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The Influence of Factor Price Distortion on the Optimization of Foreign Trade Structure

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Abstract:

The state of the factor market is the objective context of corporate decision-making. Faced with a factor market where prices are distorted, the factor input decisions made by companies based on this will be biased. From the perspective of trade structure optimization, enterprise factor input decision-making under the constraint of factor price distortion is an important factor that shows the characteristics of stickiness, imbalance, and inefficiency in the optimization of foreign trade structure. Through the measurement of factor price distortion, this paper adopts the structural equation model to focus on the influence path of factor price distortion on the optimization of foreign trade structure. The research results show that factor price distortions have a significant impact on the structure of foreign trade, and under the action of a dynamic feedback mechanism, the two will form a relatively stable reverse convergence relationship in the long-term development process.

Keywords: *Factor distortion, Foreign trade structure, Structural equation model, Reverse convergence.*

I. INTRODUCTION

Judging from the current reality of the development of foreign trade transformation, there are

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

positive changes in all aspects, but there are still many problems, such as the continued deterioration of foreign trade conditions, the continued sluggishness of foreign trade competitiveness, and the slowdown in the export growth of high-tech products. How to realize the transformation and upgrading of the foreign trade industry, enhance the competitiveness of foreign trade, and maintain China's foreign trade's stimulating effect on economic growth is a very important practical issue under the conditions of the continuous downturn in the domestic and foreign economic environment.

Since Heckscher and Olin put forward the "HO" theory, scholars have been committed to investigating the generation and development of international trade from the perspective of factor endowments [1-3]. Mere returns to scale of factors can no longer support the development needs of the modern economy, and structural optimization and technological changes have become the source of competitive advantages in international trade. The improvement of endogenous efficiency and capability of enterprises is the key to the transformation and upgrading of foreign trade [4]. However, in reality, the subjective decision-making of foreign trade enterprises' factor allocation cannot be separated from the objective constraints of the factor supply market. In a market with incomplete information and competition, the strong link between factor endowments and factor prices is gradually weakened [5]. Companies are facing a distorted factor market, and the most intuitive reaction to this distortion is factor prices. The factor input decision made by enterprises based on this is biased. The decision of enterprise innovation input under the constraint of factor price distortion is an important factor that shows the characteristics of stickiness, imbalance and inefficiency in the transformation and upgrading of China's foreign trade.

There are many existing literatures on the impact of innovation input on the transformation and upgrading of foreign trade. However,there is little research on the influence of factor price distortions and innovation input under constraints on the transformation and upgrading of foreign trade. Based on the perspective of factor price distortion constraints, this paper constructs a structural equation model, uses path analysis to analyze the path of foreign trade transformation and upgrading, and explores the dynamic feedback relationship between factor price distortion and foreign trade transformation and upgrading. And it make targeted recommendationsfor the sustainable development of foreign trade transformation and upgrading.

II. FACTOR PRICE DISTORTION AND ITS CALCULATON

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

Chacholiades [6] defined factor distortion based on Bhagwati [7] as: the market price of factors deviates from its opportunity cost due to market imperfections. From the current research, scholars basically accept Chacholiades and Bhagwati's definition of factor price distortion, that is, the degree of deviation between the manufacturer's marginal product value and the marginal cost of factors is the factor price distortion [8].

Assuming that there are only two factors, labor and capital, construct a C-D production function:

$$Y = AL^{\alpha}K^{\beta} \tag{1}$$

C-D model after logarithmic expansion:

$$lnY = A + \alpha \cdot lnL + \beta \cdot lnK + u_i \tag{2}$$

Then the marginal output of the factor is:

$$MP_L = \alpha \cdot \frac{Y}{L}, MP_K = \beta \cdot \frac{Y}{K} \tag{3}$$

The factor price distortion degree can be expressed as:

$$\frac{P \cdot MP_L}{w} = \lambda \tag{4}$$

$$\frac{P \cdot MP_K}{r} = \eta \tag{5}$$

Where P is the product price, MPL and MPK are the marginal output of labor and capital, w and r are wages and interest rates. In the calculation process, we choose economically active population as the labor force variable. The capital input stock is calculated by Jun Zhang [9] (Where P is the product price, MPL and MPK are the marginal output of labor and capital, w and r are wages and interest rates. In the calculation process, we choose economically active population as the labor force variable. The capital input stock is calculated by Jun Zhang [9] ($K_t = K_{t-1} \times (1 - \delta) + I_t$, where K_{t-1} is the capital stock of the previous period, δ and It are the capital depreciation rate this year and the total investment in fixed assets of the whole society in the current period). The dependent variable Y is GDP. We extract relevant data from 1993 to 2018 and estimated α, β, and combing the price level, wages, interest rate and other data to finally calculate the degree of price distortion of labor and capital. The results are shown in Fig

