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The Influence of Quality and Variety of New Imports on Enterprise Innovation: Evidence from China

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Abstract: In this study, we introduce the concept of differentiated quality inputs with knowledge-driven specifications for research and development (R&D) under an open economy to the endogenous growth model of knowledge spillover. Using matching industry enterprise and customs data from 2001 to 2007, which is representative of micro data at the Chinese industry level, we theoretically analyze the influence of the quality and variety of imported products on Chinese enterprises' innovation and economic growth. We find that, first, the improvement of the quality and variety of new imported products can promote enterprise innovation. Second, new imported intermediate inputs and capital goods, new imported high-technology products, and products imported from Organization for Economic Co-operation and Development (OECD) countries have stronger promoting effects on enterprise innovation. We conclude that imported products stimulate the growth of the economy through two channels: expanding the variety and increasing the quality of inputs. To verify the stability of our model, we conducted robustness tests by defining new imported products based on a base year, measuring enterprise innovation by the number of patent applications, and measuring the quality of new imported products in a new way.

Keywords: new imported products; quality; variety; enterprise innovation

1. Introduction

With the continuous improvement of the global value chain system and the increasing volume of world economy and trade, studying the impact of the trade on global economic development has become a point of interest in the field of international economics and trade. Since China's accession to the World Trade Organization (WTO), disregarding the impact of the global financial crisis in 2008 and the contraction of trade after the global economic slowdown in 2015, its total annual import volume has been on the rise. Numerous studies have been conducted on the positive effect of import trade on economic development and technological progress [1–14]. On the other hand, the import trade provides diversified product choices for enterprises, and increasing the variety of imported products is an important way to promote the productivity level of enterprises and enhance independent innovation [7,15,16]. In recent years, China's enterprise innovation has achieved rapid development, but there remains much room for the enhancement of innovation ability. A big gap between China and developed countries regarding their scientific and technological level still persists. Therefore, it is particularly important to study the effective implementation of innovation-driven strategies to promote China's high-quality economic growth. Scholars have conducted significant research on enterprise innovation and total factor productivity due to the increase in the variety and types of imported products [17–26]. Furthermore, the macro innovation environment also has a very important impact on enterprise innovation [27–30]. New studies show that the quality of an enterprise for an imported new product and its quality of growth is higher than the average level for all imported products [21,31]. However, current research on new imported products is relatively scarce.

This study contributes to the above literature on three grounds. First, it introduces the concept of imported product quality and variety into the endogenous growth model of knowledge spillover in the open economy, and theoretically analyzes the influence of these factors on innovation and economic growth. Second, it analyzes the influence of the quality and variety of new imported products on enterprise innovation using a representative of micro data at the Chinese industry level. Third, by comparing and analyzing the quality and variety of new and continuing imports and different types of new imports, it provides a panoramic study of how the quality and variety of new imported products affect enterprise innovation.

The rest of this paper is organized as follows. Section 2 provides a detailed review of related research. Section 3 shows the theoretical model. Section 4 describes the econometric model, variables and data. Section 5 presents and discusses the empirical findings. Section 6 draws conclusions.

2. Detailed Literature Review

This paper summarizes studies, which have been conducted on the positive effect of import trade on economic development and technological progress from three perspectives: the quality, variety, and heterogeneity of imported products. Early measurements of product quality were based on unit value [1,2]; however, this way of measuring product quality is not accurate, and the corresponding relationship between quality and price is affected by product heterogeneity. That is, when the degree of product heterogeneity is low, the unit value cannot effectively measure product quality [3]. Khandelwal [4] first explained the portion of the product market share that was not subject to price changes, which laid the foundation for the measurement of product quality at the macro level. Based on the quality measurement at the enterprise level, Fan and Guo [5] estimated the regression model in Khandelwal et al. [6] by using the elasticity of substitution of export products measured by Broda and Weinstein [7], and measured the quality of Chinese enterprises' export products. From the perspective of consumer utility maximization, Shi [8] and Shi and Zeng [9] measured the quality of Chinese enterprises' import and export products from 2000 to 2006 by means of a regressive method. With the gradual popularization of product quality measurement methods, the influence of imported product quality on enterprises has been widely influenced by the academic circle, including in areas concerning the relationship between import product quality and gender pay gap [10], exports [11], added value of exports [12], total factor productivity [13], output value of new products [14], and the influence of enterprise-level indicators. As an important link in the technological progress and production development of enterprises, the influence of imported product quality on enterprise innovation is increasing in importance.

Broda and Weinstein [7] measured that during the 1972–2001 period. The increase in the variety of imported products resulted in an annual increase of 1.3% in the traditional import price index and a 2.8% increase in the US GDP. Based on this method, Chen et al. [15] estimated the trade gains caused by the growth of import species in China from 1995 to 2004. Qian et al. [16] found that the technological levels of different industries and the growth of imported products in different import source countries had different influences on the total factor productivity of China's manufacturing industry. Bas and Strauss-Kahn [17] used French data to prove that the increase in the variety of import inputs leads to an increase in total factor productivity and the export scale of enterprises. Yang [18] studied the relationship between the variety of imported intermediate products and the innovation ability of enterprises using data from Chinese manufacturing enterprises and found that the variety of imported intermediate products promotes the innovation ability of enterprises. At the industry level, Sun and Lou [19] found that an increase in imported products could significantly promote the improvement of total factor productivity in the manufacturing industry, especially for capital-intensive industries, which have a stronger positive promotion effect.

Because different types of imported products have different effects on economic development, analyzing the heterogeneity of imported products is of great practical significance. A number of studies have been conducted on the impact of intermediate and final consumer goods on economic activities. The reduction of import tariffs can create more trade gains for domestic manufacturing enterprises than the reduction of final goods [20,21]. Imported capital and intermediate goods have significant positive effects on total factor productivity [22,23], but intermediate and capital goods have different influences on enterprise innovation. Kang [24] found that the import of capital goods significantly promotes the research and development (R&D) investment of Chinese enterprises, while the import of intermediate products has a significant inhibitory effect. Wei and Lin [14] measured the quality of imported products at the enterprise level, finding that the improvement of the quality of imported intermediate products significantly promotes domestic enterprise innovation, and the improvement of the quality of imported capital products has an inverted U-shaped relationship with enterprise innovation. A few scholars have also studied the influence of product technology content and the source of product import heterogeneity on enterprises. Elliott et al. [25] found that enterprises importing products from high-income countries and those importing middle and high-technology-intensive products have a larger scale and higher productivity than those importing only low-technology-intensive products, by classifying the country of origin and technology content of the imported products. Chen et al. [26] found that both the import and export of intermediate products can promote the R&D investment density of Chinese manufacturing enterprises, among which imports from high-income countries play a stronger role in promoting enterprise innovation. Thus, when analyzing the impact of imported products on enterprises, it is of great significance to distinguish product categories.

