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# IMPORT SOPHISTICATION AND ENVIRONMENTAL POLLUTION IMPROVEMENT: EVIDENCE FROM FIRM-LEVEL POLLUTION DATA IN CHINA

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Abstract. *Trade and environment are important issues closely related to the development of the national economy and the improvement of people's livelihood in the new era. Using China's industrial enterprises' pollution data and the Chinese industrial enterprises' data from 2000 to 2012, this paper systematically examines the impact of import sophistication on China's environmental pollution and its transmission mechanism from the micro-enterprise level. The research results show that import sophistication significantly reduces environmental pollution in China. After considering sample selection bias, the endogenous nature of variables, and the use of different measurement indicators, the core conclusions of this article are still valid. In non-exporting enterprises, processing trade enterprises, low energy-consumption enterprises, foreign-funded enterprises, and enterprises in the eastern region, import sophistication plays a more significant role in reducing the environmental pollution. In addition, an intermediary effect model is constructed to examine how import sophistication affects enterprises' pollution emissions. It is found that the "technology spillover effect" and "competition effect" brought about by import sophistication are two channels to reduce environmental pollution.*
**Keywords:** Import sophistication, Environmental pollution, Technology spillover effect, Competition effect, Mediating effect model

1. **Introduction.** The research on the relationship between trade and environmental pollution has always been a hot and key issue in the cross field of trade economics and environmental economics, but the conclusions of the existing studies are not consistent. Some scholars support the "Pollution Haven Hypothesis" (PHH), which states that trade causes environmental degradation in developing countries. Specifically, trade causes the transfer of polluting industries from developed to developing countries, for example, Low and Yeats [1], Lucas et al. [2], Shen [3], Zhang [4], Li and Qi [5]. Other scholars believe that trade can significantly reduce environmental pollution in developing countries through technological or allocation effects, such as Antweiler et al. [6], Liddle [7], Shen and Tang [8], Li and Lu [9], Lin and Liu [10], Cherniwchan [11], Shapiro and Walker [12], Chen [13] and Liu [14]. The existing literature has carried out a rich exploration of the relationship between trade and environmental pollution, but macro (transnational or industrial) data is basically used to study the impact of trade on environmental pollution, while micro data research is scarce [11,13,15]. At the same time, in terms of import trade, few kinds of literature specifically explore the impact of import sophistication on environmental pollution, which is of great practical significance in the current context.

The Ministry of Commerce and other departments put forward the policy measures of expanding imports to promote balanced development of foreign trade from four aspects in the Opinions on Expanding Imports to Promote Balanced Development of Foreign Trade.

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President Xi Jinping declared at the opening ceremony of the 4th China International Import Expo in November 2021 that China will continue to put the expansion of imports in an important position and increase imports from neighboring countries. Through import trade, domestic enterprises can learn and absorb foreign advanced technologies and experiences to further promote the improvement of the technology of energy conservation and emission reduction, which is an important reflection of the import effect. For example, Wang and Chen [16] found that import and export trade significantly promoted the improvement of energy efficiency and reduced pollution. Li and Ding [17] found that imported technology spillovers improved energy efficiency at the industry level and contributed to energy conservation and emission reduction. Fang and Xia [18] believed that there is a significant double threshold effect between import diversity and energy efficiency. Therefore, it will be an inevitable trend to promote import trade in the future, and import will also become an important issue in the research of China's economic development. In this context, it will be of great practical significance to explore the impact of import sophistication on environmental pollution.

Through the review of the current literature on the relationship between international trade and environmental pollution, it can be found that the existing research has the following typical defects. First, most of the existing studies measure environmental pollution from the macro level, such as the provincial level or the industry level. This measurement method cannot reflect the heterogeneity of enterprises, and may also have the error of summing up. Researches from the micro perspective are relatively scarce. Second, when exploring the relationship between international trade and environmental pollution in China, the existing studies have not explored the impact of import effect on environmental pollution from the perspective of import sophistication. Third, the existing research rarely deals with the test of the impact mechanism, and it is difficult to explain the internal mechanism of international trade affecting environmental pollution on a deeper level.

