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## Article

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RESEARCH ARTICLE



# Financial friction, resource misallocation and total factor productivity: theory and evidence from China

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## ABSTRACT

We explore the impact of financial friction on resource misallocation and total factor productivity (TFP) of China. First, the mathematical models are derived to clarify the mechanism and consequence of resource misallocation, showing that financial friction leads to resource mismatch, and thus results in the loss of TFP. Second, taking the dataset of China as the research sample, we establish econometric models to explore the impacts of financial friction on resource allocation and TFP. The results show that financial friction has negative impact on the TFP of China. In addition, the friction of financial markets will lead to factor distortion. Furthermore, the results of mechanism analysis demonstrate that resource misallocation is an important channel through which financial friction deteriorates the TFP of China, which is verified at the enterprise and province levels, respectively.

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Financial friction; resource misallocation; total factor productivity (TFP); China

## 1. Introduction

Since the promulgation of the reform and opening-up policies, China has made remarkable achievements in economic development (Zhuang, Yin, Wang, & Yang, 2019). According to the National Bureau of Statistics data, the per capita gross domestic production (GDP) of China has increased from 385 yuan to 70,892 yuan from 1987 to 2019, with an average annual growth rate of 11.2%. The economic growth theory holds that the driving force to promote a country's economy mainly comes from increased factor inputs and improvement in total factor productivity (TFP). Looking back on the history of China's economic development, the miracle of its rapid growth can be attributed to cheap labor, large-scale investment and a prosperous export trade (Li, Bao, & Liu, 2020). However, China is facing the challenges of an exhausted demographic dividend, declining return on capital and sluggish international trade caused by the COVID-19 epidemic, which has shrunk the opportunity to boost the economy by its traditional driving force. The report of the 19th National Congress of the Communist Party of China has pointed out that China's economy has shifted from high speed growth to high quality development, prompting urgency to change its economic mode. In particular, improving TFP is the key to providing new impetus for national economic growth. Earlier studies focusing on TFP have tended to be carried out from the

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perspective of technological progress (Comin & Hobijn, 2011; Parente & Prescott, 1994; Solow, 1956). Recently, more and more studies have found that the efficiency of resource allocation is also an important factor affecting TFP, providing a novel perspective for investigating China's economic problems. Although economic market reform in China generated the mechanism of resource reallocation to a certain extent (Chen and Hu, 2011), there is still much room for improvement, especially optimization of resource allocation in the manufacturing industry. Hsieh and Klenow (2009), using the database of China's industrial enterprises, found that resource misallocation among manufacturing enterprises has hindered the growth of TFP. However, if the degree of resource misallocation drops to the level of the United States, then TFP and economic output could be increased by 30% to 50%.

Previous studies have shown that the lag of the market-oriented reform process is one of the most important factors contributing to resource misallocation in China's manufacturing industry (Fan, 2008; Qian, Kang, & Tang, 2018; Yuan & Xie, 2011). Compared with the product and labor markets, market-oriented reform of the financial sector is in its weakest stage (Huang, 2010). The global financial crisis of 2008 provoked reexamination of the impact of various financial frictions in financial systems on the operation of the real economy. Although China's aggressive promotion of financial supply-side structural reform has achieved remarkable results, the issues of credit rationing, equity rationing and mortgage constraints are difficult to eradicate in the short run (Li & Chen, 2018; Stiglitz, 2018). An imperfect market system, information asymmetry and other factors hinder the free flow of capital. Generally, the core function of the financial sector is to realize the optimal allocation of capital to serve the real economy. The existence of financial friction may affect the decision-making behavior of other economic sectors such as production, employment and investment. Therefore, it is of both great theoretical and practical significance to investigate the impact of financial friction on resource misallocation and the growth of TFP in China's manufacturing industry.

Existing literature relating to this study mainly discusses financial friction, resource mismatch and TFP against the background of China from the perspectives of enterprise scale, ownership structure, financial institutions, business cycle and government intervention (see Guariglia, Liu, & Song, 2011; Jin, 2015; Liu & Cao, 2015; Ma & Li, 2014; Song, Storesletten, & Zilibotti, 2011; Wang, Luo, Wang, & Huang, 2017; Zhang & Ma, 2012). Among them, Guariglia et al. (2011) showed that although China's rapid growth has provided abundant cash flow to microenterprises, the existence of financial friction hinders the growth of enterprises with high productivity, which is unfavorable to economic restructuring and long-term economic growth. Song et al. (2011) found that the financial friction caused by ownership discrimination resulted in small and medium-sized enterprises (SMEs) being unable to obtain external financing, prompting severe capital misallocation. Wang and Liao (2013) examined the impact of financial friction on China's agricultural TFP in a two-sector structural transformation model, highlighting that financial friction can lead to decline in agricultural TFP of 30%. Liu, Wang, and Xu (2017) constructed a two-sector model with loan constraints to analyze the impact of China's interest rate liberalization policy on the capital allocation of state-owned and non-state-owned sectors. The findings demonstrated that the interest rate marketization, as part of financial friction abatement, can improve capital allocation within sectors while worsen allocation efficiency between departments. Hence, the marketization of interest

rates may fail to improve resource allocation and the overall welfare of the whole of society.

