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Chinese Firms' Productivity and Markup Rates

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Abstract: Under the dual backdrop of escalating corporate competitive pressures and China’s domestic efforts to build a consumption-oriented society, domestic enterprises need to continuously increase their markup rates while persistently reducing marginal costs to enhance product competitiveness and market power. An increasing number of scholars are now focusing on the importance of corporate markup rates, adopting diverse methodologies to quantify these rates and studying how to improve them to provide better guidance for micro-level enterprises, particularly micro and small businesses. The enhancement of enterprise productivity relies on multiple factors, including wage and benefit growth, the adoption of automation, and improvements in societal average productivity, all of which influence cost markup rates through various pathways. To investigate these dynamics, this study employs microdata from the 2000－2006 China Industrial Enterprise Database at the firm level and adopts an empirical approach to examine the impact of enterprise productivity on markup rates. The research demonstrates that enterprises should focus on improving productivity to elevate their markup rates, thereby achieving enhanced competitiveness and reduced marginal costs.

1. Introduction

As Industrial organization theory defines the cost markup rate as the degree of deviation from marginal costs, meaning that a higher cost markup rate reflects stronger market power for an enterprise. This provides a theoretical framework for studying corporate competitiveness and strategies to enhance market power[1].

Amid accelerating technological advancements and intensifying global market competition, enterprises must adapt to the evolving production and operational environment. Reducing labor costs and improving productivity have become inherent survival strategies to bolster competitiveness. However, enterprise productivity is not equivalent to the markup rate. Increased productivity does not necessarily translate into higher profits, as the former focuses on product technology and production efficiency, while the latter depends on the magnitude of markup over marginal costs. Only by lowering the marginal cost markup can enterprises achieve economies of scale and intensive growth.[2] This study employs the widely adopted De Loecker and Warzynski method to quantify enterprise markup rates[3][4], constructing two distinct measurement approaches—namely, using total output and total sales revenue—to ensure the robustness of the results. Leveraging firm-level data from the 2000 – 2006 China Industrial Enterprise Database and employing empirical methods alongside STATA analytical software, the research investigates the relationship between cost markup rates and productivity. The experimental findings strongly support the theoretical hypothesis that rising productivity significantly enhances cost markup rates. By clarifying the interplay between productivity and cost markup rates, this paper explores how Chinese enterprises can better unleash production vitality to drive improvements in markup rates[5].

2. Manuscript Preparation

(1) Model Specification

The regression model established in this paper is specified as follows[6]:

$$\text{Markup Rate}_{ft} = \beta_1 productivity + \beta_2 X_{ft} + \varepsilon_{fict} \tag{1}$$

In Equation, subscripts i and t denote firms and years, respectively. represents the vector of control variables, and is the error term.

(2) Data Source

The dataset used in this study is derived from the Annual Survey of Industrial Firms (ASIF) spanning the period 2000-2006. The ASIF provides comprehensive firm-level data on various characteristics, including production inputs, outputs, and financial performance, which enables robust empirical analysis of firm-level heterogeneity.

2.1. Estimation Method of Markup Rate

To estimate the markup rate at the enterprise level, we adopt the estimation method proposed by De Loecker and Warzynski (2012). The calculation process is as follows:

Assuming the production function of the enterprise is:

$$Q_{it} = Q_{it}(X_{it}^{1}, \cdots X_{it}^{v}, K_{it}, \omega_{it}) \tag{2}$$

Where Q_{it} represents the output level of enterprise i in period t; X_{it}^{v} represents the quantity of intermediate input factor v; K_{it} represents the capital stock of the enterprise; and ω_{it} represents the productivity of the enterprise. Assuming that the production function Q_{it} (•) is continuous and second-order differentiable, a Lagrangian function is constructed based on the principle of cost minimization, resulting in:

$$L_{it}(X_{it}^{1}, \cdots, X_{it}^{v}, K_{it}, \lambda_{it}) = \sum_{v=1}^{V} P_{it}^{X^v} X_{it}^{v} + r_{it} K_{it} + \lambda_{it}(Q_{it} - Q_{it}(\bullet)) \tag{3}$$

