2023 9th International Symposium on Social Science (ISSS 2023)
ISBN: 978-1-60595-422-6

Research on the Effect of Product Quality Upgrading on Firms' Export Performance: Based on the Micro Evidence of Quality Awards, Well-known Trademarks and Quality Certification

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ABSTRACT

The existing literature lacks the classification of product quality upgrading levels and ignores the effect of product quality upgrading at different hierarchical levels on firms' export performance. Based on this, this paper takes Chinese manufacturing exporters as the research subjects, using panel fixed effects and instrumental variables methods, and empirically examines the effect of product quality upgrading (and product quality upgrading at different levels) on firms' export performance using the 2000-2013 China Import and Export Customs Database, the China Industrial Enterprises Database, and a self-curated product quality upgrading database. The results of the research show that the number of Chinese manufacturing exporters that have upgraded their product quality is increasing. The mean and the level of product quality upgrading are both constantly elevating. Product quality upgrading has a significant positive effect on export performance, and the positive effect of product quality upgrading on export performance is greater for high-level product quality upgrading than for low and medium-level product quality upgrading. The positive effect of product quality upgrading on export performance is greater for state-owned enterprises, small enterprises, and enterprises in central and western regions. The empirical results help to refine the understanding of the export growth effect brought by product quality upgrading and provide micro evidence for China's "Great Power of Quality" strategy.

INTRODUCTION

Since the reform and opening up, China has been actively integrating into the world market and expanding its exports. 2021 China's import and export scale reached US$6.05 trillion, eight years after it first reached US$4 trillion in 2013, and crossed two major steps of US$5 trillion and US$6 trillion during the year. Behind the great achievements of China's economy and trade, some worries should also be seen since the

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21st century, the instability of the global political and economic environment has increased, and the rise of trade protectionism and the wave of anti-globalization in the international arena has brought great challenges to the development of China's foreign trade. How to achieve sustainable growth in China's economy and trade? Product quality upgrading is the fundamental way out.

From the micro level, enterprises are the main body of product quality upgrading. Only through the quality of products is upgraded at the micro-enterprise level can we achieve high-quality development at the meso-industrial level and build China's strength in quality at the national macro level. So, have Chinese manufacturing enterprises upgraded their product quality and to what level? Further, what is the effect of product quality upgrading at different levels on the export performance of enterprises? Are there any differences among different groups? These questions have rarely been answered by scholars.

Therefore, this paper takes Chinese manufacturing export enterprises as the research object, defines the connotation of product quality upgrading, constructs the evaluation index system of product quality upgrading, theoretically analyses the effect mechanism of product quality upgrading on the export performance, empirically analyses the effect of product quality upgrading (and different levels of product quality upgrading) on the export performance, and propose targeted policy recommendations.

LITERATURE REVIEW

Product Quality Upgrading and Its Evaluation Indicators

At present, there are no unified connotation and evaluation indicators of product quality upgrading in the theoretical analysis, and the proxies for product quality upgrading selected in the empirical analysis also differ significantly. To summarize, there are three categories mainly: first, directly equating product quality with product quality upgrading, i.e., taking product quality as an indicator variable of product quality upgrading (Li et al. 2018; Su et al. 2018; Shen and Yu, 2019; Zhu and Tang, 2020) [1-4]. Most of the aforementioned scholars take the measured export product quality as a proxy for export product quality upgrading and use it as a dependent variable to explore the effects of various other independent variables such as FDI, industrial agglomeration, innovation, going public, productivity, financing constraints, government subsidies, etc. on export product quality upgrading. Second, there is also a small part of the literature, which uses dynamic changes in export product quality (e.g., product quality growth rate, average product quality growth rate) as an indicator variable for export product quality upgrading (Yu et al., 2019; Cheng and Ma, 2019) [5-6]. Third, using ISO 9000 quality certification as a proxy variable for product quality upgrading. One is to see whether the enterprise obtains ISO 9000, and if the enterprise obtains it, the product quality is upgraded and assigned a value of 1, and vice versa, the product quality is not upgraded and assigned a value of 0 (Verhoogen, 2008; Xin, 2019; Xin and Xin, 2019)[7-9]; the other is to count the enterprises from the industry level or national level, and an increase

in the number of enterprises obtaining ISO 9000 means that the product quality has been upgraded (Song and Xiong, 2001; Sun and Zhang, 2011)[10-11].

Issues that need to be further discussed: product quality upgrading reflects the dynamic change of product quality in an enterprise, so it is biased to equate product quality with dynamic product quality upgrading, and it is too one-sided to use only the acquisition of ISO 9000 or the number of ISO 9000 quality certifications as a proxy variable for product quality upgrading. The current research on product quality upgrading has only demonstrated the existence of product quality upgrading without defining the hierarchical levels of product quality upgrading (low-level upgrading, medium level upgrading, and high-level upgrading). Therefore, further research is needed to define the connotation of product quality upgrading, construct corresponding evaluation indicators, enrich the database of product quality upgrading of micro-enterprises, and measure the product quality upgrading status of Chinese manufacturing export enterprises.