This paper may enrich and expand the existing research in the following aspects. First, existing studies rarely use micro-enterprise data when exploring the impact of trade on environmental pollution, and there is a lack of research on the impact of trade on China's environmental pollution based on micro-enterprise data. Based on the combination of data on Chinese industrial enterprises and pollution data from Chinese industrial enterprises, this paper systematically investigates the impact of import sophistication on China's environmental pollution and its transmission mechanism from the micro-enterprise level. The results show that enterprises' import sophistication significantly reduces China's environmental pollution. Second, this paper constructs a mediating effect model to explore the channel path through which import sophistication affects environmental pollution. It is found that import sophistication reduces environmental pollution through two channels: the "technology spillover effect" and the "competition effect", which makes up for the lack of research on impact mechanism testing in current studies.

## 2. **Theoretical and Mechanism Analysis.**

According to the existing literature, the impact of import sophistication on environmental pollution is mainly through the technology spillover effect and competition effect.

### 2.1. **Technology spillover effect.**

Products with high technical complexity contain advanced production technology and experience from exporting countries. Importing countries can improve their productivity and technological level by learning, absorbing, and improving the advanced technology and knowledge implied by these products. Coe and Helpman [19] found that in import trade, international technology spillovers would promote the total factor productivity of importing countries. Jiang and Feng [20] found that import trade produced significant technology spillover effects through empirical tests.

The improvement of technology promotes the use efficiency of the input factors, and then improves the energy utilization efficiency of enterprises, achieves the effect of energy saving and emission reduction, and reduces environmental pollution, which is the so-called "technology spillover effect". Klein and Robison [21] conducted empirical tests using data at the industry level of the United States and found that the technological progress of American enterprises promoted the improvement of energy efficiency. Lin and Polenske [22] conducted empirical tests based on China's time series data and found that technological progress promoted the improvement of energy efficiency, and the main channel of energy efficiency improvement was the progress of the technological level. Li and Zhou [23] also believed that technological progress improves the energy efficiency of enterprises and thus reduces environmental pollution through research.

2.2. **Competition effect.** The import of advanced products with high technical complexity will bring competitive pressure to domestic enterprises, while competition is conducive to promoting the improvement of innovation level [24]. Because in the face of import competition, domestic enterprises will strive to expand the R&D to promote the development of new products, that is, the fierce competition environment created by the influx of advanced imported products into the domestic market will stimulate domestic enterprises to increase investment in R&D to enhance the level of technological innovation, and capture more market, and the upgrading of technological innovation level is beneficial to promote the efficiency of energy, which is conducive to energy saving and emission reduction and pollution reduction. At the same time, to maintain or expand the original market, the domestic enterprises will also use cracking methods such as reverse engineering when importing high technological complexity products to apply the R&D and advanced technologies contained in high technological complexity imported products to the production and manufacturing of native products [25], thus promoting the energy efficiency of ascension, to reduce pollution.

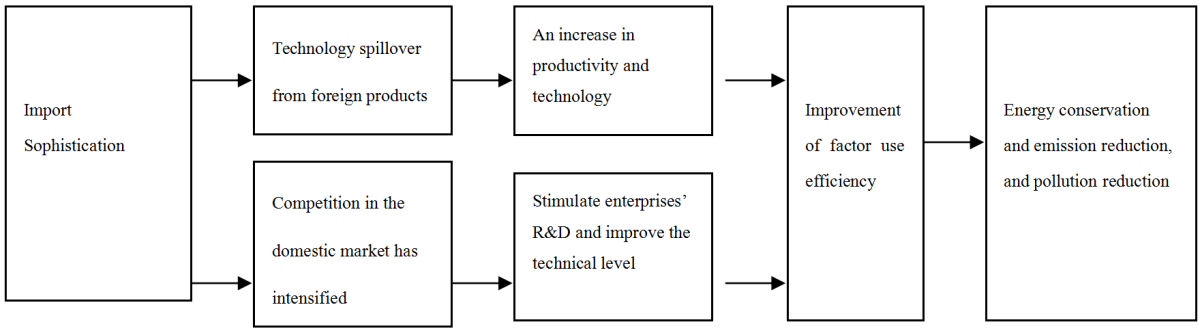


FIGURE 1. Mechanism diagram of import sophistication affecting enterprises' environmental pollution