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

1. The interest rate is calculated based on the changes in the one-year benchmark loan interest rate of the People's Bank of China from 1993 to 2018. The annual arithmetic average is taken if there is a change during the year. Other data are from the database of the National Bureau of Statistics of China. Due to space constraints, the calculation process of the regression of factor marginal output and factor price distortion is a little bit.

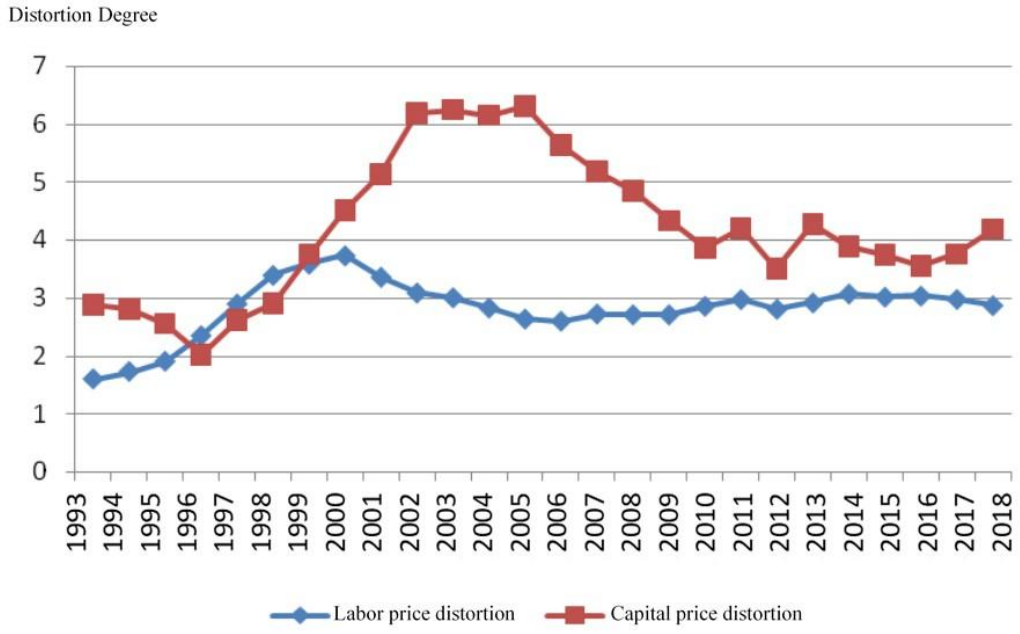

Fig 1: Distortion degree of labor and capital prices

The calculation results show that from 1993 to 2008, both labor and capital factors had positive price distortions, that is, the prices of labor factors and capital factors were underestimated. Before 2000, the degree of labor price distortion showed a gradual increase, then began to decrease, and began to stabilize around 2005, and has been maintained at around 2.8. The volatility of capital price distortion is greater than that of labor. From 1996 to about 2005, China's capital price distortions have been on the rise. It began to gradually decrease after 2005 and remained stable around 2010. From the data point of view, after taking the 1993 price level as the base period compound price factor, the degree of distortion of labor and capital both exceeded two times, and the highest year exceeded six times; the degree of distortion of labor factors exceeded 1.5 times, and the highest year exceeded 3.8 times. There are many reasons for this phenomenon. There are factors such as national macroeconomic strategies and policy

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

adjustments, as well as market incompleteness and other reasons. This article will not repeat them.

III. INTERRELATIONSHIPS AND ASSUMPTIONS

From the perspective of the revision direction of the enterprise's factor input decision, there are three possibilities: (1) Without changing the factor output efficiency, increasing input, expanding the scale of output, and obtaining scale benefits; (2) Without changing the factor output efficiency and the overall input scale, changing the relative input ratio between different factors to obtain structured benefits; (3) Without changing the overall input scale of elements, improving the output efficiency of some elements and obtain efficiency gains. The direction in which the enterprise factor input decision is revised depends on the degree and direction of factor price distortion. In the short term, due to the macroeconomic environment and total factor productivity cannot be significantly optimized. Therefore, in the short term, improving the output efficiency of factors without changing the scale of factor inputs is not the preferred solution for companies in the current harsh foreign trade environment. However, this program is the long-term first choice for most entrepreneurial enterprises. In the short term, enterprise factor decision-making is more a combination of the first two options.

