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The impact of standardization on transformation and upgrading of information industry and chemical industry

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ABSTRACT

In order to reveal the impact degree of standardization on Jiangsu Province's information industry and chemical industry during the process of transformation and upgrading, the regression equation is used in this paper. By data collection, the scatter plot and the regression analysis, the quantitative calculation can effectively reveal the correlation between total output and technical standard data in Jiangsu Province's information industry and chemical industry. For illustration, the relevant data from the "Statistical Yearbook" and "standard database" in 2008-2013 are collected and calculated carefully. The empirical results show that there is the highly linear positive correlation between the total output and the technical standard data in terms of information industry and chemical industry in Jiangsu Province. The empirical research has revealed that the technical standards can promote the integration of the independent intellectual property rights and the independent standards in the enterprises, technical standards can greatly ease the disorder competition between different enterprises and different cities, technical standards can integrate the strength of research and development in different enterprises within the industry, and technical standards can accelerate the transformation and upgrading of high-tech industries in Jiangsu Province.

KEYWORDS

Standardization; Transformation and upgrading; Information industry; Chemical industry; Jiangsu province.

INTRODUCTION

The research of American economists Shapiro and Varian (2000), the German Institute for Standardization (DIN, 2001), UK Department of Trade and Industry (DTI, 2005) all indicate that standardization can help to improve the country's competitiveness and promote the development of macroeconomic. Swann (2000) held that the impact of standards and standardization for enterprise's technological innovative activities was uncertain. The standards were divided into compatibility/interface standards, minimum quality/safety standards, variety reduction standards and information standards by Swann. He said that four criteria simultaneously exerted both the positive impact and the negative effects for the economy respectively. Kano (2000) took the mobile communications business for instance to study the relationship between technological innovation and standardization, and he proposed the viewpoint of innovation of system. Kondo pointed out that both technical standardization and technological innovation were complementary relationship. Based on contrast and analysis of four cases, Allen concluded that the positive effects of standardization on technological innovation were much more than its negative effects. Yoo (2005) held that standards played the key role in the field of enterprises' mobile broadband strategy. Blinder (2006) used questionnaires to obtain data between Germany enterprises and EU ones, and conducted the deep research on the motivation of enterprise standardization, influencing factors and the economic impact of standardization. Furthermore, Blinder respectively inspected the link between technology innovation and standardization on the level of industry and enterprise. Empirical evidence showed that innovation and standardization had virtuous circle rather than malignant one at the industry level, and standards hindered the technological innovation in enterprises in enterprise's micro level based on the questionnaire survey data. However, compared with other barriers to technological innovation, standard's impediment role was not very important. Therefore, standards were not the serious impediment to technological innovation and between standards and technological innovation were more positively correlated.

According to Deutsches Institur Fur Normung's (DIN) findings in enterprises from Germany, Austria, Switzerland and others, technical standards had the superior positive impact on the enterprise operation. Owing to the use of standards, companies reduced duplication of effort and save raw material, production continuity was ensured in enterprises, standardized production processes and management improved the efficiency of production and management in enterprises. The standardized detection enhanced product reliability and expanded sales amount of enterprises. The use of advanced standards improved enterprises' product quality, which obviously had the stronger competitive power than enterprises without using some standards. On the other hand, the use of technical standards certainly increased management cost in enterprises. According to the German surveys, the enterprises who actively participated in the standardization reduced the production costs to adapt to new standards of enterprise and created competitive advantage, defended their interests in the standardization work relative to those companies without participating in the standardization work. More than 50% of enterprises generated the great influence on the contents of standards so as to achieve the purpose of forming their own competitive dominant position through exerting influence to standardized results.

Fu Jiaji (2003) believed that companies with standardization work earned a great deal of incomes, which mainly came from three aspects. The first was the monopoly brought by the network effects. The second was the use of the patent license to get more profits. The third was to utilize the first-mover advantage to occupy the market chronically. The contribution of technological innovation to the economic growth relied on technical standard in a considerable degree. Pan Haibo (2003) studied the coordinated development of technical standards and technological innovation. He deemed that technological innovation brought some new features of technological development, and promoted the development of technical standards. What's more, the new technical standards played the double-edged sword role for technological innovation, which meant that it was not only conducive to technological innovation, but also hindered the technological innovation in some ways. Li Chuntian (2004) considered that technological standards were the double-edged sword, which meant that technical standardization seemed to be contradictory and mutually exclusive for technological innovation, and they were the unity of opposites in fact. Yang Wu (2006) put forward research method and system of technical standardized management and strategic management theory based on technological innovation. Chen Shumei (2007) analyzed the impact of EU standardization's externality for technological innovation's route in China's export enterprises.