## 3. Empirical Model, Index Measure, and Data Source.

3.1. **Empirical model setting.** This research focuses on the impact of enterprises' import sophistication on environmental pollution. The econometric model is set up by referring to relevant literature as follows:

$$SO_{2,fit} = \alpha + \beta \cdot IS_{ft} + \gamma X_{fit} + \delta_t + \delta_i + \delta_r + \varepsilon_{fit} \tag{1}$$

The subscript $f$ stands for the enterprise, $i$ stands for the industry, $t$ stands for the year and $r$ stands for the region. $SO_{2,fit}$ stands for the sulfur dioxide emissions of enterprises[1], and takes the natural logarithm in regression, and $\alpha$ is the intercept term. $IS_{ft}$ stands for the import sophistication of enterprises, and takes the natural logarithm in regression,

[1]Other pollution emissions are used as explained variables for robustness analysis.

and $\beta$ represents the impact of import sophistication on environmental pollution. $X_{fit}$ stands for the control variables at the firm level, and $\gamma$ represents the influence degree of the index composed of control variables on environmental pollution. Control variables at the enterprise level include enterprises' scale (*scale*), represented by the natural logarithm of total industrial output value; financing constraint (*Loan*), expressed by the ratio of accounts receivable and fixed assets, and the natural logarithm is used in the regression; state-owned enterprises dummy variable (*State*), the value of state-owned enterprises is 1, the value of non-state-owned enterprises is 0; dummy variable (*Fdi*) for foreign enterprises, the value of which is 1 for foreign enterprises and 0 for local enterprises; enterprises' age (*Age*), represented by the natural logarithm of the difference between the current year and the year of enterprises' establishment; capital intensity (*Capital*), expressed as the ratio of fixed assets to the number of employees, and the natural logarithm is taken in regression. In addition, considering that the omission of explanatory variables in the empirical model will lead to bias in the regression results, to effectively reduce the bias, this paper also controls the non-observed fixed effects such as year-fixed effects $\delta_t$, industry-fixed effects $\delta_i$, and region-fixed effects $\delta_r$, which are random disturbance terms. All data of control variables are from China Industrial Enterprise Database.

3.2. **Import sophistication index measurement.** Based on the research ideas of Hausmann et al. [26] and Liu et al. [27], the import sophistication index of enterprises was measured. Firstly, the sophistication at the product level is measured, and the specific calculation is made using the export data of countries in the CEPII-BACI database. Then, the sophistication at the product level is combined with the trade database of China Customs to calculate the import sophistication at the firm level.

3.3. **Data use and description.** This paper uses four sets of data, including the China Industrial Enterprise Database, China Customs Trade Database, China Industrial Enterprise Environmental Statistics, and CEPII-BACI Database, and the study period is 2000-2012. In view of the availability of micro-enterprise pollution data, the research data in this paper is only used until 2012. At present, it is a common phenomenon in the academic circle to use earlier data for current problems, and no special explanation has been found in relevant literature of top journals on the use of earlier data, such as Cherniwchan [11], and Chen [13]. The use of earlier data, which is a long time away from now, may indeed not be universal and may not be of practical significance to some extent. However, the research conclusions obtained are of theoretical significance to some extent and can be used as a guide and reference for the future reality, so the research is feasible.

## 4. Empirical Test.

4.1. **Benchmark regression results.** The benchmark regression results of import sophistication affecting enterprises' $SO_2$ emissions are listed in Table 1. To investigate the robustness of the results, columns (1) to (7) in Table 1 are the benchmark regression results obtained by adding control variables step by step. In column (1) of Table 1, only the influence of import sophistication is considered. The results show that the estimated coefficient of the variable of import sophistication is negative and passes the significance level of 5%, which preliminarily indicates that import sophistication significantly reduces $SO_2$ emissions of enterprises. Columns (2) to (7) are the regression results after gradually adding control variables. The regression coefficients of import sophistication variables in each column are still all significantly negative. It can be found that the significant negative effect of import sophistication on $SO_2$ emissions of enterprises is robust. In addition, consistent with the conclusions of most studies on environmental pollution, the regression results of the control variables did not change much.