The macro innovation environment also has a very important impact on enterprise innovation. Li [27] stated that innovation participants, regional industrial clusters, local financial support for education, science and technology, and openness would all affect the efficiency of innovation. The promotion of urbanization can also provide sufficient resources for enterprise innovation through economies of scale and urban agglomeration effects, as well as strengthen the diffusion of technical knowledge and enhance knowledge spillover [28]. Yang et al. [29] analyzed the data of listed companies from 2007 to 2013 and found that local financial autonomy can also improve the marketization level of the region where the enterprise is located and promote the innovation investment of the enterprise. However, in order to optimize the environment of enterprise macroscopic innovation, industry policy needs to be geared toward effectively promoting innovation. Li and Zheng [30] found that some enterprises "find support and innovation", and because of the industrial policy, they are required to actively carry on with strategic innovation, ignoring "real innovation". This kind of phenomenon is particularly significant in state-owned enterprises and the new technology industry. Thus, it is recognizable that effectively stimulating enterprise innovation is a complex and very realistic problem.

Because imported products contain advanced technology and are of high quality with low prices, significant research has been conducted on the influence of imported products on enterprise innovation. New imported products may bring huge competitive pressure to domestic manufacturers of similar products and prompt enterprises to increase investment in innovation and strengthen technical learning and research. However, current research on new imported products is relatively scarce. Goldberg et al. [21], from the perspective of trade liberalization of imported inputs in India, indirectly analyzed the growth of new import product categories caused by input tariff reductions and the improvement of innovation capacity of these enterprises without a detailed discussion on the direct impact of the quality and variety of new imported products on enterprise innovation. Colantone and Crinò [32] analyzed the influence of the type and quality of newly imported inputs on the production of new products.

However, the existing research and analysis remain at the industry level, without further analysis on how the new imported products affect the innovation of micro enterprises. Therefore, based on the data of Chinese industrial enterprises, this study theoretically and empirically analyzes the influence of the quality and variety of new imported products on enterprise innovation.

By comparing and analyzing the quality and variety of new and continuing imports and different types of new imports, this paper provides a panoramic study of how the quality and variety of new imported products affect enterprise innovation, and presents some valuable suggestions on how to effectively utilize imported products to promote enterprise innovation.

3. Theoretical Model

3.1. Specification of Model

Referring to the knowledge spillover model of the open economy in Rivera-Batiz and Romer [33], we build a model of two countries (domestic and foreign) and three sectors (final product, intermediate, and R&D) to study how import product quality and variety influence the growth rate of innovation. Meanwhile, referring to Colantone and Crinò [32], we assume that the intermediate products produced in the two countries have different levels of quality. The specific settings of the model are as follows:

3.1.1. The Final Product Market

The final product market is completely competitive, and only one final product is produced. Human capital H_Y and intermediate products are invested in. Intermediate products include domestic intermediate products x_i and imported intermediate products x_i^*. The two types of intermediate products have different levels of quality.

$$Y = {H_Y}^{\alpha}\left[\int_0^A (\lambda_i x_i)^{1-\alpha} di + \int_0^{A^*} \left(\lambda_i^* x_i^*\right)^{1-\alpha} di\right],\ \alpha \in (0,1), \tag{1}$$

where H_Y represents the human capital used in the production of the final product, x_i and x_i^* represent the quantity of the ith domestic intermediate product and the ith imported intermediate product invested in the final product, respectively, while lambda λ_i and λ_i^* represent the quality level of the corresponding domestic intermediate and imported intermediate products, respectively. A and A^* represent the kinds of domestic production and imports of intermediate goods, respectively, and are all continuous variables. In order to explore the relationship between economic growth and the types of imported products, by referring to Colantone and Crinò [32], we assume that the number of imported intermediate products is ε times as large as the number of domestic intermediate products, and ε is an exogenous parameter.

$$A^* = \varepsilon A,\ \varepsilon > 0 \tag{2}$$

3.1.2. The Intermediate Product Department

Similar to Rivera-Batiz and Romer [33], we assume that every new product design concept or solution invented by the R&D department is immediately transformed into an intermediate product by the intermediate product department. Therefore, A in the final product production function can represent both the domestic intermediate product category and the stock of technical knowledge. The unit production cost of the intermediate product department is 1; that is, one unit of the final product can be invested to produce one unit of intermediate product:

$$x_i = Y_i \tag{3}$$

3.1.3. The R&D Department

The R&D department invests human capital H_A in R&D and production. Due to the existence of knowledge spillover, the R&D output also depends on the existing stock of technical knowledge, including the existing domestic stock of knowledge and advanced foreign technology introduced through imports. While considering the different quality levels of domestic and foreign intermediate products, we also assume that the domestic and foreign knowledge spillovers are different, and we modify them with the coefficient related to product quality differences. We believe that the higher the product quality level, the stronger the spillover of the existing technical knowledge stock to the new technology research and development will be.

$$\dot{A} = \delta H_A\left(\lambda^{\frac{1-\alpha}{\alpha}} A + \lambda^{*\frac{1-\alpha}{\alpha}} A^*\right) \tag{4}$$

where $\dot{A}$ refers to the domestic technical knowledge increase, A and A^* are the existing domestic knowledge stock and technical knowledge stock imported through imports, respectively, and λ and λ^* are the quality level of domestic intermediate product and imported intermediate product, respectively, which measure the spillover difference of technical knowledge stock of the two countries. δ is the exogenous productivity-related parameter of the R&D department.

3.1.4. Consumer's Preference

The utility function of the representative family is constant elasticity of substitution:

$$U(C) = \int_0^{+\infty} \frac{C^{1-\theta} - 1}{1-\theta} e^{-\rho t} dt \tag{5}$$

3.2. Analysis of Market Behavior of Each Department

3.2.1. Final Product Department

The final product department maximizes profits by selecting human capital input, the quantity of various domestic intermediate products, and the quantity of imported intermediate products. The final product price is divided into 1:

$$\max_{H_Y\ x_i\ x_i^*} \pi = Y - w_Y H_Y - \int_0^A p_i x_i di - \int_0^{A^*} p_i^* x_i^* di \tag{6}$$

By solving the above optimization problems, the following equations will be obtained:

$$w_Y = \frac{\alpha Y}{H_Y} \tag{7}$$

$$p_i = (1-\alpha) H_Y{}^{\alpha} \lambda_i{}^{1-\alpha} x_i^{-\alpha} \tag{8}$$

$$p_i = (1-\alpha) H_Y{}^{\alpha} \lambda_i{}^{1-\alpha} x_i^{-\alpha} \tag{9}$$

Equation (8) is the demand function of domestic intermediate products while Equation (9) is the demand function of imported intermediate products. As seen from Equations (8) and (9), the demand function of imported intermediate products and domestic intermediate products is tilted toward the lower right, so that the intermediate product sector obtains monopoly profits.