The existing literature contains many studies on financial friction, resource mismatch and TFP. However, there exist research gaps needing more in-depth investigation. First, the current research on resource misallocation and its impact on economic output has not shed light on how inefficient resource allocation affects the real economy. In particular, the exploration of financial friction is mainly theoretical. More empirical research should be carried out to provide evidence based on factual data. Second, the combination of research perspectives from micro and macro levels could be furthered to identify more fruitful connections. Recent literature on output efficiency and resource allocation is mainly developed based on the industry level or micro-enterprise perspective, which may somewhat ignore the mechanism of resource misallocation among enterprises and regions. Furthermore, it may fail to reveal inherent relationships between resource allocation, industrial structure and regional economy, as well as the role of the financial system. In order to deal with the above questions on the basis of the literature, this paper puts financial friction, resource misallocation and TFP into a unified framework, and conducts mathematical models to deduce the mechanism and economic consequences of resource misallocation in China's manufacturing industry from the perspective of financial friction. Additionally, taking the dataset of China from 2007 to 2017 as the research sample, the present study establishes econometric models to empirically examine the impacts of financial friction on resource mismatch and TFP to clarify the mechanism between the financial sector and the manufacturing industry from micro and macro levels, respectively.

The remainder of this paper is organized as follows: in [Section 2](#), the theoretical analysis is presented. [Section 3](#) describes the methodology. The empirical results follow in [Section 4](#). And [Section 5](#) concludes this paper together with policy implications.

## 2. Theoretical analysis

Consider an economy which only produces one final manufacturing product  $Y$ , and the market is completely competitive. In this market, the manufacturer's Cobb-Douglas production function is shown in equation (1), where  $Y_s$  denotes the intermediate input goods.

$$\begin{cases} Y = \prod_{s=1}^S Y_s^{\theta_s} \\ \sum_{s=1}^S \theta_s = 1 \end{cases} \quad (1)$$

The cost-minimization problem implies that

$$P_s Y_s = \theta_s P Y \quad (2)$$

Where  $P_s$  is the price of  $Y_s$ . On this basis, we further assume that the structure of each sub-market in the manufacturing economy is typical of Dixit-Stiglitz, that is, the products have a certain degree of mutual substitution ( $\sigma$  is the elasticity of substitution), but there

are differences. In any sub-industry  $s$ , the TFP  $A_{si}$  of each firm is significantly different from each other. The above assumptions can be summarized as follows:

$$\begin{cases} Y_s = \left( \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \\ Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \end{cases} \quad (3)$$

Where  $A_{si}$  is the TFP or the technical level,  $K_{si}^{\alpha_s}$  is the capital input,  $L_{si}^{1-\alpha_s}$  is the labor input and  $\alpha_s$  is the capital-output elasticity. While  $\alpha_s$  is different among the sub-industries, it is the same within each sub-industry.

The cost-minimization problem of the manufacturing industry is put forward as follows:

$$P_s Y_s = \min \sum_{i=1}^{M_s} P_{si} Y_{si} \quad (4)$$

subject to:

$$Y_s = \left( \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (5)$$

By solving the above minimization problem, the Lagrange multiplier  $\lambda_s$  and the first-order condition are obtained as follows:

$$\lambda_s = \frac{\sigma}{\sigma-1} Y_{si}^{\frac{1}{\sigma}} P_{si} \quad (6)$$

$$P_{si} = \lambda_s \frac{\sigma-1}{\sigma} Y_{si}^{-\frac{1}{\sigma}} \quad (7)$$

## 2.1. Impact of financial friction on formation mechanism of resource misallocation

In order to clarify the role of financial friction in the formation mechanism of resource mismatch in China's manufacturing industry, this section compares the following two scenarios of financial friction and non-financial friction through mathematical analysis.

**Scenario 1.** In the absence of financial friction, the decision-making process of profit-maximization for manufacturers is set as follows:

$$\max \pi_{si} = (1 - \tau_{Y_{si}}) P_{si} Y_{si} - \omega L_{si} - (1 + \tau_{K_{si}}) R K_{si} \quad (8)$$

subject to:

$$Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \quad (9)$$

Where  $\tau_{Y_{si}}$  is the output distortion,  $\tau_{K_{si}}$  is the capital distortion and  $R$  represents the capital cost.