Table 1. Benchmark regression results

| Variable | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| $IS_{ft}$ | −0.0522** | −0.1048*** | −0.1011*** | −0.0968*** | −0.084*** | −0.07890*** | −0.0898*** |
| | (0.0256) | (0.0237) | (0.0237) | (0.0236) | (0.0236) | (0.0235) | (0.0235) |
| *Scale* | | 0.5970*** | 0.5969*** | 0.5893*** | 0.5927*** | 0.5798*** | 0.5690*** |
| | | (0.0105) | (0.0106) | (0.0105) | (0.0105) | (0.0106) | (0.0110) |
| *Loan* | | | 3.8581*** | 3.5872*** | 2.7714*** | 2.6910*** | 2.6282*** |
| | | | (0.8418) | (0.8377) | (0.8378) | (0.8357) | (0.8333) |
| *State* | | | | 0.6230*** | 0.5505*** | 0.4348*** | 0.3793*** |
| | | | | (0.0443) | (0.0446) | (0.0461) | (0.0463) |
| *Fdi* | | | | | −0.3314*** | −0.2897*** | −0.2713*** |
| | | | | | (0.0286) | (0.0288) | (0.0293) |
| *Age* | | | | | | −0.2048*** | −0.7519*** |
| | | | | | | (0.0197) | (0.0991) |
| *Capital* | | | | | | | −0.0406*** |
| | | | | | | | (0.0131) |
| Control variables | 10.25*** | 3.6226*** | 3.5508*** | 3.5367*** | 3.4928*** | 3.0916*** | 4.2714*** |
| | (0.2464) | (0.2562) | (0.2571) | (0.2558) | (0.2549) | (0.2571) | (0.2842) |
| Year fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Region fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 19665 | 19662 | 19433 | 19433 | 19433 | 19391 | 19366 |
| *j. R-sq* | 0.3875 | 0.4753 | 0.4769 | 0.4822 | 0.4859 | 0.4890 | 0.4922 |

Note: ***, ** and * indicate the significance of the regression coefficient by 1%, 5% and 10%. The numbers in parentheses are standard errors. This is with the following table.

## 4.2. **Endogeneity test.**

4.2.1. *Considering the possible sample selection bias problem.* This paper draws on the research ideas of Heckman [28] and adopts the two-stage method for the endogeneity test to overcome the possible sample selection bias problem. The test results are shown in columns (1) and (2) of Table 2. It can be found that after controlling for sample selectivity bias, the estimated coefficient of the import sophistication variable is significantly negative, which means that the core conclusion is valid. The estimated coefficient of nivmillss variable also passed the significance level of 1%. This conclusion indicates that the benchmark regression results of this research may have sample selection bias, and it is feasible and reasonable to investigate the influence of sample selection bias in this part.

4.2.2. *Two-Stage Least Square method (2SLS).* To overcome the endogeneity problem caus- ed by reverse causality and omitted variables, this paper uses the independent variables (import sophistication) with a lag of one phase and a lag of two-phase as instrumental variables of import sophistication [29]. The test results of the 2SLS are listed in columns (3) and (4) of Table 2. It can be found that regardless of whether the selected instrumental variable is the first lag period of the independent variable or the second lag period of the independent variable, the estimates of the coefficient of import sophistication variable are all significantly negative, indicating that the import sophistication reduces the $SO_2$ emissions of enterprises. Both test results show that the 2SLS regression results are robust, which also indicates that the instrumental variables selected in this paper are reasonable.

4.2.3. *Generalized Method of Moments (GMM).* GMM is also adopted in this paper to avoid the endogeneity problem. Column (5) of Table 2 reports the estimation results of GMM. It can be found that the magnitude and significance of the variable regression coefficients do not change greatly compared with the benchmark regression results, indicating that the import sophistication still significantly reduces the $SO_2$ emissions of enterprises even after controlling for the endogeneity of the model.