From the perspective of the definition of factor price distortion and its causes, the imperfection, non-competitiveness, and information asymmetry of the economic system have caused the factor market to show many characteristics of the buyer's market, and factor prices are underestimated. The value of the marginal product of the firm is higher than the price of the factor. The factor decision for enterprises to maintain and obtain more profits will be to expand the factor input ratio and change the factor input structure. Because factor prices are distorted, expanding input is realizing the distorting income encroachment on factors. Enterprises will not have the motivation to increase investment in innovation and technological innovation, because although it is profitable in the long run, it is a risky decision in the short run, the so-called ‘factor distortion lock-in’.

From the perspective of trade scale, factor price distortions have a positive effect on exports [10]. However, it was only explored from the ‘quantity’ perspective of trade scale expansion, and did not involve ‘qualitative’ analysis such as trade competitiveness and optimization of foreign trade structure. Yifu Lin [11] pointed out that the relative distortion of the prices of capital, labor, resources and other factors will cause the imbalance of corporate investment and ultimately lead to domestic overcapacity. In the foreign trade market, due to the underestimation

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

of factor prices, the competitiveness of foreign trade commodities will decline [12], which will cause the prices of foreign trade commodities to fall, and thus the marginal product value of commodities. From the perspective of labor price distortions, in order to maintain the profit scale, it is the inevitable choice of foreign trade manufacturing enterprises to lower the marginal wage or increase the value of the marginal product.

In the academic circles, most of the discussions on the transformation and upgrading path of foreign trade have accepted the thinking about the investment in innovation. Xuejie Bai and Shuang Li [13] believe that factor price distortions and imperfect factor price mechanisms will adversely affect the optimization of technological progress and the improvement of independent innovation capabilities. Kuizao Dai [14] believes that factor innovation input has a positive impact on general import and export trade. On the one hand, innovation investment enhances the innovation capability of enterprises, on the other hand, it strengthens the absorption of foreign advanced technology. Innovation investment has played an important role in improving trade quality and improving trade structure.For foreign trade companies, innovation investment has a direct impact on the technical content of the company's products and the added value of the brand. From a macro perspective, it has a positive impact on the structure of foreign trade commodities [15]. We believe that factor price distortions have a negative impact on the structure of foreign trade and the transformation and development of foreign trade by suppressing innovation input.

Therefore, we propose hypotheses H1, H2, and H3.

H1: Factor price distortions hinder the transformation and upgrading of foreign trade through the deterioration of foreign trade commodity structure.

H2: The positive impact of innovation input on the transformation and upgrading of foreign trade is realized by optimizing the structure of foreign trade commodities.

H3: Factor price distortions hinder innovation input.

H4: Distortion of factor supply and innovation input together cause dynamic changes in foreign trade transformation and upgrading.

In addition, we believe that there is a stable convergence from the distortion of factor prices to the transformation and upgrading of foreign trade. Because the transformation and upgrading of foreign trade will affect factor price distortions, the positive effect of trade on economic growth is a consensus in the economics community. Li-yang Sun [16] believes that the overall

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

development of the foreign trade industry and the optimization of the foreign trade structure are necessary conditions for capital accumulation and technological progress in foreign industries, and the low-end foreign trade structure will lead to the dependence of enterprises on the price of factor inputs. Micro-enterprises under the constraints of low-end foreign trade structure continue to stay in simple processing for global enterprises, and their profitability and growth space are limited. In order to maintain a meager profit margin, enterprises have long been in a weak position in international competition and have formed ‘weak inertia’. When enterprises in the entire foreign trade field face a dilemma, the external economy of a country will be out of balance. The direct result is that they are sensitive to external market fluctuations, lack independence, and overcapacity appears in the domestic market. Reflecting in the factor market is that the factor supplier passively adapts to the macroeconomic environment and pushes down prices. Xiao-hua Chen, Hui Liu [17] believe that my country's macroeconomic imbalance is directly related to factor price distortions to a certain extent. Factor price distortion changes the enterprise's factor use decision from the macro-constraint level of factor allocation, which affects the structure of foreign trade commodities, hinders the transformation and upgrading of foreign trade, worsens the macroeconomic environment, and ultimately further strengthens factor price distortion.

