Input Trade Liberalization and Welfare Loss of Manufacturing Enterprises: Based on the Perspective of Efficient Market Power

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Considering that upstream monopoly will lead to an exponential increase in the loss of social welfare, this paper investigates the impact of intermediate goods tariff concession on the welfare loss of manufacturing enterprises from the perspective of input trade liberalization and effective market power. It has been discovered that input trade liberalization significantly reduces the welfare loss of manufacturing enterprises. Due to the game condition in which oligopolies check each other and small businesses "gain from fishing", the inhibitory impact increases as market share decreases. The mechanism test demonstrates that input trade liberalization boosts the effect of technical competition and minimizes welfare loss through promoting market development degree and reducing factor distortion. In addition, this paper also finds that the effect of input trade liberalization on high monopolistic power enterprises is obviously stronger than that of low monopolistic power enterprises. Furthermore, the impact on non-high-tech industries and capital-intensive enterprises is significant, while that on high-tech industries and labor-intensive industries is not. Therefore, the welfare loss should be investigated from the dual perspective of market structure and marker power. Competitiveness has an important effect, while trade liberalization of intermediate inputs has a pivotal effect on promoting market development and improving resource allocation efficiency.

Keywords: input trade liberalization, effective market power, firm welfare loss

1. Introduction

The scientific estimation of welfare loss and monopoly power is a fundamental issue in the field of industrial organization. Clarifying the "structure-behavior-performance" relationship between market structure, market power, and welfare losses will be conducive to promoting fairness and efficiency. Early research found that cost of entry and elasticity of substitution are important factors influencing competition in the product market, and costs reduction can weaken monopoly

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power, and there is a U-shaped relationship between enterprise size and elasticity of substitution (Subramanian, 2013); Lu and Yu (2015) further found that trade liberalization reduces welfare losses by reducing the dispersion degree of enterprise markup and weakening the distortion of resource allocation. However, most of the existing studies focus on the final product, ignoring the multiplication effect of intermediates market power on social welfare losses. At present, the downstream market of China's manufacturing industry has basically realized free competition, but the monopoly power of the upstream market is still strong (Wang and Shi, 2014). From the perspective of the upstream of the industry, it is of great theoretical and practical significance to investigate the impact of input trade liberalization on welfare loss by clarifying the relationship between the structure, behavior and performance of monopoly enterprises.

Liberalization of input trade reflects the reduction of tariffs on intermediate goods. Since China's accession to the WTO, China's imports of intermediate goods have increased from US$79.4 billion in 2001 to US$408.4 billion in 2019, and the weighted average of import tariffs on intermediate goods have decreased from 12.66% to 2.94%, decreased by 76.78%. The literature that is highly relevant to this paper is divided into two branches, the first type of literature examines the impact of trade liberalization on enterprise product quality, productivity level, R&D investment, markup and value-added of export products from the perspective of micro-agent behavior and performance (Shi and Zhang 2016; Brandt *et al*., 2017; Mao and Xu, 2017; Li Jie *et al*., 2018; Li and Zhang 2021); The second type of literature examines the welfare effects of intermediate trade liberalization, including labor income distribution (Yu and Liang, 2014; Zhou *et al*., 2022), energy utilization and carbon emissions (Wu *et al*., 2022), and individual welfare (Qian *et al*., 2021).

The purpose of this paper is to identify the causal relationship between the liberalization of input trade and the welfare loss of manufacturing firms, while the accurate estimation of welfare loss depends on the effective measurement of market power. The existing measurement methods can be summarized into two categories: the first type is the accounting method (Domowitz *et al*., 1986), whose major advantage is that the required data is easy to obtain and the method can reflect the heterogeneity between industries. However, it ignores the influence of factors such as economic cycles and external shocks, and leads to one-sided results. The second type is the empirical method of new industrial organization, represented by Hall (1986) and Roeger (1995), which measures market power by estimating the elasticity of demand or output under the framework of market equilibrium analysis with the help of a series of assumptions. De Loecker and Warzynski (2012, hereinafter referred to as DLW) broke away from the assumptions related to market structure, and measured market power only according to the principle of firm minimization, which is a major breakthrough in the empirical method of new industrial organization. Although the method has been

widely used in related research (Damoah *et al*., 2021, Mukherjee and Chanda, 2021), it has practical difficulties due to the unobservable physical amount of output. Deng *et al*. (2022) constructed the "effective market power" index for the first time, and used the stochastic boundary analysis method (SFA) to eliminate the inefficient term to measure the market power of enterprises. But the SFA method also has some drawbacks, such as when there is a complex correlation between the input indicators of the production function, the selection of indicators may affect the accurate estimation of efficiency terms.

The existing research has laid a solid foundation for us to understand the relationship between the trade liberalization of inputs and the enterprise behavior and performance. At present, although China's upstream industry is mainly dominated by the natural monopoly of the state-owned economy, there is still a loss of resource allocation efficiency caused by price distortion. Since upstream monopolies can lead to an exponential increase in the loss of social welfare (Browning, 1997), the question that needs to be considered is: Could the trade liberalization of inputs restrain the continuous expansion of welfare losses? Is there a simple linear relationship among market structure, market power and enterprise welfare? What role does market structure, as a portrayal of the market environment, play in the process of the impact of input trade liberalization on welfare losses? Therefore, based on the perspective of trade liberalization of intermediate goods, this paper identifies the impact and internal mechanism of intermediate goods trade liberalization on the welfare loss of manufacturing enterprises by constructing an effective market power index. The marginal contribution of this paper is that: ① This paper summarizes the shortcomings of the current welfare loss estimation method, and draws on the effective market power index proposed by Deng *et al.* (2022). The two-step method of the DLW model was used to estimate the markup rate to calculate the effective market power, and the welfare loss was measured with the help of the Harberger triangle. To a certain extent, the estimation method of welfare loss at the enterprise level is enriched. ② Due to the exponential amplification effect of intermediate market power on welfare loss, this paper identifies the inhibiting effect of trade liberalization on welfare loss from the dimension of intermediate goods, and deeply explores the moderating role of market structure in it, which is a useful supplement to the research on microeconomic activities (such as pricing behavior, performance, welfare) and other related studies from the perspective of intermediate goods. ③ This paper divides the actual monopoly power of enterprises into two categories: high monopoly and low monopoly, and explores heterogeneity from multiple dimensions of industry and factor intensity, which is rarely covered in previous studies.