Effect of Product Quality Upgrading on Firms' Export Performance

Most of the existing studies on product quality upgrading and international trade focus on the influencing factors of product quality upgrading, exploring the effects of intermediate goods imports, institutional factors, industrial agglomeration, and firm innovation on product quality upgrading. In the existing studies, product quality upgrading is a result rather than a cause, but it is clear that product quality upgrading also brings a series of economic consequences (Yu, 2018) [12]. Based on this, this paper focuses on the effect of product quality upgrading on firms' export performance. The current mainstream literature mostly uses the export value as a proxy variable for firms' export performance (Li et al., 2015; Geng and Shi, 2018) [13-14]. The increase in the export value of a firm implies an increase in the recognition of the firm's products in the international market and an increase in its market share. At the macro level, Schott (2004) [15] and Hummels and Klenow (2005) [16] confirm that the significant export growth in developing countries is caused by quality upgrading. Jaimovich and Merella (2012) [17] find that countries that export high-quality products also have faster growth in total exports than those that export low-quality products. At the industry level, Li et al. (2015a; 2015b) [18-19] point out that industry-level export quality improvement in China's manufacturing industry has a catalytic effect on industry growth, but the growth of different types of manufacturing industries is affected differently by export quality upgrading. At the micro level, Liu (2013) [20] points out that the quality of China's export products has a boosting effect on exports in general. Manova and Yu (2017) [21] point out that quality products have higher export sales.

Issues that need to be further discussed: Most of the current literature focuses on the measurement of product quality and the influencing factors of product quality upgrading, i.e., product quality upgrading as an "effect" rather than a "cause", and less literature focuses on the export growth effect of product quality upgrading as a "cause". Even if some literature focuses on the export performance of product quality upgrading, it is mainly at the macro and industry levels, and there is a lack of empirical studies at the

micro level. Therefore, further research is needed to empirically examine the effect of product quality upgrading (and different levels of product quality upgrading) on firms' export performance based on a micro firm-level product quality upgrading database.

THE CONNOTATION AND EVALUATION INDEX SYSTEM OF PRODUCT QUALITY UPGRADING

The Connotation of Product Quality Upgrading

In this paper, product quality upgrading refers to the qualitative leap of an enterprise's product quality from a lower to a higher grade over time. The meaning of product quality upgrading is as follows: within a certain time and space, the product quality of an enterprise reaches or exceeds a specific standard (e.g., national or international quality certification), or gains a certain recognized quality reputation or honor (e.g., obtaining national or international well-known trademarks, famous brand products, quality awards), then it is called product quality upgrading; otherwise, product quality is not upgraded.

The Evaluation Index System of Product Quality Upgrading

When constructing the evaluation index system for product quality upgrading, we should first clarify the quality sorting. The "Central Committee of the Communist Party of China State Council on the guidance of quality improvement action" released in September 2017 can provide ideas, the document pointed out that "Improve the national quality incentive policy, continue to carry out the national quality award selection and recognition, establish a quality benchmark, promote quality advanced. ..... to cultivate and grow national enterprises and well-known brands, guide enterprises to enhance the added value of products and services, strengthen the cultivation and protection of Chinese old brands, geographical indications and other brands, and enhance the visibility and reputation of Chinese brands. ..... improve the third-party quality evaluation system and carry out high-end quality certification." Therefore, this paper takes quality awards, well-known trademarks (famous brand products), and quality certification as evaluation indicators of export product quality upgrading.

QUALITY AWARDS

Product Quality Law of the People's Republic of China, Article 6 states that the country encourages the implementation of scientific quality management methods and encourages product quality to meet and exceed industry standards, national standards, and international standards. Advanced product quality to reach the international advanced level, significant achievements of enterprise, to reward. The law is both the legal basis for the establishment of China's quality awards and reflects the quality of the award-winning enterprises with advanced quality management levels, and advanced

product quality standards. Therefore, the quality awards can be used to measure the product quality upgrading of enterprises, and different levels of quality awards (provincial government quality award, national quality award, and the world's top three quality awards (Edward Deming Prize，1951; Malcolm Baldrige National Quality Award，1987; European Quality Award，1991）can also reflect the different levels of product quality upgrading.

WELL-KNOWN TRADEMARKS (FAMOUS BRAND PRODUCT)

A well-known trademark has three basic characteristics: firstly, it is a use trademark, which is publicly used after a certain period; secondly, it is recognized and accepted by the public; thirdly, the product quality it represents must be excellent and trusted by consumers. Famous brand products are manufactured by enterprises and have independent intellectual property rights, the physical quality of the product reaches or is close to the international advanced level, in the leading position in market share, a high degree of user satisfaction, with a strong market competitiveness of the product. Enterprises that have obtained the title of well-known trademarks and famous brand products can use the well-known trademarks and famous brand product quality marks in their products, packaging, decoration, manuals, advertising, and related materials. On the one hand, it indicates that the enterprise has excellent product quality and a sound management system; on the other hand, it can also form consumer stickiness, obtain price premium and improve business performance through trademark and brand reputation. Therefore, the acquisition of well-known trademarks and famous brand products is a reflection of the product quality upgrading, and different levels of well-known trademarks (provincial well-known trademarks, Chinese well-known trademarks, and world well-known trademarks) and famous brand products (provincial famous brand products, Chinese famous brand products, Chinese world-famous brand products and world-famous brand products) can also reflect different levels of product quality upgrading.

QUALITY CERTIFICATION

In the product market, to avoid adverse selection and moral risks, companies should send adequate, effective, and reliable quality signals. If the enterprise obtains the quality certification, it will establish a good reputation and brand image, while allowing consumers to identify the quality is safe and good, i.e., releasing quality signals to consumers (Terlaak and King, 2006; Potoski and Prakash, 2009; Goedhuys and Sleuwaegen, 2013) [22-24]. Therefore, the acquisition of quality certification can reflect product quality upgrading, and different levels of quality certification (Chinese product quality certification CCC certification, and international product quality certification ISO 9000) can also reflect different levels of product quality upgrading.

In summary, this paper uses quality awards, well-known trademarks (famous brand products), and quality certification as evaluation indicators for product quality upgrading. The evaluation indicators of product quality upgrading are shown in Table 1 below.

TABLE 1. EVALUATION INDEX OF PRODUCT QUALITY UPGRADE.

