

Research on the Dynamic Effect of Factor Marketization Reform Based on Structural Evolution and Economic Growth

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Abstract: Rapid growth of China's economy strikes the attention of the world as of adopting the reform and opening-up policy. In this paper, in order to summarize the basic experience of China's economic development, an analysis framework comprising industrial structure change and economic growth was relied to explore the influence path of China's factor marketization reform on economic growth and industrial structure change; simultaneously, the panel data of China's 30 provinces and municipalities in 1998-2016 were adopted to conduct empirical test on the driving action of factor marketization reform.

Keywords: Factor marketization reform; Economic growth; Industrial structure change

1 Introduction

Factor marketization reform, by centering on production factor market, aims at fostering and establishing the price mechanism of factor market, making factor price reflect flexibly the supply and demand relations of factor market, and finally optimizing flow and allocation of production factors (see [1] and [2]). According to its essential idea, factor marketization reform leads resource allocation or reallocation, and then improves economic efficiency and promotes economic growth. Factor marketization reform is bound to bring the structural adjustment on the aspect of production factor flow under the price mechanism and drive the economic growth on the aspect of resource allocation efficiency improvement.

Here are two opposite viewpoints for the relationship between factor marketization reform and industrial structure: some scholars consider China's marketization reform drives China's industrial departments to grow bigger and constitutes the important force of driving economic growth, as well as effectively reduces the barrier of factor flow between industrial departments and boosts industrial structure adjustment [3]; other scholars consider the relative backward China's factor marketization reform results in the factor flow blockage between regions and departments, and finally result in the situation that industrial departments suffer with overcapacity and service department suffer with demand exceeds supply[4].

Based on the existing research, scholars have achieved the consensus for the one that factor marketization reform promotes economic growth; However there is still divergence in the impact of factor marketization reform on industrial structure change [5]. There are two shortcomings in the existing research: 1. In view of the definition and purpose of factor marketization reform, both of them should be incorporated into the same framework for study; 2. In the quantitative study of factor marketization reform, scholars generally use static model for analysis, and the empirical method is relatively simple, there is room for improvement.

2 Theoretical Mechanism for Impact of Factor Marketization Reform

In this work, we incorporated the institutional variable of factor marketization reform into the structure change analysis framework of existing research (see [6] and [7]), and thereby built a two-sector economy model to explain the action

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mechanism of factor marketization reform for structure change and economic growth.

2.1 Final Production Department

The final product is composed of two kinds of intermediate products Y_1 , Y_2 , and both of such two kinds of products are the constant elasticity of substitution (CES):

$$Y(t) = F(Y_1(t), Y_2(t)) = [\gamma Y_1(t)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)Y_2(t)^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \quad (1)$$

Where: $0 < \varepsilon, \gamma < 1$, γ and $(1-\gamma)$ are respectively the percentage of the intermediate product Y_1 and Y_2 to the composition of final product. Assuming the price of two intermediate products and final product is respectively P_1 , P_2 and P , The problem of the demand on final product can be described as:

$$\begin{aligned} \max_{Y_1(t), Y_2(t)} Y(t) &= [\gamma Y_1(t)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\gamma)Y_2(t)^{\frac{\varepsilon-1}{\varepsilon}}]^{\frac{\varepsilon}{\varepsilon-1}} \\ \text{s.t.} \quad P_1 Y_1 + P_2 Y_2 &\leq Y \end{aligned} \quad (2)$$

By solving it, the competitiveness equilibrium solution of final product market can be obtained:

$$Y_1(t) = \left[\frac{P_1(t)}{\gamma P(t)} \right]^{-\varepsilon} Y(t) \quad (3)$$

$$Y_2(t) = \left[\frac{P_2(t)}{(1-\gamma)P(t)} \right]^{-\varepsilon} Y(t) \quad (4)$$

2.2 Intermediate Production Department

Assuming the intermediate product is produced by the C-D technique and the production factor invested in the production is labor (L_i) and capital (K_i), the paper herein distinguishes the factor marketization reform into the labor factor marketization reform (M_1) and the capital marketization reform (M_2), the production function of intermediate product is:

$$Y_1(t) = A [M_1(t)L_1(t)]^{\alpha_1} [M_2(t)K_1(t)]^{1-\alpha_1} \quad (5)$$

$$Y_2(t) = A [M_1(t)L_2(t)]^{\alpha_2} [M_2(t)K_2(t)]^{1-\alpha_2} \quad (6)$$

In the production of intermediate product, the percentage of labor and capital is respectively α_i and $(1-\alpha_i)$. In the formula aforesaid, A is the technical level. Assuming the total amount of production factor in the economy is already given: $L_1(t) + L_2(t) = L(t)$; $K_1(t) + K_2(t) = K(t)$. The factor market equilibrium, in the circumstance that two production factors: labor force and capital, can flow free, should meet the following equation:

$$MPL_1 = MPL_2; MPK_1 = MPK_2 \quad (7)$$

2.3 Static Analysis

Under the constraint conditions of labor force and capital resource, the distribution of two factors between different departments can be obtained under the market equilibrium principle aforesaid:

$$\phi(t)^{\alpha_1} = B_1 M_1(t)^{\alpha_2-\alpha_1} M_2(t)^{\alpha_1-\alpha_2} [1-\phi(t)]^{\alpha_2} \quad (8)$$

$$\varphi(t)^{1-\alpha_1} = B_2 M_1(t)^{\alpha_2-\alpha_1} M_2(t)^{\alpha_1-\alpha_2} [1-\varphi(t)]^{1-\alpha_2} \quad (9)$$

In the formula aforesaid, $\phi(t)$ is the input quantity of labor force in the department 1 at the time of t , namely $\phi(t) = L_1(t)/L(t)$; $\varphi(t)$ is the input amount of capital in the department 1 at the time of t , namely $\varphi(t) = (K_1(t))/K(t)$. Where: B_1 and B_2 are the constants. In order to investigate the impact of factor marketization reform on structure change, we calculated the derivatives of $M_1(t)$ and $M_2(t)$ with $\phi(t)$ and $\varphi(t)$ respectively, so we obtained:

$$\frac{\partial \phi(t)}{\partial M_1(t)} = \frac{(\alpha_2 - \alpha_1) B_1(t) M_1(t)^{\alpha_2-\alpha_1-1} M_2(t)^{\alpha_1-\alpha_2} (1-\phi(t))^{\alpha_2}}{\alpha_1 \phi(t)^{\alpha_1-1} + \alpha_2 B_1(t) M_1(t)^{\alpha_2-\alpha_1} M_2(t)^{\alpha_1-\alpha_2} (1-\phi(t))^{\alpha_2-1}} \quad (10)$$

$$\frac{\partial \varphi(t)}{\partial M_2(t)} = \frac{(\alpha_1 - \alpha_2)B_2(t)M_1(t)^{\alpha_2 - \alpha_1}M_2(t)^{\alpha_1 - \alpha_2 - 1}(1 - \varphi(t))^{1 - \alpha_2}}{(1 - \alpha_1)\varphi(t)^{-\alpha_1 - 1} + (1 - \alpha_2)B_2(t)M_1(t)^{\alpha_2 - \alpha_1}M_2(t)^{\alpha_1 - \alpha_2}(1 - \varphi(t))^{1 - \alpha_2}} \quad (11)$$

According to the Formula (11), labor force flows toward the labor intensive industry sectors along with the labor factor marketization reform; whereas the capital factor flows out from the labor intensive industry and flows to the capital intensive industry sector as the capital marketization reform goes.

2.4 Dynamic Analysis

In order to further investigate the dynamic impact of factor marketization reform on industrial structure change and economic growth, we hypothesized the capital stock changed by following the rules herein below:

$$\frac{dK(t)}{dt} = sY(t) - \delta K(t) \quad (12)$$

In the Formula (12), s is the saving rate, δ is the depreciation rate; assuming the factor marketization reform goes at the fixed rate, so the technical progress rate is g , the population growth rate is n :

$$\frac{\dot{M}_1(t)}{M_1(t)} = m_1 \geq 0; \frac{\dot{M}_2(t)}{M_2(t)} = m_2 \geq 0; \frac{\dot{A}(t)}{A(t)} = g \geq 0; \frac{\dot{L}(t)}{L(t)} = n \geq 0 \quad (13)$$

In order to make steady-state analysis, we marked the effective per capita capital as $\widehat{k(t)}$ and defined it as $\widehat{k(t)} = \frac{K(t)}{M_1(t)L(t)}$.

Under the circumstance that the capital-output ratio is a constant, so the constant growth path (CGP) can be defined and thereby we can obtain the ones as follows on the CGP:

$$\frac{\dot{\phi}}{\phi} = \frac{\dot{\varphi}}{\varphi} = (1 - \varepsilon)(\alpha_2 - \alpha_1)m_2 \quad (14)$$

$$\frac{\dot{\widehat{y}}}{\widehat{y}} = g + \left[\frac{\alpha_1(1 - \varepsilon) + 2\varepsilon\alpha_2}{\alpha_1} \right] (\alpha_2 - \alpha_1)m_2 + (1 - \alpha_1)m_2 \quad (15)$$

According to the Formula (14) and (15), factor marketization reform may exert an influence on industrial structure and economic growth, especially the capital marketization reform may promote the flow of labor force and capital. In view of the economic growth rate, factor marketization reform and technical progress are the important impetus of economic growth.

