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Research on the Foreign Trade Transformation and Upgrading of Convergence Path from the Perspective of Factor-Supply Distortion based on SEM

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Abstract

From the perspective of factor-supply distortion, combining innovation input in investigation into transformation and upgrading of foreign trade in China, network relation between factor-supply distortion, innovation input, macroeconomic environment, foreign trade structure and foreign trade transformation and upgrading were analyzed by constructing structural equation model. Studies have shown that: Factor-supply distortion exerts a negative impact on foreign trade transformation and upgrading by worsening foreign trade structure; innovation input exerts positive impact on foreign trade transformation and upgrading by optimizing foreign trade structure, but innovation input efficiency renders this impact insignificant; interaction between factory-supply distortion, innovation input, macroeconomic environment, foreign trade structure, foreign trade transformation and upgrading results in a stable convergence network system.

Keywords*: Factor-supply distortion; Innovation input; Transformation and upgrading of foreign trade; Structural equation model*

1. Introduction

Acceleration of transformation of foreign trade development mode has been raised to the height of national economic strategy security. Seen from the reality of current development of foreign trade transformation, despite some positive changes, qualitative change has not happened yet, and a series of problems still exist, including slowed export growth of high-tech products, continued deterioration of conditions for foreign trade, foreign trade competitiveness downturn, *etc*. How to achieve foreign trade transformation and upgrading under the domestic and international economic downturn, enhance foreign trade competitiveness and maintain economic growth promotion of China's foreign trade has become a very important practical problem.

Since Heckscher (1919) and Ohlin (1933) proposed "H-O" theory, scholars have been tirelessly exploring emergence and development law of international trade from the perspective of factor endowment (Samuelson P. A[1],1971； Jones R. W. A [2], 1971； Grossman, G., & Helpman, E. [3], 1991). Under the background of knowledge economy, causes and interest sources of world trade are gradually shifting from exogenously given endowment advantages to technical or human capital advantages acquired through creation (Grossman & Helpman, 1991, 1994) [4-5]. Enterprises' endogenous efficiency and capacity upgrade are the key to foreign trade transformation and upgrading, thus increased innovation input becomes an inevitable choice for restructuring and development of foreign trade enterprises (Teixeira and Fortuna[6],2010; Autant-Bernard[7],2011). However, in reality, foreign trade enterprises' subjective decision on

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factor allocation is always unable to get rid of objective constraints of macro element supply market. The non- competitive distortion of factor market makes factor price unable to accurately reflect relative abundance of factors (Lin Yifu, 2004). Passive distortion of factor supply affects enterprises' decisions on factor input, leading to macroeconomic instability and imbalance (Mao Yushi, 2008). Enterprises' decision on innovation input under factor supply distortion constraints is an important factor of viscous, unbalanced, non-effective features exhibited by China's foreign trade transformation and upgrading.

Currently, there is abundant research on impact of innovation input on foreign trade transformation and upgrading, but less research on impact of innovation input under factor supply distortion constraint on foreign trade transformation and upgrading. In this paper, from the perspective of factor supply distortion constraint, structural equation model was constructed, network path analysis method was adopted to analyze network of foreign trade transformation and upgrading, and interaction between factor supply distortion, innovation input, foreign trade structure, foreign trade transformation and upgrading was explored to put forward corresponding countermeasures and suggestions for sustainable development of foreign trade transformation and upgrading.

2. Correlation between Factor Supply Distortion, Innovation Input, Foreign Trade Transformation and Upgrading and Hypothesis

Chacholiades (1971) [8], on the basis of Bhagwati (1971) [9], defined factor distortion as: imperfection of the market leads to factor market price deviation from its opportunity cost, as a result, production factor resource can not achieve optimal allocation in the national economy, namely, non-optimal allocation of production factor resources. Factor-supply distortion is defined as dynamics change of spatial aggregation structure, factor value composition of factor endowments under stimulation of specific external condition, factor mobility disorder and market segmentation caused by non-economic endogenous factors such as natural conditions, government regulation, *etc*.

Studies found serious factor-supply distortion in China which results in the conversion of enterprises' cost advantage to export advantage, but hinders efficient allocation of resources (Shi Bingzhan[10], Xian Guoming[11] *et al*., 2012, 2013). Some scholars believe that improvement in resource endowment structure is a key factor in transformation and upgrading of foreign trade development mode (Yang Jijun, Fan Conglai, 2012) [12], and that an important factor to promote export of Chinese enterprises is not high productivity but factor endowment advantage (Liu Chongli, Huang Pingchuan, 2013) [13].Scholars have different views on whether factor- supply distortion optimizes export product structure of Chinese enterprises. Fu Dongping (2009) [14] considered that factor distortion leads to current loss of low-cost advantage of Chinese products and worsens China's export product structure. Geng Wei (2013) [15] regarded that factor distortion contributes to increased diversification of foreign trade commodities. But what is certain is that, when factor market is in non-competitive distortion, factor price can not accurately reflect relative abundance extent of factors, which affects enterprises' factor selection and leads to distortion in resource use structure (Lin Yifu, 2004). With greater expected return of shortage(including economic and non-economic), factor-supply distortion locks factors that should have flowed into foreign trade manufacturing enterprise in other areas of the economy, changes factor configuration of foreign trade manufacturing enterprises, and directly affects output structure, namely commodity structure, thereby affecting foreign trade transformation and upgrading.