Variables	Symbols	Meaning
Product quality upgrading	QU	Obtained the provincial well-known trademarks (provincial famous brand products) QU=1, the provincial government quality award QU=2; the Chinese well-known trademarks (Chinese famous brand products) QU=3, the Chinese world famous brand products QU=4, the Chinese product quality certification QU=5, the national quality award QU=6; the world famous trademark (world famous brand product) QU=7, the international quality certification(ISO 9000) QU=8, the world's top three quality awards QU=9 . If an enterprise receives more than one quality honor at the same time, the one with the largest value is taken.
Low-level export product quality upgrading	LQU	Obtained the provincial well-known trademarks (provincial famous brand products) or get the provincial government quality award LQU take 1, otherwise take 0.
Mid-level export product quality upgrading	MQU	Obtained Chinese well-known trademarks (Chinese famous brand products, Chinese world-famous brand products) or Chinese product quality certification or national quality award MQU take 1, otherwise take 0.
High-level export product quality upgrading	HQU	Obtained the world well-known trademarks (world famous brand products) or international quality certification or the world's top three quality awards (Edward Deming Prize，1951; Malcolm Baldrige National Quality Award，1987; European Quality Award，1991）HQU take 1, otherwise take 0.

A STATISTICAL MEASUREMENT OF PRODUCT QUALITY UPGRADING OF CHINESE MANUFACTURING EXPORT ENTERPRISES

Data Sources

The research object of this paper is export enterprises, and the data are obtained from three major databases, the 2000-2013 Chinese Import and Export Customs Database collected by the Chinese Customs Office, the Chinese Industrial Enterprises Database collected by the Chinese National Bureau of Statistics, and the Chinese Export Product Quality Upgrading Database collected by the author.

For the treatment of the Chinese import and export customs database, this paper refers to the treatment of Fan and Guo (2015)[25], and Yu and Zhang (2017)[26]: the

first step removes observations with missing information, including observations with missing enterprise names, countries of origin and destination, HS product codes, etc.; the second step eliminates observations with trade amounts less than USD50 and transaction quantities less than 1; the third step, the observations of trade intermediaries are removed; the fourth step, the eight-digit Harmonized System of trade products from 2000-2013 are converted into six-digit Harmonized System, and then the six-digit Harmonized System of different versions of each year are uniformly converted to Harmonized System version of 1996; finally, the export enterprise data from 2000-2013 are retained.

For the treatment of the Chinese industrial enterprises database, this paper refers to the treatment of Brandt et al. (2017)[27], and Yang(2015)[28]: the first step eliminates observations with zero, negative or missing enterprise names, gross industrial output value, sales, capital stock, total assets, fixed assets, and employees, etc.; the second step eliminates observations with the number of employees less than or equal to eight; the third step eliminate observations with the survival age of enterprises less than 0; the fourth step eliminate observations with total assets less than fixed assets, total assets less than current assets, total assets less than net fixed assets, industrial value added greater than industrial sales value, etc.; finally, retain observations of manufacturing industries with industry codes 13-43.

To merge and match the Chinese import and export customs database and the Chinese industrial enterprise database, this paper refers to Fan and Guo (2015) [25]: the first step, enterprises with the same name and year are merged; the second step, enterprises with the same postal code and the same last seven digits of the telephone number are merged again.

According to the names of export enterprises from 2000-2013 obtained by the above merging and matching, the assignment of export product quality upgrading is carried out. Among them, the quality awards information obtained from the official website of the enterprise, the data platform of the provincial government, and the public documents of awards and recognition published by the provincial government and relevant competent departments in previous years; the well-known trademarks and famous brand products information obtained from the official website of the enterprise, the provincial market supervision administration, the provincial intellectual property office and the website of the well-known trademark; the quality certification information obtained from the official website of the enterprise, the national public service platform of certification and accreditation information, and the website of China Quality Certification Center. The Chinese export product quality upgrading database collected in this paper is a useful supplement to the existing micro database of Chinese industrial enterprises.

Through the above treatment, we finally obtained 417072 observations for 124332 exporters from 2000–2013.

The Overall Measurement of Product Quality Upgrading of Chinese Manufacturing Export Enterprises

The overall measurement results of product quality upgrading of Chinese manufacturing export enterprises from 2000 to 2013 are shown in Table 2. The number of Chinese manufacturing export enterprises achieving product quality upgrading is increasing, and the proportion of enterprises achieving product quality upgrading in the total sample increased from 3.09% in 2000 to 55.38% in 2013. The mean of product quality upgrading is also increasing, from 0.2319 in 2000 to 4.2231 in 2013. Among them, the number of enterprises with high-level product quality upgrading is the largest, followed by medium-level product quality upgrading and low-level product quality upgrading.

TABLE 2. PRODUCT QUALITY UPGRADING MEASUREMENT RESULTS OF CHINESE MANUFACTURING EXPORT ENTERPRISES FROM 2000-2013.

Year	Observations	Total number of product quality upgrading enterprises	Number of low-level product quality upgrading enterprises	Number of medium-level product quality upgrading enterprises	Number of high-level product quality upgrading enterprises	The mean of Product quality upgrading
2000	14694	454	9	33	412	0.2319
2001	17572	766	71	33	662	0.3113
2002	17864	1264	81	256	927	0.4861
2003	23177	2699	289	663	1747	0.7532
2004	15275	1864	192	454	1218	0.7912
2005	38056	6237	927	1384	3926	1.0230
2006	42800	8456	1240	1717	5499	1.2482
2007	46309	10582	1372	1846	7364	1.4907
2008	29855	7785	1029	1131	5625	1.7204
2009	26875	8231	952	1062	6217	2.0732
2010	31876	11173	1161	1062	8950	2.4395
2011	29446	13401	485	1108	11808	3.4044
2012	40579	21057	619	1453	18985	3.9292
2013	42694	23644	617	1421	21606	4.2231

AN EMPIRICAL STUDY ON THE EFFECT OF PRODUCT QUALITY UPGRADING ON THE EXPORT PERFORMANCE

Econometric Model Setting and Description of Variables

In this paper, the logarithm of the export value is taken as the explanatory variable and the product quality upgrading is taken as the core explanatory variable. The econometric model is established as follows.

$$\ln export_{it} = \beta_0 + \beta_1 QU_{it} + \Sigma_l \beta_l firmhete_{it} + \Sigma_n \beta_n control_{it} + u_i + u_t + \varepsilon_{it} \quad (1)$$

In equation (1), the subscripts i, t denotes firm and year, respectively; ui denotes firm fixed effects; ut denotes year fixed effects, and ε it is the random error term.