By substituting equation (7) into equation (8), the following equation (10) can be obtained:

$$\max \pi_{si} = (1 - \tau_{Y_{si}}) \lambda_s \frac{\sigma - 1}{\sigma} Y_{si}^{\frac{\sigma-1}{\sigma}} (Y_{si})^{\frac{\sigma-1}{\sigma}} - \omega L_{si} - (1 + \tau_{K_{si}}) RK_{si} \quad (10)$$

By solving the above maximization problem and substituting equation (6) into the expression, the demand for capital and labor by manufacturers are as follows:

$$\begin{cases} (1 - \tau_{Y_{si}}) \frac{\sigma-1}{\sigma} \alpha_s P_{si} Y_{si} = (1 + \tau_{K_{si}}) RK_{si} \\ (1 - \tau_{Y_{si}}) \frac{\sigma-1}{\sigma} (1 - \alpha_s) P_{si} Y_{si} = \omega L_{si} \end{cases} \quad (11)$$

**Scenario 2.** If there exists financial friction, the profit maximization process of firms in the manufacturing industry is as follows:

$$\max \pi_{si} = \lambda_s \frac{\sigma - 1}{\sigma} Y_{si}^{\frac{\sigma-1}{\sigma}} (Y_{si})^{\frac{\sigma-1}{\sigma}} - \omega L_{si} - RK_{si} \quad (12)$$

subject to:

$$\begin{cases} Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \\ \omega L_{si} + \xi RK_{si} \leq W(z_{si}, \eta) \end{cases} \quad (13)$$

In this problem, we consider the mortgage constraint condition faced by enterprises, whereby  $\xi$  represents the mortgage rate of the capital expenditure,  $z_{si}$  represents the characteristics of enterprises such as the wealth level and  $\eta$  indicates the friction degree of the financial system. The higher the coefficient is, the lower the degree of friction, and thus the more perfect the financial system. The function  $W(z_{si}, \eta)$  is an increasing function about  $z_{si}$  and  $\eta$ , its value representing the total funds that one enterprise can obtain. The higher the level of wealth accumulation, as well as the more perfect the financial system, the higher the amount of financing. The Lagrange function is set as follows:

$$L(L_{si}, K_{si}) = \lambda_s \frac{\sigma - 1}{\sigma} Y_{si}^{\frac{\sigma-1}{\sigma}} (Y_{si})^{\frac{\sigma-1}{\sigma}} - \omega L_{si} - RK_{si} + \mu(z_{si}, \eta) [W - \omega L_{si} - \xi RK_{si}] \quad (14)$$

The above maximization problem implies that

$$\begin{cases} \frac{1}{1+\mu(z_{si}, \eta)} \frac{\sigma-1}{\sigma} \alpha_s P_{si} Y_{si} = \frac{1+\xi\mu(z_{si}, \eta)}{1+\mu(z_{si}, \eta)} RK_{si} \\ \frac{1}{1+\mu(z_{si}, \eta)} \frac{\sigma-1}{\sigma} (1 - \alpha_s) P_{si} Y_{si} = \omega L_{si} \end{cases} \quad (15)$$

Comparing equations (11) and (15), the following results can be obtained:

$$\begin{cases} (1 - \tau_{Y_{si}}) = \frac{1}{1+\mu(z_{si}, \eta)} \\ (1 + \tau_{K_{si}}) = \frac{1+\xi\mu(z_{si}, \eta)}{1+\mu(z_{si}, \eta)} \end{cases} \quad (16)$$

From equation (16), the higher the degree of financial friction, the higher the degree of resource misallocation. Specifically, when there is friction in the financial system,  $\eta$  will decrease, and the value of  $\mu(z_{si}, \eta)$  will become larger because of the characteristics of decreasing functions, which will generate resource misallocation among manufacturing enterprises.

## 2.2. Impact of resource misallocation on TFP

In this section, with reference to Hsieh and Klenow (2009), this paper constructs a theoretical model to analyze the impact of resource misallocation on manufacturing industrial TFP. As China is still in the period of economic transition, the marketization process of the financial sector lags far behind other markets (Huang, 2010), resulting in severe capital distortion (Jian, Xu, Lv, Lu, & Li, 2018). Therefore, the following analysis only considers capital distortion when constructing models.