TABLE 2. Endogeneity test

| Variables | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| | Heckman two-stage method | | 2SLS | | GMM |
| | The first stage (Probit) | The second stage | Lag phase 1 | Lag phase 2 | |
| $SO_{ft}$ | $-0.0558^{***}$ (0.1237) | $-0.0124^{***}$ (0.0251) | $-0.6008^{***}$ (0.0510) | $-0.6856^{**}$ (0.9620) | $-0.1227^{***}$ (0.3547) |
| KP-LM | | | $20.332^{***}$ | $13.747^{***}$ | |
| Wald RK F | | | $18.856^{***}$ | $12.653^{***}$ | |
| invmillsss | | $0.1076^{***}$ (0.1326) | | | |
| Constant term | Yes | Yes | Yes | Yes | Yes |
| Year fixed effect | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effect | Yes | Yes | Yes | Yes | Yes |
| Region fixed effect | Yes | Yes | Yes | Yes | Yes |
| AR(1) | | | | | 0.0678 [0.0000] |
| AR(2) | | | | | 0.4377 [0.0000] |
| Observations | 17565 | 15377 | 15218 | 12434 | 14119 |
| *j. R-sq* | 0.1547 | 0.2103 | 0.1385 | 0.1468 | |

## 4.3. **Robustness test.**

4.3.1. *Other measures of pollution emissions.* For the sake of the robustness of test results, nitrogen oxide emission and soot emission are continued to be used to measure environmental pollution for robustness tests. The results show that the estimated coefficients of the two different measures of environmental pollution are significantly negative, indicating that changing the environmental pollution method will not change the core conclusion of this paper, that is, the benchmark regression results are robust. In addition, this paper also replaces $SO_2$ emission by coal consumption to conduct a robustness test. The results show that the estimated coefficient of coal consumption is still significantly negative, indicating that the import sophistication reduces the coal consumption of enterprises. In conclusion, changing the calculation method of enterprises' pollution emissions will not affect the core conclusion of this paper, namely, the import sophistication significantly reduces the $SO_2$ emissions of enterprises. Limited by space, results are available on request.

4.3.2. *Other measures of import sophistication.* This paper further adjusts the calculation of product technical complexity according to the difference in product quality [30], to obtain other measurement methods of import sophistication. The test results show that

the magnitude and significance of the estimated coefficient of the import sophistication variable do not change much, indicating that the impact of import sophistication on $SO_2$ emissions of enterprises will not vary with different measurement methods of explanatory variables. Limited by space, results are available on request.

### 4.4. **Heterogeneity analysis.**

4.4.1. *Whether the enterprise exports or not.* It can be found that the import sophistication of both exporting and non-exporting enterprises significantly reduces $SO_2$ emissions. However, by comparing the absolute value of the estimated coefficient, it is found that for non-exporting enterprises, the effect of import sophistication on reducing $SO_2$ emissions is stronger than that for exporting enterprises. Limited by space, results are available on request.

4.4.2. *The trade modes of enterprises.* The results show that the import sophistication significantly reduces the $SO_2$ emissions of both general trading and processing trade firms. However, by comparing the absolute value of the estimated coefficient, it is found that for processing trade enterprises, the effect of import sophistication on reducing $SO_2$ emissions is stronger than that for general trading enterprises. Limited by space, results are available on request.

4.4.3. *Whether the high energy consumption industry or not.* Based on the research ideas of Han et al. [31], this research defines nine industries such as petroleum, chemical, iron and steel, coal, nonferrous metals, building materials, electric power, textile and papermaking as high energy consumption industries, and the remaining industries as low energy consumption industries. Sub-sample regression is conducted respectively, and the results show that the import sophistication significantly reduces the $SO_2$ emissions of enterprises in both high-energy and low-energy industries. However, by comparing the absolute values of the estimated coefficients, it is found that for the low energy consumption industries, the effect of import sophistication on reducing $SO_2$ emissions is stronger than that for the high energy consumption industries. Limited by space, results are available on request.

4.4.4. *The ownership of enterprises.* The results show the estimation results for both foreign-funded and domestic enterprises, and the results show that the import sophistication significantly reduces the $SO_2$ emissions of both foreign-funded and domestic enterprises. However, by comparing the absolute value of the estimated coefficient, it is found that for foreign-funded enterprises, the effect of import sophistication on reducing $SO_2$ emissions is stronger than that of domestic enterprises. Limited by space, results are available on request.

