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The interaction between standards development and economic growth of China

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Abstract

China has been participating in the international standards activities since the reform and opening up period. China's standards action has not only brought about significant changes in the way of international trade, but also changed the connotation and manifestation of economic growth, which has further affected China's position in the world standards development. On the basis of qualitative analysis of the interaction between standards development and economic growth, this paper quantitatively analyzes the degree of interaction between them. The results indicate that the higher standards in a country, the stronger its economic strength and the higher its position in world standards development. This conclusion is helpful for the government, industry authorities, and enterprises to pay more attention to standards in quality management and improve the standards level.

Keywords: Standards, Economic growth, Technological innovation, China, Quality assurance

Introduction

Standards have become a significant part of international trade[1]. It plays an irreplaceable role in product quality assurance, building trust in trade, facilitating the flow of goods, and improving the development of the global market. At present, facing the increasingly competitive world market, a country's competitive advantage depends not only on capital, labor, land, and other factors of production, but also on the comprehensive national strength with technology as the core and the ability to transform technology into standards to improve economic efficiency and competitive advantage. "Technology patentation and patent standards" is an important feature of industrial competition, especially in high-tech industries. Furthermore, some multinational enterprises maintain their competitive advantage by participating in international standards activity. Nowadays, the strategic significance of standards have been widely recognized and emphasized among academia and industry.

In 2000, DIN (German institute for standards) pointed out that standards is the "key driver of economic growth." The internal mechanism is that the standards could reduce the time gap between technological innovation, diffusion, and application.

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[1]This paper describes standard, standardization and standards, which we collectively call standards.

Therefore, standards update accelerates technological innovation. Blind [1] provided an extensive discussion on the influence of standards on international trade and built an international standards classification (ICS) versus standards international trade classification (SITC) table. As pointed out by Blind [1], trade value shows a positive relation with standards. Further, Blind [2], Schmid [3] and Mai Lvbo [4, 5] conducted empirical studies and draw conclusions that standards have become an important factor in promoting economic development. Swann et al. [6] had studied on the similar topic; he illustrated that national standards have significant positive influence on UK import and export trade, while there is no significant evidence that the international standards have such impact on export and import trade. On the contrary, Blind and Jungmittag [7] argued that German national standards exert a negative influence on its international trade, while the international standards could promote import and export trade in German. Moenius [8] analyzed data from 12 OECD member states and found that both national standards and international standards have a positive impact on bilateral trade, but this effect differs among different sectors. Blind [9] focused on bilateral trade between Germany and Britain. He indicated that international standards do have a positive influence on trade, while the impact of national standards is uncertain. However, the study on bilateral trade between France and Germany shows that neither national nor international standards adopted by Germany promote from German to France (Blind and Jungmittag [9]). But the international standards promote import from France. Subsequently, empirical studies conducted by Czubala et al. [10] and Mangelsdorf [11] verified the view of Blind [7].

At present, the research of the standard's impact on trade and economic growth mainly focuses on one-way research. Few scholars have opened the black box of standards affecting economic growth and demonstrated that there is an interaction between standards development and economic growth. On the other hand, there are some researchers focusing on the impact of standards in developed countries by taking developed countries and some countries which have bilateral trade with them as samples. Research on the trade effects of developing country standards is still rare. Since China is the largest trading country in the world and the largest developing country, it is of great theoretical significance and practical value to select China as the research object to examine the trade effect of standards development. Therefore, this study makes up for this deficiency.

The related mechanism

The effect of standards on economic growth

Standards is a normative document which is formulated by consensus and approved by recognized bodies for common use and repeated use in order to obtain the best order within a certain range. Therefore, standards is an institutional arrangement, and the institution as one of the factors of production has an impact on economic growth. This paper argues that standards influence macroeconomic growth mainly based on the following character.

The first character is unity. The unity here mainly refers to in the consistency of "coding" and "language." In particular, standards enable products to be consistent with requirements and gain market recognition on one hand. The market with certificated

products will have less uncertainty and further enhanced integration (Cowan et al.; Grimaldi and Torrisi; Velkar) [12–14]. On the other hand, it improves the specification consistency of products and services, verifies that products and services actually meet requirements, reduces enterprises production costs as well as technical barriers to trade in international markets, and thus ensures the free goods circulation (Butter) [15]. Last but not least, standards could motivate the spread of knowledge to a certain extent (Benezech et al.) [16]. For example, the ISO9000 standards provide a common language to underpin the coding process knowledge within an enterprise. Without unified and complete standards, there will be obstacles in the dissension of knowledge about product and services.