3.2.2. Intermediate Product Department

The intermediate product segment faces a downward sloping demand curve and is priced to maximize profits as follows:

$$\max_{p_i} \pi = p_i x_i - Y_i = p_i x_i - x_i \tag{10}$$

By solving the above problem, the following equations can be obtained:

$$\max_{p_i} \pi = p_i x_i - Y_i = p_i x_i - x_i \tag{11}$$

$$\max_{p_i} \pi = p_i x_i - Y_i = p_i x_i - x_i \tag{12}$$

To simplify the model, we use the average quality of domestic intermediates to eliminate the difference in quality of domestic intermediates and adopt a similar treatment for imported intermediates.

$$x_i = x = (1-\alpha)^{\frac{2}{\alpha}} H_Y \lambda^{\frac{1-\alpha}{\alpha}} \tag{13}$$

$$\pi_i = \pi = \alpha(1-\alpha)^{\frac{2-\alpha}{\alpha}} H_Y \lambda^{\frac{1-\alpha}{\alpha}} \tag{14}$$

Similarly, the demand function of foreign intermediate products is similar to that of domestic intermediate products:

$$p_i^* = p^* = \frac{1}{1-\alpha} \tag{15}$$

$$x_i^* = x^* = (1-\alpha)^{\frac{2}{\alpha}} H_Y \lambda^{*\frac{1-\alpha}{\alpha}} \tag{16}$$

$$\pi_i^* = \pi^* = \alpha(1-\alpha)^{\frac{2-\alpha}{\alpha}} H_Y \lambda^{*\frac{1-\alpha}{\alpha}} \tag{17}$$

Put x and x^* into the production function:

$$Y = (1-\alpha)^{\frac{2(1-\alpha)}{\alpha}} H_Y \left(\lambda^{\frac{\alpha}{1-\alpha}} A + \lambda^{*\frac{\alpha}{1-\alpha}} A^*\right) = (1-\alpha)^{\frac{2(1-\alpha)}{\alpha}} H_Y A \lambda^{\frac{1-\alpha}{\alpha}} \omega \tag{18}$$

$$w_Y = \alpha(1-\alpha)^{\frac{2(1-\alpha)}{\alpha}} A \lambda^{\frac{1-\alpha}{\alpha}} \omega \tag{19}$$

where,

$$w_Y = \alpha(1-\alpha)^{\frac{2(1-\alpha)}{\alpha}} A \lambda^{\frac{1-\alpha}{\alpha}} \omega \tag{20}$$

3.2.3. Research and Development Department

According to Equation (20), we can simplify the R&D department's production function (4) to:

$$\dot{A} = \delta H_A A \lambda^{\frac{1-\alpha}{\alpha}} \omega. \tag{21}$$

Competitive R&D departments invest human capital H_A, produce knowledge and technologies, and sell them to intermediate product departments at P_A price:

$$\max_{H_A} \pi = P_A \dot{A} - w_A H_A = P_A \delta H_A \lambda^{\frac{1-\alpha}{\alpha}} A \omega - w_A H_A \tag{22}$$

$$w_A = \delta \lambda^{\frac{1-\alpha}{\alpha}} A \omega P_A \tag{23}$$

Since the intermediate product sector is freely accessible, the price P_A paid by the intermediate product manufacturer for the design technology and concept of the product is equal to the discounted value of the monopoly profit earned by the intermediate product manufacturer. Because the interest rate at equilibrium is constant r, the no-arbitrage condition is obtained: $P_A = \frac{\pi}{r}$. So:

$$P_A = \frac{\pi}{r} = \frac{1}{r} \alpha(1-\alpha)^{\frac{2-\alpha}{\alpha}} H_Y \lambda^{\frac{1-\alpha}{\alpha}} \tag{24}$$

$$w_A = \frac{1}{r} \alpha(1-\alpha)^{\frac{2-\alpha}{\alpha}} H_Y \lambda^{\frac{2(1-\alpha)}{\alpha}} \delta A \omega \tag{25}$$

3.2.4. Consumer Behavior

Consumers maximize utility under the premise of inter-temporal budget constraints. We can obtain the following Euler Equation:

$$g = \frac{\dot{C}}{C} = \frac{r-\rho}{\theta} \tag{26}$$

3.3. Competitive Equilibrium Analysis

Under the equilibrium growth path—the economic growth rate $g = \dot{C}/C = \dot{A}/A$—the wage rate of the final product department is the same as that of the R&D department, and the sum of the human capital of the two departments is the same as constant H, thus it can be obtained as follows:

$$w_A = w_Y \tag{27}$$

$$g = \frac{r-\rho}{\theta} = \delta H_A \lambda^{\frac{1-\alpha}{\alpha}} \omega \tag{28}$$

$$H_A + H_Y = H \tag{29}$$

Solving the above three equations, the equilibrium growth rate can be obtained:

$$g_A = g = \frac{\delta(1-\alpha)\lambda^{\frac{1-\alpha}{\alpha}} H - \rho}{\theta + \frac{1-\alpha}{\omega}}, \tag{30}$$

where: $\omega = 1 + \varepsilon\left(\frac{\lambda^*}{\lambda}\right)^{\frac{1-\alpha}{\alpha}}$.

Next, this study focuses on how the quality and variety of imported products affect the growth rate of innovation. In terms of the innovation of growth to ω partial derivatives, the following equation can be obtained:

$$\frac{\partial g_A}{\partial \omega} = \frac{\delta(1-\alpha)\lambda^{\frac{1-\alpha}{\alpha}} H - \rho}{(\theta\omega + 1 - \alpha)^2} \times (1-\alpha) \tag{31}$$

First, let us look at the plus or minus of the numerator. The following equation can be obtained from Equation (27):

$$\frac{\partial g_A}{\partial \omega} = \frac{\delta(1-\alpha)\lambda^{\frac{1-\alpha}{\alpha}} H - \rho}{(\theta\omega + 1 - \alpha)^2} \times (1-\alpha) \tag{32}$$

The result of the above equation can be substituted into Equation (28), and the following equations can be obtained:

$$\delta(1-\alpha) H_Y \lambda^{\frac{1-\alpha}{\alpha}} - \rho = \delta H_A \lambda^{\frac{1-\alpha}{\alpha}} \theta\omega \tag{33}$$

$$\delta(1-\alpha) H \lambda^{\frac{1-\alpha}{\alpha}} - \rho = \delta H_A \lambda^{\frac{1-\alpha}{\alpha}} [\theta\omega + (1-\alpha)] \tag{34}$$

In Equation (34), all the parameters on the right are greater than 0; $\alpha \in (0,1)$; therefore, the molecules of $\frac{\partial g_A}{\partial \omega}$ are greater than zero $\frac{\partial g_A}{\partial \omega} > 0$.