In terms of labor supply distortion, since reform and opening up, with the promotion of urbanization, rural labor force originally attached to farmland is freed, and common pursuit of migrant workers is to achieve maximized revenue configuration by working away from hometown. The cheap labor force makes a great contribution to enhanced competitiveness of China's foreign trade, and also boosts rapid economic development in

southeastern coastal areas. However, due to limitations of household registration system and Chinese traditional concept, the main force of foreign trade production (migrant workers) has never been the main consumer group in coastal areas. Spatial separation of production and consumption leads to "homecoming tide" and "labor shortage". Faced with scarcity of skilled workers in labor market, massive homecoming tide of ordinary workers and college students' discrimination against foreign trade processing, labor input costs of foreign trade enterprises is increasing. Under constant product price, value of marginal product is bound to be less than marginal wage, *i.e.* .To cut marginal wage or raise value of marginal product is the inevitable choice for foreign trade manufacturing enterprises. In the current international competition environment, it is almost impossible to unilaterally raise product price without changing added value of product technology. Meanwhile, "homecoming tide" results in a lack of skilled workers engaged in foreign trade processing and the market flooded with "green hand", so unilateral increase in marginal output is unrealistic. Therefore, marginal wage cut will be the only choice for foreign trade manufacturing enterprises (which is also the easiest to implement in buyer factor market). Low wage is certainly accompanied by "low output", but the "low output" doesn't mean quantity but quality. As it is difficult for foreign trade manufacturing enterprises to improve technical content, quality, competitiveness of products, pursuit of brand value falls to nothing, thus leading to insignificant foreign trade transformation and upgrading.

Seen from the perspective of capital supply distortion, China's capital supply distortion is mainly reflected in aspects of policy discrimination against corporate body, lack of capital market supervision, lack of inter-regional financing channel, which can be summed up as imperfection in capital market development. Due to such imperfect capital market, capital return rate of virtual capital market is often higher than that of industrial capital market, thus leading to huge speculative demand (such as real estate, stocks, *etc*.). With the continued deterioration of the international economic environment and continued appreciation of yuan, the overall industry characteristics of low added value and low rates of return exacerbates deviation of capital from foreign trade industry, and increases cost for enterprises to have access to capital, that is . In order to maintain a balanced input and output, foreign trade manufacturing enterprises passively reduce capital demand price, as a result of which, financing condition of foreign trade manufacturing enterprises has no competitive advantage, and financing difficulty becomes inevitable for foreign trade manufacturing enterprises. In a market economy, lack of capital is tantamount to "making bricks without straw". Due to it, high-tech talents can not be recruited, high-tech equipment can not be afforded, huge marketing investment can not be made, innovation input is inadequate, technical content, quality and competitiveness of products can not be improved, pursuit of brand value falls to nothing, foreign trade manufacturing enterprises are thus fixed in the low end of international industrial chain.

In turn, foreign trade transformation and upgrading will also impact factor-supply distortion. The positive role of trade in promoting economic growth is a consensus among economists. Effect of foreign trade transformation and upgrading on factor-supply distortion is achieved through changes in the macroeconomic environment. Yuan Qigang (2010) [16] analyzed changes in China's trade structure, verified mechanism and pathway for changes in foreign trade structure for capital accumulation and technological progress from both theoretical and empirical aspects, concluding that low-end foreign trade structure will lead to foreign trade enterprises' dependence on labor and resource elements in production process. Low-end production and operation mode worsens corporate profitability and growth potential, making companies rely more on cost control and use more inexpensive elements. Seen from the perspective of the whole society, macroeconomic environment dragged down by foreign trade exacerbates uneven

distribution of factor income, thereby amplifying liquidity barrier of factor-supply and structural contradictions of market segmentation, *etc*.

In addition, in exploration of path of China's foreign trade transformation and upgrading, the academic community mostly gives consideration to innovation input. Scholars believe that innovation input exerts positive impact on import and export of general trade, not only enhances innovation capacity of enterprises, but also strengthens absorption of foreign advanced technology, which plays an important role in improving China's trade quality and trade structure (Cui Minqiang, 2012) [17]. For foreign trade enterprises, innovation input directly changes technical content and brand added value of their products, which exerts positive impact on foreign trade structure from a macro point of view.

In summary, factor-supply distortion changes corporate decision-making on element use from macro-level constraints on factor allocation, thereby affecting foreign trade structure and ultimately hindering development of foreign trade transformation and upgrading; innovation input changes value and structure of corporate element use from the perspective of value, thereby optimizing foreign trade structure and ultimately exerting a positive impact on foreign trade development of a country. Dynamic changes in foreign trade structure and foreign trade transformation and upgrading are combined results of factor- supply distortion and innovation input.

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

H1: Factor-supply distortion hinders foreign trade transformation and upgrading by worsening foreign trade structure.

H2: Viscous foreign trade transformation and upgrading strengthens factor-supply distortion by worsening macroeconomic environment.

H3: Innovation input exerts positive impact on foreign trade transformation and upgrading by optimizing foreign trade structure.

H4: Dynamic changes in foreign trade transformation and upgrading are combined results of factor- supply distortion and innovation input.

H5: There are significant mutual effect between factor-supply distortion and innovation input.

H6: Interaction between factor-supply distortion, innovation input, macroeconomic environment, foreign trade structure, foreign trade transformation and upgrading forms a stable convergence system.

3. Demonstration of Path of Foreign Trade Transformation and Upgrading Based on Factor- Supply Distortion

3.1. Model Specification

Structural equation model is most commonly used to analyze mutual relation between unobservable variables. General measurement equation and structural equation can be expressed as:

Measurement equation:

$$X = \Lambda_x \xi + \delta, \ Y = \Lambda_y \eta + \varepsilon \tag{1}$$

Structural equation:

$$\eta = \lambda \xi + \gamma \eta + \tau \tag{2}$$

Wherein, X is exogenous observable variable, Y is endogenous observable variable, δ and ε are respectively measurement error of X, Y, ξ and η are respectively exogenous latent variable and endogenous latent variable; Λ_x, Λ_y means relationship between X, Y and latent variables ξ, η; λ represents influence structure coefficient matrix of exogenous

latent variable ξ for endogenous latent variable η; γ shows the relationship between endogenous latent variables, ζ is a residual term.