The second character is compatibility. The compatibility of standards is reflected in helping products integrate. This kind of integration generates economics of scale and thus boosts the prosperity of intra-industry trade. Standards can shorten the time for new products to appear on the market, promote the widespread use of innovative products, create a fair innovation environment for large and small enterprises, improve the interoperability of the network industry, and thus promote innovation (Swann) [17]. On the other hand, standards have its net effect which will lead to "less diversity" of products, although the reduction of variety is not the explicit goal. Actually, standards simultaneously pave the way for scale economies and reduced transaction costs (Raballand and Aldaz) [18]. Second, standards may generate network effect to accelerate technology diffusion which could spread "learning by doing" effect in enterprises, which greatly lower the learning cost. Meanwhile, innovation is underpinned by network effects enhanced by standards in industries such as information and communications technology. There is a common hypothesis in economic: if standards can reduce transaction costs, it could also support the division of labor, even outsourcing in multiple activities sometimes (Steinmueller) [19].

The third character is compliance. The compliance of the standards endows them with the feature of the contract, which enhances mutual trust and ensures the smooth transaction. This character is mainly reflected in the following two aspects: first, it could break down technical barriers to trade (TBT), accelerate market access, and incent market competition. In order to follow the standards, enterprises usually need to adjust features, specifications, and performance of products. However, discriminatory or extremely high cost of complying with the standards will raise obstacles for further integration of enterprises into the whole trading system. In fact, trade and market competition will be inhibited by strict environmental standards and rules. Klimenko [20, 21] argues that trade will be impeded in the form of technical trade barriers due to over-strict standards. Secondly, it reduces the quality information asymmetry by releasing qualification signals, so as to establish a trust system and secure the market order. As the basis for both parties to reach a contract, standards can reduce the uncertainty in economic activities by making merchandises quality information available to consumers (Hudson and Jones [22]; Butter and Mosch [23]).

The fourth function is security. The security function of standards is reflected by the following aspects: product quality, product safety, and environmentally friendly. First, it protects consumer's rights by guaranteeing the quality of products and services mainly from mandatory standards. Second, the safety standards ensure public health and safety, including product and service safety. Third, environmental management and

ecological standards promote environmental protection, environmental carrying capacity, and robustness.

These four characteristics or function of standards help to form a unified market, in which goods circulation, labor division, and outsourcing be improved, innovation ability be influenced, transaction cost be reduced, and market competition be stimulated. These four characteristics or function of standards secure market order, consumers' wellbeing, and public health, promoting trade and productivity as well as the business environment. It could also safeguard the quality safety and environment and, therefore, drive macroeconomic growth. In addition, standards, as an institutional arrangement, has a double-sided influence on the economy. A thorough standards framework arrangement can boost economic growth, while unreasonable standards framework will hinder economic growth.

The effect of economic growth on standards

It is generally agreed that international trade depends not only on the price factor, but also the quality and service. In the competition of improving products and services quality, a country will strive to establish relevant national standards and seek an international discourse right. Adoption and the effectiveness of international standards by a country mainly depends on the country's ability to absorb technology. Blind [2], from the perspective of intra-industry trade, indicates that the adoption of international standards is conducive to promoting the specialized production of differential products, realizing the large economics of scale and promoting intra-industry trade. Therefore, standards could be viewed as an important indicator to measure a country's competitiveness. Meanwhile, trade and economic growth will also impact standards in return. The rapid growth of a country's economy often brings changes in environment and resources which may lead to the emergence of new development (including new technology and new method). Otherwise, the lack of corresponding standards for new technology drives the government and the market to set new standards and improve the standards level. For example, the development of new energy vehicles has pushed forward the evolution of industrials such as electric vehicles, batteries, and charging piles and the related standards. However, there are only a few researches focus on the complementary relationship between standards development and economic growth.

The interaction mechanism between standards development and economic growth is shown in Fig. 1.