2. Theoretical Hypothesis and Mechanism Analysis

2.1. Measure of Welfare Loss from the Perspective of Effective Market Power

The welfare loss is calculated by calculating the area of the triangle of deadweight losses caused by market forces. And there are three shortcomings in measuring market power based on the traditional "Structure-Conduct-Performance" (SCP) paradigm: First, the marginal price or marginal costs obtained from the accounting data is unreliable; Second, the cross-sectional changes of the industrial structure can actually be captured; Third, empirical studies based on the S-C-P paradigm aim to estimate the simplified relationship between structure and performance (Bresnahan, 1989). The previous two deficiencies can be overcome by the two-step approach proposed by De Loecker and Warzynski (2012). The third shortcoming points out that the existing research simply boils dowm monopoly power to market structure or market power, which is obviously not scientific enough. In fact, monopoly power in economics is a portrayal of the monopoly power of enterprises, but the market share indicates the market structure of the incumbent. The Lerner index, a classic measure of market power, reflects enterprises' behavior in pricing beyond marginal cost. Therefore, regardless of the causal relationship between structure and behavior, this paper argues that the two should be combined to examine market power. The steps for specific estimation are as follows:

1. Suppose the production function of enterprise *i* in period *t* is:

$$Q_{it} = Q_{it}\left(X_{it}^{1},\ldots X_{it}^{V},K_{it},\omega_{it}\right) \tag{1}$$

Among them, V is a variable input. The output of a firm depends on the input of variable factors ($X_{it}^{1},\ldots X_{it}^{V}$) such as labor, intermediate inputs, and also on the level of capital (K_{it}) and productivity (ω_{it}).The first-order condition of the variable element is obtained by minimizing the cost of the enterprise:

$$P_{it}^{X^{V}} = \lambda_{it}\frac{\partial Q_{it}(\cdot)}{\partial X_{it}^{V}} \tag{2}$$

Among them, $P_{it}^{X^{V}}$ is variable factor prices for enterprises, λ_{it} is marginal cost. De Loecker and Warzynski (2012) have defined markup as the proportion of price to cost, namely $\mu_{it} = \frac{P_{it}}{c_{it}} = \frac{P_{it}}{\lambda_{it}}$. Multiply both sides of Equation (2) by $\frac{X_{it}}{Q_{it}}$ and substitute it into this equation to obtain the formula for calculating the market power of enterprises (Lerner index):

$$\psi_{it} = 1-\left(\mu_{it}\right)^{-1} = 1-\left(\theta_{it}^{X}\left(\tau_{it}^{X}\right)^{-1}\right)^{-1} \tag{3}$$

Among them, $\theta_{it}^{x} = \frac{\partial Q_{it}(\cdot)/\partial X_{it}}{Q_{it}/X_{it}}$ indicates the output elasticity of variable elements, $\tau_{it}^{x} = \frac{X_{it}P_{it}^{X^{V}}}{PQ_{it}}$ indicates the share of variable factor costs in total revenue.

2. The market power of enterprises originate from Lerner (1934)'s the depiction of the marginal monopoly profit based on the price elevation degree of the monopoly market. This method is based on the traditional S-C-P paradigm, which believes that there is a "linear" logical relationship between the market share and market power of enterprises. However, the positive influence of the market share on the competitiveness of the manufacturers is ignored from the simple perspective of the enterprise pricing, and enterprises with large market share may not adopt monopolistic behavior. Therefore, this paper combines market power and market share to construct an effective market power indicator(ϖ). The market share (*s*) is expressed as the proportion of the sales revenue of *i* enterprises' *j* products in the total sales revenue of *j* products. The specific calculation formula is as follows:

$$\varpi_{ijt} = s_{ijt} \times \left(1-\left(\theta_{it}^{X}\left(\tau_{it}^{X}\right)^{-1}\right)^{-1}\right) = s_{ijt} \times \psi_{it} \tag{4}$$

3. The Harberger triangle outlines the loss of welfare caused by the market power of enterprises, which is the area of the triangle ABC in Figure 1. It is calculated as follows:

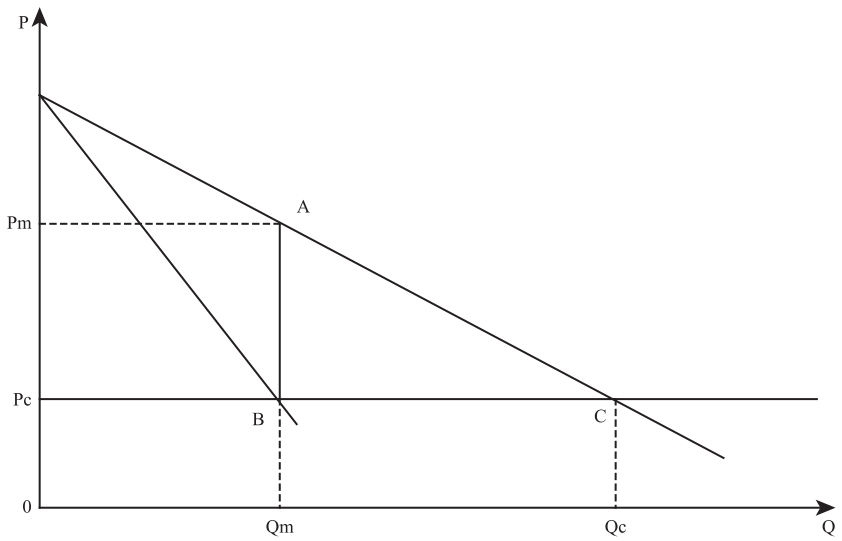

Figure 1. Harberger Triangle of Welfare Loss

$$S_{ABC} = \frac{1}{2}(P_m - P_c)(Q_c - Q_m) = \frac{1}{2}dPdQ = -\frac{1}{2}\left(\frac{dP}{P}\right)^2 PQ\left(-\frac{dQ/dP}{Q/P}\right) = -\frac{1}{2}\varpi^2 PQ\eta \quad (5)$$

Among them, $\frac{dP}{P} = \frac{P - MC}{P}$ is the degree of price elevation of monopoly enterprises, namely market power ψ_{it}; η is price elasticity of demand; PQ is sales revenue of monopoly enterprises. $\eta = -\frac{1}{\psi_{it}}$ can be known by the Lerner index and substituted into the formula of welfare loss in this paper:

$$flss_{ijt} = -\frac{1}{2}P_{it}Q_{it}\left(\psi_{it}\right)^2\left(-\frac{1}{\psi_{it}}\right) = \frac{1}{2}P_{jt}Q_{jt}s_{ijt}\psi_{it} = \frac{1}{2}P_{jt}Q_{jt}\varpi_{ijt} \quad (6)$$

Among them, $P_{it}Q_{it}$ represents the sales revenue of monopoly enterprises, and $P_{jt}Q_{jt}$ represents the total industry revenue.