Based on the above analysis, we propose the following hypotheses:

H5: The stickiness of the transformation and upgrading of foreign trade has strengthened the distortion of factor prices, which is achieved by deteriorating the macroeconomic environment.

H6: The viscosity of the optimization of the foreign trade commodity structure has strengthened the distortion of factor prices, which is achieved by deteriorating the macroeconomic environment.

H7: The stickiness of foreign trade transformation and upgrading hinders the optimization of foreign trade commodity structure.

H8: The interaction of factor supply distortion, foreign trade commodity structure, macroeconomic environment, innovation input, and foreign trade transformation and upgrading has formed a stable convergence system.

IV. EMPIRICAL TEST OF CONVERGENCE PATH

4.1 Model Setting

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

Assume that factor price distortions (V1), innovation inputs (V2), foreign trade commodity structure (V3), foreign trade transformation and upgrading (V4), and macroeconomic environment (V5) are five potential variables. According to assumptions, construct a structural equation model.

Model (1) is used to verify the hypothesis:

H1: Factor price distortions hinder the transformation and upgrading of foreign trade through the deterioration of foreign trade commodity structure; H2: The positive impact of innovation input on the transformation and upgrading of foreign trade is realized by optimizing the structure of foreign trade commodities; H3: Factor price distortions hinder innovation input; H4: The dynamic changes in the transformation and upgrading of foreign trade are the result of the combined effect of factor supply distortion and innovation input.

Model (2) is used to verify the hypothesis:

H5: The stickiness of the transformation and upgrading of foreign trade has strengthened the distortion of factor prices, which is achieved by deteriorating the macroeconomic environment; H6: The viscosity of the optimization of the foreign trade commodity structure has strengthened the distortion of factor prices, which is achieved by deteriorating the macroeconomic environment; H7: The stickiness of foreign trade transformation and upgrading hinders the optimization of foreign trade commodity structure; H8: The interplay among factor supply distortions, innovation input, macroeconomic environment, foreign trade commodity structure, and foreign trade transformation and upgrading forms a stable convergence system.

4.2 Variables and Data

According to the structural equation model, the variables involved in the empirical study are shown in TABLE I.In TABLE I, factor price distortions are obtained by calculation, and other data are obtained by querying the database of statistical institutions and after simple calculation processing.

TABLE I. Variables and their descriptions

Latent Variable	Observed Variable	Data Sources

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

Factor price distortion（V_1）	Labor price distortion（LPD） Capital price distortion（KPD）	Calculated
Innovation input（V_2）	R&D personnel investment（RDL） R&D capital investment（RDK）	National Bureau of Statistics Database
Foreign trade commodity structure (V_3)	Proportion of resource-intensive commodity exports (PRX) Proportion of labor-intensive commodity exports (PLX) Proportion of capital-intensive commodity exports (PKX) Proportion of exports of high-tech products (PHX)	World Bank World Development Database
Foreign trade transformation and upgrading (V_4)	Terms of trade index (TT) Technology Commodity TC Index (TTC)* Service Trade TC Index (TC)	World Bank World Development Database National Bureau of Statistics Database
Macroeconomic environment *（V_5）	GDP growth rate（RGDP） Industrial contribution rate（RIC） Proportion of loss-making companies（RLF）	National Bureau of Statistics Database

Note: Technical commodities are replaced by SITC 7 commodities; the data year is 1993-2018.

4.3 Empirical Analysis

4.3.1 Sample Reliability and Validity Test

This article uses statistical software SPSS19.0 to analyze the reliability and validity of observable variables. From the test results, the consistency of each measurement index is strong, and the structure validity is good (the relevant parameters are omitted).

4.3.2 Exploratory Factor Analysis

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

The statistical software SPSS19.0 is used to perform KMO sample measurement and Bartlett sphere test on the data. The results show that the KMO value is 0.775, which is greater than the critical value 0.7; the P value of the Bartlett sphere test is close to 0, indicating that there is a high correlation between model variables, which is suitable for factor analysis.