First, the maximization problem of manufacturing industry  $s$  is as follows:

$$\max P_s Y_s - \sum_{i=1}^{M_s} P_{si} Y_{si} \quad (17)$$

subject to:

$$Y_s = \left( \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \quad (18)$$

The first-order conditions are

$$\frac{\partial \pi}{\partial Y_{si}} = P_s \frac{\sigma}{\sigma-1} \left( \sum_{i=1}^{M_s} Y_{si}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \left( Y_{si}^{-\frac{1}{\sigma}} \right) \frac{\sigma-1}{\sigma} - P_{si} = 0 \quad (19)$$

and

$$\frac{\partial \pi}{\partial Y_{sj}} = P_s \frac{\sigma}{\sigma-1} \left( \sum_{j=1}^{M_s} Y_{sj}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}} \left( Y_{sj}^{-\frac{1}{\sigma}} \right) \frac{\sigma-1}{\sigma} - P_{sj} = 0 \quad (20)$$

$$P_{si} = \left( \frac{Y_{si}}{Y_{sj}} \right)^{-\frac{1}{\sigma}} P_{sj} \quad (21)$$

$$P_{si} Y_{si} = (Y_{si})^{\frac{\sigma-1}{\sigma}} (Y_{sj})^{\frac{1}{\sigma}} P_{sj} \quad (22)$$

$$\sum_{i=1}^{M_s} P_{si} Y_{si} = Y_s^{\frac{\sigma-1}{\sigma}} P_{sj} (Y_{sj})^{\frac{1}{\sigma}} \quad (23)$$

When the economy is in equilibrium, the final manufacturer will get no extra profit on the basis of the complete competition hypothesis. This indicates that

$$P_s Y_s = \sum_{i=1}^{M_s} P_{si} Y_{si} \quad (24)$$

and

$$P_s Y_s = Y_s^{\frac{\sigma-1}{\sigma}} P_{sj} (Y_{sj})^{\frac{1}{\sigma}} \quad (25)$$

Hence, the output of manufacture  $i$  in industry  $s$  is as follows:



$$Y_{si} = \left( \frac{P_s}{P_{si}} \right)^\sigma Y_s \quad (26)$$

Additionally, equation (27) is the profit function of manufacturers in the presence of capital distortion.

$$\max \pi_{si} = P_{si} Y_{si} - \omega L_{si} - (1 + \tau_{K_{si}}) R K_{si} \quad (27)$$

subject to:

$$\begin{cases} Y_{si} = A_{si} K_{si}^{\alpha_s} L_{si}^{1-\alpha_s} \\ Y_{si} = \left( \frac{P_s}{P_{si}} \right)^\sigma Y_s \end{cases} \quad (28)$$

By solving the maximization problem to get the firm's output price.

$$P_{si} = \left( \frac{\sigma}{\sigma - 1} \right) \left( \frac{\omega}{1 - \alpha_s} \right)^{1-\alpha_s} \left( \frac{R}{\alpha_s} \right)^{\alpha_s} \frac{(1 + \tau_{K_{si}})^{\alpha_s}}{A_{si}} \quad (29)$$

The scale of capital, labor and output of manufacture  $i$  can be obtained thus:

$$\begin{cases} K_{si} = c_1 Y_s \frac{A_{si}^{\sigma-1}}{(1 + \tau_{K_{si}})^{1+\alpha_s(\sigma-1)}} \\ c_1 = P_s^\sigma \left( \frac{\sigma-1}{\sigma} \right)^\sigma \left( \frac{1-\alpha_s}{\omega} \right)^{\sigma(1-\alpha_s)} \left( \frac{\alpha_s}{R} \right)^{\alpha_s} \left( \frac{1-\alpha_s}{\alpha_s} \right)^{\alpha_s-1} \left( \frac{R}{\omega} \right)^{\alpha_s-1} \end{cases} \quad (30)$$

$$\frac{K_{si}}{L_{si}} = \left( \frac{\alpha_s}{1 - \alpha_s} \right) \frac{\omega}{R} \frac{1}{(1 + \tau_{K_{si}})} \quad (31)$$

$$\begin{cases} Y_{si} = c_2 Y_s \frac{A_{si}^\sigma}{(1 + \tau_{K_{si}})^{\alpha_s \sigma}} \\ c_2 = P_s^\sigma \left( \frac{\sigma-1}{\sigma} \right)^\sigma \left( \frac{1-\alpha_s}{\omega} \right)^{\sigma(1-\alpha_s)} \left( \frac{\alpha_s}{R} \right)^{\alpha_s \sigma} \end{cases} \quad (32)$$

From equations (30), (31) and (32), for a given amount of total output  $Y_s$ , the allocation of capital, labor and output mainly depends on TFP  $A_{si}$  and capital distortion  $\tau_{K_{si}}$ . Therefore, in the absence of capital distortion, the allocation of resources is entirely determined by the TFP, in that, compared with enterprises with lower TFP, enterprises with higher TFP possess more resources. However, the existence of capital distortion causes distortion of resource allocation for TFP, leading to resource misallocation.