Data and methodology

The empirical method

In this paper, a VAR (vector autoregression) model is employed to measure the interaction between standards development and economic growth. VAR model is usually used to construct a model by taking each endogenous variable in the system as a function of the lagging value of all endogenous variables in the system. The VAR model is a more practical and reliable method than the traditional regression econometric model during data fitting. The mathematical expression of the model is as follows:

$$y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + B x_t + \varepsilon_t \tag{1}$$

where y_t is the column vector of endogenous variables with k dimension, x_t is the column vector of exogenous variables with d dimension, P is the order of the lag, $k \times k$
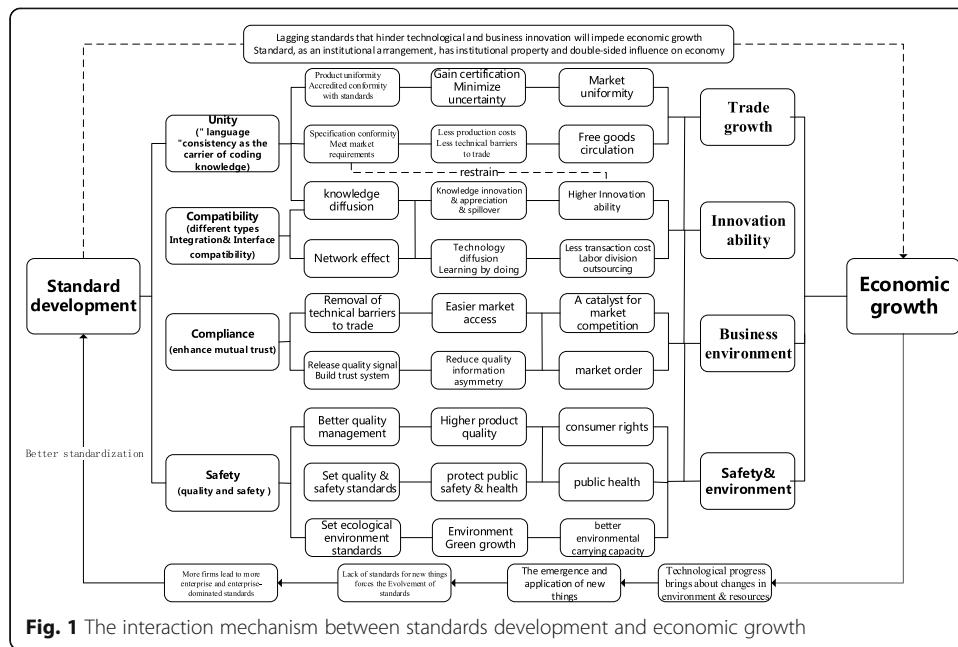
Fig. 1 The interaction mechanism between standards development and economic growth

dimensional matrices A and$k \times d$ dimensional matrices B are the coefficient matrices to be estimated, and ε_t is the random error which is a column vector with k dimensional.

Variable selection and data sources

Based on the purpose of our research, the following variables were selected considering the mechanism analysis and empirical model.

Explained variables are introduced in this paragraph. In this paper, the indicators representing economic growth, export volume, import volume, and innovation capacity are all taken as indicators of per capita in order to eliminate the impact of scale. Among these indicators, the economic growth indicator is the logarithm of per capita GDP (PGDP), which is the logarithm of the value that the original GDP divided by the total population. The logarithm of PGDP is adjusted to the 1978 constant prices according to the nominal GDP deflator. The exports and imports value of trade are deflated according to the domestic CPI index, and then take the logarithm of the per capita level. The index of innovation ability is usually measured by patent level, among which invention patents are mainly used. Therefore, this paper takes the logarithm of the number of per capita invention patents to represent the innovation ability.

The other kind of variables is explanatory variables (standards capacity). During the study, we obtained the national standards stock and adopted international standard stock data by searching the Standards Administration (SAC) database. Besides, we referred to the related research methods to calculate international standards number, namely if a standards is marked as "IDT (means be equivalent to)" an existing international standards in the Standards Administration (SAC) database or "MOD (modified adopt)" an international standards, the standards will be classified as an international standards. In order to eliminate the impact of scale, the variables based on the standards are reflected as the per capita level. The population calculation unit is one million

to avoid the order of magnitude difference caused by the excessive difference between the standards quantity and population. The variable definitions are shown in Table 1.