Suppose factor-supply distortion (S1), innovation input (S2), foreign trade structure (S3), foreign trade transformation and upgrading (S4), macroeconomic environment (S5) are five latent variables (see Table 1 for observed variables and their descriptions). According to the hypothesis, the five structural equation models in this paper are as follows:

Model 1:
$$S_4 = \Lambda_{41}TT + \Lambda_{42}TTC + \Lambda_{43}TC + \varepsilon_4$$
$$S_3 = \Lambda_{31}RSX + \Lambda_{32}RLX + \Lambda_{33}RKX + \Lambda_{34}RHX + \varepsilon_3$$
$$S_1 = \lambda_4 S_4 + \lambda_3 S_3 + \gamma_1 LSD + \gamma_2 KSD + \tau_1$$

Model 2:
$$S_1 = \Lambda_{11}LSD + \Lambda_{12}KSD + \varepsilon_1$$
$$S_5 = \Lambda_{51}RGDP + \Lambda_{52}RIC + \Lambda_{52}RLF + \varepsilon_5$$
$$S_4 = \lambda_1 S_1 + \lambda_5 S_5 + \gamma_1 TT + \gamma_2 TTC + \gamma_3 TC + \tau_2$$

Model 3:
$$S_4 = \Lambda_{41}TT + \Lambda_{42}TTC + \Lambda_{43}TC + \varepsilon_4$$
$$S_2 = \Lambda_{21}RDL + \Lambda_{22}RDK + \varepsilon_2$$
$$S_1 = \lambda_4 S_4 + \lambda_2 S_2 + \gamma_1 LSD + \gamma_2 KSD + \tau_3$$

Model 4:
$$S_4 = \Lambda_{41}TT + \Lambda_{42}TTC + \Lambda_{43}TC + \varepsilon_4$$
$$S_3 = \Lambda_{31}RSX + \Lambda_{32}RLX + \Lambda_{33}RKX + \Lambda_{34}RHX + \varepsilon_3$$
$$S_2 = \Lambda_{21}RDL + \Lambda_{22}RDK + \varepsilon_2$$
$$S_1 = \lambda_4 S_4 + \lambda_3 S_3 + \lambda_2 S_2 + \gamma_1 LSD + \gamma_2 KSD + \tau_4$$

Model 5:
$$S_4 = \Lambda_{41}TT + \Lambda_{42}TTC + \Lambda_{43}TC + \varepsilon_4$$
$$S_3 = \Lambda_{31}RSX + \Lambda_{32}RLX + \Lambda_{33}RKX + \Lambda_{34}RHX + \varepsilon_3$$
$$S_1 = \Lambda_{11}LSD + \Lambda_{12}KSD + \varepsilon_1$$
$$S_2 = \lambda_4 S_4 + \lambda_3 S_3 + \lambda_1 S_1 + \gamma_1 RDL + \gamma_2 RDK + \tau_5$$

Model (1) is used to verify hypothesis (1): factor-supply distortion hinders foreign trade transformation and upgrading by worsening foreign trade structure; model (2) is used to verify hypothesis (2): viscous foreign trade transformation and upgrading strengthens factor-supply distortion by worsening macroeconomic environment; model (3) is used to verify hypothesis (3): innovation input exerts positive impact on foreign trade transformation and upgrading by optimizing foreign trade structure; model (4), (5) are an integration of model (1) and model (2), which are used to verify hypotheses (4), (5), (6), that is, factor-supply distortion and innovation input synergistically affect path of foreign trade transformation and upgrading.

3.2. Variable and Data

According to setting of structural equation model as well as the foregoing mechanism analysis, empirical study variables and their descriptions are shown in Table 1. In Table 1, except factor-supply distortion, other data can be accessed through query of statistics agency database and simple calculation processing.

Table 1. Variable and its Description

Latent variable	Observed Variable	Data source
Factor-supply Distortion (S1)	Labor supply distortion (LSD) Capital supply distortion (KSD)	China Population and Employment Statistics Yearbook Database of National Bureau of Statistics
Innovation input (S2)	R & D staff input (RDL) R & D capital investment (RDK)	Database of National Bureau of Statistics
Foreign Trade Structure (S3)	Proportion of resource-intensive merchandise in export (RSX) Proportion of labor-intensive merchandise in export (RLX) Proportion of capital-intensive merchandise in export (RKX) Proportion of high-tech products in export (RHX)	World Development Database of World Bank
Transformation and upgrading of foreign trade (S4)	Terms of trade index (TT) Technology Commodity TC Index (TTC) * Trade in Service TC index (TC)	World Development Database of World Bank Database of National Bureau of Statistics
Macroeconomic environment * (S5)	GDP growth rate (RGDP) Industrial Contribution rate (RIC) Proportion of unprofitable firms(RLF)	Database of National Bureau of Statistics

Note: Technical commodities are replaced by SITC 7 commodities.

The two observed variables of factor-supply distortion can only be obtained through a series of complex calculations.

