy is still in a stage of rapid development, the industrial structure will still continue to be optimized, and only the speed of optimization has been slowed down. So, whether on a national or regional level, there is no significant correlation between the economic New Normal and industrial structure upgrade. Regression (5) shows a high consistency of industrial structure upgrade determinants in Eastern region and those on a national level, because the Eastern region is of "key importance" concerning China's economy, occupying the lion's share of national economy, supporting the country's rapid economic development, thus the regression results show the strong correlation between their industrial structure upgrades.

Regression (6)–(8) shows that the industrial structure upgrade in the Northeast, Central and Western regions has no strong correlation with per capita income levels, but shows strong correlation with domestic investment. Especially in the central region, among many other factors, only domestic investment has significant correlation with the level of industrial structure upgrade. During 2003–2014, the country has promulgated regional development strategies like Revitalizing the Old Industrial Bases in Northeast China, Rise of Central China, West Development, etc., increasing state investment to promote economic development of these regions. Therefore, economic development and optimization of industrial structure in the northeast, central and Western regions owe to government investment to a large extent. During 2003–2014, government budget in the Western region accounted for 13.54% of the total social investment, much higher than the other three regions, followed by the central region of 5.12%, the Northeast region of 4.45%, the Eastern region of 3.45% as the lowest. At the same time, these regions are based on traditional manufacturing industries which are subsidized by government investment to a great extent, so that these industries can take the initiative to promote production mode transformation, upgrade industrial structure, which is not closely related to resident consumption demand after income increase, leading to the uncorrelated relation between the residents' income level and the industrial structure upgrade in the regression results. It can be seen, the increase of industrial structure upgrade level in the northeast, central and Western regions is mostly promoted by government investment, lacking market-oriented factors like household consumption demand as driving force.

In the regression of the Western region, besides the significant correlation between domestic investment and the regional industrial structure upgrade, the labor supply also shows a weak correlation with the regional industrial structure upgrade. During 2003–2014, with the progress of West Development strategy, the rapid economic development of the Western provinces created a large number of jobs, resulting in significant employment increase in the Western region. Take Tibet for example, the unemployment rate in 2003 was 5%, and in 2014 it dropped to 2.47%, reducing by half. The rapid increase of labor supply is beneficial for industrial structure upgrade, thus the regression results of the Western region indicate the correlation between them. Compared with the Western region,

although the central region has also benefited from the policy of Rise of Central China Plan, its unemployment rate has always kept 3.5%–4%, with no significant fluctuation, so the regression results show no correlation between them.

5.3. Robust check

To check the robustness of the results, we re-estimate the model by using the alternative measure of New Normal. We use the provincial GDP instead of New Normal dummy to measure the effect of New Normal on industrial upgrading. As is shown by results in Table 8, variables including resident consumption, domestic investment, technology improvement, labor supply and New Normal have the identical effects on industrial structure upgrading with Tables 6 and 7, at national and provincial levels, which is a manifestation of robustness. And variable of New Normal is not significantly correlated with industrial upgrading. China has entered the New Normal era which is usually consistent with economic growth slowdown rather than recession, and consequently New Normal has not created exogenous shocks to industrial structure upgrade. New Normal is not significantly correlated with industrial structure upgrade. While development mode has shifted from demand-side management to supply-side reform, and innovation-driven has been the key development strategy, and hence variables including technology improvement are significantly correlated with industrial structure upgrade, which is verified by the result that technology improvement is significantly correlated with industrial structure upgrade at national, Eastern and Northeast level. But technology improvement is not significantly