Note that the TFP of different enterprises in the same sub-industry are different from each other. In the case of capital distortion, we sum up the labor and capital input of all enterprises in each sub-industry to calculate the TFP at the industry level as follows:

$$L_s \equiv \sum_{i=1}^{M_s} L_{si} = L \frac{(1 - \alpha_s) \theta_s}{\sum_{s=1}^S (1 - \alpha_s) \theta_s} \quad (33)$$

$$K_s \equiv \sum_{i=1}^{M_s} K_{si} = K \frac{\theta_s \alpha_s / (1 + \overline{\tau_{K_s}})}{\sum_{s=1}^S [\theta_s \alpha_s / (1 + \overline{\tau_{K_s}})]} \quad (34)$$

Where  $L = \sum_{s=1}^S L_s$  and  $K = \sum_{s=1}^S K_s$  denote the supply of labor and capital, respectively. In the whole manufacturing economy,  $\overline{\tau_{K_s}} = \sum_{i=1}^{M_s} \tau_{K_{si}} \left( \frac{K_{si}}{K_s} \right)$  indicates capital distortion at the industry level calculated using all the sub-industries. The total output of the whole manufacturing economy can be expressed as follows:

$$Y = \prod_{s=1}^S (A_s K_s^{\alpha_s} K_s^{1-\alpha_s})^{\theta_s} \quad (35)$$

When there exists capital distortion, TFP  $A_s$  of industry  $s$  is as follows:

$$A_s = \left\{ \sum_{i=1}^{M_s} \left[ A_{si} \left( \frac{1 + \tau_{K_{si}}}{1 + \overline{\tau_{K_s}}} \right)^{-\alpha_s} \right]^{\sigma-1} \right\}^{\frac{1}{\sigma-1}} \quad (36)$$

When there is no capital distortion, equation (36) will change into the following form:

$$A_s = \left\{ \sum_{i=1}^{M_s} A_{si}^{\sigma-1} \right\}^{\frac{1}{\sigma-1}} \quad (37)$$

Where TFP  $A_s$  of industry  $s$  is equal to the TFP of all enterprises in the sub-industry. Therefore, compared with equation (36), if the TFP shown in equation (37) is significantly higher, it indicates that resource misallocation will lead to the loss of the TFP of the whole manufacturing industry.

### 3. Methodology

#### 3.1. Econometric models

In order to investigate the impact of financial friction on resource allocation and TFP in China, we use the dataset of manufacturing industry in China as the research sample, and establish econometric models for empirical analysis as shown below. In particular, the present study is developed from the perspectives of enterprise and province, respectively.

$$TFP_{it} = \alpha_0 + \alpha_1 Fri_{it} + \sum_{k=1}^n \beta_k Controls_{it}^k + \varepsilon_{it} \quad (38)$$

$$Mis_{it} = \gamma_0 + \gamma_1 Fri_{it} + \sum_{k=1}^n \beta_k Controls_{it}^k + \varepsilon_{it} \quad (39)$$

$$TFP_{it} = \eta_0 + \eta_1 Mis_{it} + \sum_{k=1}^n \beta_k Controls_{it}^k + \varepsilon_{it} \quad (40)$$

Where  $i$  is the individual unit (namely, the enterprise or province),  $t$  is time and  $\varepsilon$  is the error term.  $TFP$  is the total factor productivity of the manufacturing industry,  $Fri$  is the degree of financial friction,  $Mis$  is resource misallocation, and  $Controls$  denotes the control variables. Equation (38) examines the impact of financial friction on the TFP of

manufacturing industry. If the coefficients  $\alpha_1$  is negative and significant, it indicates that the friction of financial markets of China reduces the TFP of manufacturing industry. Equation (39) shows the relationship between financial friction and resource misallocation in China's manufacturing industry. The estimated coefficient of  $\gamma_1$  is expected to be significantly positive, suggesting that the financial fiction can cause the inefficiency of resource allocation. In equation (40), the estimated coefficient of  $\eta_1$  is expected to be negative and significant, which implies that the resource misallocation resulting from financial friction may eventually hinder the amount of the TFP in China's manufacturing industry.

### 3.2. Variable definition, data source and sample selection

#### 3.2.1. Measurement of TFP

First, this paper estimates the TFP at the enterprise level (*TFP\_Com*) based on the micro data of China's A-share listed companies. With reference to Qian et al. (2018), The production function of an enterprise is set as follows:

$$Y_{it} = A_{it} K_{it}^{\alpha} L_{it}^{\beta} M_{it}^{\gamma} \quad (41)$$

Where  $Y_{it}$  represents the output of enterprise  $j$ ,  $K_{it}$ ,  $L_{it}$  and  $M_{it}$  represent the amounts of labor, capital and intermediate inputs, respectively.  $A_{it}$  represents the TFP. On this basis, taking the logarithm on both sides of equation (41) and considering the factors of random interference, equation (42) can be obtained as follows:

$$y_{it} = a_{it} + \alpha k_{it} + \beta l_{it} + \gamma m_{it} + \varepsilon_{it} \quad (42)$$