Factor-supply distortion is mainly characterized by factor liquidity barrier and market segmentation, which can be understood as deviation of factor market supply from price mechanism, that is, difference in factor supply elasticity. Suppose factor supply is a function of factor price:

$$S_i(L_i, K_i) = f(w_i, r_i)$$

When constraint of total factor supply is not considered:

$$\frac{\partial S_i(L_i, K_i)}{\partial w_i} > 0 \text{ , and } \lim_{w \to +\infty} \frac{\partial S_i(L_i, K_i)}{\partial w_i} = +\infty ;$$

$$\frac{\partial S_i(L_i, K_i)}{\partial r_i} > 0 \text{ , and } \lim_{r \to +\infty} \frac{\partial S_i(L_i, K_i)}{\partial r_i} = +\infty$$

But in reality, inconformity of factor supply elasticity in different space and industrial structures is an often case, namely:

$$\frac{\Delta S_i(L_i, K_i) \Big/ S_i(L_i, K_i)}{\Delta w_i \Big/ w_i} < 1 < \frac{\Delta S_j(L_j, K_j) \Big/ S_j(L_j, K_j)}{\Delta w_j \Big/ w_j} \tag{3}$$

$$\frac{\Delta S_i(L_i, K_i) \Big/ S_i(L_i, K_i)}{\Delta r_i \Big/ r_i} < 1 < \frac{\Delta S_j(L_j, K_j) \Big/ S_j(L_j, K_j)}{\Delta r_j \Big/ r_j} \tag{4}$$

The inconformity of factor supply elasticity is factor-supply distortion, and degree of such distortion can be reflected by sequence standard deviation of factor supply elasticity:

$$\varepsilon_L = \phi(S_L) = \sqrt{\frac{\sum (s_{Li} - \bar{s}_{Li})^2}{n}} \quad (5)$$

$$\varepsilon_K = \phi(S_K) = \sqrt{\frac{\sum (s_{Ki} - \bar{s}_{Ki})^2}{n}} \quad (6)$$

Wherein, S_L is labor supply elasticity, S_K is capital supply elasticity.

Calculation of labor supply distortion in formula (5) involves two variables, namely labor supply amount and labor price in various provinces of China. Given China's massive labor migration, number of migrants is deemed as amount of migrant labor supply in the calculation. As there is no first-hand data of quantity statistics of migrant workers, we take difference of amount of resident population and regional registered population at the end of the year as amount of regional floating population. In the calculation process, we collected registered population data and resident population data from 1991 to 2014. As for labor price, we chose wages of the provinces over the years instead. The calculation results are shown in Figure 1.

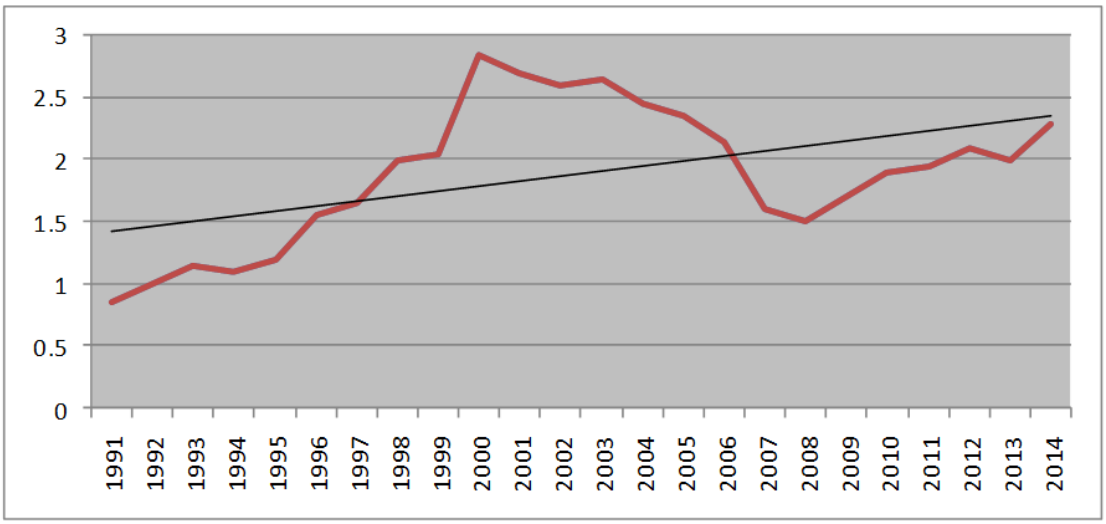

Figure 1. Trend of Chinese Labor Supply Distortion over 1991-2014

Calculation of capital supply distortion in formula (6) involves two variables, namely capital and capital price(interest rate). Because there are different input prices between real economy and virtual economy, we classify capital user into two categories, namely real economy (non-financial institutions) and virtual economy (financial institutions). First, calculate annual change in fixed assets investment based on total amount of investment in fixed assets, calculate annual change in credit capital source based on credit capital source of financial institutions; second, calculate funds price that represents real economy based on annual changes in loan rate of financial institutions, calculate funds price that represents virtual money based on annual changes in deposit rate of financial institutions; and finally, based on calculated annual changes in deposit and loan interest rate and credit capital source of fixed asset investment and financial institutions, calculate capital supply elasticity, and thus capital supply distortion. The results are shown in Figure 2.

