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How Do Large Epidemics Redistribute Market Power? Evidence from the 2003 SARS Shock in China

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Background

Market power plays a vital role in various fields of economics, by influencing social welfare, resource allocation, and economic development. It is also an important factor that shapes firms' heterogeneity in behavior and competitiveness. While it is costly to build, once established, it is typically persistent and difficult to change. Exogenous shocks, such as the SARS epidemic, may change the consumption habits of consumers and the production/trading decisions of affected firms, potentially reducing these firms' market power and competitiveness. In addition, large epidemics almost always lead affected manufacturing firms to accumulate inventories, causing them to reduce prices. This paper examines the impact of severe epidemics on the redistribution of market power and investigates the role of inventory in the process, using the 2003 SARS epidemic in China as a natural experiment.

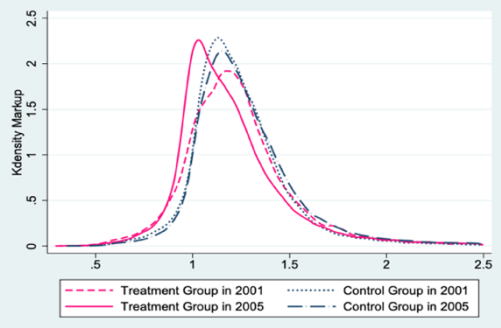


Figure 1 Markup distribution for the Treatment and Control Groups before and after SARS.

Model

When there is inventory heterogeneity and demand uncertainty, the traditional measure of market power-- referred to as raw markup ($\tilde{\mu}_{jt}$) hereafter and defined as the ratio of output price to marginal production cost --- does not capture firms' true markup. This is because holding inventory incurs additional costs and creates benefits through avoiding stockout. And the existence of inventory causes a difference between sales and output, affects endogenous pricing and production decisions, and, more importantly, makes production and pricing decisions dynamic.

To understand the role of inventory and demand uncertainty in market power, we extend the model of Kahn (1987) to accommodate flexible markup, by allowing for flexible production and inventory costs together with a flexible demand function. This model describes firms' dynamic decisions on production, pricing, and inventory when facing uncertain demand. Our model provides a straightforward measure of markup in the presence of demand uncertainty and inventory dynamics. This improves the literature on the measurement of markup using the production function approach.

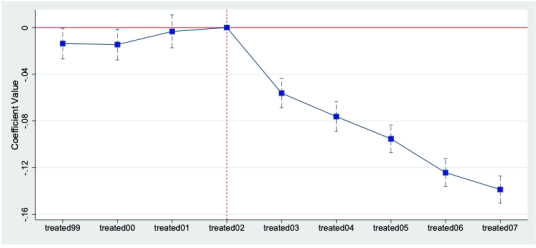
$$\mu_{jt} = \frac{p_{jt}}{\frac{\beta \int_{-\infty}^{Q_{jt}} V'(n_{jt}) dG(u_{jt})}{G(Q_{jt})}} = \frac{\tilde{\mu}_{jt} G(Q_{jt})}{1 - \tilde{\mu}_{jt}[1 - G(Q_{jt})]} \quad (1)$$

Equation (1) shows the markup measurement proposed in this paper. The first equality describes the markup definition in the presence of uncertain demand and inventory dynamics --- the ratio of price over total variable costs of supplying one more unit (including traditional marginal production costs, inventory costs, and the potential opportunity costs of inventory). The last equality provides a straightforward method to calculate the markup empirically: first, calculate the raw markup $\tilde{\mu}_{jt}$; second, estimate the not-stockout probability ($1 - G(Q_{jt})$) and use it to adjust the raw markup following Equation (1). Then we can obtain the true markup with demand uncertainty and inventory dynamics. The traditional raw markup $\tilde{\mu}_{jt}$ ignores the costs of inventory and its potential opportunity costs when selling products, biasing the firm true market power.