Considering the above method, it is clear that the growth rate of innovation g_A has a positive relationship with ω. Reviewing the ω definition : $\omega = 1 + \varepsilon\left(\frac{\lambda^*}{\lambda}\right)^{\frac{1-\alpha}{\alpha}}$. ω is mainly decided by two parts: the first is the coefficient ε of imported intermediates variety coefficient and the second is the relative quality of imported and domestic intermediates λ^*/λ.

Taking the derivative further, we know that: $\frac{\partial \omega}{\partial \varepsilon} > 0$, $\frac{\partial \omega}{\partial (\lambda^*/\lambda)} > 0$.

Here, ε and λ^*/λ have a positive marginal effect on ω. Therefore, we can draw an important conclusion that imported intermediate products can affect technological innovation and economic growth in the economy through two channels, namely, more varieties of imported products, higher imported products quality, and higher technological innovation and economic growth rate.

Referring to Rivera-Batiz and Romer [33] and Colantone and Crinò [32], the concept of import product quality and variety is introduced into the model. The important conclusions of this section are as follows: Imports can influence innovation through both quality and variety. In many imported products, the quality and variety are uneven, and the impact of various products on enterprise innovation is not the same. As for the influence of product heterogeneity on enterprise innovation, few scholars pay attention to the difference between products with different import statuses. Chen and Zhan [31] found that the new import growth rate of product quality is higher than the average level of all imported products. Colantone and Crinò [32] analyzed new imported products at the industry level, finding that the improvement of the quality and variety of new imported products compared with continuous imported products could promote the production of new products, thus increasing the economic growth rate. Therefore, in the empirical part, we will further explore the impact of the special composition of new imported products on enterprise innovation.

4. Econometric Models, Variables, and Data

4.1. Econometric Model

4.1.1. Basic Econometric Model

In the theoretical model proposed above, we have obtained two important channels for the influence of imported products on enterprise innovation, namely quality and variety. Now, we further analyze the influence of the quality and variety index of newly imported products on enterprise innovation. Hence, we built the following two benchmark models:

$$NP_{ijkt} = \alpha_0 + \alpha_1 * QN_{ijkt} + \alpha X + u_j + u_k + u_t + \varepsilon_{ijkt} \tag{35}$$

$$NP_{ijkt} = \beta_0 + \beta_1 * VSN_{ijkt} + \beta X + u_j + u_k + u_t + \varepsilon_{ijkt} \tag{36}$$

where i represents enterprise, j represents industry, k represents region, and t represents year. The explained variable *NP* is the enterprise innovation index, which is expressed by the proportion of new products (the proportion of the output value of new products in the total industrial output value). (Enterprise innovation is an important part of enterprise management. It is the key factor that decides the development direction, scale, and speed of the company. Enterprise innovation involves organizational innovation, technological innovation, management innovation, strategic innovation, and other issues. It is expressed by the proportion of new products in this section and the number of patent applications in Section 5.4.) The explanatory variable *QN* represents the quality of new imports, *VSN* represents the variety of new imports, u_j, u_k, *and* u_t represent industry, province, and year fixed effects, respectively; ε_{ijkt} is a random disturbance term; and X represents the vector of the control variables. (When we added the square term of the variable QN and VSN to the regression model, coefficients of these variables were not statistically significant, so we chose the linear model.)

This study considers the influence of the quality and variety of new imported products on enterprises' innovation. However, the decision of enterprises to increase the innovation of new products may encourage them to introduce high quality and multiple varieties of new imported products, which may lead to endogenous problems. Similar to Chen and Zhan [31], this paper uses the enterprise-level GDP per capita indicator of importing countries constructed by Wei and Lin [14] as an instrumental variable.

4.1.2. Comparison of the Influence of New Imported Products and Continuous Imported Products on Enterprise Innovation

In order to further highlight the special nature of the group of newly imported products in all products, we attempt to analyze whether the newly imported products have a greater advantage over the continuously imported products in terms of the issue affecting the innovation of enterprises. We use the following model to estimate:

$$NP_{ijkt} = \theta_0 + \theta_1 QN_{ijkt} + \theta_2 QE_{ijkt} + \theta X + u_j + u_k + u_t + \varepsilon_{ijkt}, \tag{37}$$

$$NP_{ijkt} = \theta_0 + \theta_3 \frac{VSN_{ijkt}}{VSE_{ijkt}} + \theta X + u_j + u_k + u_t + \varepsilon_{ijkt}, \tag{38}$$

where QN is the new import product quality, QE is the continuous import product quality, and VSN and VSE are the new imported product variety and continuous import product variety, respectively. Because of the new import product and continuous import product variety with full collinearity, here, we use the ratio of the variety of newly imported products to the variety of continuously imported products (VSN/VSE), namely the relative variety of newly imported products, to analyze the difference in the impact of the variety of the two types of products on enterprise innovation.

Thereafter, we further analyze whether the impact of the quality of new imported products on enterprise innovation is affected by the variety of new imported products. We estimate the following econometric model through the interaction term between the relative variety of new imported products and the quality of new imported products:

$$NP_{ijkt} = \gamma_0 + \gamma_1 QN_{ijkt} + \gamma_2 QN_{ijkt} * \frac{VSN_{ijkt}}{VSE_{ijkt}} + \gamma_3 \frac{VSN_{ijkt}}{VSE_{ijkt}} + \gamma X + u_j + u_k + u_t + \varepsilon_{ijkt} \tag{39}$$

Based on the above measurement model, we can obtain the marginal impact of the quality of new imported products on enterprise innovation by differentiating

$$\frac{\partial NP}{\partial QN} = \gamma_1 + \gamma_2 * \frac{VSN}{VSE} \tag{40}$$

First, by testing γ_2, we can determine how the relative variety of new imported products affects the marginal impact of the quality of new imported products on the innovation of enterprises. Second, when $VSN = VSE$; that is, when the types of new imported products and continuous imported products are equal, the marginal impact of the quality of new imported products on the innovation of enterprises is $\gamma_1 + \gamma_2$. By examining whether $(\gamma_1 + \gamma_2)$ is significant, we can obtain the effect of the quality of new imported products without the interference of import variety on enterprise innovation.

4.2. Variables Definition

4.2.1. Explained Variable NP

Similar to Chen and Zhan [31], this study uses the ratio of the new product value to the total industrial output value (the proportion of the output value of new products and the total industrial output value of enterprises in the database of Chinese industrial enterprises) to measure enterprise innovation.