2.2. Trade Liberalization of Intermediate Goods and Welfare Losses: An Analysis of Direct Effects and Mechanisms

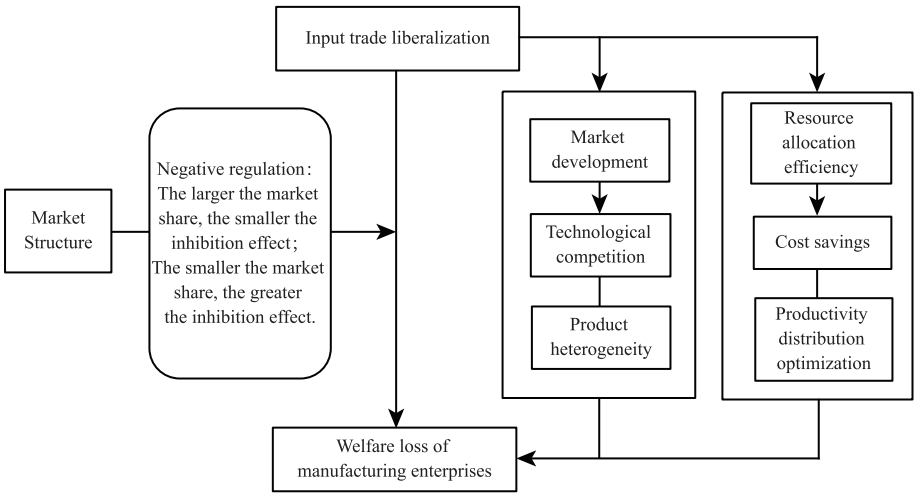

Figure 2. Mechanism Framework Diagram of Input Trade Liberalization Affecting the Welfare Loss of Manufacturing Enterprises

Hypothesis 1: Input trade liberalization can help reduce the social welfare losses caused by manufacturing monopolies.

The factors leading to welfare loss are diversified. For China's manufacturing industry, the monopoly power of the upstream intermediate goods industry is an important factor in generating welfare costs. Bjertnæs (2007) found that intermediate market power exposes the final goods market to additional social welfare losses, which are even 40 times the welfare costs of a single final goods market monopoly. Therefore, weakening the market power of intermediate goods, reducing the upstream monopoly of manufacturing industry, and enhancing the availability of intermediate goods for small-and medium-sized enterprises are important ways to restrain the expansion of social welfare losses. At present, the upstream industry of China's manufacturing industry mainly presents the characteristics of natural monopoly, which is caused by differences in technology and productivity (Huang and Ping, 2020). The input trade liberalization weakens the access restriction by reducing the import tariff of intermediate goods, which will enrich the types and quantity of intermediate goods in the domestic market, strengthen the quality of intermediate goods. All these eventually spread to the whole industry through the spillover effect of technology. The more manufacturing enterprises have profited from this, the larger the inhibition effect on welfare losses caused by upstream monopoly.

Hypothesis 2: Market structure plays a role as a moderating mechanism in the process of the impact of input trade liberalization on welfare losses.

The distribution of benefits of trade liberalization is heterogeneous and affected by factors such as market environment and institutional quality (Pavcnik, 2017). Considering that the market structure is a description of the market environment, and the market share reflects the market structure of the incumbent, this paper argues that the inhibitory effect of input trade liberalization on welfare losses will change with the change of market structure. Given that there is no linear logical relationship between market structure and market power, a larger market share does not necessarily lead to a stronger market power. It is more likely that oligopolies will compete with each other and small enterprises will profit from it, namely it may be easier to form a Cournot equilibrium between large enterprises, while small firms tend to implement a leader-follower game and adopt pricing strategies after observing the decisions of large firms (Deng *et al*., 2022). At this time, although large enterprises have a certain market share, their actual pricing power is limited, while small enterprises have strong independent pricing power. Therefore, for firms with large market shares, although input trade liberalization can affect market power through cost-saving effects (Mukherjee and Chanda, 2021), its intervention ability is limited under the established game model. Thus, the larger the market share, the less inhibiting effect on the welfare loss of input trade liberalization will be. For enterprises with a small market share, potential competitors that cannot be ignored are key to curbing welfare losses (Baumol, 1982). After input trade liberalization, factors such as technology spillovers, cost savings, and profit motives attract the entry of enterprises in the periphery of the industrial chain.

The most vulnerable to potential entrants are the internal small and medium-sized enterprises. Therefore, the smaller the market share, the greater the inhibitory effect of intermediate trade liberalization on welfare losses.

Hypothesis 3: The liberalization of input trade inhibits welfare losses by optimizing market development and resource allocation efficiency to strengthen the competitive effect.

Porter (1990) analyzes that national economic development needs to go through four stages: production factor driven, investment driven, innovation driven and wealth driven, among which the first three stages are the main sources of national competitiveness. Reduced tariffs on intermediate goods can help create strong technology spillovers, enhance enterprises' innovation capabilities, and broaden their product range (Goldberg *et al*., 2010).Therefore, this paper argues that the liberalization of input trade can reduce the welfare losses caused by monopoly power by expanding market abundance to strengthen market development[1], alleviating factor distortions to enhance the availability of production factors, and relaxing technological restrictions to strengthen technological competition and cost-saving ability among enterprises. On the one hand, the abundant intermediate varieties can help enterprises break through the technical threshold. The improvement of enterprises' innovation ability enhances the heterogeneity of their own products, and promotes enterprises to get rid of the suppression of rent-seeking monopoly forces under the effect of technological competition, thereby reducing welfare losses. On the other hand, the liberalization of input trade has broken down the barriers on the flow of domestic intermediate goods market. As a result, the production cost of the enterprise is reduced. The overall productivity level of the industry has improved. The misallocation of factor resources and the spatial distribution of productivity were optimized. The monopoly power of oligopolies over the industry has plummeted (Fiorini *et al*., 2021). Eventually, the loss of benefits is inhibited.