According to Eq. (1) and the variables in the table, the Eq. (1) can be written as:

$$
\begin{bmatrix} \text{LNPGDP} \\ \text{LNPEXP} \\ \text{LNPIMP} \\ \text{LNPPAT} \end{bmatrix} = A_1 \begin{bmatrix} \text{LNPGDP}_{(t-1)} \\ \text{LNPEXP}_{(t-1)} \\ \text{LNPIMP}_{(t-1)} \\ \text{LNPPAT}_{(t-1)} \end{bmatrix} + \cdots + A_p \begin{bmatrix} \text{LNPGDP}_{(t-p)} \\ \text{LNPEXP}_{(t-p)} \\ \text{LNPIMP}_{(t-p)} \\ \text{LNPPAT}_{(t-p)} \end{bmatrix}
$$
$$
+ B \begin{bmatrix} \text{LNPGB}_t \\ \text{LNPCB}_t \\ \text{LNPMOD}_t \\ \text{LNPIDT}_t \end{bmatrix}_t + \varepsilon_t \tag{2}
$$

The description of data sources is list as follows. The standards related data mainly come from the Standards Administration (SAC) database, which provides important information such as the number of national standards, their attributes, code, the number of adopted international standards, and degree of adoption. The macro data such as China's total trade, imports, and exports are collected from *China Statistical Yearbook 2017*. China's foreign trade price index is calculated based on the World Bank database. Data on patent applications in China are retrieved from the website of the State Intellectual Property Office. To make sure of the statistical caliber and data availability, the research period was from 1978 to 2017.

Descriptive statistical analysis

In this study, the variance inflation factor (VIF) analysis is necessary to avoid the problem of multi-collinearity between the control variables and lag terms of the explained variables. The average coefficient of VIF is 3.68, which is less than 5. The results indicate that the possibility of collinearity between the coefficients is relatively low. The descriptive statistics in this study are shown in Table 2.

Figure 2 shows the national standards and international standards stock growth trend. As shown in the figure, the number of national and international standards is increasing steadily since 1978, and the share of international standards adopted in the current total standards have also greatly increased during this period. In particular, China adopted two international standards in 1978 and up to 17,269 in 2017. Take the

Table 1 Variable definitions

Variable	The variable name	Symbol	Definition and calculation
Explained variable	Economic growth	LNPGDP	The logarithm of per capita GDP
	Exports volume	LNPEXP	The logarithm of per capita exports volume
	Import volume	LNPIMP	The logarithm of per capita import volume
	Innovation ability	LNPPAT	The number of patents every 100,000 population
Standards capacity	National standards stock	LNPGB	The logarithm of national standards stock every 1,000,000 population
	Adopted international standards stock	LNPCB	The logarithm of adopted international standards stock every 1,000,000 population
	Amended adopted international standards stock	LNPMOD	The logarithm of amended adopted international standards stock every 1,000,000 population
	Equivalent-to-international standards stock	LNPIDT	The logarithm of equivalent to the international standards stock every 1,000,000 population

Table 2 Descriptive statistical analysis

Variable	Average	Variance	Minimum	Maximum
LNPGDP	8.565	1.617	5.953	10.990
LNPEXP	9.232	2.211	5.122	11.940
LNPIMP	9.167	2.102	5.233	11.733
LNPPAT	10.097	2.055	3.689	12.948
LNPGB	9.092	1.591	5.081	10.880
LNPCB	4.866	2.350	-1.571	7.125
LNPMOD	1.887	2.688	-2.303	5.770
LNPIDT	4.564	2.356	-1.585	6.678

year 2017 as an example, the international standards stock accounts for 33% of the standards structure, and the increment accounts for 20%. Meanwhile, the scale of China's foreign trade was also increasing obviously. In particular, the flow of import and export trade in China became much faster after 2001 when China joined the World Trade Organization. In 1978, China's total import and export volume was 35.5 billion Yuan, including 16.76 billion Yuan of export value and 18.74 billion Yuan of import value. In 2017, China's total import and export volume was 27792.092 billion Yuan. The export and import value was 15331.832 billion Yuan and 12460.260 billion Yuan respectively.