TABLE II. KMO and bartlett test

Kaiser-Meyer-Olkin measure of sampling adequacy		**.775**
Bartlett's sphericity test	Approximate chi-square	373.055
	df	55
	Sig.	.000

4.3.3 Significance Test of Path Coefficient and Load Coefficient

Use AMOS7.0 software to test the significance of the path coefficient between latent variables and the load coefficient between each latent variable and the observable variable. The results are shown in TABLE III. The C.R value of each variable is greater than the critical value of 1.96, indicating that the load coefficient between the latent variable and the observable variable is estimated to be significant.

TABLE III. Estimated result of path and load factor

Path	**Model (1)**		**Model (2)**	
	Standardized path coefficient	**C.R.**	**Standardized path coefficient**	**C.R.**
V_2<---V_1	-0.269	6.111		
V_3<---V_1	-0.537	2.903		

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

V_3<---V_2	0.374	6.771		
V_4<---V_3	0.734	2.511		
V_5<---V_4			0.662	3.354
V_5<---V_3			0.144	3.799
V_3<---V_4			0.691	3.003
V_1<---V_5			-0.551	3.145
$\frac{\chi^2}{df}$=1.323, GFI=0.931, RMSEA=0.026 NFI=0.926, TLI=0.933, CFI=0.989			$\frac{\chi^2}{df}$=1.657, GFI=0.917, RMSEA=0.037 NFI=0.901, TLI=0.919, CFI=0.967	

4.3.4 Model Fit Evaluation

This study selects $\frac{\chi^2}{df}$, GFI, RMSEA, NFI, TLI and CFI to evaluate the fit between the model and the data. In the two models, the six types of indicators have reached the recommended values, indicating that the overall fit between the measurement model and the data is good.

V. PATH ANALYSIS

The simulation results of structural equation models (1) and (2) are shown in Fig 2. From the perspective of the path coefficient, the direct path coefficient of factor price distortion (V1) to foreign trade commodity structure (V3) in model (1) is -0.537, that is, the impact of factor price distortion on the external commodity structure is negative and relatively significant. The direct path coefficient of innovation input (V2) to foreign trade commodity structure (V3) is 0.374, that is, the impact of innovation input on foreign trade commodity structure is positive and relatively significant. The direct path coefficient of foreign trade commodity structure(V3)to foreign trade transformation and upgrading (V4) is 0.734, that is, the impact of foreign trade commodity structure on foreign trade transformation and upgrading is positive and relatively significant. It can be seen from this that the obstacles to the transformation and upgrading of foreign trade caused by the distortion of factor prices are realized through the deterioration of the structure of foreign trade commodities. The indirect path coefficient is: -0.394 (-0.537×0.734). Suppose H1 is established. The positive impact of innovation input on the transformation and upgrading of

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

foreign trade is realized by optimizing the structure of foreign trade products, and its indirect path coefficient is 0.274 (0.374×0.734). Suppose H1 is established. Factor price distortions hinder innovation input, and its direct path coefficient is -0.269. Suppose H1 is established. The dynamic change of foreign trade transformation and upgrading is the result of the combined effect of factor supply distortion and innovation input. Its compound path coefficient is -0.468(-0.537+(-0.269×0.374)) ×0.734). Suppose H1 is established.

In model (2), the direct path coefficient of foreign trade transformation and upgrading (V4) on the macroeconomic environment (V5) is 0.662, that is, foreign trade transformation and upgrading have a positive impact on the macroeconomic environment. The direct path coefficient of the foreign trade commodity structure (V3) to the macroeconomic environment (V5) is 0.144, that is, the foreign trade commodity structure has a positive impact on the macroeconomic environment. The direct path coefficient of the macroeconomic environment (V5) to factor price distortions (V1) is -0.551, that is, the macroeconomic environment has a negative impact on factor price distortions.

According to the relevant path coefficient of model (1), it can be seen that the intensification of factor price distortion caused by the stickiness of foreign trade transformation and upgrading is achieved by deteriorating the macroeconomic environment. The indirect path coefficient is -0.365 (-0.551×0.662). Suppose H5 is established. The viscosity of the optimization of the foreign trade commodity structure strengthens the distortion of factor prices through deteriorating the macroeconomic environment, and its indirect path coefficient is: -0.079 (-0.551×0.144). Suppose H6 is established. The stickiness of foreign trade transformation and upgrading hinders the optimization of foreign trade commodity structure. The direct path coefficient is 0.691, and the suppose H7 is established.

Combining model (1) and model (2) to observe systematically, we can find that: the interaction of factor supply distortion, innovation input, macroeconomic environment, foreign trade commodity structure, and foreign trade transformation and upgrading has formed a stable convergence system. Suppose H8 is established.

Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

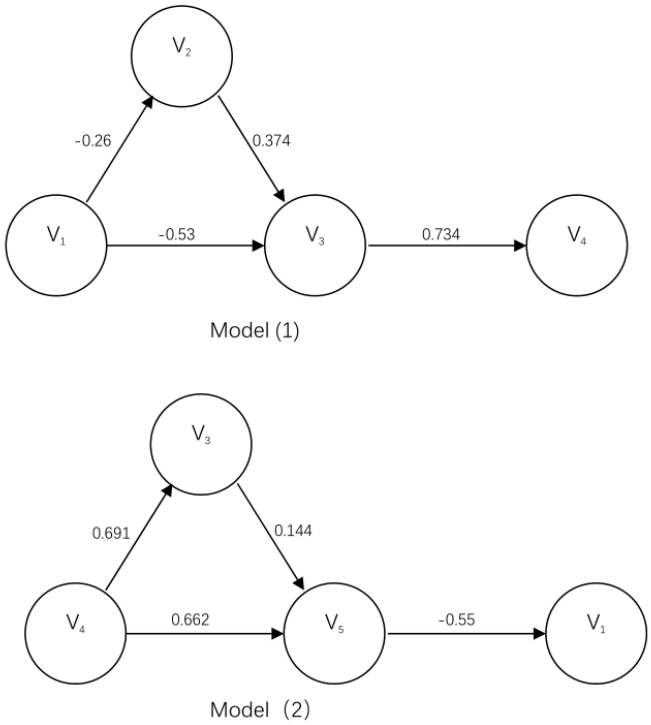

Fig 2: Structural equation model diagram

VI. RESEARCH CONCLUSIONS AND COUNTERMEASURES

Faced with a factor market where prices are distorted, the factor input decisions made by companies based on this will be biased. From the perspective of trade structure optimization, enterprise factor input decision-making under the constraint of factor price distortion is an important factor in the optimization of foreign trade structure showing the characteristics of stickiness, imbalance, and inefficiency. Based on the existing literature, this article has realized an effective measurement of factor price distortions, put forward several theoretical hypotheses around the interaction between factor price distortions and optimization of foreign trade structure, and conducted empirical tests through structural equation models. Research shows that: factor price distortions have a significant impact on the structure of foreign trade. This influence is not a one-way static relationship. Under the action of the dynamic feedback mechanism, the relationship between factor price distortion, innovation input, macroeconomic environment, foreign trade commodity structure, and foreign trade transformation and upgrading will form a

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

relatively stable reverse convergence relationship in the long-term development process.

Repairing factor price distortions is the key to breaking the reverse convergence relationship between factor price distortions and the optimization of foreign trade structure. First, the circulation of factors must be optimized and the supply of factors must be adjusted. Factor price distortion is closely related to factor supply. To repair the distortion of factor prices, solutions must be provided on the factor supply side. It is necessary to further bridge the geographical gap, reduce the spatial inequality of income distribution, reduce the spatial division of labor, and adjust labor supply from the side, thereby satisfying the labor demand for the transformation and upgrading of foreign trade. It is necessary to deepen financial reforms, balance the 'virtual and real' economic relations, strengthen the mutually beneficial and win-win development relationship between the real economy and finance, and in particular strengthen financial support for the foreign trade industry, instead of investing too much in the virtual economy and real estate.Second, establish a scientific innovation input mechanism on the basis of evaluation, avoid simple and extensive innovation input, emphasize unbalanced innovation input, and make the government's innovation guidance more reasonable in structure. Establish an effective management and supervision mechanism for the government's guided innovation investment to improve the efficiency of innovation investment. From an enterprise perspective, it is necessary to focus on innovative concepts, change the extensive management model, incorporate innovation into the enterprise's development strategy, and continuously strengthen the enterprise's own innovation awareness; Increase the investment of enterprises in independent innovation, establish a good and standardized enterprise management system, start with organizational structure, internal incentives, financial supervision and information disclosure, improve the management and supervision mechanism of enterprises, and build a good environment for enterprise innovation; Actively carry out cooperative research and development between schools and enterprises, reduce research and development costs, diversify risks, and realize the complementarity of technology and talents.

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Design Engineering

ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

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ISSN: 0011-9342

Issue: 11 | Pages: 468 - 483

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