TABLE 3. DESCRIPTIVE STATISTICS OF THE MAIN VARIABLES IN THE MODEL.

Variables	Observations	Average value	Standard deviation	Minimum value	Maximum value
lnexport	417072	9.1224	2.1145	-1.1568	19.0698
QU	417072	1.9980	3.3689	0.0000	8.0000
LQU	417072	0.0217	0.1457	0	1
MQU	417072	0.0327	0.1778	0	1
HQU	417072	0.2276	0.4193	0	1
TFP	387024	6.0590	1.0698	-3.3430	14.0168
lnKL	405833	3.5514	1.4061	-6.3604	13.5569
scale1	417072	0.5934	0.4912	0	1
scale2	417072	0.3103	0.4626	0	1
scale3	417072	0.0856	0.2797	0	1
lnage	417072	2.1517	0.6663	0	5.1358
lnin	417072	1.3056	1.0179	0	6.6695
finance	385660	4.2021	3.3906	0	15.6622
fi	417072	0.2798	0.3504	0	1
sub	417072	0.3327	0.4712	0	1

Note: The presence of negative numbers and zeros causes some other variables to have missing samples and fewer observations during the calculation.

In the baseline regression analysis, the export value of enterprises from the Chinese import and export customs database is used, which is transformed using the current year's RMB-USD exchange rate and divided by 1000 so that the unit of measurement is thousand dollars. There are three main categories of explanatory variables: the first category is the core explanatory variable product quality upgrading QU. The second category is the firm heterogeneity variables firmhete, which includes: (1) total factor productivity TFP. This paper measures total factor productivity according to the LP method, ACF method, and Wooldridge method [29-31], respectively, which are noted as TFP, TFP_acf, and TFP_ wrdg, using TFP in the benchmark regression analysis， then TFP_acf and TFP_wrdg in the robustness analysis. (2) Capital intensity lnKL, which is measured by taking the logarithm of the ratio of net fixed assets to the number of

employees. (3) Enterprise scale lnscale, this paper generates three dummy variables scale1, scale2, and scale3 based on the classification criteria of large, medium, small, and micro enterprises released by the National Bureau of Statistics in 2017, which represent small, medium, and large enterprises, respectively, while micro enterprises are used as a benchmark reference. (4) Firm age lnage, which is measured by the present year minus the open year plus one, then taking the logarithm. (5) Enterprise innovation capability lnin, the current indicators to measure innovation capability mainly using R&D investment, new product output value, intangible assets, etc., but considering the above indicators in the database of Chinese industrial enterprises are missing more seriously after 2007. Therefore, this paper adopts the logarithm of enterprise export product categories from the China Import and Export Customs database to measure the innovation capability of enterprises. The more types of products exported by an enterprise, the higher the R&D efficiency of the enterprise. (6) Enterprise financing constraint finance, which is measured by the logarithm of interest expense plus one and the enterprise's gearing ratio, respectively, which are noted as finance and finance_ DAR, and is used in the baseline regression analysis as finance and in the robustness analysis as finance_ DAR. The third category is controlling variables control, which mainly includes: (1) foreign capital participation fi, which is measured by the ratio of foreign capital input to total assets of firms in this study. (2) government subsidy sub, which is a dummy variable, when the enterprise subsidy value is greater than zero, sub=1; otherwise sub=0. (3) enterprise-level dummy variable center, when the enterprise is directly under the central government, center=1; otherwise, it is a local enterprise, center=0. (4) enterprise ownership dummy variable ownership. when the enterprise is a foreign-invested enterprise, foreign=1; otherwise, it is a domestic-funded enterprise, foreign=0. When the enterprise is a state-owned enterprise, state=1; otherwise, it is a non-state-owned enterprise, state=0. (5) The enterprise location dummy variable region, this study divides the 31 provinces into eastern, central, and western regions according to the classification criteria of Sheng and Niu (2009) [32], generating 2 regional dummy variables region1 and region2, representing the central and eastern regions respectively, while the western region is used as the benchmark region.

The Effect of Product Quality Upgrading on Export Performance: A Benchmark Regression

In this paper, firstly, based on the F-test in the fixed-effects model, it is known that the fixed-effects model should be selected among the pooled regression model and the fixed-effects model; secondly, this study also conducts the random-effects estimation and passes the Hausman test, which shows that the fixed-effects model should be selected among the fixed-effects model and random-effects models. Therefore, for equation (1), this paper finally reports the estimation results of fixed effects as shown in Table 4.