3. Study Design and Data Description

3.1. Empirical Research Strategies

This paper takes manufacturing enterprises as the research object, examining the causal relationship between the liberalization of input trade and the economic activities of firms. China joined the WTO in 2001 and has faced extensive tariff concessions

[1] Market abundance is an important part of market development, including factor market abundance and product market abundance. The higher the abundance of the market, the higher the total amount and quality of various factors and products in the market, the more reasonable the distribution structure, and the higher the degree of market development.

since then. In order to avoid estimation bias due to the time lag of policy measures, this paper lags the intermediate goods trade liberalization variable by one period. Based on the research of Zhu *et al*. (2018), this paper establishes the following basic model:

$$lflss_{ijt} = \alpha_1 + \beta_1 \tau_{j,t-1}^{input} + \delta_1 Z_{j,t-1} + \gamma_1 X_{i,t} + \eta_{i,1} + \eta_{t,1} + \varepsilon_{ijt,1} \quad (7)$$

Among them, $lflss_{ijt}$ is the logarithm of the welfare loss of manufacturing enterprises, *i*, *j*, and *t* refer to the company, industry, and year, respectively. $\tau_{j,t-1}^{input}$ is the core explanatory variable with one period lag, the import tariff of intermediate goods; $Z_{j,t-1}$ is the control variable at the industry level; $X_{i,t}$ is the control variable at the enterprise level; η_t , η_i denote fixed effects at the time and individual levels; $\varepsilon_{ijt,1}$ is the error term. In order to test whether there is a moderating effect, this paper introduces market share on the basis of model (7) by drawing on the research of Ludema *et al*. (2021) and Li *et al*. (2019), and establishes the following moderating mechanism model:

$$lflss_{ijt} = \alpha_2 + \beta_2 \tau_{j,t-1}^{input} + \chi \tau_{j,t-1}^{input} \times s_{ijt} + \kappa s_{ijt} + \delta_2 Z_{j,t-1} + \gamma_2 X_{i,t} + \eta_{i,2} + \eta_{t,2} + \varepsilon_{ijt,2} \quad (8)$$

Among them, s_{ijt} represents the market share of enterprises used to depict the market structure.

3.2. Indicator Measurement

3.2.1. The Welfare Loss of Manufacturing Enterprises

Harberger (1954) first established the social cost model to measure the degree of market monopoly. This model describes the welfare loss caused by market forces with the welfare dynamic change caused by the pricing of monopoly manufacturers higher than the marginal cost. Many scholars believe that this algorithm may underestimate the welfare loss caused by monopolies. The reasons include the application of local equilibrium, the emergence of non-price competition, the assumption of unit price elasticity and the calculation of excess profit (Hu and Chen, 2014). This paper argues that the accurate estimation of welfare losses should first clarify the "nonlinear" relationship between market share and market power. Therefore, based on the Harberg triangle, this paper constructs a welfare loss measurement model of China's manufacturing enterprises on effective market power.

3.2.2. Liberalization of Trade in Intermediate Goods

Based on the research of Wang and Li (2021), this paper measures the import tariff of industry intermediate goods. The specific calculation formula is as follows:

$$\tau_{jt}^{input} = \sum_k \vartheta_{jk} \tau_{kt}^{output} \tag{9}$$

Among them, ϑ_{jk} represents the proportion of input from industry k in industry j, which is calculated from the China Input-Output Table in 2002; τ_{kt}^{output} represents the import tariff of k industry in t year., based on the simple average of the industry under the national economic industry classification four digit code (CIC4).

3.2.3. Other Variables

Enterprise level: (1) Total factor productivity of enterprises(*tfp*). In this paper, based on the study of Head and Ries (2003), the formula *tfp*=ln*(y/n)-s**ln*(k/n)* is used to calculate the total factor productivity of enterprises. Among them, *y* is measured by the gross industrial output value, *k* is the fixed asset, *n* is the number of employees, and *s* is the capital contribution in the production function, which is 1/3 (Hall and Jones, 1999). (2) The size of the enterprise (*lsize*), which is measured as the logarithm of the number of employees employed by the enterprise. (3) The age of the enterprise (*lage*), which refers to the logarithm of the number of opening years of the enterprise at the sample year. (4) Capital intensity of the enterprise (*lkl*), which is the logarithm of the ratio of net fixed assets to the number of employees. (5) Enterprise operating profit (*lpro*), which is measured by the logarithm of the proportion of total profit in the total output value of the period. (6) Corporate finance constraints, including internal financing constraints (*lin_fin*) and external financing constraints (*lex_fin*). Internal Financing Constraint = ln[(Current Assets - Current Liabilities)/Net Fixed Assets of the Enterprise], reflecting the accumulation of the enterprises' own funds and funds in the course of operations. The smaller the value, the greater the internal financing constraints. External financing constraint = ln(accounts payable/sales of the main business of the enterprise), reflecting the level of bank loans and commercial credit financing. The smaller the value, the greater the external financing constraint.

Industry level: (1) Import tariffs on final goods (*lout*) under four-digit-code industries. Controlling changes in the tariff level of final goods has led to increased competition among manufacturing enterprises from foreign manufacturers. (2) Degree of agglomeration in four-digit-code industries (*EG*), measured by the *EG* index, which reflects the barriers to entry for companies entering the industry during the sample period.

3.3. Data Description and Processing

The measures of welfare loss mainly use the data of manufacturing enterprises in China from 2000 to 2014 and the China Statistical Yearbook from 2001 to 2015. In this paper, we first refer to the practice of Huang and Wu (2013) to deflator the monetary variables; Then, the years with serious data missing in the industrial and enterprise database were deleted, and the research of Xie *et al*. (2008) was used to correct them. Finally, the national economic industry code is unified into GB/T 4754–2002 standard.

Import tariff data are derived from the WITS database. First, this paper harmonizes the product codes of import tariffs into the HS2002 version based on the product-level conversion table provided by the United Nations Statistics Division; Then, drawing on the practice of Brandt *et al*. (2017), this paper unifies the tariff data under the national economic industrial classification and calculates the simple average import tariff of the final goods; Finally, with the help of China's Input-Output Table in 2002, the intermediate goods input coefficient calculated, and multiplied and summed with the final product tariff to obtain China's intermediate goods import tariff from 2000 to 2015.