4.4.5. *Region.* The results show that the import sophistication significantly reduces the $SO_2$ emissions of enterprises in the eastern region, but has no significant impact on the $SO_2$ emissions of enterprises in the central and western regions. Limited by space, results are available on request.

## 5. **Mechanism Test.**

5.1. **Construction of mediating effect model.** The foregoing content has confirmed that import sophistication significantly reduces enterprise $SO_2$ emissions, but the channel path through which import sophistication affects enterprises' $SO_2$ emissions has not been analyzed. Therefore, a mediating effect model is constructed in this study to explore the mechanism by which import sophistication affects enterprise $SO_2$ emissions. According to the above theoretical mechanism analysis, this study selects enterprises' productivity

and enterprises' R&D investment as mediating variables and constructs a mediating effect model to test the internal mechanism of import sophistication:

$$SO_{2,fit} = \alpha_1 + \beta_1 \cdot IS_{ft} + \gamma X_{fit} + \delta_t + \delta_i + \delta_r + \varepsilon_{fit} \quad (2)$$

$$tfp_{fit} = \alpha_2 + \beta_2 \cdot IS_{ft} + \gamma X_{fit} + \delta_t + \delta_i + \delta_r + \varepsilon_{fit} \quad (3)$$

$$Inn_{fit} = \alpha_3 + \beta_3 \cdot IS_{ft} + \gamma X_{fit} + \delta_t + \delta_i + \delta_r + \varepsilon_{fit} \quad (4)$$

$$SO_{2,fit} = \alpha_4 + \beta_4 \cdot IS_{ft} + \sigma \cdot tfp_{fit} + \omega \cdot Inn_{fit} + \gamma X_{fit} + \delta_t + \delta_i + \delta_r + \varepsilon_{fit} \quad (5)$$

The Olley-Pakes semi-parametric method (OP method) is used to measure the total factor productivity of the enterprise, and takes the natural logarithm in regression. $Inn_{fit}$ stands for the R&D input of enterprises, with R&D investment assigned as 1, and no R&D investment assigned as 0.

5.2. **Test results of mediating effect model.** The test results of the action mechanism of import sophistication affecting $SO_2$ emission of enterprises are listed in Table 3 below. Column (2) shows the estimation results with enterprises' productivity as the explained variable. It is found that the estimated coefficient of import sophistication is significantly positive, indicating that import sophistication significantly promotes the improvement of enterprises' productivity. Column (3) reports the estimation results of enterprises' R&D input as the explained variable, and it is found that the estimated coefficient of import sophistication is significantly positive, indicating that import sophistication significantly promotes enterprises to increase R&D input. Column (4) reports the effect of the intermediary variable of enterprises' productivity on $SO_2$ emissions. It is found that the estimated coefficient of the intermediary variable of enterprises' productivity is significantly negative, indicating that the improvement of enterprises' productivity significantly reduces enterprise $SO_2$ emissions. Column (5) reports the effect of the intermediary variable of enterprises' R&D input on enterprises' $SO_2$ emissions. It is found that the estimated coefficient of the intermediary variable of enterprises' R&D input is significantly negative, indicating that the increase of enterprises' R&D input can help reduce enterprises' $SO_2$ emissions. It is worth noting that when the variables of enterprises' productivity and R&D input are added to column (4) and column (5) respectively, the absolute value of