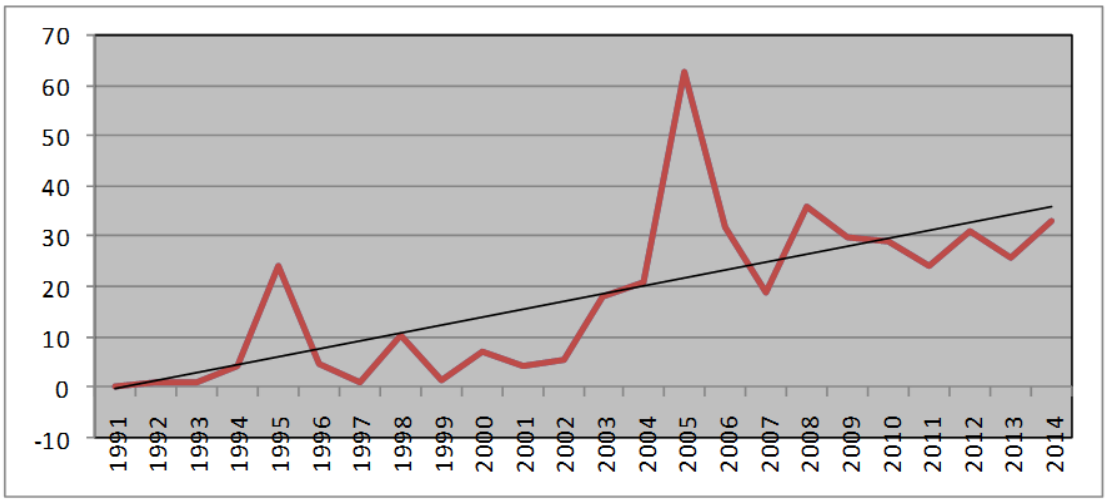

Figure 2. Trend of Chinese Capital Supply Distortion over 1991-2014

3.3. Empirical Analysis

(1) Sample Reliability and Validity Test

In this paper, statistical software SPSS19.0 was used for reliability and validity analysis of observable variables. Cronbach'sa value of latent variables are between 0.711-0.849, overall Cronbach'sa value is 0.811, indicating strong consistency of measurement indexes. For observation index of latent variables, principal component factor and varimax orthogonal rotation method was adopted for validity analysis. Standard factor load factor of observable variable is about 0.7. Only variable load of "technology commodity TC index" is less than the critical value of 0.5, demonstrating good construct validity of latent variables.

(2) Exploratory Factor Analysis

Statistical software SPSS19.0 was used for KMO sample measurement and Bartlett test of sphericity of data. The results showed that: KMO value is 0.775, larger than the critical value of 0.7; P value of Bartlett test of sphericity is close to 0, indicating presence of high relevance between model variables, so factor analysis is suitable.

Table 2. KMO and Bartlett test

Take sample of adequate Kaiser-Meyer-Olkin for measurement		.775
Bartlett test of sphericity	Approximate chi-square	373.055
	df	55
	Sig.	.000

(3) Significant test of path coefficient and load factor

Software AMOS7.0 was used for significant test of path coefficients of latent variable and load factor between latent variable and observable variable. The results are shown in Table 3: Except S1 → S2 path coefficient in model (2) and S1 → S2, S2 → S3 path coefficient CR value in model (4), CR values of the remaining variables are greater than the critical value of 1.96, indicating high estimated significance of load factor between latent variables and observable variables.

Table 3. Result of Path, Load Factor Estimate

			Model(1)		Model(2)		Model(3)		Model(4)		Model(5)	
			Path/Load factor	C.R.	Path/Load factor	C.R.	Path/Load factor	C.R.	Path/Load factor	C.R.	Path/Load factor	C.R.
S_2	←	S_1							-0.611	2.156		
S_3	←	S_1	-0.537	2.903					-0.648	2.707	-0.633	2.979
S_4	←	S_1	-0.114	1.957								
S_1	←	S_2									0.411	2.357
S_3	←	S_2					0.144	3.799	0.033	2.643	0.101	3.589
S_4	←	S_2					0.103	3.951				
S_4	←	S_3	0.734	2.511			0.691	3.003	0.683	2.711	0.701	2.637
S_5	←	S_4			0.738	4.395						
S_1	←	S_4			-0.163	2.475						
S_1	←	S_5			-0.551	3.145						
LSD	←	S_1	0.781	3.451	0.621	5.195			0.594	4.119	0.639	3.251
KSD	←	S_1	0.374	6.771	0.337	3.113			0.344	6.771	0.353	5.552
RDL	←	S_2					0.791	3.777	0.822	3.851	0.712	3.551
RDK	←	S_2					0.737	3.017	0.771	2.115	0.668	3.017
RSX	←	S_3	-0.269	6.111			-0.385	6.569	-0.374	7.109	-0.357	7.406
RKX	←	S_3	0.904	8.149			0.761	7.341	0.813	5.808	0.745	5.717
RLX	←	S_3	0.273	4.914			0.244	7.339	0.803	8.434	0.844	6.047
RHX	←	S_3	0.662	3.354			0.593	4.326	0.781	3.872	0.801	4.125
TT	←	S_4	-0.343	5.487	-0.398	4.222	-0.351	3.937	-0.357	4.443	-0.303	3.992
TTC	←	S_4	0.334	4.38	0.724	3.789	0.413	4.157	0.476	4.157	0.455	3.939
STC	←	S_4	-0.361	2.994	-0.451	3.661	-0.376	3.097	-0.414	2.116	-0.477	2.203
RGDP	←	S_5			0.351	2.285						
RIC	←	S_5			0.614	2.089						
RLF	←	S_5			0.462	2.963						

(4) Model fitting evaluation

In this paper, six indicators of χ^2/df (relative chi-square), GFI (goodness of fit index), RMSEA(root mean square of approximation error), NFI (specification fit index), TLI (Tucker-Lewis coefficient) and CFI (comparative fit index) were selected to assess fit goodness of model and data. In the five models, the six indicators failed to meet the requirements of recommended value, indicating overall good fitting of measurement model and data(see Table 4).