4. Input Trade Liberalization and Changes in Welfare Losses of Manufacturing Enterprises: Identification of Actual Effects and Mechanisms

4.1. Exploration on the Relationship Between Input Trade Liberalization and the Change of the Welfare Loss of Manufacturing Enterprises

4.1.1. Basic Model of the Actual Effects

This paper mainly focuses on the changes in the welfare loss of manufacturing enterprises under effective market power. As shown in the estimates in columns (1) and (2) of Table 1, the reduction of tariffs on intermediate goods can directly reduce the welfare losses caused by monopolies, regardless of whether control variables are introduced. In order to clarify whether the market structure of enterprises in the context of effective market power has a moderate effect in the process of reducing welfare losses caused by tariff cuts on intermediate goods, this paper introduces market share on the basis of the benchmark model. The regression results are shown in column (3) of Table 1, the interaction coefficient between tariffs and market share is significantly negative. The results show that the impact of input trade liberalization on the change of welfare loss is significantly affected by the market share of enterprises. Due to the existence of a game situation in which oligopolies contain each other and the

independent pricing power of small enterprises increases, the inhibition effect increases with the decrease of market share.

Table 1. Microeconomic Effects of Trade Liberalization in Intermediate Goods

	Explanatory variables:*lflss*		
	(1)	(2)	(3)
lag_ltariff	0.0153***	0.0109***	0.0105***
	(7.32)	(4.85)	(5.23)
s			10.5028***
			(38.92)
*lag_ltariff*s*			−0.0870***
			(−3.09)
Control variables	No	Yes	Yes
Time fixation effect	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes
Constant	10.2505***	−18.3880***	−16.5962***
	(581.67)	(−179.32)	(−177.47)
Observations	249,551	151,665	151,665
R^2	0.4238	0.7627	0.8098

Note: The values in parentheses are t-statistics under the enterprise-level clustered standard error, ***,**, and * represent 1%, 5%, and 10% significant levels, respectively. The following tables are the same.。

4.1.2. Robustness and Endogeneity Test

(1) Variable Stability Test

Explanatory variables: In order to exclude the instability caused by different production functions, this paper uses two methods to modify the measurement method of welfare loss variables. First, the output variable in the production function is indicated by the total output of the enterprise, rather than the original value-added of the enterprise (*lflss_new*); Second, the trans-log function used in the estimation of market power is replaced by the Lagrangian function (*lflss_fuction*). Explanatory variables: The two and three period lagged term of intermediate tariffs were introduced to test the robustness and the time continuity of trade policies. The regression results show that the inhibitory effect of the decline of intermediate tariffs on welfare loss is robust and time-sustainable.

(2) Sample Bias Handling

The sample in this paper is selected from the China Industrial Enterprise Database

from 2000 to 2015, which defines enterprises as all state-owned enterprises and non-state-owned enterprises above designated size. Before 2011, the standard of "above designated size" was sales greater than 5 million yuan, but after 2011, it was changed to sales greater than 20 million yuan. Therefore, in order to maintain the consistency of the sample, this paper deletes the sample of enterprises with sales less than 20 million yuan to correct the sample bias and then investigate the robustness of the basic conclusions.

(3) Data Extremum Processing

In this paper, the explanatory variables and the core explanatory variables are winsorized by 1% on both sides to verify the stability of the sample data and exclude the interference of extreme values. The results are shown in columns (1) and (2) of Table 2, and there is a significant positive correlation between intermediate tariffs and welfare losses, which is consistent with the basic regression results.

Table 2. Robustness Tests for Sample Changes and Estimation Method Changes

	Deviation correction	Extremum processing	Reform of the exchange system	Difference-in-differences
	(1)	(2)	(3)	(4)
lag_ltariff	0.0110***	0.0094***	0.0109***	
	(4.82)	(4.22)	(4.85)	
did				−0.1552***
				(−71.97)
Control variables	Yes	Yes	Yes	Yes
Time fixation effect	Yes	Yes	Yes	Yes
Enterprise fixed effect	Yes	Yes	Yes	Yes
Constant	−18.3695***	−18.2677***	−18.3880***	−16.5751***
	(−173.94)	(−177.63)	(−179.32)	(−146.08)
Observations	146,443	151,665	151,665	132,258
R^2	0.7603	0.7587	0.7627	0.7902

(4) Revision of the Factors of Change in the Exchange Rate System

Aghion *et al*. (2009) argue that exchange rate institutional flexibility can have a negative impact on a country's productivity; Wang *et al*. (2020) further found that the difference in the expected output growth rate of enterprises under the two exchange rate regimes is realized through productivity progress. And the greater the exchange rate fluctuation, the slower the output growth rate of enterprises in the next period. Considering the major reform of the RMB exchange rate mechanism in 2005, this paper performs regression analysis after excluding the data from 2005 to 2006, and

finds that the impact of intermediate trade liberalization on the change of welfare loss is basically consistent with the basic regression conclusion.

(5) Endogeneity and Optimization of Measurement Methods

The mainstream method to solve endogeneity is to find instrumental variables to perform two-stage least squares estimation of the model. Admittedly, for the purposes of this paper, it is difficult to find a suitable tool variable. Fuchs-Schündeln and Hassan (2015) state that natural experiments can describe causality and solve endogeneity problems. Scholars such as Lu and Yu (2015) and Wang and Li (2021) examine the economic effects of intermediate trade liberalization by using China's accession to the WTO as a quasi-natural experiment. Based on the above research, in order to further verify the robustness of the core conclusions, eliminate endogenous problem, and optimize the measurement method, we extend the sample year to 1997 and use 2001 as the time point of policy shock, and use the difference-in-difference method for robustness analysis. The treatment effect model was constructed as follows:

$$lflss_{ijt} = \alpha_3 + \beta_3 \tau_{j,2001}^{input} \times shock_t + \delta_3 Z_{j,t-1} + \gamma_3 X_{i,t} + \eta_{i,3} + \eta_{t,3} + \varepsilon_{ijt,3} \quad (10)$$

Among them, $\tau_{j,2001}^{input}$ is the tariff on intermediate goods in 2001. $shock_t$ is a dummy variable of policy shock, which is equal to 0 in 1996–2001 and 1 in 2002–2015. The regression results are shown in column (4) of Table 2, $\tau_{j,2001}^{input} \times shock_t$ is significantly negative. The results hows that compared with the control group, after joining the WTO, the social welfare losses caused by monopoly in the industries with high intermediate tariffs (treatment group) decreased, which is consistent with the basic regression conclusion of this paper.

(6) Quantile Regression

The basic model mainly uses the mean reversion method to explore the impact of intermediate trade liberalization on the condition expectation of welfare loss. In order to comprehensively investigate the impact of input trade liberalization on the distribution of welfare losses, this paper selects four quantiles of 0.25, 0.5, 0.75 and 0.85, and performs quantile regression. We found that the basic regression conclusions were robust at different quantiles.