Results and discussion

Unit root test and Granger causality test

When applying VAR time series model, the stationary of the variable sequence must be tested to avoid the problem of pseudo-regression. In this paper, Augmented Dickey–Fuller test is used to test the variables, and the results are shown in Table 3. According
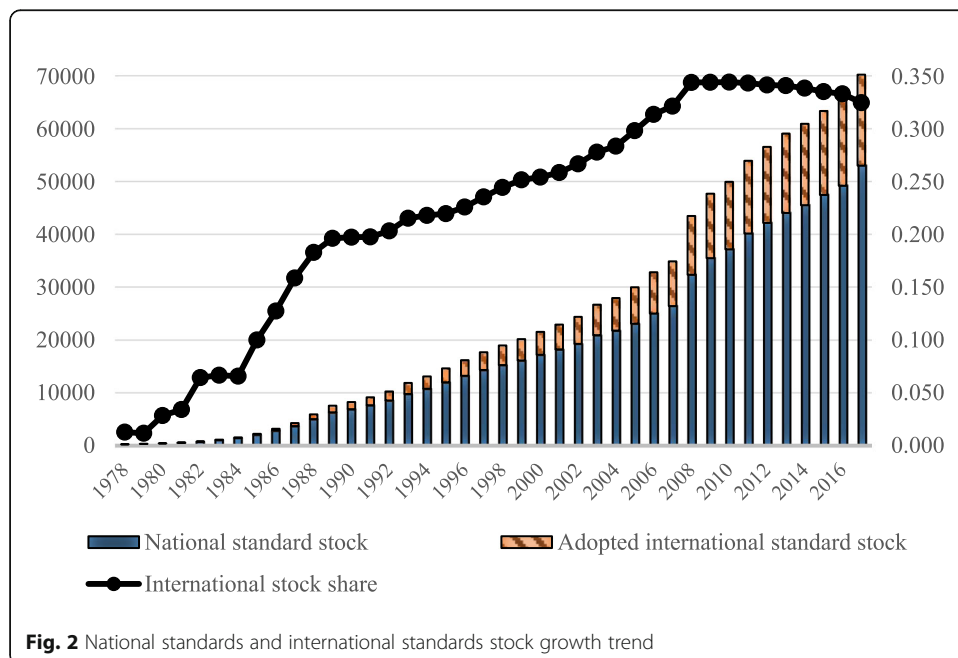

Fig. 2 National standards and international standards stock growth trend

Table 3 Unit root test

Variable	Test form (C,T,L)	Test value	p value	Test result (below 5%)	Test result (below 10%)
LNPGDP	(0,0,0)	− 13.348	0.000	Stable	Stable
LNPEXP	(0,0,0)	− 2.716	0.071	Unstable	Stable
△LNPEXP	(0,0,1)	− 5.003	0.000	Stable	Stable
LNPIMP	(0,0,0)	− 2.422	0.136	Unstable	Unstable
△LNPIMP	(0,0,1)	− 4.355	0.000	Stable	Stable
LNPPAT	(0,0,0)	− 1.795	0.383	Unstable	Unstable
△LNPPAT	(0,0,1)	− 5.958	0.000	Stable	Stable
LNPGB	(0,0,0)	− 13.348	0.000	Stable	Stable
LNPCB	(0,0,0)	− 9.299	0.000	Stable	Stable
LNPMOD	(0,0,0)	− 0.568	0.878	Unstable	Stable
△LNPMOD	(0,0,1)	− 5.412	0.000	Stable	Stable
LNPIDT	(0,0,0)	− 6.962	0.000	Stable	Stable

The test form C, T, and L respectively represent the intercept, trend, and lag period of the testing equation

to the test results, variables such as LNPGDP, LNPGB, LNPCB, and LNPINT are 0-order I (0) sequences, and the rest variables are first-order I (1) sequences at the significance level of 5%.

Furthermore, we applied the Granger causality test to judge the causality between the standards and economic growth. The optimal lag order is determined by AIC criterion, as shown in Table 4.The results indicate that, at the significance level of 5%, all sequences constitute a two-way granger causality. For example, LNPGB and LNPGDP constitute a two-way granger causality. LNPGB is the granger cause of LNPGDP, and vice versa. That is, the deepening of China's standards development may have affected China's economic growth, but whether this effect is positive or negative remains to be further studied.