Model 1 in Table 4 is the basic model, and its regression results show that product quality upgrading has a significant positive effect on export performance. A higher level of product quality upgrading of enterprises implies a higher level of quality reputation, consumer recognition, and quality management, which undoubtedly releases quality

signals to the export market and therefore brings an increase in export value. Total factor productivity has a significant positive effect on export performance. The higher total factor productivity of the firm implies that the higher output the firm can produce per unit of factor input, the higher the export competitiveness in the market, and thus the higher export value. Capital intensity has a significant positive effect on export performance. The higher the capital intensity, the more likely it is to achieve technological innovation and product quality upgrading, thus contributing to higher export value. Enterprise scale has a significant positive effect on export performance. The export value of large enterprises is higher than that of small, medium, and micro enterprises. Enterprise age has a negative but insignificant effect on export performance. Enterprise innovation capability has a significant positive effect on export performance. The financing constraints have a significant positive effect on export performance.

TABLE 4. BASELINE REGRESSION RESULTS OF PRODUCT QUALITY UPGRADING, FIRM HETEROGENEITY AND EXPORT PERFORMANCE.

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
QU	0.026*** (0.002)	0.026*** (0.002)	0.026*** (0.002)	0.026*** (0.002)	0.026*** (0.002)	0.026*** (0.002)
TFP	0.150*** (0.004)	0.151*** (0.004)	0.150*** (0.004)	0.150*** (0.004)	0.150*** (0.004)	0.150*** (0.004)
lnKL	0.046*** (0.004)	0.046*** (0.004)	0.045*** (0.004)	0.045*** (0.004)	0.045*** (0.004)	0.045*** (0.004)
scale1	0.264*** (0.033)	0.265*** (0.033)	0.264*** (0.033)	0.264*** (0.033)	0.264*** (0.033)	0.264*** (0.033)
scale2	0.494*** (0.035)	0.496*** (0.035)	0.493*** (0.035)	0.494*** (0.035)	0.493*** (0.035)	0.493*** (0.035)
scale3	0.688*** (0.039)	0.692*** (0.039)	0.686*** (0.039)	0.686*** (0.039)	0.686*** (0.039)	0.686*** (0.039)
lnage	0.051*** (0.010)	0.052*** (0.010)	0.051*** (0.010)	0.051*** (0.010)	0.051*** (0.010)	0.052*** (0.010)
lnin	0.825*** (0.007)	0.825*** (0.007)	0.824*** (0.007)	0.824*** (0.007)	0.823*** (0.007)	0.823*** (0.007)
finance	0.020*** (0.001)	0.020*** (0.001)	0.020*** (0.001)	0.020*** (0.001)	0.020*** (0.001)	0.020*** (0.001)
fi		0.081*** (0.011)	0.068*** (0.011)	0.068*** (0.011)	0.066*** (0.011)	0.065*** (0.011)
sub			0.088*** (0.006)	0.088*** (0.006)	0.088*** (0.006)	0.088*** (0.006)
center				-0.118 (0.078)	-0.118 (0.078)	-0.107 (0.078)
foreign					0.072*** (0.023)	0.071*** (0.023)
state						-0.041** (0.019)
constant	6.285*** (0.128)	6.265*** (0.128)	6.259*** (0.128)	6.258*** (0.128)	6.220*** (0.128)	6.222*** (0.128)
Region Effect	yes	yes	yes	yes	yes	yes
Enterprise Effect	yes	yes	yes	yes	yes	yes
Year Effect	yes	yes	yes	yes	yes	yes
Observations	358048	358048	358048	358048	358048	358048
R^2	0.247	0.247	0.248	0.248	0.248	0.248

Note: Data in square brackets under the estimated coefficients are the standard deviations of clustering at the firm level; ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

Model 2 adds foreign participation to the basic model 1, and the regression results of model 2 show that foreign participation has a significant positive effect on export performance.

Model 3 further adds the government subsidy variable, and the regression results of model 3 show that the export value of enterprises that receive government subsidies is significantly higher than that of enterprises that do not receive government subsidies.

Model 4 further adds the enterprise-level variable, and the regression results from model 4 show that: compared with local enterprises, the enterprises directly under the central government do not have a significant advantage in terms of export value.

Model 5 further adds the enterprise ownership variable (foreign-invested vs. domestic enterprises), and the regression results of model 5 show that: the export value of foreign-invested enterprises is significantly higher than that of domestic enterprises.

Model 6 further adds the enterprise ownership variable (state-owned vs. non-state-owned enterprises), and the regression results of model 6 show that the export value of state-owned enterprises is significantly lower than that of non-state-owned enterprises.

Robustness Test

ENDOGENOUS PROBLEMS AND THE TREATMENT

When estimating fixed effects in equation (1), there may be an endogenous problem between product quality upgrading and export value. A higher level of product quality upgrading means that an enterprise has advanced quality management, has reached advanced product quality standards, or has gained some kind of recognized quality reputation or honor, which enables consumers to identify and purchase goods through quality awards, well-known trademarks, famous brand products, certification marks, etc. Therefore, the export value of an enterprise increases. On the other hand, the higher the export value, the more the enterprise has the strength to invest in R&D innovation, build a brand and trademark, implement high-end quality certification, etc. Therefore, the product quality upgrading will be higher. In addition, there may be a mutual influence relationship between total factor productivity TFP and export value. Therefore, in this paper, the product quality upgrading QU and total factor productivity TFP are taken as endogenous variables, the corresponding instrumental variables are constructed, and other enterprise heterogeneity characteristics variables and control variables are regarded as exogenous variables.

In constructing instrumental variables for product quality upgrading QU, this paper follows the idea of Liu et al. (2018) [33] of using industry-level indicator variables as instrumental variables for firm-level endogenous variables and uses the industry's product quality upgrading (in addition to itself) and the proportion of firms in the industry that achieve high-level product quality upgrading (in addition to itself) as instrumental variables. The reason is that if the industry's product quality upgrading is

high, it will bring competitive pressure to enterprises in the industry whose product quality is not upgraded or upgraded at a low level, and the "competition effect" will force them to improve technology, obtain quality certification, building the famous brand, win government quality award and then achieve product quality upgrading. Therefore, the instrumental variables at the industry level affect the enterprises in the industry, while the enterprises as a small part of the industry, have less effect on the industry-level product quality upgrading. In constructing the instrumental variables for total factor productivity TFP, this paper uses the first order lagged TFP as the instrumental variable.