Where  $y_{it}$ ,  $a_{it}$ ,  $k_{it}$ ,  $l_{it}$ , and  $m_{it}$  are the logarithmic forms of  $Y_{it}$ ,  $A_{it}$ ,  $K_{it}$ ,  $L_{it}$ , and  $M_{it}$  respectively, and  $\varepsilon_{it}$  is the random disturbance term, satisfying the hypothesis of white noise. Considering that  $a_{it}$ , namely, the TFP of manufacturing enterprises, cannot be directly observed, and the ordinary least squares (OLS) estimation might cause deviations. With reference to Lu and Lian (2012), the present study additionally employs the non-parametric linear programming (LP) method to calculate the TFP.

Second, the TFP at the province level (*TFP\_Pro*) is also measured to examine the macro impacts of financial friction on resource misallocation and TFP. In order to incorporate more factors into the estimation model, this paper employs the data envelope analysis (DEA) and Malmquist index to measure the TFP at the macro level of province (Tian, Lu, & Li, 2021). The definitions of input-output factors are show in Table 1.

**Table 1.** Definition of input-output factors.

Type	Index	Definition	Unit
Inputs	Capital stock	The total investment in fixed assets (Zhang, Wu, & Zhang, 2004).	$10^8$ yuan
	Labor input	The number of employees at the end of a year.	$10^4$ people
	Energy consumption	The electricity consumption of the whole society.	$10^8$ Kilowatt-hour
	Human capital	The average years of education.	year
	Infrastructure	The road area per capita.	square meters
Output	Economic output	The real gross domestic product.	$10^8$ yuan

### 3.2.2. Resource misallocation

Referring to the existing literature, the present study uses the dispersion of TFP to measure the degree of mismatch of resources (Asker, Collard-Wexler, & De Loecker, 2014; Han, Zhang, & Feng, 2017; Nie & Jia, 2011). Specifically, at the micro level, the standard deviation values of manufacturing enterprises' TFP are used to measure resource misallocation(*Mis\_Com*); and at the macro level, the median values of the standard deviations of TFP in different provinces are obtained to denote resource misallocation(*Mis\_Pro*).

### 3.2.3. Financial friction

Financial frictions refer to the imperfections in financial markets that impede the free flow of capital factors, including policy distortions (Gilchrist, Sim, & Zakrajšek, 2013), information asymmetries (Bernanke & Gertler, 1989), and imperfect contracts (Hart & Moore, 1994). The presence of financial frictions can lead to inadequate supply of financial products and restricted market transactions, as evidenced by borrowing constraints in debt financing, restrictions on the sale of shares in equity financing, individual-specific risks that cannot be fully insured under incomplete markets, and incomplete participation in financial markets (Brunnermeier, Eisenbach, & Sannikov, 2012). Considering the availability of data, this paper measures financial frictions at the firm level from the perspective of financing constraints. With reference to Kaplan and Zingales (1997), the present study constructs the KZ index, and the larger the KZ index, the higher the degree of financing constraints faced by companies. In addition, bank credit (*Debt*) is the main mode of financing in China. Therefore, following the idea of Shao (2010), we measure the macro-level performance of financial frictions by deviations from the average level of credit resources(*Debt\_p50*) across regions, with financial friction (*Fri\_Pro*) =  $|Debt - Debt\_p50|/Debt\_p50$ . And a larger degree of this deviation indicates a more severe degree of financial friction faced by the provinces.

### 3.2.4. Control variables

In order to eliminate the bias due to missing variables, referring to Jing and Zhang (2021) and Song, Zhou, and Si (2021), we include the control variables at the levels of enterprise and province, respectively. First, the control variables at the enterprise level are as follows: (1) the firm size(*Size*), expressed by the logarithm of total assets; (2) the age of enterprise(*Age*), expressed by the logarithm of listing years; (3) the level of assets and liabilities(*Lev*), expressed by the ratio of total liabilities to total assets; (4) the profitability(*Roe*), expressed by the return on net assets; (5) the concentration of equity(*Hold*), expressed by the percentage of shares held by the first largest shareholder; (6) the size of the board of directors (*Board*), expressed by the logarithm of the number of directors; (7) the nature of property(*Soe*), which is assigned as 1 if it is state-owned and 0 otherwise. Second, at the level of province, the following variables are included: (1) economic development(*Eco*), expressed by the logarithm of real GDP; (2) the capacity of technological innovation (*Tech*), expressed by the logarithm of research and development input; (3) the level of marketization (*Mark*), expressed by the marketization index; (4) the scale of population (*Pop*), expressed by the logarithm of the amount of the total population.