Table 4 Granger causality test results

Null hypothesis	χ^2 value	p value	Null hypothesis	χ^2 value	p value
LNPGBeypothe	19.42	0.007***	LNPCB***othe	16.30	0.006***
LNPGDP**othe	23.86	0.000***	LNPGDP**othe	12.06	0.017**
LNPGB***othe	12.41	0.030**	LNPCB***othe	27.51	0.004***
LNPEXP**othe	23.25	0.000***	LNPEXP**othe	45.95	0.000***
LNPGB***othe	18.56	0.005***	LNPCB***othe	14.65	0.012**
LNPIMP**othe	26.25	0.000***	LNPIMP**othe	13.15	0.022**
LNPGB --- LNPPAT	18.44	0.000***	LNPCB***- LN	27.26	0.000***
LNPPAT --- LNPGB	15.43	0.009***	LNPPAT**-- L	14.87	0.010**
LNPMOD**-- LN	35.05	0.000***	LNPIDT**-- LN	20.08	0.001***
LNPGDP**-- LN	12.34	0.030**	LNPGDP**-- LN	9.68	0.022**
LNPMOD**-- LN	25.77	0.007***	LNPIDT**-- LN	24.22	0.001***
LNPEXP**-- LN	11.37	0.045***	LNPEXP**-- LN	7.18	0.067*
LNPMOD**-- LN	22.19	0.001***	LNPIDT**-- LN	16.31	0.006***
LNPIMP**-- LN	10.97	0.052*	LNPIMP**-- LN	20.30	0.000***
LNPMOD --- LNPPAT	23.90	0.000***	LNPIDT**-- LN	14.04	0.003***
LNPPAT --- LNPMOD	9.69	0.084*	LNPPAT --- LN	8.15	0.086*

*, **, and *** represent the significance level of 10%, 5%, and 1% respectively (*p < 0.10; **p < 0.05; ***p < 0.001)

Co-integration test

From previous analysis, there exit non-stationary characteristics between the original sequence of variables. Therefore, Johansen test is adopted in this paper to test the co-integration relationship between variables. The testing results are shown in Table 5. The results indicate that the trace statistics of all variables are significant which means there is a long-term equilibrium co-integration relationship between explained variables and explanatory variables.

We further standardize the co-integration vector, and the co-integration relationship between variables is arranged as shown in Table 6. There is significant evidence that standards enhance economic strength. The stronger the economic strength, the higher a country's position in the global standards development. Further research shows that first, among the following variables, the equivalent adoption of international standards has the highest impact (2.242) to the economic growth, and the activity with the lowest impact is to modify the adoption of international standards; the impact of national standards and the adoption of international standards are basically identical. Second, in terms of export trade, the impact of adopting international standards is the highest (4.041), which is significantly greater than that of other three types of standards, and the impact of national standards is the lowest (2.055). Third, for import trade, the adoption of international standards has the most obvious impact, which is 3.760, while the modification of international standards has the least impact, which is 0.615. Fourthly, for patents, the impact of adopting international standards are highest (3.518), and the impact of adopting international standards are the least (0.634).

Unit circle test and impulse response function

In this study, the residual analysis is applied after the estimation of the error correction model. We conducted LM test to test whether there is autocorrelation in the residuals. The testing results show that there is no autocorrelation in the residuals of each variable. It is necessary to verify whether the VECM system is in a stable process by testing its eigenvalues. If all the eigenvalues are inside the unit circle, they constitute a stable process. Take LNPGB as an illustration (shown in Fig. 3); all of the eigenvalues are in the unit circle, which indicates that the VECM of this model is stable. At the same time, this paper analyzes the impulse response function of the above model. As shown in Fig. 4, the impact of LNPGB variable on the four variables of LNPGDP, LNPEXP, LNPIMP, and LMPPAT tends to be stable for a long term in different periods. This indicates that the impact effect does not change in general.

Table 5 Co-integration test

Sequence data	Rank statistics	Sequence data	Rank statistics	Sequence data	Rank statistics	Sequence data	Rank statistics
LNPGB--LNPGDP	41.114***(0.000)	LNPCB--LNPGDP	36.607*** (0.000)	LNPMOD--LNPGDP	69.034*** (0.000)	LNPIDT--LNPGDP	61.313*** (0.000)
LNPGB--LNPEXP	31.963***(0.000)	LNPCB---LNPEXP	22.801*** (0.000)	LNPMOD--LNPEXP	9.781*** (0.002)	LNPIDT--LNPEXP	49.402*** (0.000)
LNPGB--LNPIMP	46.217***(0.000)	LNPCB---LNPIMP	24.977*** (0.000)	LNPMOD--LNPIMP	28.081*** (0.000)	LNPIDT--LNPIMP	63.680*** (0.000)
LNPGB--LNPPAT	112.53***(0.000)	LNPCB---LNPPAT	271.60*** (0.000)	LNPMOD--LNPPAT	5.782** (0.016)	LNPIDT--LNPPAT	50.701*** (0.000)