Most notably, Li Mingxing (2009) pointed out that enterprise standard strategy was to follow the evolution development route of "technology patent→patent standardization→international standard→market standard" in empirical cases at present. According to Li Mingxing (2010) research results, the specific developmental patterns and the evolutionary path of enterprises' standard strategy focusd on the five-step strategies at the micro level, which included "patent license→the cooperation between patents and standards→standard upgrade→the appearance of technical standard alliance→the fit between the market and interest". In the era of knowledge economy, the formal standards were developed by a national, regional or international (ISO, IEC, etc.) standards body, and passed through this organization's formal approval process. The popular standards included ISO 9000 Quality management, ISO 14000 Environment management, ISO 3166 Country codes, ISO 26000 Social responsibility, ISO 500001 Energy management, ISO 31000 Risk management, ISO 22000 Food safety management, ISO 27001 Information security management as well as ISO 20121 Sustainable events in the world nowadays. The whole standardization process changed from "Plan-Do-Check-Adjust" to seven steps including problem, goal, point of cause, root causes, counter measures, follow-up and standardization (seen in Figure 1). The technological standards have become the key factor that can affect businesses, industries and national competitive power.

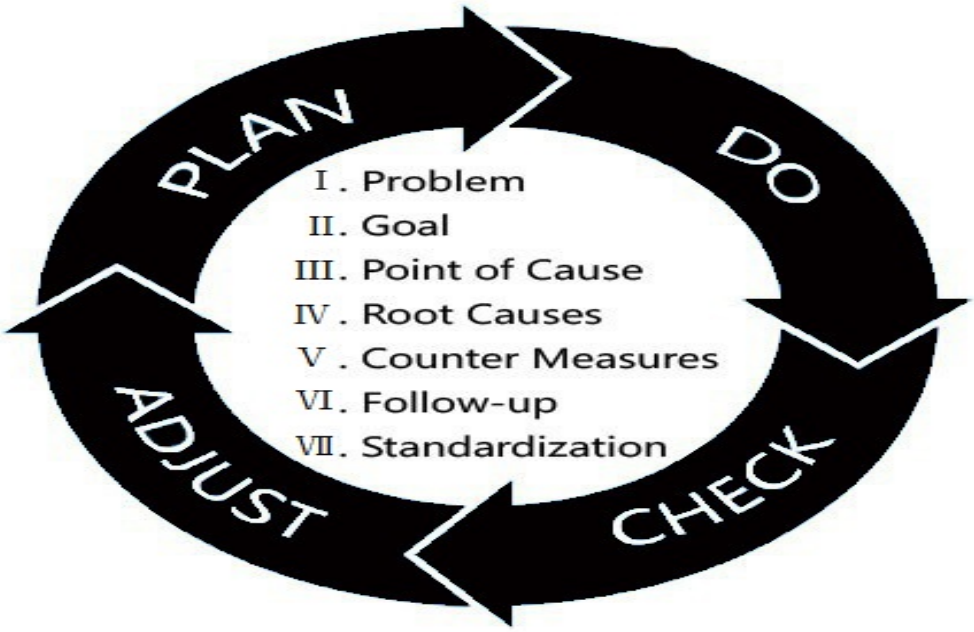

Figure 1. Standards process

Source: http://www.yml.cc/en/pdca.html

Furthermore, once enterprises have access to the inventive patents and the technological standards, their export products can pour into the developed nations without the technology trade barrios limit. Ten years ago technical standards in DVD industry had been controlled 6C alliance, which was subject to strict patent protection. In 1999, in order to limit a lot of exports to Chinese DVD products, 6C imposed high royalties to Chinese export enterprises that made DVD products. In 2002, China's enterprises established EVD technology with independent intellectual property rights and applied the international standards in the International Standardization Organization due to the independent innovation, which completely got rid of DVD-related standard and patent constraints and eliminated technical barriers to trade. So it is important for the government to formulate the relative laws to those patent standards from outside. October 28, 2013, the Guangdong Provincial Higher People's Court made the final judgment relation to Huawei Technologies Co., Ltd. (Huawei) v. InterDigital Group of Campanies (hereinafter referred to as IDC). Because U.S.A's IDC company behaviors constituted the monopoly, Huawei won 20 million Yuan compensation. The case created at least three "firsts". Firstly, it was the first cause of litigation caused by standard essential patents. Secondly, China's court found that the patentee constituted the abuse of market dominance for the first time because the patent standard holders asked for an unreasonable fee. Thirdly, China's court first introduced "FRAND principles" as a basis for intellectual property right judgment.