Table 3. Test results of the mechanism of action

| Variables | (1) $SO_{2,fit}$ | (2) $tfp_{fit}$ | (3) $Inn_{fit}$ | (4) $SO_{2,fit}$ | (5) $SO_{2,fit}$ | (6) $SO_{2,fit}$ |
|---|---|---|---|---|---|---|
| $IS_{ft}$ | $-0.0898^{***}$ | $0.0042^{**}$ | $0.1945^{***}$ | $-0.0727^{***}$ | $-0.0331^{**}$ | $-0.0132^{***}$ |
| | (0.0235) | (0.0017) | (0.0549) | (0.0233) | (0.0672) | (0.0666) |
| $tfp_{fit}$ | | | | $-1.4282^{***}$ | | $-2.0870^{***}$ |
| | | | | (0.0845) | | (0.2785) |
| $Inn_{fit}$ | | | | | $-0.0087^{**}$ | $-0.0075^{*}$ |
| | | | | | (0.0191) | (0.0189) |
| Control variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Year fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Region fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant term | $4.2714^{***}$ | $0.6644^{***}$ | $-6.9086^{***}$ | $5.1859^{***}$ | $3.1616^{***}$ | $4.6952^{***}$ |
| | (0.2842) | (0.0204) | (0.6681) | (0.2873) | (0.8510) | (0.8675) |
| Observations | 19366 | 30368 | 16209 | 19360 | 15247 | 14246 |
| *j. R-sq* | 0.4922 | 0.4771 | 0.1980 | 0.4998 | 0.5206 | 0.5294 |

the estimated coefficient of the core explanatory variable of import sophistication decreases significantly compared with the benchmark regression result in column (1). At the same time, column (6) is the result after adding the mediating variables of enterprises' productivity and R&D input, the absolute value of the estimated coefficient of the core explanatory variable of import sophistication further decreases compared with the benchmark regression result in column (1). It shows again that the import sophistication reduces the $SO_2$ emission of enterprises through two possible channels: improving enterprises' productivity and increasing enterprises' R&D investment. The above analysis indicates that the "technology spillover effect" and "competition effect" are the channels through which import sophistication affects enterprises' $SO_2$ emissions.

## 6. **Conclusions and Policy Implications.**

6.1. **Conclusions.** Using China Industry Enterprise Database, China Customs Trade Database, China Industry Enterprise Environmental Statistics and CEPII-BACI Database, this paper systematically investigates the impact of import sophistication on environmental pollution and its mechanism in China. The findings are as follows. Firstly, the import sophistication significantly reduces the emissions of $SO_2$. After considering sample selection bias, the endogenous nature of variables, and the use of different measurement indicators, the core conclusion of this article is still valid. Secondly, the results of subsample regression show that the improvement of import sophistication of non-exporting enterprises has a stronger effect on reducing $SO_2$ emissions than exporting enterprises. The improvement of import sophistication of processing trade enterprises has a stronger effect on reducing $SO_2$ emissions than that of general trading enterprises. The improvement of import sophistication of enterprises in low energy consumption industries has a stronger effect on reducing $SO_2$ emissions than enterprises in high energy consumption industries. The improvement of import sophistication of foreign-funded enterprises has a stronger effect on reducing $SO_2$ emissions than domestic enterprises. The improvement of import sophistication of enterprises in eastern China significantly reduces $SO_2$ emissions, while the improvement of import sophistication of enterprises in central and western China does not affect $SO_2$ emissions. Thirdly, through the mechanism test of the influence channel, it is found that the import sophistication reduces the $SO_2$ emissions of enterprises through two channels: the "technology spillover effect" and "competition effect".

6.2. **Policy implications.** Import sophistication can significantly reduce environmental pollution, showing that the import trade not only promotes China's foreign trade and economic development, but also promotes the improvement of the environment and thus improves the welfare level of the Chinese society, which is a strong boost of the advance of the construction of the trade power provides in new normal. Currently, the shift from the high input, high consumption, and high pollution of extensive economic development mode to the "green development" mode is beneficial to reduce the pollution of the environment, and promote the sustainable development of the economy. The closure of the "one size fits all" type of high energy consumption, high pollution, and low output of development of the enterprises' path will damage the social welfare in the long run, which is not an effective path to sustainable economic development. Therefore, the direct closure of enterprises with high consumption, high pollution, and low output can only improve the environment in the short term, but is not a long-term solution to effectively promote economic growth and development. Given this, the government can improve environmental conditions by encouraging enterprises to increase the complexity of high technology products of import and expanding opening to the outside world. At the same time, enterprises should strengthen human capital accumulation, focus on labor skills improving, raise their ability of technical learning and absorption, increase R&D investment, improve

the efficiency of the use of inputs, reduce the pollution of the environment, and achieve the "win-win" of energy conservation and emission reduction and economic growth.

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