4.2.2. Core Explanatory Variable

The quality of newly imported products QN is addressed as follows: referring to Shi and Zeng [9] for the measurement of import product quality at the enterprise level, we have measured import product quality at the enterprise level [31]. The definition of product category in this study is based on two dimensions of import source—country c and HS6 bit coding h. By comparing the import product information of the enterprise in the current year with that of the previous year, if a certain HS6 bit code product h was not imported in the previous year, or the HS6 bit code product was also imported in the previous year, but was imported from a different country in the current year, the imported product is considered as the new imported product defined in this paper.

The variety of newly imported products is the proportion of newly imported products types in all imported products types of the enterprise in the current year. The definition of product category is based on two dimensions of import country of origin and HS6 bit coding of the product.

4.2.3. Control Variables

Referring to Wei and Lin [14] and Yang [18], control variables at the enterprise level include enterprise age (age), government subsidy rate (subr), sales scale (lnsale), capital intensity (lnKI), human capital (lnWG), and whether the enterprise exports (export). Referring to Yan and Zhang [34], industry-level variables control enterprise GB4 industry market concentration, expressed by the Herfindahl-Hershman index (HHI). Referring to Li [27], He and Zhang [35], and Yang et al. [29], control variables at the city level include educational investment (edu*)*, investment in science and technology (tech), the logarithm of per capita GDP of cities (PGDP), urbanization level (urban), labor cost (labor cost), and regional trade specialization index (TSI). The definitions of the variables, data sources, and descriptive statistics of variables are shown in Appendix A, Tables A1 and A2.

4.3. Data Description and Matching

4.3.1. Customs Data

This paper conducts a series of calculations and analyses based on the customs database from 2000 to 2007. Because this study analyzes the impact of new imported products on enterprise innovation, the definition of new products includes enterprises' product import information covering two consecutive years. That is, we only keep the sample of enterprises with import behavior for two consecutive years. This study also carries out the following processing in terms of the customs data. (1) Exclude the last year without import behavior of the enterprise, keeping only two consecutive years to retain the import of the enterprise sample. (2) Delete the data with missing key information, including the observed value of the missing enterprise name, product code, and import country name. (3) Delete samples with an annual import quantity of less than 1 and trade volume less than $50. (4) Eliminate enterprise names that contain the keywords "trade", "import and export", and "commerce and trade" in the trade middlemen sample considering that trade middlemen do not carry out product production and enterprise innovation activities. (5) Align the HS8 bit codes of each year with the 6-bit codes of the 2002 version, and summarize the import data of the HS6 bit codes for each year. On this basis, it is aligned with the 4-bit Codes of SITC Rev.2 and the 3-bit Codes of ISIC Rev.4. The conversion standards between codes are derived from the Product Code file in the BACI database of CEPII. (6) Retain the manufacturing samples with ISIC Rev.4 codes located between 100–330 and SITC4 subcodes located between 5000–9000. (7) Classify the products according to technical content and the classification standard of Lall [36]. We eliminate the primary products and resource products because the value of these two types of products mainly comes from a natural resource endowment, which is unable to accurately measure the connotation of product quality difference. (8) Retain the sample with the largest quantity unit if the same product registered in the customs database correspond to more than one quantity unit.

4.3.2. Industrial Enterprise Database

Due to the absence and unreality of a large number of key variable data in China's industrial enterprise database after 2008, this study uses industrial enterprise data from 2001 to 2007 and the China Customs database from 2000 to 2007 (China's industrial enterprise database from 2001 to 2007, which is a representative of micro data at Chinese industries level, is generally accepted to study on Chinese enterprises, and it is the relatively good micro data of Chinese enterprises, because there is a relative lack of micro data on companies in China). The import product quality and variety data of enterprises are from the customs database. According to the above method, the customs database is sorted, and the quality and variety index are calculated. The enterprise innovation and control variables at the enterprise level are all from the industrial enterprise database. In order to reduce the interference of the error records on the empirical research, the industrial enterprise database is processed as follows: (1) eliminate enterprise samples with fewer than 8 employees; (2) exclude the sample of current assets, total fixed assets, and net fixed assets that are negative or greater than total assets; and (3) exclude samples of enterprises founded before 1949, lacking enterprise names, zero intermediate investment, negative research and development funds, and new product output value. Control variable data at the city level are obtained from the CEIC database.

4.3.3. Matching the Customs Database with the Industrial Database

As the enterprise coding system of the customs database and China Industrial Enterprise database are different, we need to match the two databases. Referring to the Dai and Yu [37] method, we match the databases according to the same enterprise name, the same enterprise postcode, or the last seven digits of a telephone number. To sort the customs database, we obtain the quality data of 9,103,317 imported products of 2459 categories from 2001 to 2007 and the quality and variety data of 375,687 imported products of enterprises. After further matching with the industrial and enterprise database, we obtain a total of 124,881 samples of enterprises with newly imported products from 2001 to 2007, among which 103,306 are samples of enterprises with both newly imported products and continuously imported products.

5. Influence of the Quality and Variety of New Imported Products on Enterprise Innovation

5.1. Baseline Regression Results

First, we analyze the impact of the quality and variety of new imported products on enterprise innovation. In Table 1, Columns (1–3) report the impact of the quality of newly imported products on enterprise innovation, and Columns (4–6) report the regression results of the impact of the variety proportion of newly imported products on enterprise innovation. (Hausman test shows that the fixed effect model should be selected. Therefore, if there is no special annotation, the regression analysis in the following part will be the fixed effect regression.) As indicated by the first three columns, the coefficients of the quality of newly imported products are all significantly positive, which indicates that with the improvement of the quality of newly imported products, the innovation ability of enterprises is enhanced. After endogeneity treatment, the quality of newly imported products still has a significant impact on enterprises' innovation. As indicated by the last three columns, the variety of new imported products also has a significant promoting effect on the production of new products. Taken together, the new import product quality and variety of enterprise innovation has a certain promotion effect. This is because the enterprise introduces higher quality and a greater variety of new products. On the one hand, due to the use of new inputs, which can improve the quality of the enterprise's finished goods, or due to the introduction of high-quality equipment, enterprise efficiency and new product output are improved. On the other hand, in order to make better use of these new inputs and improve their ability to launch new products, enterprises may adopt new production processes and equip more researchers to learn the structure and technology of new inputs.

Table 1. The influence of the quality and variety of new imported products on enterprise innovation.