**Table 2.** The statistical description of variables.

Variables	Observation	Mean	St.Dev	Min	Median	Max
<i>TFP_Com</i>	5137	13.977	0.957	10.611	13.931	16.182
<i>Mis_Com</i>	5137	0.947	0.032	0.906	0.951	1.014
<i>Fri_Com</i>	5137	1.262	2.099	−9.825	1.525	14.073
<i>Size</i>	5137	22.188	1.283	17.019	22.045	27.104
<i>Age</i>	5137	2.388	0.673	0.000	2.565	3.296
<i>Lev</i>	5137	0.478	0.189	0.016	0.484	1.411
<i>Roe</i>	5137	0.063	0.733	−45.551	0.067	14.775
<i>Hold</i>	5137	36.741	15.334	3.390	35.549	89.093
<i>Board</i>	5137	2.182	0.210	1.000	2.197	2.890
<i>Soe</i>	5137	0.644	0.479	0.000	1.000	1.000
<i>TFP_Pro</i>	330	0.998	0.064	0.828	1.000	1.166
<i>Mis_Pro</i>	330	0.063	0.025	0.000	0.067	0.114
<i>Fri_Pro</i>	330	0.791	0.936	0.006	0.409	3.991
<i>Eco</i>	330	9.377	0.918	6.866	9.483	11.175
<i>Tech</i>	330	12.168	1.406	8.630	12.147	15.673
<i>Mark</i>	330	6.412	1.869	2.540	6.335	10.859
<i>Pop</i>	330	8.117	0.859	5.704	8.249	9.280

### 3.2.5. Data source and sample selection

The research sample of this paper is based on the panel dataset of China from 2007–2017. First, the financial data of the listed companies in this paper were from the CSMAR, CCER and WIND databases. In order to eliminate the negative impact of outliers, the samples were selected according to the following principles: (1) excluding companies with poor financial performance that were specially processed by the exchange; (2) excluding listed companies with missing data; and (3) excluding listed companies with unclear industry attribution. Second, the provincial panel dataset includes 30 provinces of China. Due to the limitation of data availability, Tibet, Taiwan, Hong Kong and Macao are excluded from this paper. All the macro data are obtained from China Statistical Yearbook, China Financial Statistics Yearbook and China Energy Statistical Yearbook, respectively. Table 2 shows the statistical description of the variables.

## 4. Empirical results and discussion

### 4.1. Company level regression results

Table 3 reports the empirical results at the micro level. In column (1), the estimated coefficient of financial friction on TFP is  $-0.070$ , which is significant at the 1% level,

**Table 3.** Impacts of financial friction and resource misallocation on TFP (company level).

Variables	(1)	(2)	(3)
	<i>TFP</i>	<i>Mis_Com</i>	<i>TFP</i>
<i>Fri_Com</i>	−0.070*** (−12.610)	0.001** (2.207)	
<i>Mis_Com</i>			−0.628*** (−2.781)
<i>Constant</i>	5.903*** (13.313)	0.560*** (23.777)	6.806*** (13.455)
Controls	Yes	Yes	Yes
Observations	5137	5137	5137
R-square	0.353	0.391	0.287

Notes: (1) T-values in parentheses; (2) \*\* and \*\*\* represent significance levels of 5% and 1%, respectively.

showing that financial friction hinders the growth of enterprises' TFP. In column (2), the estimated coefficient of financial friction on resource misallocation is 0.001, which is significantly positive, indicating that the existence of financial friction aggravates the degree of resource distortion. The regression results of columns (1) and (2) shows that, at the enterprise level, the frictions of financial markets lead to the inefficiency of resource allocation and the loss of the TFP in the manufacturing industry. Furthermore, column (3) reports the regression results of resource misallocation on TFP, which examines the transmission mechanism of the loss of TFP. The estimated coefficient of resource misallocation on TFP is  $-0.628$ , which is significant at the 1% level, demonstrating that as the degree of financial friction increases, the degree of resource mismatch among manufacturing enterprises deepens, thus reducing enterprises' TFP. From the above results, it can be concluded that at the company level, the financial friction leads to the distortion of resource allocation among enterprises. Additionally, the financial friction poses negative impacts on TFP and thus hinders the high-quality development of manufacturers. With regard to the transmission mechanism, the resource misallocation is an important transmission channel through which financial friction affects the TFP of manufacturing enterprises.