TABLE 5. REGRESSION RESULTS FOR INSTRUMENTAL VARIABLES.

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
QU	0.269***	0.269***	0.268***	0.268***	0.268***	0.268***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
TFP	0.204***	0.205***	0.204***	0.204***	0.203***	0.203***
	(0.015)	(0.0146)	(0.015)	(0.015)	(0.015)	(0.015)
lnKL	0.025***	0.025***	0.025***	0.025***	0.025***	0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
scale1	0.276***	0.277***	0.277***	0.277***	0.277***	0.277***
	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
scale2	0.432***	0.433***	0.433***	0.433***	0.432***	0.432***
	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)	(0.044)
scale3	0.586***	0.587***	0.585***	0.585***	0.585***	0.585***
	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)	(0.049)
lnage	-0.010	-0.010	-0.010	-0.010	-0.010	-0.009
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
lnin	0.678***	0.678***	0.677***	0.677***	0.677***	0.677***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
finance	0.011***	0.011***	0.011***	0.011***	0.011***	0.011***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
fi		0.035**	0.030**	0.029**	0.029**	0.029**
		(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
sub			0.039***	0.039***	0.039***	0.040***
			(0.008)	(0.008)	(0.008)	(0.008)
center				-0.043	-0.043	-0.039
				(0.083)	(0.083)	(0.084)
foreign					0.016	0.016
					(0.027)	(0.027)
state						-0.012
						(0.021)
constant	6.177***	6.158***	6.159***	6.159***	6.151***	6.151***
	(0.239)	(0.239)	(0.239)	(0.239)	(0.239)	(0.239)
Region Effect	yes	yes	yes	yes	yes	yes
Enterprise Effect	yes	yes	yes	yes	yes	yes
Year Effect	yes	yes	yes	yes	yes	yes
Kleibergen-Paap rk LM statistic	381.871***	382.557***	382.346***	382.320***	382.268***	381.880***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Kleibergen-Paap rk Wald F statistic	128.199	128.431	128.355	128.345	128.327	128.194
	{13.43}	{13.43}	{13.43}	{13.43}	{13.43}	{13.43}
Hansen J statistic	0.201	0.204	0.222	0.220	0.220	0.221
Observations	177029	177029	177029	177029	177029	177029

Note: The data in square brackets below the estimated coefficients are the standard deviations of firm-level clustering; ***, **, and * represent the 1%, 5%, and 10% significance levels, respectively; the values in square brackets below the Kleibergen-

Paap rk LM statistic are the companion probability values, i.e., the p-values, with the original hypothesis being "there is an under identification problem" The values in brackets below the Kleibergen-Paap rk Wald F statistic are the critical values at the 10% level of the Stock-Yogo test, with the original hypothesis that "instrumental variables are strongly correlated with endogenous variables"; the Hansen J statistic reports the companion probability values, i.e., the p-values, with the original hypothesis that "all instrumental variables are exogenous".

After constructing the instrumental variables, this paper used the panel instrumental variables method to estimate equation (1), and the estimation results are shown in Table 5.

After adopting instrumental variables to further overcome the endogeneity problem, the sign and significance of the estimated coefficients of *QU* in Table 5 remain substantially unchanged. The estimated results for the firm heterogeneity variables and the control variables also remain largely consistent, reflecting that the baseline regression results in the previous section are reliable and that the possible theoretical endogeneity problem due to "reciprocal causality" does not substantially affect the estimation results.

CHANGE THE EXPLANATORY VARIABLES

The export value which is from the Chinese industrial enterprises' database now was used as a proxy variable for the explanatory variable *lnexport*, and the regression of equation (1) was performed, and the results are shown in Table 6. The regression results of model 1 in Table 6 show that the estimated coefficients of the core explanatory variable product quality upgrading *QU* are all significantly positive at the 1% level, which is consistent with the baseline regression results; the sign and significance of the regression coefficients of the firm heterogeneity characteristics variables also do not change substantially; the estimated results of the control variables also remain largely consistent, indicating that the conclusions drawn are robust.

CHANGE THE FIRM HETEROGENEOUS CHARACTERISTIC VARIABLES

TABLE 6. REGRESSION RESULTS OF CHANGING THE EXPLANATORY VARIABLES AND FIRM HETEROGENEITY CHARACTERISTICS VARIABLES.

Explanatory variables	Changing the explanatory variables	Change the heterogeneous characteristics of the enterprise variable	
	Model 1	Model 2	Model 3
QU	0.022***(0.002)	0.026***(0.002)	0.025***(0.002)
TFP	0.233***(0.004)		
TFP_acf		0.133***(0.004)	
TFP_wrdg			0.161***(0.004)
lnKL	0.067*** (0.004)	0.056***(0.004)	0.058***(0.004)
scale1	0.329***(0.034)	0.310***(0.033)	0.262*** (0.033)
scale2	0.625***(0.036)	0.588***(0.034)	0.511***(0.034)

scale3	0.957***(0.040)	0.832***(0.039)	0.723***(0.039)
lnage	0.104***(0.010)	0.073***(0.010)	0.064***(0.010)
lnin	0.520***(0.006)	0.827***(0.007)	0.823***(0.007)
finance	0.024***(0.001)		
finance_DAR		0.105***(0.013)	0.109***(0.013)
fi	0.005(0.011)	0.043***(0.011)	0.052***(0.011)
sub	0.066***(0.006)	0.097***(0.006)	0.095***(0.006)
center	-0.055(0.077)	-0.092(0.072)	-0.096(0.072)
foreign	0.052**(0.022)	0.081***(0.023)	0.077***(0.023)
state	-0.045**(0.018)	-0.045**(0.019)	-0.045**(0.019)
constant	6.412***(0.120)	6.434***(0.131)	6.122***(0.132)
Region Effect	yes	yes	yes
Enterprise Effect	yes	yes	yes
Year Effect	yes	yes	yes
Observations	358048	366803	366803
R^2	0.191	0.248	0.251

Note: The data in square brackets under the estimated coefficients are the standard deviations of firm-level clustering; ***, **, and * represent the 1%, 5%, and 10% significance levels, respectively.