	(1)	(2)	(3)	(4)	(5)	(6)
	OLS	**FE**	**FE + IV**	**OLS**	**FE**	**FE + IV**
QN	0.0120 ***	0.0251 ***	0.0337 ***			
	(0.0026)	(0.0035)	(0.0044)			
VSN				0.0257 ***	0.0306 ***	0.0374 ***
				(0.0024)	(0.0032)	(0.0049)
age		0.0016 ***	0.0016 ***		0.0017 ***	0.0017 ***
		(0.0001)	(0.0001)		(0.0001)	(0.0001)
subr		0.2775 ***	0.2755 ***		0.2755 ***	0.2738 ***
		(0.0490)	(0.0490)		(0.0490)	(0.0490)
lnsale		0.0180 ***	0.0181 ***		0.0178 ***	0.0178 ***
		(0.0006)	(0.0006)		(0.0006)	(0.0006)
lnKI		0.0013 *	0.0012 *		0.0012 *	0.0011
		(0.0007)	(0.0007)		(0.0007)	(0.0007)
lnWG		0.0128 ***	0.0130 ***		0.0127 ***	0.0128 ***
		(0.0016)	(0.0016)		(0.0016)	(0.0016)
export		0.0261 ***	0.0264 ***		0.0265 ***	0.0268 ***
		(0.0020)	(0.0020)		(0.0020)	(0.0020)
HHI		0.2289 ***	0.2290 ***		0.2230 ***	0.2217 ***
		(0.0296)	(0.0296)		(0.0296)	(0.0296)
edu		0.0520 *	0.0523 *		0.0483 *	0.0476 *
		(0.0287)	(0.0287)		(0.0287)	(0.0287)
tech		0.6483 ***	0.6460 ***		0.6502 ***	0.6491 ***
		(0.1031)	(0.1031)		(0.1031)	(0.1031)
PGDP		−0.0128 ***	−0.0125 ***		−0.0125 ***	−0.0123 ***
		(0.0045)	(0.0045)		(0.0045)	(0.0045)
urban		0.0333 ***	0.0329 ***		0.0319***	0.0314 ***
		(0.0070)	(0.0070)		(0.0070)	(0.0070)
laborcost		−0.0091	−0.0092		−0.0095	−0.0097
		(0.0078)	(0.0078)		(0.0078)	(0.0078)
TSI		0.0212 ***	0.0205 ***		0.0205 ***	0.0199 ***
		(0.0064)	(0.0064)		(0.0064)	(0.0065)
Constant	0.0574 ***	−0.0360	0.0704	0.0450 ***	−0.0426	0.0634
	(0.0009)	(0.0655)	(0.0665)	(0.0016)	(0.0654)	(0.0666)
N	104017	65146	65146	104017	65146	65146
R^2	0.0800	0.1199	0.1193	0.0808	0.1204	0.1199

Notes: OLS, FE, and IV indicate ordinary least squares, fixed effects, and instrumental variables, respectively. The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

5.2. Comparison of the Influence of New Imported Products and Continuous Imported Products on Enterprise Innovation

Column (1) of Table 2 lists the influence of the quality of new imported products and the quality of continuously imported products on the innovation of enterprises. The results show that the quality of newly imported products still has a significant promoting effect on the innovation of enterprises, while the improvement in the quality of continuously imported products has no significant influence on the production rate of new products. In Column (2) of Table 2, we analyze the relative variety of new imported products; that is, the effect of the ratio of new imported products to continuously imported products on the enterprise's new product value rate. The regression results show that the improvement of the category of new imported products compared with the continuous imported products can promote product innovation in enterprises to a certain extent, and this promotion effect is very significant. The above regression results show that the quality and variety of newly imported products have a stronger promoting effect on enterprise innovation than that of continuously imported products.

Table 2. Comparison of the influence of new imported products and continuous imported products on enterprise innovation.

	(1)	(2)	(3)
QN	0.023 ***		0.025 ***
	(0.007)		(0.006)
QE	0.005		
	(0.006)		
VSN/VSE		0.001 ***	0.004 ***
		(0.000)	(0.001)
QN*(VSN/VSE)			−0.007 ***
			(0.001)
Other control variables	YES	YES	YES
N	53774	53774	53774
R^2	0.117	0.117	0.117

Notes: The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

In order to further explore the impact of the quality and variety of newly imported products on enterprise innovation, we analyze whether the impact of the quality of newly imported products on enterprise innovation was affected by the variety of imported products. The results in Column (3) of Table 2 show that coefficients γ_1 and γ_3 are significantly positive, while coefficient γ_2 is significantly negative. This shows that both the quality of new imported products and the relative variety have a significant positive effect on the innovation of new products. However, the improvement of the relative variety of new imported products will, to a certain extent, inhibit the marginal impact of the quality of new imported products on enterprise innovation. This may be due to the cost constraints that enterprises face, which often prevent them from obtaining new imports of both high quality and a wide variety. At the same time, this also indicates that the new imported product category is better in larger quantities, but that there is a critical value. When the new imported product category exceeds 3.57 times the continuous imported product category, the quality of the new imported product will no longer provide a driving force for enterprise innovation. This is more in line with economic reality. This means that it is not advisable to blindly pursue the diversification of new imported products while ignoring the quality of products. It is also not recommended for enterprises to change input products in large quantities every year, as this may cause employees to be too unfamiliar with how to use input products, and even cause various problems such as mismatching of production equipment and input technology. In addition, the regression results in Column (3) have another profound meaning when *VSN/VSE = 1*. When the same kind of newly imported products and continuously imported products are imported, the marginal effect of the quality of newly imported products on the innovation of enterprises is expressed as $\gamma_1 + \gamma_2$. We can obtain the influence of the quality of newly imported products on the innovation of enterprises without the interference of product variety. The results show that $\gamma_1 + \gamma_2$ is significantly greater than 0 (p-value was 0.001), indicating that improving the quality of new imported products could significantly promote the innovation of new products, even if the types of new imported products are the same as those of continuous imported products.

5.3. Heterogeneous Effect of New Imported Products on Enterprise Innovation

5.3.1. The Influence of New Imported Intermediate Goods and Capital Goods on Enterprise Innovation

We analyze the impact of the quality and variety of new imported products with different end uses on enterprise innovation (Table 3). We classify new imports into consumer goods, intermediate goods, and capital goods according to their end-use. Among them, intermediate goods and capital goods are put into the production process of the enterprise, which affects the production of the product and technological progress of the enterprise. Therefore, we analyze the influence of newly imported intermediate goods and capital goods on enterprise innovation. From the observed values of the sample, we see that the number of enterprises with newly imported intermediate goods is much higher than that with newly imported capital goods. From the perspective of product quality, the quality of new imported intermediate goods and capital goods has a positive impact on enterprise innovation, among which the promotion of intermediate goods quality has a stronger role in promoting enterprise innovation. From the perspective of product variety, the increase in the variety of new imported capital goods and intermediate goods can promote the enterprise's product innovation ability, and the difference between the two is not significant.