4.2. Exploration of Channels for the Liberalization of Input Trade to Affect the Change of Welfare Loss

From hypothesis 3, liberalization of input trade can inhibit the expansion of welfare losses by expanding market abundance to strengthen market development, and optimizing the efficiency of resource allocation to form technological competition

and cost saving effects. Since the availability of production factors and the rational allocation of resources are important factors for reducing welfare losses, this paper draws on the research of Jiang (2022) to focus on the identification of the causal relationship of input trade liberalization on mediator. Therefore, this paper constructs the following mediation model:

$$d\_market_{jpt} = \alpha_4 + \beta_4 \tau_{j,t-1}^{input} + \eta_{i,4} + \eta_{t,4} + \varepsilon_{ijt,4} \tag{11}$$

$$tfp\_theil_{jpt} = \alpha_5 + \beta_5 \tau_{j,t-1}^{input} + \eta_{i,5} + \eta_{t,5} + \varepsilon_{ijt,5} \tag{12}$$

Among them, *d_market* represents the reciprocal of the market development index of prefecture-level cities. The data comes from the research of Wang *et al*. (2016), which uses the statistical bulletin of prefecture-level cities and the statistical yearbooks of each province to calculate the market development score. *Tfp_theil* represents the efficiency of resource allocation, which is measured by the degree of dispersion of enterprise productivity. In this paper, the degree of productivity imbalance distribution among enterprises is measured by the Theil index. The model regression results are shown in Table 3. Columns (1) is the results of basic regression. Columns (2) and (3) are the effects of input trade liberalization on the mediator. This paper finds that the deeper the degree of trade liberalization of inputs, the higher the market development score, the smaller the degree of unbalanced distribution of productivity, and the higher the efficiency of resource allocation. As a result, the mediating effect is significant.

Table 3. Mechanism of The Impact of Intermediate Trade Liberalization on Welfare Losses

	Welfare loss	Market development	Productivity dispersion
	(1)	(2)	(3)
lag_ltariff	0.0109***	0.0004**	0.0008***
	(4.85)	(1.98)	(4.97)
Control variables	Yes	Yes	Yes
Time fix effect	Yes	Yes	Yes
Enterprise fix effect	Yes	Yes	Yes
Constant	−18.3880***	0.8264***	0.1025***
	(−179.32)	(88.82)	(15.20)
Observations	151,665	157,922	157,233
R^2	0.7627	0.7620	0.4238

5. Further Exploration: the Heterogeneity of the Impact of Input Trade Liberalization on the Change of Welfare Loss

In order to further explore whether there is heterogeneity in the core conclusions, this part conducts the following detailed research from the perspectives of the actual monopoly ability, industry nature, and factor density of enterprises.

First of all, enterprises that with monopoly power higher than the industry average are classified as high monopoly enterprises, and those below the average are classified as low monopoly enterprises. According to the results listed in columns (1) and (2) of Table 4, it can be seen that the level of effective monopoly power does not affect the inhibitory effect of input trade liberalization on welfare loss, but the impact effect on enterprises with high monopoly power is significantly greater than that of enterprises with low monopoly power. This conclusion excludes the case of "Cournot equilibrium" among oligopolies and echoes the moderating effect. The results show that for enterprises with high effective market power, the inhibitory effect of the liberalization of input trade on welfare loss is significantly greater than that for than enterprises with low effective market power.

Secondly, according to the classification standard of high-tech industries implemented by the National Bureau of Statistics, this paper divides the samples into two categories : high-tech and non-high-tech[1], based on four-digit industry codes, and examines the effect of technological competition from whether they are in high-tech industries. The results of columns (3) and (4) of Table 4 show that the intermediate goods tariff concession has no significant effect on the welfare loss of enterprises in high-tech industries, but has a significant effect on the inhibition of welfare losses in non-high-tech industries. The reason is that the high-tech industry already has a high barrier to entry, with few potential competitors for the incumbent enterprises, and the intermediate goods used may need to be specially customized, so the impact of the intermediate goods tariff concession on the welfare loss of such enterprises is not significant. However, for non-high-tech industries, the entry threshold is relatively low. The competition between incumbent enterprises or competition from potential entrants leads to a great increase in the level of factor marketization and product marketization, and the efficiency of resource allocation is improved. At the same time, increased competition leads to tariff concessions on intermediate goods, which can significantly reduce welfare losses.

Finally, according to the factor intensity of enterprises, the samples are divided into

[1] The high-tech industry includes six categories: pharmaceutical manufacturing, aviation, spacecraft and equipment manufacturing, electronic and communication equipment manufacturing, computer and office equipment manufacturing, medical equipment and instrumentation manufacturing, and information chemicals manufacturing. For the specific four-digit industry codes, please refer to the "Classification of High-tech Industries (Manufacturing)" document issued by the National Bureau of Statistics. This article unifies the industry to the identification standard of [GB/T4754-2002].

capital-intensive and labor-intensive enterprises[1]. The results are shown in columns (5) and (6) of Table 4, and the impact of tariff concessions on intermediate goods on the welfare loss of capital-intensive enterprises is significant, but not on labor-intensive enterprises. The reason is that labor-intensive enterprises require a large amount of labor, such as the clothing and textile industry, food processing industry and other industries, which are more sensitive to the cost of labor factors and have less demand for imported intermediate goods. Therefore, the impact of the reduction of tariffs on intermediate goods on the welfare loss of such enterprises is not significant. Capital-intensive industries have higher requirements for capital investment, which also need high-tech import factors (such as advanced technology and equipment). Therefore, the reduction of tariffs on intermediate goods can significantly inhibit the welfare losses caused by the monopoly power of such enterprises.

Table 4. Heterogeneity Test of Actual Monopoly Power, Industry Nature, and Factor Intensity

	High monopoly power	Low monopoly power	High technology	Non-high-tech	Labor	Capital
	(1)	(2)	(3)	(4)	(5)	(6)
lag_ltariff	0.0245***	0.00752**	0.0286	0.00968***	0.00263	0.00901***
	(4.35)	(2.42)	(1.56)	(3.97)	(0.20)	(3.24)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Time fix effect	Yes	Yes	Yes	Yes	Yes	Yes
Enterprise fix effect	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−17.79***	−17.58***	−18.52***	−18.53***	−17.04***	−18.44***
	(−65.23)	(−108.18)	(−20.37)	(−149.47)	(−25.34)	(−132.36)
Observations	89847	141772	20415	211204	31954	187070
R^2	0.576	0.624	0.655	0.589	0.630	0.584
Test for coefficient differences of *lag_lntariff* between groups [P value]	−0.017***		−0.019***		0.006*	
	[0.000]		[0.000]		[0.052]	

Note: The meaning of the coefficient difference P value between groups is the probability that the difference between the *lag_lntariff* estimated coefficients in different groups is not equal to 0, which is obtained based on 1000 bootstrap times.