3 Design of Empirical Research

According to the theoretical analysis as presented in Part 2, we can see the factor marketization reform plays the important promotion role for industrial structure change and economic growth. In order to verify the conclusion and evaluate the "reform dividend" released by factor marketization reform, we set the measuring equation as the one as follows:

$$\ln(pgdp_{it}) = \alpha_0 + \alpha_1 Market_t + \varphi Control_{mt} + \varepsilon_{it} \quad (16)$$

$$Structure_{it} = \beta_0 + \beta_1 Market_t + \lambda Control_{nt} + \mu_{it} \quad (17)$$

In the metering equation aforesaid, $\ln(pgdp_{it})$ is the logarithm of the per capita GDP of every province (municipality directly under the central government), signifying the economic growth of every region; $Structure_{it}$ is the industrial structure change index constructed by the included angle cosine method, used for measuring the industrial structure change level; $Market_t$ is the marketization progress index constructed by scholars such as Fan Gang and Zhu Hengpeng, serving as the proxy variable of factor marketization reform in the paper; Control is the control variable set, including labor input scale, capital input scale, total factor productivity level, human capital level, fiscal expenditure level, opening degree and regional urbanization level. The data used by the paper here are the panel data of 30 China's provinces (autonomous regions or municipalities) in 1998-2016, the required data here in were excerpted from China Compendium of Statistics 1949-2008 and China Statistical Yearbook.

Table 1: Benchmark regression result

Variables	(1)	(2)	(3)	(4)	(5)	(6)
Market	0.1319*** (17.6786)	0.0409*** (7.1773)	0.0431*** (8.9843)	0.0280*** (7.8264)	0.0092** (2.2827)	0.0123*** (2.9297)
Control variable	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effect	Yes	Yes		Yes	Yes	
Observations	570	570	570	570	570	570
R ²	0.367	0.751		0.102	0.214	

Note: *, **, *** shows respectively the significance on the significance level of 0.1, 0.05 and 0.01; The numerical value in the brackets is the corresponding t value.

According to the Table 1, it can be seen that factor marketization reform promoted economic growth significantly and was significant; when adding other control variables, the elastic coefficient of factor marketization reform for economic growth was declined, but the significance level did not change; when using panel datas stochastic effect approach to re-estimate, the function of factor marketization reform on economic growth was approximate to that of the Model (2). In view of the empirical results aforesaid, China’s factor marketization reform played important role in the promotion of economic growth. Besides, according to the regression results as shown in the Model (4) – (6) in Table 1, the factor marketization reform played the same promotion rule in the change of industrial structure, where the factor marketization reform in three models was all significant.

In order to conduct the robustness test, we replaced the explained variable and the core explanatory variable in the metering equation (16) and (17) to conduct the regression again, see Table 2 for the results. To be specific, we adopted the logarithmic value of the total GDP, namely $\ln(gdp_t)$ and industrial structure optimization index Advance as the explained variables, the government market relations (*Market**) in the marketization process indexes of Fan Gang and Zhu Hengpeng as the core explanatory variables.

Table 2: Robustness test

Variables	$\ln(gdp)$	$\ln(pgdp)$	Advance	Structure
Market	0.0682*** (6.9643)		0.0186*** (5.8969)	
Market*		0.0309*** (4.5884)		0.0192*** (3.9490)
Control variable	Yes	Yes	Yes	Yes
Observations	510	570	570	570
R ²	0.787	0.738	0.613	0.229

Note: *, **, *** shows respectively the significance on the significance level of 0.1, 0.05 and 0.01; The numerical value in the brackets is the corresponding t value.

According to Table 2, the factor marketization level did not exert positive influence on economic growth and industrial structure change after the explained variables and the core explanatory variables were replaced, and it was still significant. Such result signifies the regression result is basically robust.

The control variables had already been added in the empirical test aforesaid, but there are so many factors affecting economic growth and industrial structure change level and they are so difficult to control; these factors might result in the endogenous problem caused by missing variable. In order to relieve the endogenous problem, we also adopted the dynamic panel data regression (DPD) approach and the Differences-in-Differences approach (DID) to conduct the endogeneity test, where the dynamic panel regression equation is detailed as follows:

$$\ln(pgdp_{it}) = \alpha_0 + \alpha_1 \ln(pgdp_{i,t-1}) + \alpha_2 Market_t + \varphi Control_{mt} + \varepsilon_{it} \tag{18}$$

$$Structure_{it} = \beta_0 + \beta_1 Structure_{i,t-1} + \beta_2 Market_t + \lambda Control_{nt} + \mu_{it} \tag{19}$$