Table 4. Fit Index

Index Name		Evaluation criteria	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Absolute fit index	χ^2/df	Smaller than 2	1.323	0.623	0.945	1.657	1.512
	GFI	Greater than 0.9	0.931	0.964	0.945	0.917	0.922
	RMSEA	Smaller than 0.05, the smaller the better	0.026	0.011	0.021	0.037	0.019
Relative fit index	NFI	Greater than 0.9, the closer to 1the better	0.926	0.987	0.948	0.901	0.927
	TLI	Greater than 0.9, the closer to 1the better	0.933	0.949	0.955	0.919	0.933
	CFI	Greater than 0.9, the closer to 1the better	0.989	0.998	0.971	0.967	0.951

Note: The table provides the optimal standard of the fit index. Take RMSEA for example, its value smaller than 0.05 indicates that the model fits well, value in between 0.05-0.08 indicates acceptable model fit (Browne & Cudeck, 1993) . Therefore, in the actual study, analysis may depend on specific circumstances.

4. Path Analysis

Seen from path coefficient, direct network path coefficient of factor-supply distortion for foreign trade transformation and upgrading in model (1) is -0.114, relatively insignificant, while indirect network path coefficients of factor-supply distortion for foreign trade transformation and upgrading in model (1), (4), (5) are respectively-0.394 (-0.537 × 0.734), - 0.443 (-0.648 × 0.683), - 0.444 (-0.633 × 0.701), relatively significant. Thus, factor-supply distortion hinders foreign trade transformation and upgrading by worsening foreign trade structure, and hypothesis H1 is valid.

Direct network path coefficient of foreign trade transformation and upgrading for factor- supply distortion in model (2) is -0.163. The impact is not obvious, while indirect network path influence coefficient of foreign trade transformation and upgrading, macroeconomic environment and factor-supply distortion is -0.407, significantly greater than the direct influence coefficient. This suggests that better foreign trade transformation and upgrading improves macroeconomic environment, so that factor-supply distortion is repaired to some extent, while viscous foreign trade transformation and upgrading strengthens factor-supply distortion by worsening macroeconomic environment. Thus, hypothesis H2 that foreign trade transformation and upgrading exerts negative impact on factor- supply distortion through mediation of macroeconomic environment is valid.

Direct network path coefficient of innovation input for foreign trade transformation and upgrading in model (3) is 0.103, relatively insignificant, while indirect network path coefficient of innovation input for commodity structure and foreign trade transformation and upgrading is 0.099, also insignificant. Therefore, hypothesis that foreign trade transformation and upgrading exerts positive impact by optimizing foreign trade structure cannot be verified. The possible reasons of such situation are: despite China's current rapid growth of innovation input, structure and efficiency of innovation input have not been effectively released; enterprises and departments badly in need of innovation resource are not taken seriously, innovation input appears to be inefficient.

In terms of foreign trade, what is reflected is weakened innovation, technological content and brand effect of foreign trade commodity, and thus there is no positive impact on foreign trade transformation and upgrading.

Model (4), (5) is an integration of model (1), (3), which involves factor- supply distortion and innovation input in impact on foreign trade structure and foreign trade transformation and upgrading. Seen from network path coefficient of the model, foreign trade structure subjects to combined influence of factor-supply distortion and innovation input. Wherein, direct influence of factor-supply distortion is respectively 0.648 and 0.633, direct influence of innovation input on foreign trade structure is respectively 0.033 and 0.101 (further proving improvement of hypothesis H3). Direct influence of foreign trade structure on foreign trade transformation and upgrading is respectively 0.683 and 0.701. Thus, despite efficiency problem of innovation input which makes its impact on foreign trade structure lower, its impact is still positive. Hypothesis H4 that dynamic changes in foreign trade transformation and upgrading are combined results of factor-supply distortion and innovation input is valid.

Model (4), (5) not only verify hypothesis H4, but also hypothesis H5. In model (4), network path coefficient of factor-supply distortion for innovation input is -0.611, suggesting that factor-supply distortion hinders innovation resource input. It also confirms from the side macro constraint of factor supply on innovation input, and all decision-making on innovation input is bound to subject to reality of macro factor supply. Difference between model (5) and model (4) is only in direction of the arrow between factor-supply distortion and innovation input. Model (5) is set to verify whether innovation input exerts the same positive effect on factor-supply distortion. Seen from network path coefficient, influence coefficient of innovation input for factor-supply distortion is 0.411, suggesting that factor innovation input strengthens factor-supply

distortion. The reason is that factor innovation is enterprises' positive improvement to change the current status of low-end development, which requires enterprises to give up their previous development model and use factors of high use value, makes enterprises give up some of the original factor input plan, increases spatial and temporal fluctuations in factor supply elasticity and worsens liquidity barrier and market segmentation of factors. Hence, hypothesis H5 is valid.

Putting model (1), (3), (4), (5) together, a systemic view reveals that: factor-supply distortion exerts a negative impact on foreign trade transformation and upgrading by worsening foreign trade structure; although innovation input exerts positive impact on foreign trade transformation and upgrading by optimizing foreign trade structure, efficiency of innovation input renders this impact insignificant; meanwhile, factor-supply distortion will hinder innovation input and the latter will further strengthen the former. Thus, combined effect of factor-supply distortion and innovation input on foreign trade transformation and upgrading is negative, viscous reality of foreign trade transformation and upgrading is stable. Model (2)'s verification of hypothesis H2 demonstrates that foreign trade transformation and upgrading will strengthen factor-supply distortion by worsening economic environment. Thus, interaction between factor-supply distortion, innovation input, macroeconomic environment, foreign trade structure, foreign trade transformation and upgrading forms a stable convergence system. Hypothesis H6 is valid.