[1] Labor-intensive refers to the food processing industry, food manufacturing industry, beverage manufacturing industry, tobacco processing industry, textile industry, paper and paper products industry; Capital-intensive refers to petroleum processing, coking and nuclear fuel processing industry, non-metallic mineral products industry, ferrous metal smelting and rolling processing industry, non-ferrous metal smelting and rolling processing industry, metal products industry, general equipment manufacturing industry, special equipment manufacturing industry, instrumentation and cultural office machinery manufacturing industry.

6. Conclusion and Policy Implications

Welfare loss is an important source of inefficient resource allocation. How to reduce the loss of welfare from the perspective of intermediate goods, give full play to the decisive role of the market in the allocation of resources, and enhance the core competitiveness of China's manufacturing industry is the focus of current social attention. This paper examines the impact of input trade liberaliztion on welfare loss in the manufacturing industry, and finds that: (1) Liberalization of input trade can curb the welfare losses caused by the monopoly of manufacturing enterprises. However, due to the influence of market structure, the inhibition effect will increase with the decrease of market share; (2) Liberalization of input trade reduces welfare losses by strengthening market development and improving the efficiency of resource allocation; (3) According to the heterogeneity analysis of the actual monopoly ability, industry nature and factor intensity of enterprises, it shows that the inhibition effect of input trade liberaliztion on the welfare loss of high-monopoly enterprises is greater than that of low-monopoly enterprises, and the impact on non-high-tech industries and capital-intensive enterprises is significantly positive, but the impact on high-tech industries and labor-intensive enterprises is not significant. Based on the above conclusions, this paper puts forward the following policy implications.

First, we should continue to promote input trade liberalization in an efficient manner, adhere to the strategy of "promoting reform through opening-up", and guard against the continuous expansion of the monopoly power of enterprises. Government departments should change the import restriction to encourage the import of high-tech, high-quality and low-cost intermediate goods. In particular, import tariffs on high-tech equipment, key components and other factors should be lowered to enhance the availability of production factors for enterprises. We should take the initiative to reduce the trade barriers with other countries through bilateral or multilateral negotiations, and minimize entry barriers for imported intermediate goods. In addition, we should implement the strategy of "multilateralism", actively establish good trading partner relations with countries in the sub-region, and strengthen bilateral and multilateral competition and cooperation by joining RCEP, CPTPP and other agreements, so as to optimize the living environment of domestic small and medium-sized enterprises.

Second, we should pay attention to the competitive effect caused by imported intermediate goods, encourage enterprises to increase R&D investment, further promote market-oriented reforms, and drive internal and external economic circulations with innovation. This paper finds that input trade liberalization strengthens market development through technological competition, and improves the efficiency of resource allocation through cost saving, and thus inhibits welfare loss. Therefore, the reduction of the industry access threshold requires enterprises to continuously optimize product layout, diversify intermediate varieties and quality, and increase R&D

investment, so as to counter monopoly forces by forming effective competitiveness. Government departments should also strengthen R&D subsidies to drive the modernization of the industrial chain with innovation. At the same time, government departments should continue to deepen the reform of the economic system, adhere to the concept of "factor flow" for the "14th Five-Year Plan" period, rely on diversified channels to break the upstream monopoly, and provide a fair playing field for small and medium-sized enterprises.

Third, we should distinguish the actual monopoly power, industry nature, and factor density of enterprises, and then implement differentiated industrial management strategies. Specifically, first, in view of rent-seeking monopolistic behavior, we should actively adopt effective anti-monopoly measures to encourage the innovative behavior of leading enterprises in the industrial chain, so as to promote the development of small and medium-sized enterprises. Second, we should efficiently promote market-oriented reforms and increase R&D subsidies. At the same time, we should regularly review the authenticity and foresight of R&D patents in high-tech industries, and put an end to fraud for subsidies at the root. Third, in the context of the continuous input trade liberalization of trade in intermediate goods, we should formulate fair and effective income redistribution policies and guard against social welfare loss caused by the market power of labor factors.

References

Aghion, P., Bacchetta, P., Ranciere, R., & Rogoff, K. (2009). Exchange Rate Volatility and Productivity Growth: The Role of Financial Development. *Journal of Monetary Economics*, 56(4), 494–513.

Baumol, W. (1982). Contestable Markets: An Uprising in the Theory of Industry Structure. *American Economic Review*, 72(1), 1–15.

Bjertnæs, G. H. (2007). The Welfare Cost of Market Power. Accounting for Intermediate Good Firms. Discussion Papers, No.502.

Brandt, L., Van Biesebroeck, J., Wang, L., & Zhang, Y. (2017). WTO Accession and Performance of Chinese Manufacturing Firms. *American Economic Review*, 107(9), 2784–2820

Bresnahan, T. F. (1989). Empirical Studies of Industries with Market Power. *Handbook of Industrial Organization*, Amsterdam: North-Holland.

Browning, E. K. (1997). A Neglected Welfare Cost of Monopoly-and Most Other Product Market Distortions. *Journal of Public Economics*, 66(1), 127–144.

Damoah, K. A., Giovannetti, G., & Sanfilippo, M. (2021). Markup dispersion and firm entry: evidence from Ethiopia. *Oxford Bulletin of Economics and Statistics*, 83(2),

299–327.

De Loecker, D., & Warzynski, F. (2012). Markups and Firm-Level Export Status. *The American Economic Review*, 102(6), 2437–2471.

Deng, Z., Pang, R., & Chen, Y. (2022). From Market Power to Effective Market Power: An Example of Chinese Pharmaceutical Industry. *Journal of Management World (Guanli Shijie)*, 1, 90–106.

Domowitz, I., Hubbard, R. G., & Petersen, B. C. (1986). Business Cycles and the Relationship Between Concentration and Price-Cost Margins. *Rand Journal of Economics*, 17(1), 1–17.

Fiorini, M., Sanfilippo, M., & Sundaram, A. (2021). Trade Liberalization, Roads and Firm Productivity. *Journal of Development Economics*, 153, 1–48.

Fuchs-Schuendeln, N., & Hassan, T. A. (2015). Natural experiments in macroeconomics. Working Paper No. 21228.

Goldberg, P. K. Khandelwal, A. K., Pavcnik, N., & Topalova, P. (2010). Imported Intermediate Inputs and Domestic Product Growth: Evidence from India. *Quarterly Journal of Economics*, 125(4), 1727–67.