** and *** represent the significance level of 5% and 1% respectively (**$p < 0.05$; ***$p < 0.001$)

Table 6 The impact of standards on economic growth, trade, and patents

Variable	LNPGB	LNPCB	LNPMOD	LNPIDT
LNPGDP	1.701***	1.620***	0.633***	2.242***
	(0.000)	(0.000)	(0.000)	(0.000)
LNPEXP	2.055***	2.386***	2.757***	4.041***
	(0.000)	(0.000)	(0.002)	(0.000)
LNPIMP	2.066***	3.760***	0.615***	2.467***
	(0.000)	(0.000)	(0.009)	(0.000)
LNPPAT	2.530***	3.203***	0.634**	3.518***
	(0.000)	(0.000)	(0.016)	(0.000)

** and *** represent the significance level of 5% and 1% respectively (** $p < 0.05$; *** $p < 0.001$). The probability value of the regression coefficient for the co-integration equation is in the parenthesis

Analysis of variance

According to the variance analysis results (taking LNPGB as an example), LNPGB has a great influence on LNPGDP, LNPEXP, LNPIMP, and LMPPAT. Among these variables, the impact to LNPGDP, LNPEXP, and LNPIMP is mainly self-caused. Such impact is still as high as 87.35%, 79.144%, and 89.300% in the tenth phase. The impact of LNPPAT mainly comes from LNPGB, which was 71.816% in the tenth phase. We could conclude from the results that the impact of national standards on economic growth, export, or import is not significant, while it has significant impact on patents (Table 7).

Conclusion

We can conclude that the higher the standards level of a country, the stronger its economic strength; the stronger the country's economic strength, the higher its position in the world standards development. The result analysis also shows that the impact of
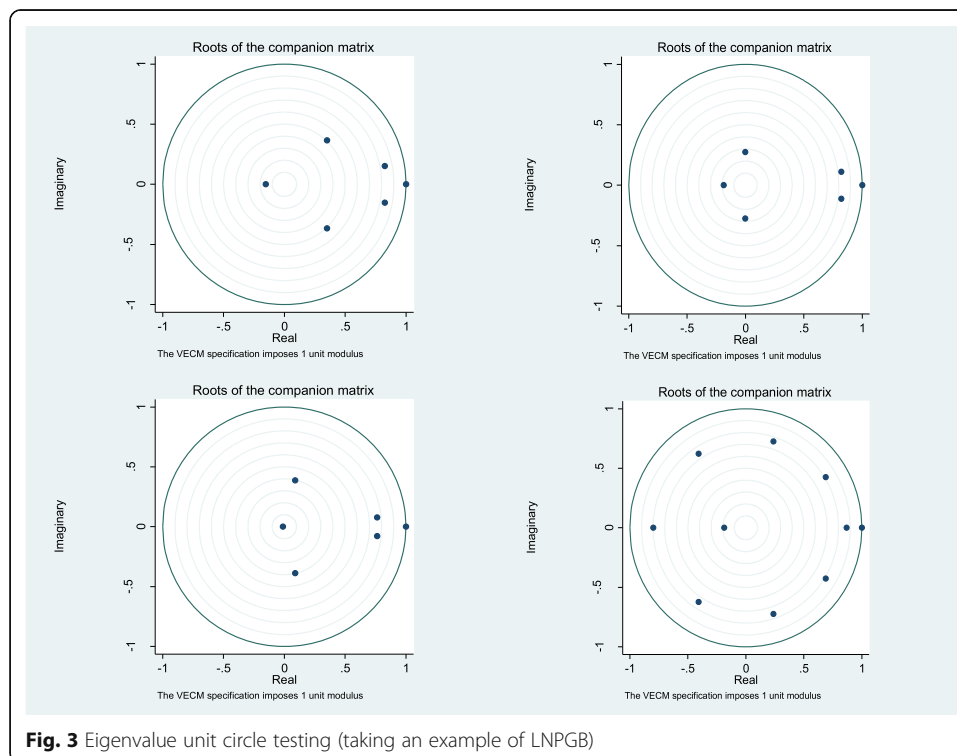