Table 8. Robust Check

Variable	National	Eastern Region	Northeast Region	Central Region	Western Region
<i>C</i>	7.024855*** (20.24982)	7.698156*** (17.77719)	4.701845*** (7.665301)	6.927360*** (13.32297)	6.424001*** (8.797521)
<i>PGDP_{it}</i>	−0.013975** (−2.225534)	−0.018691*** (−3.777686)	−0.009500 (−0.158353)	−0.004278 (−0.465355)	0.010884 (0.523995)
<i>DI_{it}</i>	7.44E-06*** (5.901939)	3.34E-06*** (2.712704)	1.55E-05*** (4.743165)	1.06E-05*** (7.052828)	1.55E-05*** (3.926802)
<i>TECH_{it}</i>	0.001327** (2.095150)	0.003111*** (4.020900)	0.004201** (3.010256)	−0.001267 (−0.927253)	−0.000572 (−0.502617)
<i>LAB_{it}</i>	−0.039080** (−2.330685)	−0.089538*** (−4.088205)	0.082384** (3.361090)	0.023101 (−0.927253)	−0.065004 (−1.623592)
<i>NEW_{it}</i>	0.008976 (1.339895)	0.010136 (1.674540)	0.017349 (0.296540)	−0.001668 (−0.184509)	−0.009359 (−0.450416)
<i>F</i> -Statistic	87.50188	298.2566	21.67529	55.76712	9.873590
Magnitude					
<i>R</i> ²	0.901135	0.975471	0.844208	0.901402	0.554351

Note: ***, **, * respectively refer to the significant test on 1%, 5%, and 10% level; the *t* in the bracket refers to statistic magnitude.

correlated with industrial structure upgrade at middle and Western level, owing to the relatively low development level and factor-driven development mode which can't provide impetus for economic growth.

6. Conclusion and Policy Suggestions

The paper measured the industrial structure upgrade indexes at the level of the nation, regions and 31 provinces, by employing a empirical model which introduced the New Normal as a dummy variables and included demand-side and supply-side determinants. Following conclusions have been made: First, the industrial structure upgrade indexes show an upward trend at the national, regional or provincial level, indicating that China's industrial structure has been constantly optimizing; Second, in terms of regional and provincial level, the industrial structure upgrade level of the Eastern region is significantly higher than the Northeast, Central and Western regions, but the Western region boasts the fastest speed of industrial structure optimization; Third, the empirical results show that the impact of the New Normal on industrial structure upgrade is not significant mainly because fundamentally the economic is still growing despite the economic slowdown in the New Normal, so the industrial structure is still escalating and upgrading; Fourth, nationally, consumption demand, domestic investment, technological progress and labor supply have significant influence on industrial structure upgrade. But regionally, the Eastern region is consistent with the national level, while industrial structure upgrading of the Northeast, the Central and Western regions mostly rely on state policies like Revitalizing the Old Industrial Bases in Northeast China, Rise of Central China, West Development, etc., rather than utilization of technology, human capital and other core advantages.

This paper proposes the three following policy suggestions: First, promote the supply-side structural reform which includes institutional reform, financial system reform and fiscal system reform. Market should play a dominant role in driving technological advancement and industrial upgrading by making full use of market vitality. The government should accelerate the reform of financial system and fiscal system by improving the proactive supervision, process supervision and supervision afterwards for the publicly funded projects. On the one hand, provide direct financial supports for emerging industries in the form of government financial aid; on the other hand, reduce the fiscal pressure of emerging enterprises through tax regulation. Second, attach great importance to the key role of innovation-driven force in the industrial structure upgrade. The most obvious feature of the New Normal is the economic growth slowdown, for which the countermeasure is to promote the innovation-driven strategy and change the dynamic mechanism. More support is needed through innovation and technological improvement for industrial structure optimization. However, the research results show the influence of technological supply on industrial structure upgrade is not obvious, especially in the Western and central regions. So both the government and enterprises should increase investment in research and development, accommodate strategies of innovation-driven, "Internet+", "Made in China 2025" and thus cultivate new impetus and growth points for industrial structure optimization in the New Normal. Third, strategies like Revitalizing the Old Industrial Bases in

Northeast China, Rise of Central China, West development, should be vigorously promoted, but industries to be supported should be selected scientifically. Government investment, especially regional development strategies, is important to guide industrial structure optimization direction. However, full consideration should be given to the prospects of industrial development, when selecting supporting objects. On the one hand, enterprises should be encouraged to voluntarily undertake restructuring, transformation and upgrading by adopting supply-side structural reforms, removing excess capacity, removing zombie enterprises, in an effort to provide space and resources for emerging industry development. On the other hand, investments in aerospace, other advanced manufacturing and modern services including finance and health care should be expanded, and thus cultivating appropriate strategic emerging industries consistent with market demand and local advantages. Special funds and policies should be provided to support “Internet + creation” to improve the existing resource allocation and reconstruct the industrial pattern.

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