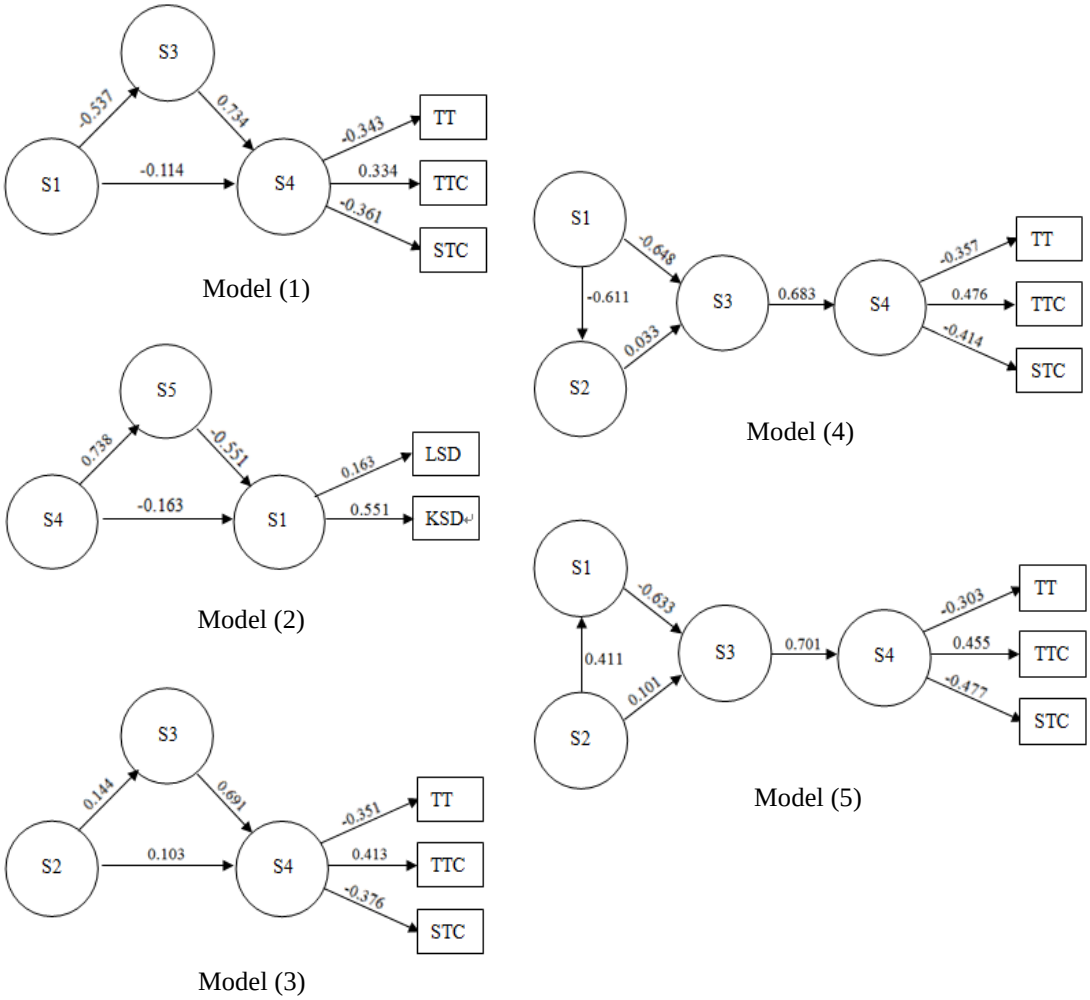

Figure 3. Structural Equation Model and Path Coefficient

5. Conclusions, Countermeasures and Suggestions

Based on existing literature, from the perspective of factor-supply distortion and combining innovation input in investigation into transformation and upgrading of foreign trade in China, a series of theoretical hypotheses were proposed, relation between factor-supply distortion, innovation input, macroeconomic environment, foreign trade structure and foreign trade transformation and upgrading was analyzed by constructing structural equation model. Studies have shown that: Factor-supply distortion hinders foreign trade transformation and upgrading by worsening foreign trade structure; innovation input exerts positive impact on foreign trade transformation and upgrading by optimizing foreign trade structure (as effectiveness of innovation input is not properly displayed, further study on verification of this hypothesis is needed); dynamic changes in foreign trade transformation and upgrading are combined results of factor-supply distortion and innovation input; factor-supply distortion constrains innovation input, while the latter strengthens the former; foreign trade transformation and upgrading exerts repair effect on factor-supply distortion by influencing macroeconomic environment; interaction between factor-supply distortion, innovation input, macroeconomic environment, foreign trade structure, foreign trade transformation and upgrading forms a stable convergence system.

In order to change the reality of factor distortion, improve quality and efficiency of foreign trade transformation and upgrading, and destroy stable convergence between them, the paper suggests improvement in at least the following aspects.

First, optimize factor circulation and regulate factor supply. Process of household registration system and social security system reform should be accelerated. Medical insurance networking, real-time settlement of trans-provincial remote medical treatment should be accelerated. Regional gap between small household registration and social security system should be further narrowed, income distribution inequality in space should be narrowed, space division of labor should be reduced, which plays the role of regulating labor supply from the side and thus meets labor demand of foreign trade transformation and upgrading. Financial reform should be deepened, “virtual, real” economic relation should be balanced, mutual benefit development of real economy and finance should be strengthened, those requirements deviating from real economic development should be abandoned, and wrong operation principle and practice of one-sided pursuit of financial self-development should be discarded. Limited credit resources should be put in real economy and SMEs rather than virtual economy and real estate. In particular, financial support of foreign trade should be strengthened.