Table 3. Influence of new imported intermediate goods and capital goods on enterprise innovation.

	(1)	(2)	(3)	(4)	(5)	(6)
Quality of capital goods	0.035 *** (0.005)		0.048 *** (0.007)			
Quality of intermediate goods		0.022 *** (0.005)	0.075 *** (0.011)			
Variety of capital goods				0.041 *** (0.005)		0.074 *** (0.009)
Variety of intermediate goods					0.025 *** (0.003)	0.069 *** (0.008)
Other control variables	YES	YES	YES	YES	YES	YES
N	35832	59548	31160	35832	59548	31160
R^2	0.124	0.118	0.125	0.125	0.118	0.127

Notes: The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

5.3.2. The Influence of New Imported Products from Different Import Source Countries on Enterprise Innovation

Furthermore, we divide the different import source countries into Organization for Economic Co-operation and Development (OECD) and non-OECD countries, and measure the quality and variety of new products imported from OECD and non-OECD countries, respectively, before analyzing their different influences on enterprise innovation. The results are shown in Table 4. As indicated, the number of enterprises importing new products from OECD countries is much higher than that from non-OECD countries, and the impact of the two types of new imported products on enterprise innovation is significantly positive. The quality and variety of new products imported from OECD countries have a higher promotional effect on enterprise innovation than those from non-OECD countries, and the marginal impact is about twice that of new products imported from non-OECD countries. The coefficient difference between the quality of new imports from OECD and non-OECD countries is significant at the 10% level, while the coefficient difference between the varieties of new imports is significant at the 5% level. This indicates that enterprises should pay more attention to the introduction of products from OECD countries when making decisions regarding imports.

5.3.3. Influence of New Imported Products with Different Technological Content on Enterprise Innovation

According to the classification of product technology content by Lall [36], we analyze the difference in the influence of newly imported low-tech, medium-tech, and high-tech products on enterprise innovation. The results are shown in Table 5. As shown in the table, the number of enterprises with new imports of medium-tech products is the largest, followed by that of low-tech products, and then high-tech products as the lowest. The regression coefficient in the table shows that the improvement in the quality and variety of newly imported high-tech products has the strongest promotional effect on enterprise innovation, followed by medium-tech products, while the quality and variety of low-tech products have no significant influence on enterprise innovation. Therefore, it is advisable that when selecting new imported products, enterprises devote themselves to improving the quality and variety of newly imported high-tech products and simultaneously improve the quality and variety of newly imported medium-tech products, so as to activate the stimulating effect of imported products on enterprise innovation to a greater extent.

Table 4. The influence of the quality and variety of new imported products in different import source countries on enterprise innovation.

	(1)	(2)	(3)	(4)	(5)	(6)
Non-OECD product quality	0.015 ***		0.028 ***			
	(0.006)		(0.0094)			
OECD product quality		0.030 ***	0.051 ***			
		(0.004)	(0.008)			
Variety of non-OECD product				0.010 **		0.037 ***
				(0.004)		(0.008)
Variety of OECD product					0.034 ***	0.057 ***
					(0.004)	(0.007)
Other control variables	YES	YES	YES	YES	YES	YES
N	41876	54745	31271	41876	54745	31271
R^2	0.127	0.120	0.134	0.127	0.121	0.135

Notes: The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

Table 5. Influence of new imported products with different technological content on enterprise innovation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Low technical quality	−0.003			−0.018				
	(0.006)			(0.028)				
Medium technical quality		0.021 ***		0.033 ***				
		(0.004)		(0.011)				
High technical quality			0.090 ***	0.144 ***				
			(0.009)	(0.020)				
Variety of low-tech products					0.003			0.043 ***
					(0.004)			(0.016)
Variety of medium-tech products						0.023 ***		0.056 ***
						(0.004)		(0.012)
Variety of high-tech products							0.104 ***	0.176 ***
							(0.007)	(0.016)
Other control variables	YES	YES	YES	YES	YES	YES	YES	YES
N	45409	52944	27520	18987	45409	52944	27520	18987
R^2	0.105	0.114	0.137	0.122	0.105	0.115	0.141	0.125

Notes: The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

5.4. Robustness Test

5.4.1. Defining New Imports Based on a Base Year

Considering that the new imported products referred to in this study are defined as the products imported in the current year but not in the previous year, and that the influence of the enterprises that began importing in the current year is also eliminated, the products introduced in intermittent years cannot be accurately identified. Thus, referring to Yang's [38] identification method for enterprise entry and exit, we redefine new imported products by taking a certain year as the base year, and the subsequent years as being relative to the base year. Using a base year as the reference for defining new products will not only limit the initial products, but will also limit inspection during the period, while an enterprise must continue to import for many years. Nonetheless, the analysis of the year furthest from the base year could result in an increasing number of products being defined as new imports, with some of these being incorrectly included in the new definition. Therefore, to avoid a lengthy investigation period leading to a sample size that is too small and an investigation period that is too short, leading to weak reliability of regression results, new import data from 2001 to 2003 based on the year 2000, and new import data from 2005 to 2007 based on the year 2004 were used for the regression analysis. The regression results in Columns (1),(2) and (3),(4) of Table 6, based on the years 2000 and 2004, respectively, show that the quality and variety coefficients of new imports are still significantly positive.

Table 6. Robustness test.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
QN	0.030 ***		0.028 ***		0.150 ***		0.031 ***
	(0.003)		(0.004)		(0.032)		(0.004)
VSN		0.035 ***		0.034 ***		0.152 ***	
		(0.004)		(0.004)		(0.024)	
Other control variables	YES	YES	YES	YES	YES	YES	YES
Industry fixed effect	YES	YES	YES	YES	YES	YES	YES
Province fixed effect	YES	YES	YES	YES	YES	YES	YES
Year fixed effect	YES	YES	YES	YES	YES	YES	YES
N	43363	43363	49635	49635	21783	23916	65146
R^2	0.127	0.128	0.109	0.109	0.1922	0.1909	0.120

Notes: The brackets denote standard error, and *, **, and *** denote statistical significance at 10%, 5%, and 1%, respectively. The fixed effects of industry, year, and province were added into the regression.

5.4.2. Defining Innovation in Terms of Patent Applications

The data age is only from 2001 to 2007 when the production rate of new products is used to measure enterprise innovation in the previous article, which is relatively old and may not represent the situation in recent years. The number of patent applications can be used to measure enterprises' high-quality innovation achievements, and the data have been updated in recent years. This study uses the number of patent applications to measure enterprise innovation, and analyzes the impact of the quality and variety of new imported products on enterprise patent applications from 2001 to 2013 to test whether the impact of new imported products on enterprise innovation is sound. Referring to Tang et al. [39], we perform a logarithmic transformation on the number of patent applications. As shown in (5) and (6) of Table 6 above, when we use the number of patent applications to measure enterprise innovation and extend the data year to 2001–2013, the promotional effect of the quality and variety of new imported products on enterprise innovation is very stable. (The number of enterprise patent applications can be used to measure enterprise innovation, and the data can be expanded to 2001–2013. However, due to the absence of a large number of data indicators in the industrial and enterprise database from 2008 to 2013, a small amount of control variable is missing at the enterprise level. The missing control variables include government subsidy rate, human capital, and capital intensity.)