The regression of equation (1) by changing the measures of total factor productivity TFP and financing constraint FINANCE is shown in Table 6. The regression results of model 2 and model 3 in Table 6 show that the estimated coefficients of the core explanatory variable product quality upgrading QU are all significantly positive at the 1% level, which is consistent with the baseline regression results; the sign and significance of the regression coefficients of the firm heterogeneity characteristics variables also do not change substantially; the estimated results of the control variables also remain largely consistent, indicating that the conclusions drawn are robust.

Regression in Groups

ENTERPRISES OF DIFFERENT OWNERSHIP

In this paper, grouped regressions are estimated for foreign-invested, state-owned, and private enterprises. The regression results from model 1 to model 3 in Table 7 show that product quality upgrading has a significant positive effect on the export performance of foreign-invested, state-owned, and private enterprises, and the positive effect of state-owned firms is greater, followed by private enterprises and foreign-invested enterprises.

ENTERPRISES OF DIFFERENT SCALE

In this paper, grouped regressions are estimated for large, medium, small, and micro-enterprises. The regression results from model 4 to model 7 in Table 7 show that product quality upgrading has a significant positive effect on the export performance of large, medium, and small enterprises, and the positive effect of small enterprises is greater,

followed by medium enterprises and large enterprises. The estimated coefficient of product quality upgrading is positive but insignificant in the micro-enterprise group.

ENTERPRISES OF DIFFERENT REGION

In this paper, grouped regressions are estimated for enterprises in the eastern, central, and western regions. The regression results from models 8 to 10 in Table 7 show that product quality upgrading has a significant positive effect on the export performance of enterprises in the eastern, central, and western regions, and the positive effect is higher in the central and western regions, relatively smaller in the eastern region.

TABLE 7. REGRESSION RESULTS OF ENTERPRISES OF DIFFERENT OWNERSHIP, CALE AND REGION.

Explanatory variables	Different ownership			Different scale				Different region		
	Foreign Invested	State-owned	Private	Large	Medium	Small	Micro	East	Middle	West
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
QU	0.023*** (0.002)	0.032*** (0.010)	0.026*** (0.003)	0.009** (0.004)	0.020*** (0.003)	0.029*** (0.002)	0.030 (0.026)	0.025*** (0.002)	0.038*** (0.009)	0.036*** (0.013)
TFP	0.149*** (0.005)	0.114*** (0.023)	0.149*** (0.008)	0.174*** (0.013)	0.156*** (0.009)	0.141*** (0.005)	0.054 (0.038)	0.153*** (0.004)	0.105*** (0.019)	0.112*** (0.028)
lnKL	0.032*** (0.005)	0.075*** (0.025)	0.026*** (0.007)	0.100*** (0.014)	0.073*** (0.008)	0.030*** (0.005)	0.038 (0.038)	0.045*** (0.004)	0.046*** (0.018)	0.017 (0.027)
scale1	0.285*** (0.042)	-0.085 (0.226)	0.224*** (0.059)					0.259*** (0.035)	0.249** (0.119)	0.454** (0.194)
scale2	0.528*** (0.044)	0.181 (0.240)	0.400*** (0.061)					0.490*** (0.036)	0.389*** (0.127)	0.775*** (0.207)
scale3	0.756*** (0.049)	0.319 (0.251)	0.606*** (0.075)					0.680*** (0.041)	0.636*** (0.151)	0.983*** (0.229)
lnage	0.147*** (0.015)	0.024 (0.037)	0.056*** (0.018)	0.026 (0.021)	0.018 (0.020)	0.088*** (0.014)	0.143 (0.222)	0.055*** (0.011)	0.077* (0.041)	-0.064 (0.057)
lnin	0.744*** (0.009)	1.069*** (0.034)	0.881*** (0.011)	0.943*** (0.012)	0.798*** (0.013)	0.792*** (0.008)	0.813*** (0.083)	0.817*** (0.007)	0.906*** (0.031)	0.923*** (0.044)
finance	0.014*** (0.002)	0.026*** (0.007)	0.019*** (0.002)	0.016*** (0.003)	0.015*** (0.002)	0.023*** (0.002)	0.001 (0.019)	0.019*** (0.001)	0.026*** (0.006)	0.028*** (0.010)
constant	6.712*** (0.185)	5.781*** (0.405)	5.287*** (0.214)	7.051*** (0.642)	7.056*** (0.181)	6.219*** (0.219)	6.874*** (0.572)	6.026*** (0.056)	5.549*** (0.229)	5.237*** (0.354)
Region Effect	yes	yes	yes	yes	yes	yes	yes	no	no	no
Industry Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Enterprise Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year Effect	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Observations	203788	14355	114263	31526	115174	208122	3226	329074	19169	9735
R^2	0.221	0.292	0.302	0.283	0.224	0.224	0.228	0.250	0.240	0.232

Note: The data in square brackets under the estimated coefficients are the standard deviations of firm-level clustering; ***, **, and * represent the 1%, 5%, and 10% significance levels, respectively.