Hall, R. E. (1986). Market Structure and Macroeconomic Fluctuations. *Brookings Papers on Economic Activity,* 2, 285–322

Hall, R. E., & Jones, C. I. (1999). Why Do Some Countries Produce So Much More Output Per Worker Than Others?. *The Quarterly Journal of Economics*, 114(1), 83–116.

Harberger, A. C. (1954). Monopoly and Resource Allocation. *American Economic Review*, 44(2), 77–92.

Head, K., & Ries, J. (2003). Heterogeneity and the FDI Versus Export Decision of Japanese Manufacturers. *Journal of the Japanese and International Economies,* 17(4), 448–467.

Hu, D., & Chen, Y. (2014). Market Power and the Measurement of Its Welfare Losses: A Review. Journal of Shandong University (Philosophy and Social Sciences) *Journal of Shandong University (Philosophy and Social Sciences) (Shandong Daxue Xuebao (Zhexue Shehui Kexue Ban))*, 1, 41–51.

Huang, F., & Wu, C. (2013). The Market Power in the Chemical Drug Industry of China. *China Economic Quarterly (Jingjixue (Jikan))*, 12(2), 511–526.

Huang, X., & Ping, X. (2020). Administrative Monopoly or Natural Monopoly—— Reexploring the Necessity of State-owned Economy's Control on Upstream Industries. *China Industrial Economics (Zhongguo Gongye Jingji)*, 3, 81–99.

Jiang, T. (2022). Mediating Effects and Moderating Effects in Casual Inference. *China Industrial Economics (Zhongguo Gongye Jingji)*, 5, 100–120.

Lerner, A. P. (1934) The Concept of Monopoly and the Measurement of Monopoly Powers. *Review of Economic Studies*, 1(3), 157–175.

Li, H., & Zhang, Y. (2021). Trade Liberalization of Intermediate Goods, Economic

Spatial Agglomeration and Enterprise Productivity. *Industrial Economics Research (Chanye Jingji Yanjiu)*, 3, 84–98.

Li, J., Wang X., & Li, J. (2018). R&D Subsidy Policy, Trade Liberalisation of Intermediate Inputs and Firms' R&D Investment. *The Journal of World Economy (Shijie Jingji)*, 41(8), 129–148.

Li, L., Yan, L., & Huang, J. (2019). Transportatoin Infrastructure Connectivity and Manufacturing Indusries in Peripheral Cities in China: Markup, Productivity and Allocation Efficiency. *Economic Research Journal (Jingji Yanjiu)*, 54(12), 182–197.

Lu, Y., & Yu, L. (2015). Trade Liberalization and Markup Dispersion: Evidence from China's WTO Accession. *American Economic Journal-Applied Economics*, 7(4), 221–253.

Lu, Y., Tao, Z., & Yu, L. (2012) Agglomeration and Markup. MPRA Paper, No. 38974.

Ludema, R. D., Mayda, A. M., Yu, Z., & Yu, M. J. (2021). The Political Economy of Protection in GVCs: Evidence from Chinese Micro Data. *Journal of International Economics*, 131,103479.

Mao, Q., & Xu, J. (2017). Does Input Trade Liberalization Raise Firms' Markups: Evidence from China. *China Economic Quarterly (Jingjixue (Jikan))*, 16(2), 485–524.

Mukherjee, S., & Chanda, R. (2021) Tariff Liberalization and Firm-Level Markups in Indian Manufacturing. *Economic Modelling*, 103,105594.

Pavcnik, N. (2017). The Impact of Trade on Inequality in Developing Countries. NBER Working Paper No. 23878.

Porter, M. E. (1990). *The Competitive Advantage of Nations*. New York: Free press.

Qian, X., Li, Y., & Wang, B. (2021). Consumer Heterogeneity, Trade Liberlization of Intermediate Inputs and Distribution Effects of Individual Welfare. *China Economic Quarterly (Jingjixue (Jikan))*, 21(5), 1661–1690.

Roeger, W. (1995). Can imperfect Competition Explain the Difference between Primal and Dual Producticity Measures? Estimates for US Manufacturing. *Journal of Political Economy*, 103(2), 316–330.

Shi, B., & Zhang, Y. (2016). Trade Liberalization and Quality Upgrading of Chinese Firms' Imported Intermediate Products. *Journal of Quantitative & Technological Economics (Shuliang Jingji yu Jishu Jingji)*, 33(9), 3–21.

Subramanian, A. (2013) Product Market Competition, Managerial Compensation, and Firm Size in Market Equilibrium. *Management Science*, 59(7), 1612–1630.

Wang, J., Liu, L., & Zou, J. (2020) Re-examination of the Impact of Exchange Rate Regime Flexibility on Productivity Growth. *The Journal of World Economy (Shijie Jingji)*, 43(1), 23–46.

Wang, X., Fan, G., & Hu, L. (2016). *Marketization Index of China's Provinces*. Social Sciences Academic Press. (in Chinese).

Wang, Y., & Li, N. (2021). Input Trade Liberalization and Factor Market Distorions.

Industrial Economics Research (Chanye Jingji Yanjiu), 9, 43–61.

Wang, Y., & Shi, B. (2014). Upstream Monopoly and Quality Upgrading of Chinese Firms. *Economic Research Journal (Jingji Yanjiu)*, 49(4), 116–129.

Wu, C., Su, N. , Guo, W., & Wei, W. (2022). Import Competition and the Improvement in Pollutant Discharge from Heterogeneous Enterprises: Evidence from China. *Journal of Environmental Management*, 310,114809.

Xie, Q., Luo, S., & Zhang, Y. (2008). Productivity Growth and Convergernce across China's Industrial Economy. *China Economic Quarterly (Jingjixue (Jikan))*, 3, 809–826.

Yu, M., & Liang, Z. (2014). Trade Liberalization and China's Labor Income Share: An Empirical Analysis Based on Data from Manufacturing Trade Firms. *Journal of Management World (Guanli Shijie)*, 7, 22–31.

Zhou, S., He, B., Ni, H., & Pang, S. (2022). Trade Liberalization and Regional Labor Market Dynamics: Evidence from China's WTO Accession. *Journal of International Money and Finance*, 125,102635.

Zhu, S., Zhong, T., & Li, R. (2018). Input Trade Liberalization and Product Markup of Multi-product Exporters. *Industrial Economics Research (Chanye Jingji Yanjiu)*, 1, 41–59.