5.4.3. The Quality of Newly Imported Products Measured by Fan and Guo (2015) Method

Referring to Shi and Zeng [19], we measure the quality of newly imported products [31]. However, an endogeneity problem may appear when the higher quality of products results in higher prices. Shi and Zeng [9] used the average price of the same kind of products imported from other countries as the instrumental variable. This, however, would result in a large loss of samples, reduced sample representativeness, and generality of conclusions. Thus, we refer to the method of Fan and Guo [5] and construct the following quality measurement model:

$$log\ (q_{ihct})\ +\ \sigma log\ (p_{ihct})\ = \varphi_h + \varphi_{ct} + \varepsilon_{ihct} \tag{41}$$

In contrast to the Shi and Zeng [9] method, this method uses known alternative elasticity information rather than an estimation. The elasticity of substitution data was derived from the elasticity of substitution of HS3 code products imported from China as measured by Broda and Weinstein [7].

φ_h represents the fixed effect of the product, φ_{ct} represents the country year combined fixed effect, and $\hat{\varepsilon}_{ihct}/(\sigma-1)$ represents product quality.

Furthermore, we carry out quality standardization at the product level and the summary at the enterprise level, similar to the Shi and Zeng [9] method. Column (7) in Table 6 reports the influence of the quality of new imported products, measured through Fan and Guo's [15] method. The results show that the conclusion of this study, which states that enterprises can promote enterprise innovation by importing new products of higher quality, is very robust.

6. Conclusions

First, this paper introduces the concept of imported product quality and variety into the endogenous growth model of knowledge spillover in the open economy, and theoretically analyzes the influence of these factors on innovation and economic growth. It is found that both the variety and quality of imported intermediate products can influence technological innovation and economic growth. That is, the greater the variety of imported products, the higher the quality of imported products, and the higher the technological innovation and economic growth rate.

Second, this study analyzes the influence of the quality and variety of new imported products on enterprise innovation using matching industry enterprise and customs data from 2001 to 2007, which is a representative of micro data at the Chinese industry level. It is found that the quality and variety of new imported products have a significant promoting effect on enterprise innovation. The higher the quality of new imported products, the richer the variety, which can effectively promote the new product innovation of enterprises. The improvement of quality and relative variety of newly imported products has a stronger effect on enterprise innovation than that of continuously imported products. Even if an enterprise imports the same kind of newly and continuously imported products, the improvement of the quality of newly imported products can still promote enterprise innovation. Concurrently, the improvement of the relative variety of new imports will, to some extent, restrain the influence of the quality of new imports on enterprise innovation. Therefore, it is shown that more types of new imports may not be better, and enterprises should not blindly pursue the increase of new imported product types, but should pay more attention to the quality of new products.

Third, based on the analysis of the heterogeneity of new imported products, it was found that the improvement in the quality and variety of new imported intermediate products and capital goods, new imported medium and high-tech products, as well as new imported products from OCED and non-OCED countries, all have a significant promoting effect on the innovation of enterprises. However, the improvement in the quality of new imported intermediate products has a stronger promoting effect on enterprise innovation than capital goods, and the improvement of the quality and variety of new imported products from OECD countries has a stronger promoting effect on enterprise innovation than that of new imported products from non-OECD countries. Among the new imports with different technology content, the quality and variety of high-tech products have the strongest influence on enterprise innovation, followed by medium-tech products. As for the choice of new imported products, enterprises should actively increase the introduction of high-quality and high-tech intermediate products and capital goods from developed countries.

From both theoretical and empirical perspectives, this study finds that the quality and variety of new imported products have a promoting effect on enterprise innovation, but the influencing channels and mechanisms need to be further studied. In addition, the protection of intellectual property rights and other related rights of foreign enterprises in the process of learning and digesting many kinds of imported high-quality products is very important and also needs further study.

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Appendix A

Table A1. Variable definitions and data sources.

Variables	Variable Definitions	Data Source
NP	The proportion of the output value of new products and total industrial output value of enterprises	Industrial Enterprise Database (IED)
QN	The quality of newly imported products	Calculate based on Customs Database
VSN	The proportion of newly imported product types in all imported product types of the enterprise	Calculate based on Customs Database
lnRD	The logarithm of R&D investment	IED
age	The difference between the current year and the year of business operation is added by 1	IED
subr	The ratio of government subsidies to business sales	IED
lnsale	The logarithm of business sales	IED
lnKI	The logarithm of the average balance of net fixed assets divided by the number of employees	IED
lnWG	The logarithm of total wages and benefits divided by the number of employees	IED
export	Whether the enterprise exports	IED
HHI	Herfindahl-Hershman index	Calculate based on IED
edu	The proportion of education expenditure in the general budget of local finance	CEIC
tech	The proportion of spending on science and technology in the local government general budget	CEIC
PGDP	The logarithm of per capita GDP of cities	China Economic Database (CEIC)
urban	The proportion of non-agricultural population in the total population	CEIC
laborcost	The logarithm of the average wage of urban workers	CEIC
TSI	The proportion of city net export in total import and export trade	CEIC

Table A2. Descriptive statistics of variables.

Variables	Observations	Mean	Standard Deviation	Minimum	Maximum
NP	103328	0.0604	0.1988	0	1
QN	124881	0.5602	0.1501	0	1
VSN	124881	0.5914	0.2632	0.0217	1
lnRD	12161	5.7947	2.2862	0.0826	15.8642
age	124784	9.4264	5.8960	1	59
subr	124808	0.0018	0.0514	0	17.1150
lnsale	124807	11.0817	1.4294	2.9349	19.1313
lnKI	103063	4.0558	1.4241	0.0001	14.5317
lnWG	103335	3.0794	0.6439	0.0152	10.4076
export	124881	0.7836	0.4118	0	1
HHI	124881	0.0186	0.0297	0.0010	1.0000
edu	106212	0.1547	0.0472	0.0783	0.4943
tech	100345	0.0118	0.0146	0.0003	0.0685
PGDP	124188	10.5802	0.5287	7.8845	11.6016
urban	119260	0.5548	0.2210	0.0735	1.2195
laborcost	124476	10.1875	0.3550	8.6727	10.8885
TSI	97932	0.1309	0.2478	-0.9203	1.6928

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