Under the background of globalization of intellectual property rights economy, technology standards based on the inventive patents is vital for the rapid development in Jiangsu Province, so that the standardization at the level of enterprise and industry leads to achieve a steady rise of both quantity and quality in the field of regional economy. According to the industrial policy of Jiangsu provincial government, the strategic emerging industries include manufacturing and services, while the high-tech industries mainly refer to manufacturing. So how to measure the impact on the standardization to the transformation and upgrading of manufacturing mainly refers to measuring the impact on the standardization to the transformation and upgrading of high-tech industries in fact in Jiangsu Province. By selecting the authoritative data from the two industries such as information technology and chemical industry in Jiangsu Province, using the correlation analysis, regression analysis and other quantitative research methods, authors accurately measure the influence degree of the standardization to the transformation and upgrading in Jiangsu Provincial manufacturing from the aspect of the empirical level, which can provide the objective and accurate basis for the government and its functional departments in terms of formulating and implementing standardization strategy.

Empirical research on the effect of standardization to the transformation and upgrading of Jiangsu Provincial information industry

As far as the development of information industry is concerned, the standardization is one of the industry's core competitiveness. Based on the above reference analysis at home and abroad, "technical standard quantitative index" represents standardization and "total output "represent the transformation and upgrading in order to quantitatively measure the performance of standardization to promote the transformation and upgrading of Jiangsu Provincial's industry development. By consulting, collection and calculation of the relevant data from the "Statistical Yearbook" and "standard database" in 2008-2013, the relevant research data can be seen in the Table 1.

Table 1 Basic data

Years	Total output of Jiangsu Provincial information industry（¥100 million）	Information technical standard data（Piece）
2008	8308.98	10065
2009	7930.4	10550
2010	10111.16	11039
2011	12131.62	11506
2012	13846.25	11879
2013	15101.25	12209

Make X1= Information technical standard data（Piece）, X2= Total output of Jiangsu Provincial information industry（¥100 million）. Input the data in Table 1 to SPSS19.0 and make the descriptive statistical analysis of the data, so the Table 2 is followed. According to Table 2, we can get the basic situation of information technical standard data and the total output of Jiangsu Provincial information industry.

Table 2 Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
X1	6	10065.00	12209.00	11208.0000	813.51337
X2	6	7930.40	15101.25	11238.2767	2943.31001
Valid N (list wise)	6				

1.1Correlation analysis of total output of Jiangsu Provincial information industry and information technical standard data

Use SPSS software to process the information technical standard data and the total output of Jiangsu Provincial information industry in Table 1 and draw a scatter plot in Figure 2. As can be seen from the scatter plot, data points are located substantially on a straight line, indicating that there may be correlation.