Fig. 3 Eigenvalue unit circle testing (taking an example of LNPGB)
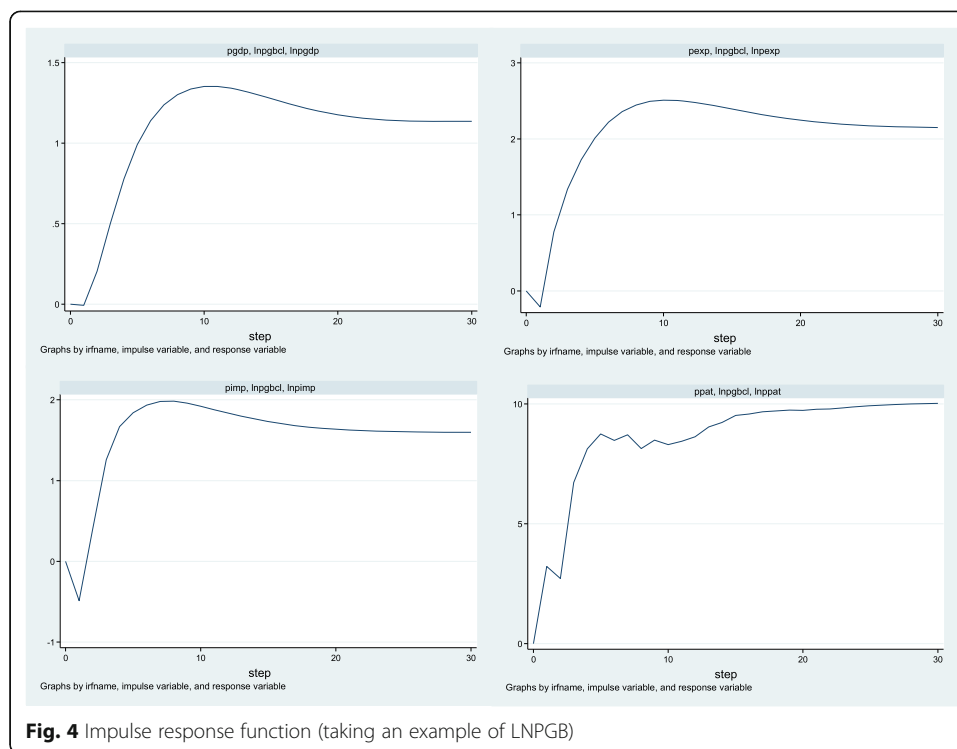
Fig. 4 Impulse response function (taking an example of LNPGB)

national standards is greater than international standards on economic growth, among which the impact of adopted international standards is greater than that of modified international standards. On the contrary, in terms of trade growth, international standards' influence to trade is more significant than national standards, and the impact on imports is greater than exports. In addition, the impact of adopted international standards is far greater than the impact of modified international standards on both sides trade. From the perspective of technological progress, international standards have a greater impact than national standards, among which the impact of equivalent adopted international standards is greater than modified international standards.

From the previous study, we provide the following suggestions for Chinese standards development. We should continuously improve the internationalization level of standards and raise the proportion of international standards at the same time. These two

Table 7 Analysis of variance (LNPGB as an example)

Phase	LNPGDP	LNPGB	LNPEXP	LNPGB	LNPIMP	LNPGB	LNPPAT	LNPGB
1	100.00	0.000	100.00	0.000	100.00	0.000	100.00	0.000
2	99.999	0.001	99.830	0.170	99.407	0.593	94.044	5.956
3	99.699	0.301	98.291	1.709	99.343	0.657	90.275	9.726
4	98.609	1.391	95.122	4.878	97.487	2.513	72.407	27.594
5	96.779	3.221	91.536	8.465	95.191	4.809	56.256	43.744
6	94.571	5.429	88.080	11.920	93.269	6.731	44.675	55.325
7	92.342	7.658	85.050	14.950	91.769	8.231	38.078	61.922
8	90.301	9.699	82.566	17.435	90.640	9.360	32.887	67.113
9	88.529	11.471	80.618	19.382	89.837	10.163	29.993	70.007
10	87.035	12.965	79.144	20.857	89.300	10.700	28.184	71.816

initiatives are crucial to promote the "going global" of Chinese standards. From the innovation development point of view, it is necessary to reform the standards system and optimize the standards structure. Besides, the important role of equivalent-to-international standards in the global competitiveness should be emphasized. Last but not least, the strategic guide mechanism of standards development should be formulated to give full play to the guiding role of "China standards" on international and domestic trade as well as the economic growth.

In conclusion, this study reveals the mechanism of the interaction between standards development and economic growth solved the differential impact of standards structure on trade and economic growth. In the meantime, the interaction between standards development and economic growth involves other components of the National Quality Infrastructure (NQI), and the relationship between standards development and economic growth will be further studied in the future.

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