Simultaneously, we set the DID regression equation as:

$$\ln(pgd_{it}) = \alpha_0 + \alpha_1 Time_i \times Treat_i + \alpha_2 Market_t + \varphi Control_{mt} + \varepsilon_{it} \tag{20}$$

$$Structure_{it} = \beta_0 + \beta_1 Time_i \times Treat_i + \beta_2 Market_t + \lambda Control_{nt} + \mu_{it} \tag{21}$$

In the measuring model (20) and (21), *Time* is the time dummy variable, *Treat* is the regional dummy variable. Since 2003 when the Central Committee of the Communist Party of China promulgated the Decisions on Some Questions of Improving Socialist Market Economy System, China launched the market mechanism-based resource allocation mechanism and intensified the reform of household registration system to encourage factors to enter market for sufficient circulation. By 2007, 12 provinces of China substituted the household register for the agricultural and non-agricultural registered permanent residence and overturned the barriers of the dual household registration system (Such 12 provinces include Hebei Province, Liaoning Province, Jiangsu Province, Zhejiang Province, Fujian Province, Shandong Province, Hubei Province, Hunan Province, Guangxi Province, Chongqing City, Sichuan Province and Shaanxi Province). The policy has stronger exogeneity and generates the experiment group and the control group.

Table 3: Exogeneity test

Model	DPD	DPD	DID	DID
Variables	$\ln(gdp)$	<i>Structure</i>	$\ln(gdp)$	<i>Structure</i>
<i>Time</i> × <i>Treat</i>			0.1326*** (7.0460)	0.4578* (7.0460)
<i>L. ln(gdp)</i>	1.0732*** (534.1179)			
<i>L. Structure</i>		0.6882*** (34.0868)		
Market	0.0017*** (6.7330)	0.0060*** (8.3881)		
Time			0.2701*** (15.1059)	0.3430 (1.4379)
Treat			-0.3072*** (-9.8121)	0.3992* (1.7301)
Control variable	Yes	Yes	Yes	Yes
Observations	540	570	570	570

Note: *, **, *** shows respectively the significance on the significance level of 0.1, 0.05 and 0.01; The numerical value in the brackets is the corresponding t value.

In Table 3, Second and third columns reported the empirical result of dynamic panel approach; The fourth and fifth columns reported the regression result of DID (difference-in-difference). In view of the regression result of dynamic panel, economic growth and industrial structure change had stronger inertia, namely both of them were highly dependent on their performance in the last time; even so, factor marketization reform boosted positively economic growth and industrial structure change. In view of the result of DID (difference-in-difference), for the economic growth, the coefficient of *TimeTreat* was significantly positive, the net effect of reform of household registration system on economic growth was 0.1326. The reform of household registration system, namely the agricultural and non-agricultural registered permanent residence was replaced by the household register, enhanced the cross-region and cross-industry flow of labor force factor, and the release of liquidity promoted the industrial structure change significant. According to the last column in Table 3, the coefficient of *TimeTreat* was significantly positive, and the release of factor liquidity promotes the industrial structure change positively.

Through the empirical results, we can see that since the implementation of China’s reform and opening-up policy, factor marketization reform has played a significant role in promoting economic growth and the change of industrial structure, releasing a strong ”Institutional Dividend”, but in recent years, the power of factor marketization reform is declining, mainly because China’s economic environment and the world economic environment it faces are changing.

4 Conclusions

In this paper, a mathematical model containing industrial structure evolution and economic growth was established, and then a normative analysis was conducted to obtain the short-term and long-term effect of factors market-oriented reform on industrial structure evolution and economic growth; additionally, the panel data of 30 provinces and municipalities of China were used to check the conclusions generated from theoretical part in an empirical form. Through our study, we are inspired by:

Firstly, the factor's market-oriented reform is one of the important driving force of China for industrial structure evolution and economic growth. China has already adopted the reform and open-up policy for more than 40 years. During the period, China's industrial structure had gone through significant adjustment and China's economic growth had remained the double-digit growth for a long time; in addition to the contributions of Demographic Dividend, the market-oriented reform of China's product market and factor market released huge Structural Dividend effect.

Secondly, the size of Reform Dividend Effect varies with the change in the economic environment in which the conditional function of factor's market-oriented reform comes into play. A special attention should be paid to the non-linear effect of factors market-oriented reform. Chinese government, in view of the current situation that China's reform is in the Deep Water Zone, must make accurate judgment on its economic environment to achieve the reform breakthrough in the key field, and then release the potentials of production factor market.

Presently, China is staying in the period of assaulting fortified positions for its reform, and the reform in the production factor market is still lagging behind the product market reform to a large extent, so China's reform must focus on the land market, labor force market and capital market; moreover, the technology transaction market is one of the bottlenecks restraining China's economic growth. So the important measures of Chinese government for realizing stable economic growth during the economic transformation period are to tap the potentials of production factor market, boost and improve actively the factor market reform.

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