Where $P_{it}^{X^v}$ represents the total cost, X_{it}^{v} is the Lagrange multiplier, and r_{it} represents the purchase price of intermediate input factors and the cost of capital use. Assuming that the adjustment cost between intermediate input factors in the production process is 0, under a given output level, the marginal cost of enterprise production is: $mc_{it} = \lambda_{it}$ ($\lambda_{it} = \frac{\partial L_{it}}{\partial Q_{it}}$), From the first-order condition of cost minimization, the following expression is obtained:

$$\frac{\partial Q_{it}(\bullet)}{\partial X_{it}^{v}} \frac{X_{it}^{v}}{Q_{it}} = \frac{1}{\lambda_{it}} \frac{P_{it}^{x^v} X_{it}^{v}}{Q_{it}} \tag{4}$$

Defining the enterprise markup rate as markup $\mu_{it} = \frac{P_{it}}{\lambda_{it}}$, combined with equation (4), X_{it}^{v} the output elasticity of intermediate input factors is derived:

$$\theta_{it}^{X^v} = \mu_{it} \frac{P_{it}^{X^v} X_{it}^{v}}{P_{it} Q_{it}} \tag{5}$$

Where $\frac{P_{it}^{X^v} X_{it}^{v}}{P_{it} Q_{it}}$ represents the output elasticity of intermediate input factor X_{it}^{v}, and represents the expenditure share of intermediate input factors, which can be directly observed from the micro-enterprise database. Therefore, only by estimating the output elasticity $\theta_{it}^{X^v}$ of enterprise input factors can the enterprise's markup rate be obtained μ_{it}.

For the calculation of output elasticity at the enterprise level, this paper follows the approach of De Loecker and Warzynski (2012) by incorporating high-order polynomials in the regression process to obtain factor output elasticity at the enterprise level. The specific calculation process includes the following two stages:

Stage 1: Set a translog production function:

$$y_{it} = \beta_l l_{it} + + \beta_u u_{it} + \beta_{ll} (l_{it})^2 \beta_k k_{it} + \beta_{kk} (k_{it})^2 + \beta_{uu} (u_{it})^2 + \beta_{lk} (l_{it} k_{it}) + \beta_{lu} (l_{it} u_{it}) + \beta_{lu} (u_{it} k_{it}) + \beta_{luk} (l_{it} u_{it} k_{it}) + \omega_{it} + \varepsilon_{it} \tag{6}$$

Where y_{it} represents the logarithm of the actual output of the enterprise, l_{it} represents the logarithm of the labor input of the enterprise, l_{it} represents the logarithm of the actual capital stock of the enterprise, and u_{it} represents the logarithm of the quantity of intermediate input factors; ε_{it} is a white noise sequence.

From equation (6), the output elasticity of intermediate input factors can be derived:

$$\theta_{it}^{u} = \frac{\partial y_{it}}{\partial u_{it}} = \beta_u + 2\beta_{uu} u_{it} + \beta_{lu} l_{it} + \beta_{uk} k_{it} + \beta_{luk} l_{it} k_{it} \tag{7}$$

Stage 2: Assume that the productivity of the enterprise follows a first-order autoregressive process:

$$\omega_{it} = g_t (\omega_{it-1}) \omega_{it} + \varepsilon_{it} \tag{8}$$

Based on the output expression obtained in Stage 1, the estimated ϕ_t actual output level can be obtained, thereby obtaining the estimated expression for enterprise productivity:

$$\omega_{it} = \phi_t - [\beta_l l_{it} + \beta_k k_{it} + \beta_u u_{it} + \beta_{ll}(l_{it})^2 + \beta_{kk}(k_{it})^2 + \beta_{uu}(u_{it})^2 + \beta_{lk}(l_{it}k_{it}) + \beta_{lu}(l_{it}u_{it}) + \beta_{lu}(u_{it}k_{it}) + \beta_{luk}(l_{it}u_{it}k_{it})] \quad (9)$$

By adopting a non-parametric Generalized Methods of Moments (GMM) estimation method, the input coefficients of intermediate factors and the output elasticity of intermediate input factors are obtained. Combined with the expenditure share of intermediate input factors, the enterprise's markup rate is then calculated[6][7].