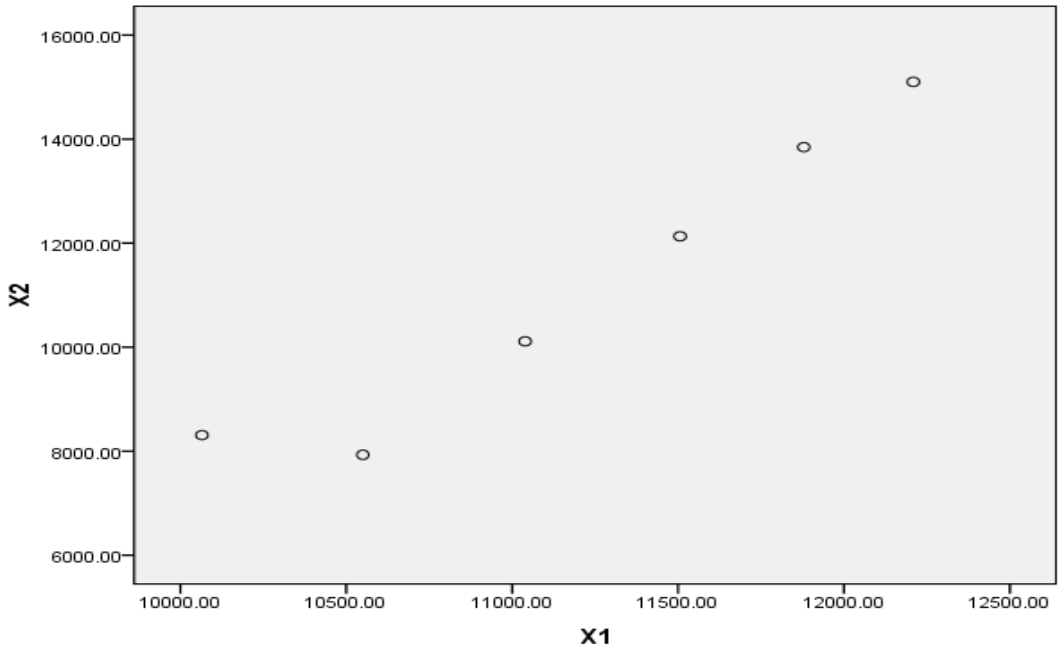

Figure 2. The scatter plot of information technical standard data and total output of Jiangsu Provincial information industry

Notes : X1 means the information technical standard data（Piece）, X2 means the total output of Jiangsu Provincial information industry（¥100 million）

Use SPSS software to make correlation analysis of the information technical standard data and the total output of Jiangsu Provincial information industry in Table 1 and we can get Table 4. Therefore, it indicates a significant correlation.

Table 4 Correlation between total output of Jiangsu Provincial information industry and information technical standard data

Correlations			
		X1	X2
X1	Pearson Correlation	1	.969**
	Sig. (2-tailed)		.001
	N	6	6
X2	Pearson Correlation	.969**	1
	Sig.(2-tailed)	.001	
	N	6	6
**. Correlation is significant at the 0.01 level (2-tailed).			

As can be seen from the above data and the analytical results, the correlation coefficient of X1 and X2 is 0.969. So the total output of Jiangsu Provincial information industry and the information technical standard data have the significant correlation. Since $0.8<|r|\leq 1$, the total output of Jiangsu Provincial information industry and the information technical standard data show the special highly linear positive correlation. It reflects that with the increase of the information technical standard data, the total output of Jiangsu Provincial information industry shows the significant growth tendency.

According to the formula of the linear correlation coefficient r:

$$R=\frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2\cdot\sum_{i=1}^{n}(y_i-\bar{y})^2}} \quad (1)$$

According to Table 2, we get $\bar{x}$=11208.0000, $\bar{y}$=11238.2767, then take the data in Table 1 into the formula, so calculate R≈0.97. It is basically consistent with the correlation analysis of the data. By applying the method of correlation analysis and mathematical formula, we can present the significant correlation results between the total output of Jiangsu Provincial information industry and the information technical standard data.

Regression analysis of total output of Jiangsu Provincial information industry and information technical standard data

On the basis of correlation analysis, the regression analysis of total output of Jiangsu Provincial information industry and information technical standard data can be conducted, so as to further study the relationship between these data (see Table 5).

Table 5 Model Summary

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.969[a]	.939	.923	815.93495
a. Predictors: (Constant), X1				

According to regression analysis, model summary (see Table 5) can be obtained, where R is 0.969, which is consistent with the results of correlation analysis.

Table 6 Coefficients analysis

Coefficients[a]						
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	Std. Error	Beta		
1	(Constants)	-28046.235	5038.314		-5.567	.005
	X1	3.505	.449	.969	7.814	.001
a. Dependent Variable: X2						
y=-28046.235+3.505x						

According to Tables 6 and 7, the results of the regression analysis of the total output of Jiangsu Provincial information industry and the technical standard number of information display: regression coefficients a = -28046.235, b = 3.505 (see Table 6).

Table 7 Regression coefficients

Anova[b]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	4.065E7	1	4.065E7	61.063	.001[a]
	Residual	2662999.392	4	665749.848		
	Total	4.332E7	5			
a. Predictors: (Constant), X1						
b. Dependent Variable:X2						

The regression equation: y=-28046.235+3.505x.

The linear relationship is good. By variance analysis, sig. = .001, which shows that the regression effect is general. In the regression equation, X1 is regarded as the Information technical standard data（Piece）, and X2 is regarded as the total output of Jiangsu Provincial information industry(¥100 million).

Conclusions

Based on the empirical analysis above, both the total output of information industry in Jiangsu Province and the information technical standard data show the highly linear positive correlation. If the transformation and upgrading of information industry in Jiangsu is successful, we should constantly strengthen the setting, implementation and promotion of the technical standards step by step.