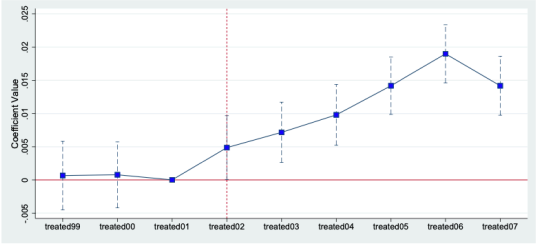
The model predicts that a higher level of inventory reduces market power: because higher inventory stock pressures firms to cut prices and reduce markup. Moreover, higher demand uncertainty requires firms to produce more and hold more inventory to buffer against stockout, which increases supply costs and reduces markup. These results are confirmed empirically in a large panel of Chinese manufacturing firms.

Data and Methodology

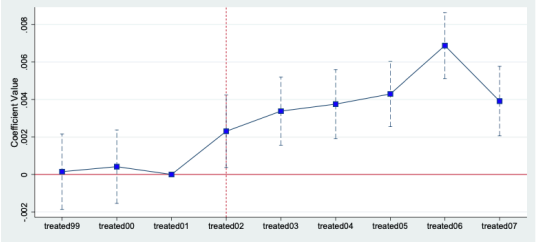
The paper uses a detailed firm-level data set, the Annual Survey of Industrial Enterprises, collected by the National Bureau of Statistics of China from 1998 to 2007. The data set includes all Chinese state-owned enterprises (SOEs) and non-SOEs whose annual sales are no less than RMB 5 million. Detailed production information is reported in the data set, including the values of output, sales, end-of-period inventory stock, and the variable costs. Because SARS generated a large negative shock to firms located in provinces that were seriously affected but much less of a shock to firms in other provinces, it provides a natural experiment to analyze the impact of epidemics on market power using a difference-in-differences style analysis. In our analysis, we treat firms located in the four heavily hit provinces (Beijing, Guangdong, Shanxi, and Inner Mongolia) as the treatment group and those located in other provinces in Mainland China as the control group. Then the difference between the two groups captures the redistribution of market power across firms when markup is used as the dependent variable.



(a) Markup



(b) Inventory Ratio



(c) Demand Uncertainty

Figure 2 Dynamic effects of SARS on markup, inventory ratio, and demand uncertainty

Key Finding

First, the SARS redistributed market power substantially from the SARS-affected firms to firms in other areas. It reduced the average markup of firms located in the four provinces that were hit hardest by SARS by 7.8 percentage points, relative to other firms. The impact is long-lasting. After the initial drop of 5.5 percentage points in 2003, the decline in markup accumulated to 13.8 percentage points in 2007 relatively for firms in the SARS-affected areas. This suggests that although epidemic shocks are transient, they may have long-lasting effects on market power, presumably because they may change some fundamental factors such as consumer preference, demand uncertainty, and firms' production and inventory strategies.

Second, inventory and demand uncertainty played an important role in driving the impact of SARS on the redistribution of market power. SARS increased the average inventory ratio by 1.4 percentage points (an 11% increase) and demand uncertainty by 14% of a standard deviation for firms in the SARS-impacted provinces relatively. Like markup, the effects are long-lasting. As a mechanism, the increase in both contributed to around 26% of the SARS effect on markup.

Additionally, the authors tested the heterogeneity of SARS's impact by exploiting differences in the timing of SARS outbreaks between Guangdong province and other provincial-level administrative regions, as well as variations in the degree of impact across different regions. Consistent and robust heterogeneous results further bolster the causal relationship.

Policy Implication

The paper demonstrates the necessity of accounting for the heterogeneity in inventory stock and demand uncertainty to understand market power. Market power is typically persistent and difficult to change, while the exogenous shock may significantly redistribute the market power in manufacturing industries, and inventory dynamics play a vital role in this process. The enforcement costs of antitrust and competition laws for developing countries are relatively high, thus, accurately evaluating firm market power is the prerequisite for related studies. When measuring firm markup, researchers should take into consideration the heterogeneity of inventory dynamics among different firms and the effects of related short- and long-run shocks on them.

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