The estimation method for productivity uses the logarithm of the value added of enterprise products divided by the logarithm of enterprise labor force[8][9].

2.2. Control Variables

We control for the following variables[10]:

(1) Industry Market Size (ind_size), measured by the logarithm of the total sales revenue of enterprises in the 4-digit industry;

(2) Industry Herfindahl-Hirschman Index (ind_hhj4), calculated as ind_hhj4 = Σ(total_sale_ij / Σ(total_sale_ij)^2), where total_sale_ij represents the sales revenue of enterprise i in 4-digit industry j;

(3) Industry Competition Degree (ind_compt), measured by the logarithm of the number of enterprises in the 4-digit industry;

(4) Average Wage of Enterprise (wage), measured by the logarithm of the ratio of total wages to total employees;

(5) Capital-Output Ratio of Enterprise (k_q), measured by the logarithm of the ratio of net fixed assets to total output value;

(6) Capital Intensity of Enterprise (k_l), measured by the logarithm of the ratio of net fixed assets to total employees.

3. Measurement results and Conclusions

Table 1 Hypothesis Testing

Dependent variable	Markup1	Markup1	markup1	Markup1
	(1)	(2)	(3)	(4)
productivity	.502*** (.0000)	.502*** (.0000)	.502*** (.0000)	.439*** (.0000)
ind_size		.010*** (.0000)	.032***(.0000)	.456*** (.0000)
ind_hhj4			.634***(.0000)	.313***(.0000)
ind_compt				-.457*** (.0000)
k_l				.586*** (.0031)
k_q				-.542***(.0032)
wage				.006*** (.0000)
Constant term	-1.465***(.0000)	-1.533*** (.0000)	-1.688*** (.0000)	-2.824*** (.0000)

Note: Standard errors are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Based on the choice of indicators for measuring total enterprise output, this paper constructs two different indices of firm markup rates, namely makeup1 and makeup2 .

In the calculation of makeup1 , the firm's total output is used as the measure, while in the calculation of makeup2 , the firm's total sales revenue is adopted. For robustness considerations, we regress both makeup1 and makeup2 on key variables and control variables.

The regression results for makeup1 and makeup2 on the key variables are presented in Table 1 and Table 2, respectively, with the outcomes as follows:

Table 2 Hypothesis Testing

Dependen variable	Markup2	Markup2	Markup2	Markup2
	(1)	(2)	(3)	(4)
productivity	.423*** (.0000)	.423*** (.0000)	.424*** (.0000)	.590*** (.0000)
ind_size		.012*** (.0000)	.0624***(.0000)	.851*** (.0000)
ind_hhj4			1.424***(.0000)	.276***(.0000)
ind_compt				-.846*** (.0000)
k_l				.210*** (.0000)
k_q				-.170***(.0000)
wage				.073*** (.0000)
Constant term	-1.205***(.0000)	-1.284** (.0000)	-1.639*** (.0000)	-4.921*** (0.0000)

Note: Standard errors are reported in parentheses; ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Tables 1 and 2 report the regression results of the mechanism through which firm productivity affects the markup rate.

Column (1) uses the firm markup rate as the dependent variable. The test results show that the regression coefficient of firm productivity is significant at the 1% level, indicating that firm productivity has a significant positive effect on the markup rate by reducing marginal costs.

Columns (2) to (4) retain the firm markup rate as the dependent variable but include additional control variables: industry market size, industry Herfindahl-Hirschman Index (HHI), industry competition intensity, firm average wage, firm capital-output ratio, and firm capital intensity. The test results confirm that the regression coefficient of firm productivity remains significant at the 1% level, demonstrating the robustness of firm productivity as an explanatory variable.

4. Conclusions and Recommendations

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