Empirical researches on the effect of standardization to the transformation and upgrading of Jiangsu Provincial chemical industry

In order to quantitatively measure the performance of standardization to promoting the transformation and upgrading of Jiangsu Provincial chemical industry, "technical standard quantitative index" represents standardization and "total output" represents the transformation and upgrading. By consulting, collection and calculation of the relevant data from the "Statistical Yearbook" and "Standard Database" in 2008-2013, the Table 8 can be followed.

Table 8 Basic data

Years	**Total output of Jiangsu Provincial chemical industry**（¥100 million）	**Technical standard number of chemical industry**（**Piece**）
2008	4900	3508
2009	6000	3988
2010	7700	4302
2011	12100	4714
2012	13700	5098
2013	15400	5340

Input the data in Table 8 to SPSS19.0 and make the descriptive statistical analysis of the data, the Table 9 can be seen.

Table 9 Descriptive Statistics

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
X	6	4900.00	15400.00	9966.6667	4348.63963
Y	6	3508.00	5340.00	4491.6667	691.95308
Valid N (list wise)	6				

Correlation analysis of total output of Jiangsu Provincial chemical industry and technical standard number of chemical industry

Use SPSS software to process the technical standard number of chemical industry and the total output of Jiangsu Provincial chemical industry in Table 8 and draw a scatter plot (seen in Figure 3). As can be seen from the scatter plot, data points are located substantially on a straight line, indicating that there may be correlation.

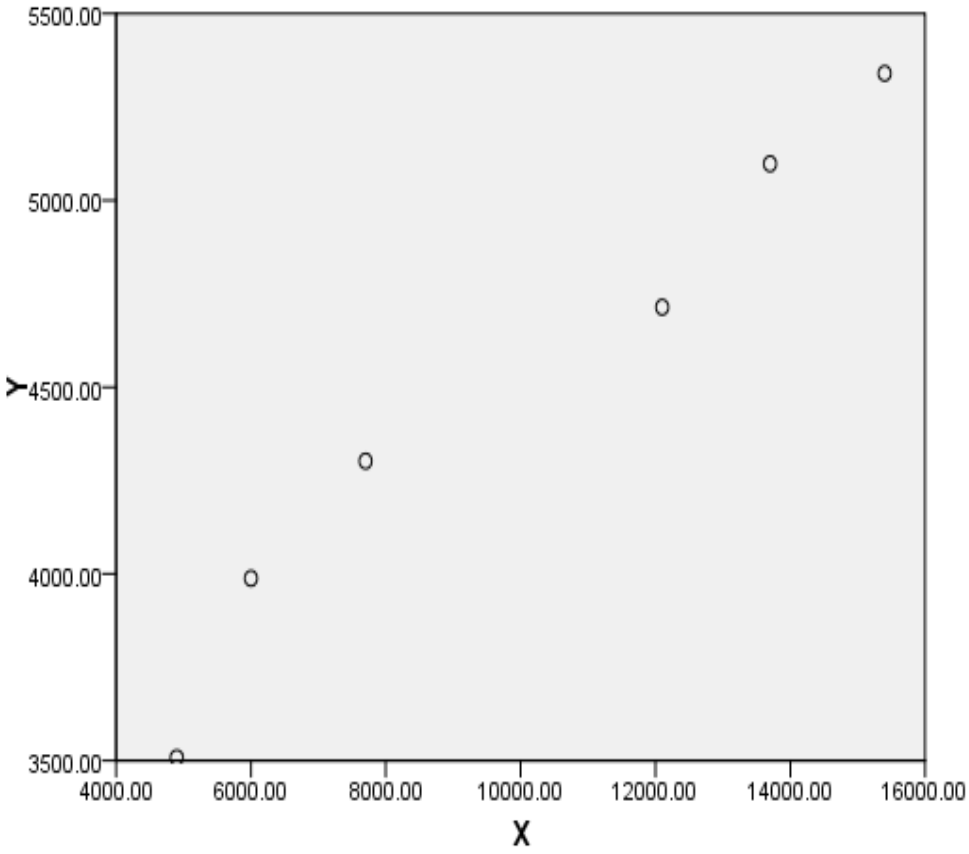

Figure 3 The scatter plot of technical standard number of chemical industry and total output of Jiangsu Provincial chemical industry

Notes：X means the total output of Jiangsu Provincial chemical industry（¥100 million）, and Y means the technical standard number of chemical industry（Piece）

Use SPSS software to make correlation analysis of the technical standard number of chemical industry and the total output of Jiangsu Provincial chemical industry in Table 8 and we can get Table 10. Therefore, it indicates the significant correlation.