## 4.2. Province level regression results

Table 4 reports the empirical results at the province level. From the column (1), the financial friction has negative impact on the TFP, in the sense that the regression coefficient is  $-0.011$ , which is significant at the 1% level. Additionally, the impact of financial friction on resource misallocation is positive and significant, which is shown in column (2) that the estimated coefficient is 0.024, meaning that as the degree of financial friction deepens, the inefficiency of resource allocation will worsen. To further analyze the transmission mechanism of resource misallocation, the estimated coefficient of  $-0.472$  in column (3) shows that financial friction can hinder the overall TFP through the misallocation of resources, in that resource mismatch was one of the most important channels through which financial markets can negatively affect China's economic growth. The results of this section indicate that, at the province level, resource misallocation was one of the most important transmission variables between financial friction and TFP. Financial friction can distort the allocation of resources, and thus lead to the loss of TFP at the macro level. In the long run, the above transmission mechanism will hinder

**Table 4.** Impacts of financial friction and resource mismatch on TFP (province level).

Variables	(1) <i>TFP</i>	(2) <i>Mis_Pro</i>	(3) <i>TFP</i>
<i>Fri_Pro</i>	$-0.011^{***}$ ( $-5.620$ )	$0.024^*$ ( $1.793$ )	
<i>Mis_Pro</i>			$-0.472^{***}$ ( $-6.010$ )
Constant	$0.798^{***}$ ( $20.224$ )	$-1.254^{***}$ ( $-3.693$ )	$0.818^{***}$ ( $21.005$ )
Controls	Yes	Yes	Yes
Observations	330	330	330
R-square	0.332	0.453	0.316

Notes: (1) T-values in parentheses; (2) \* and \*\*\* represent significance levels of 10% and 1%, respectively.

the sustainable growth of the economy, which will eventually threaten the implementation of high-quality development of China.

## 5. Conclusions and implications

The present study explores the impact of financial friction on resource misallocation and TFP of China from the perspectives of micro and macro levels, respectively. First, the mathematical models are derived to clarify the formation mechanism and economic consequences of resource misallocation of the manufacturing industry in China, in the sense that the higher the level of financial friction, the higher the degree of resource mismatch faced by manufacturers, resulting in the loss of overall TFP. Furthermore, taking the dataset of China from 2007 to 2017 as the research sample, the present study establishes econometric models to explore the impacts of financial friction on resource allocation and TFP from two different perspectives, namely, the micro level of enterprise, and the macro level of province, respectively. The empirical results show that financial friction has a negative impact on the TFP of China. Financial friction is positively correlated with resource misallocation, that is, the friction of financial markets will lead to factor distortion at the levels of enterprise and province, respectively. Additionally, the results of the transmission mechanism analysis demonstrate that resource misallocation is one of the most important channels through which financial friction deteriorates the TFP of China, which is verified at the enterprise and province levels, respectively. The findings of this paper reveal that the imperfection of financial markets has caused irrational resource allocation in China, which is not conducive to improving the service quality of the financial sectors to the real economy. Moreover, this will lead to the loss of TFP in the manufacturing industry as well as the whole economy, which will eventually hinder the high-quality development of China.

Discussion of the impact of financial friction on resource misallocation and TFP in China is not only of strong theoretical significance, but also of high value for designing relevant policies. Thus, based on the above analysis, we put forward the following policy implications:

First, due to the inefficiency of the financial markets and imperfection of the financial system in China, capital doesn't not flow into areas with higher rates of return on investment, resulting in the distorted phenomenon of resource misallocation. Therefore, as the most important part of the national financial intermediary system, commercial banks should allocate credit funds according to the principle of efficiency, and abandon the discrimination of ownership to realize the free flow of capital. The government, whose functions include policy making and financial regulation, should promote structural reform of the financial supply-side, avoid excessive interference in the credit decision-making of commercial banks, continuously optimize the competitive environment of the financial market, reduce the degree of financial friction as well as information asymmetry between banks and enterprises, encourage diversification of financial products and relax restrictions on capital flow, all of which could be conducive to improving the efficiency of resource allocation in the manufacturing industry of China.

Second, our results show that the resource misallocation can negatively affect the TFP, it is necessary to take measures to cope with the challenge of resource misallocation in

China. In essence, the problem of resource misallocation is largely rooted in the fuzzy boundary between the government and the market. The market mechanism is optimal for the allocation of resources. When the government excessively interferes with the operation of the market economy, it leads to the deterioration of resource allocation. Therefore, the boundary between government and markets should be carefully clarified. To this end, the government should break its administrative monopoly to reduce interference in the allocation of resources to create a fairer market environment, letting the market play a decisive role in the allocation of resources to realize the efficient resource allocation. However, government action does not always lead to resource mismatch. Appropriate administrative activities can sometimes manage the problem of market failure and ensure reasonable and orderly operation of the economy. Therefore, it is essential to clearly define the boundary between the market and the government, in other words, combining flexible adjustment of the market and the necessarily rigid constraints of the government, to realize reasonable allocation of resources to improve the TFP. The above measures would have a positive impact on the future development and growth of China's economy.

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