FURTHER RESEARCH

What is the effect of product quality upgrading at different levels on firms' export performance? For this purpose, the following econometric model is set up.

$$\ln export_{it} = \beta_0 + \beta_1 LQU_{it} + \beta_2 MQU_{it} + \beta_3 HQU_{it} + \Sigma_l \beta_l firmhete_{it} + \Sigma_n \beta_n control_{it} + u_i + u_t + \varepsilon_{it} \quad (2)$$

In equation (2), the core explanatory variables are firms' product quality upgrading levels, including low-level product quality upgrading LQU, medium-level product quality upgrading MQU, and high-level product quality upgrading HQU. The explanatory variables, firm heterogeneity characteristics variables, and control variables are the same as above.

Equation (2) is estimated using the fixed effects estimation method and the results are shown in Table 8. The regression results in Table 8 show that low-level product quality upgrading, medium-level product quality upgrading, and high-level product quality upgrading all have significant positive effects on export performance, and the positive effect of high-level product quality upgrading on export performance is greater, i.e., if a company obtains a world-famous trademark (world famous brand product) or ISO 9000 or world top three quality awards, it can enhance export performance to a greater extent. Low-level product quality upgrading has the next highest positive effect on export performance. The positive effect of medium-level product quality upgrading on export performance is relatively small.

TABLE 8. REGRESSION RESULTS OF PRODUCT QUALITY UPGRADING LEVELS, FIRM HETEROGENEITY AND EXPORT PERFORMANCE.

Explanatory variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LQU	0.199***	0.198***	0.196***	0.196***	0.196***	0.196***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
MQU	0.106***	0.107***	0.105***	0.105***	0.105***	0.105***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
HQU	0.217***	0.216***	0.214***	0.214***	0.214***	0.214***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
TFP	0.150***	0.151***	0.150***	0.150***	0.150***	0.150***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
lnKL	0.046***	0.045***	0.045***	0.045***	0.045***	0.045***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
scale1	0.262***	0.264***	0.263***	0.263***	0.263***	0.263***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
scale2	0.491***	0.494***	0.491***	0.491***	0.491***	0.491***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
scale3	0.685***	0.689***	0.683***	0.683***	0.683***	0.683***
	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)	(0.039)
lnage	0.051***	0.053***	0.051***	0.051***	0.052***	0.053***

	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
lnin	0.825***	0.825***	0.823***	0.823***	0.823***	0.823***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
finance	0.020***	0.020***	0.020***	0.020***	0.020***	0.020***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
fi		0.080***	0.068***	0.068***	0.066***	0.065***
		(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
sub			0.087***	0.087***	0.088***	0.088***
			(0.006)	(0.006)	(0.006)	(0.006)
center				-0.118	-0.118	-0.106
				(0.078)	(0.078)	(0.078)
foreign					0.071***	0.070***
					(0.023)	(0.023)
state						-0.041**
						(0.019)
constant	6.289***	6.269***	6.263***	6.263***	6.225***	6.227***
	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)
Region Effect	yes	yes	yes	yes	yes	yes
Industry Effect	yes	yes	yes	yes	yes	yes
Enterprise Effect	yes	yes	yes	yes	yes	yes
Year Effect	yes	yes	yes	yes	yes	yes
Observations	358048	358048	358048	358048	358048	358048
R^2	0.247	0.248	0.248	0.248	0.248	0.248

Note: Data in square brackets under the estimated coefficients are the standard deviations of clustering at the firm level; ***, **, and * represent 1%, 5%, and 10% significance levels, respectively.

CONCLUSIONS AND POLICY RECOMMENDATIONS

This paper defines the connotation of product quality upgrading, constructs the evaluation index system of product quality upgrading, divides the three levels of product quality upgrading, reveals the influence mechanism of product quality upgrading on the export performance, empirically analyses the influence of product quality upgrading on the export performance of enterprises, and obtains the following conclusions: (1) The number of Chinese industrial enterprises that have upgraded their product quality from 2000 to 2013 is increasing, and the mean and the level of product quality upgrading are increasing. (2) Product quality upgrading has a significant positive effect on the export performance of enterprises, but there are some differences among enterprises of different ownership, different scales, and different regions. The positive effect of product quality upgrading on export performance is greater for high-level product quality upgrading than for low-level product quality upgrading and medium-level product quality upgrading; the positive effect of product quality upgrading on export performance is greater for state-

owned enterprises than for private and foreign enterprises; the positive effect of product quality upgrading on export performance is greater for small enterprises than for medium and large enterprises, and the effect of product quality upgrading on export performance is not significant for micro-enterprises. The positive effect of product quality upgrading on the export performance of enterprises in central and western regions is greater than that of enterprises in eastern regions. (3) Total factor productivity of enterprises, capital intensity, enterprise scale, the innovation capacity of enterprises, financing constraints, foreign investment participation, and government subsidies all have significant positive effects on export performance.

The policy implications of this paper are as follows: (1) Enterprises should continuously upgrade product quality, take the initiative to participate in the selection of quality awards, actively build well-known trademarks and brand reputation through advertising, marketing promotion, social welfare, etc., and carry out ISO 9000 quality certification. (2) Enterprises should continue to improve the capital intensity, actively attract foreign investment, increase R%D, and improve productivity. (3) Government should further increase the subsidies to Chinese industrial enterprises within the scope of WTO rules. In addition, the government and the community should strengthen the promotion of quality-leading enterprises and mobilize and protect the enthusiasm of enterprises for quality innovation and quality upgrading.

ACKNOWLEDGEMENTS

Fund project: "Research on the economic effects of product quality upgrading: micro evidence based on government quality awards, well-known trademarks and quality certification" (GD20XYJ08), a project of the 13th Five-Year Plan of Guangdong Provincial Philosophy and Social Sciences.

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