The statistical analysis of SPSS19.0 software showed that the correlation coefficient r of the total output of Jiangsu Provincial chemical industry and the technical standard number of chemical industry is 0.981 (seen in Table 10).

According to the formula of the linear correlation coefficient r:

Table 10 Model Summary

Model Summary									
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.981a	.962	.953	150.21424	.962	102.097	1	4	.001
a. Predictors: (Constant), X b. Dependent Variable: y									

$$r=\frac{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)\left(y_i-\bar{y}\right)}{\sqrt{\sum_{i=1}^{n}\left(x_i-\bar{x}\right)^2\cdot\sum_{i=1}^{n}\left(y_i-\bar{y}\right)^2}} \quad (2)$$

$$=\frac{n\sum_{i=1}^{n}x_iy_i-\sum_{i=1}^{n}x_i\cdot\sum_{i=1}^{n}y_i}{\sqrt{n\sum_{i=1}^{n}x_i^2-\left(\sum_{i=1}^{n}x_i\right)^2}\cdot\sqrt{n\sum_{i=1}^{n}y_i^2-\left(\sum_{i=1}^{n}y_i\right)^2}}$$

We can calculate r=0.981, and 0.8<|r|. It proves that both the total output of Jiangsu Provincial chemical industry and the technical standard number of chemical industry have the highly linear correlation.

Linear regression analysis of total output of Jiangsu Provincial chemical industry and technical standard number of chemical industry

On the basis of correlation analysis, both the regression analysis of total output of Jiangsu Provincial chemical industry and technical standard number of chemical industry are calculated, so as to further study the relationship between these data (seen in Table 11).

Table 11 Coefficients analysis

Coefficients [a]						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2935.959	165.729		17.715	.000
	X	.156	.015	.981	10.104	.001
a. Dependent Variable: Y y=2935.959+0.156x						

The results of the regression analysis of the total output of Jiangsu Provincial chemical industry and the technical standard number of chemical industry display: regression coefficients a = -28046.235, b = 3.505 (seen in Table 11).

According to the regression equation, y=2935.959+0.156x. In the regression equation, X is regarded as the total output of Jiangsu Provincial chemical industry (¥100 million), and Y is regarded as the technical standard number of chemical industry (Piece).

Therefore, the linear relationship is good. By variance analysis, sig. = .001, which shows that the regression effect is significant (seen in Table 12).

Table 12 Regression coefficients

Anova[b]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2303738.065	1	2303738.065	102.097	.001[a]
	Residual	90257.269	4	22564.317		
	Total	2393995.333	5			

a. Predictors: (Constant), X. b. Dependent Variable: Y

Conclusions

Both the total output of chemical industry and the technical standard number of chemical industry in Jiangsu Province show the highly linear positive correlation. So Jiangsu Province should constantly strengthen the promotion of the technical standards to make the chemical industry's GDP better.

RESULTS AND CONCLUSIONS

Firstly, the relevant high-tech industries' technical standards promote the integration of independent intellectual property rights and the independent standards in the enterprises. The high-tech enterprises should actively explore the strategic pattern of the technical standards so as to promote the transformation and upgrading of information industry and chemical industry in Jiangsu Province.

Secondly, the high-tech industries' technical standards can greatly ease the disorder competition between different enterprises and different cities, which can regulate the internal order of the high-tech industries and form agglomeration effects within information industry and chemical industry in Jiangsu Province.

Thirdly, the high-tech industries' technical standards can integrate the strength of research and development in different enterprises within the industry. It can enhance the speed and efficiency of the emerging of the high-tech industrial enterprises' innovation, which can rapidly accelerate the pace of scientific research achievements transforming into the productive forces and guide enterprises to find their market positions in high-end industry in China.

Fourthly, "Standardization + enterprise scale + industrial clustering" is the development pattern of high-tech industries in Jiangsu Province. "Technology patent-patent standardization-standard market" is the development path of high-tech industries in Jiangsu Province. High-tech industries and enterprises can implement the technological innovation, patent creation, design and implementation of standards, which can fundamentally enhance the core competitiveness of enterprises and industry in Jiangsu Province.

In short, China and Jiangsu Province have respectively designed and implemented the high-tech industries' technical standards from the national level and local level. One the one hand, technical standards can enhance the quality and level of high-tech products in Jiangsu Province. On the other hand, they can accelerate the transformation and upgrading of high-tech industries in Jiangsu Province.

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