Second, strengthen capital market innovation, and solve the problem of financing difficulty of SMEs. Financing difficulty of SMEs is a systemic problem facing the real economy, and also the biggest bottleneck in transformation development of foreign trade enterprises. To break this bottleneck, the first is to improve and strengthen financial services for small and micro businesses, and support their financing. Trade financing channels should be vigorously developed, registration costs and threshold should be lowered, special funds for trade financing should be established, availability of loans to small and micro businesses should be effectively improved, financial service coverage for small and micro businesses should be broadened, development of foreign trade enterprises should be supported; development of foreign trade service institutions in line with market law should be encouraged and supported, the problem of information asymmetry between banks and enterprises should be solved through establishment of specialized import and export trade service platform, so that financing services can be effectively provided to SMEs; development of network financing should be encouraged, introduction of

relevant policies and norms should be accelerated(Such financial products as "Yu Ebao" realize integration of money market fund and strong channel of Internet, dramatically reduce hidden costs of customer purchase, and also increase funds price, contributing to alleviation sign in fund price distortion).

Third, clarify market dominant position of innovation input, improve efficiency of innovation input. Adherence to innovation-driven development is an inevitable choice to accelerate foreign trade transformation and upgrading, but market dominant position of innovation input should be clarified. Position of enterprise and government in innovation input shows a master-slave relationship. Moreover, innovation driving is not just to increase innovation input strength from scale, but more importantly, to enhance innovation input quality from structure. From the government point of view, effective innovation evaluation mechanism should be established to provide real and objective evaluation of enterprise innovation process and results; scientific innovation input mechanism should be established on the basis of evaluation, simple, extensive innovation input should be avoided, non-equilibrium innovation input should be emphasized, so that government innovation guidance is more rational in structure; effective management and supervision mechanism should be established for guiding innovation investment of government to improve efficiency of innovation input. From enterprise point of view, attention should be paid to innovative ideas, extensive management model should be changed, innovation should be put in enterprise development strategies, and enterprises' sense of innovation should be continuously strengthened; enterprise input in independent innovation should be increased, good standard enterprise management system should be established, enterprise management and supervision mechanism should be improved from organizational structure, internal motivation, financial supervision and information disclosure, *etc*. to build a good environment for business innovation; research and development cooperation between schools and enterprises should be actively carried out to reduce development costs, spread risk and achieve complementation between technologies and talent.

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References

[1] P. A. Samuelson, "Ohlin Was Right", Swedish Journal of Economics, vol. 73, **(1971)**, pp. 365-384.
[2] R. W. Jones, "A Three-Factor Model in Theory: Trade and History", Trade Balance of Payments and Growth, vol. 2, **(1971)**, pp.3-21.
[3] G. Grossman and E. Helpman, "Quality Ladders in the Theory of Growth", Review of Economic Studies, vol. 58, **(1991)**, pp.43-61.
[4] G. Grossman and E. Helpman, "Innovation and Growth in the Global Economy", MIT Press: Cambridge, **(1991)**, pp.56-78.
[5] G. Grossman and E. Helpman, "Technology and Trade", NBER Working Paper, vol. 12, **(1994)**, pp.77-85.
[6] A. A. C. Teixeira and N. Fortuna, "Human Capital, R&D, Trade and Long run Productivity. Testing the Technological Absorption Hypothesis for the Portuguese Economy, 1960-2001", Research Policy, Vol. 3,(2010), pp.335-350 .
[7] Autant-Bernard.C., J.P.Guironnet, N.Massard, 2011. "Agglomeration and Social Return to R＆D: Evidence from French Plant Productivity Changes", International Journal of Production Economics, vol. 1, **(2001)**, pp. 34-42 .
[8] Chacholiades, "International Trade Theory and Policy", Auckland; Singapore: McGraw-Hill, **(1971)**.
[9] Bhagwati and N. Jagdish, "The generalized theory of distortions and welfare", Trade, balance of payments and growth, **(1971)**, pp.69-90.

[10] S. Bingzhan and X. Guoming, "Factor price distortion and export behavior of industrial enterprises in China", China Industrial Economics, vol. 2, **(2012)**, pp.47-56.
[11] X. Guoming and C. Yahao, "Whether multiple factor distortion promotes export of Chinese enterprises", Economic Theory and Business Management, vol. 4, **(2013)**, pp.23-32
[12] J. Yang and C. Fan, "Lewis turning point, comparative advantage materialization and choice of China's foreign trade development mode", Economist, vol. 2, **(2012)**, pp.22-29.
[13] C. Liu and P. Huang, "Endowment advantage and productivity of China's enterprise export", Modern Management Science, vol. 2, **(2013)**, pp.12-14
[14] D, Fu, "Impact of factor price change on Chinese export", Contemporary Economics, vol. 5, **(2009)**, pp.76-77.
[15] G.Wei, "Whether factor price distortion improves diversification level of China's export enterprises", World Economy Study, vol. 9, **(2013)**, pp.134-160.
[16] Q. Yuan, "An Empirical Analysis of Impact of China Trade Structure Change on Economic Growth", PhD thesis, Nankai University, **(2010)**.
[17] M. Cui and X. Chen, 2012, "R & D expenditure, per capita capital and general business development", On Economic Problems, vol. 6, **(2012)**, pp.44-54.V.Bebchuk, "The state of corporate governance research", Review of Financial Studies, vol. 23, **(2010)**, pp. 939-961.

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