



# The Impact of Firm Size and Market Concentration on Firm Productivity Evidence from Indonesian Manufacturing

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**Abstract.** This study investigates the impact of firm size and market concentration on firm productivity in Indonesian manufacturing. Firm size has been enduring interest in studies on firm productivity as the impact can be positive or negative. On the other hand, market concentration has increasingly been a key concern in evaluating firm productivity. This study used firm-level panel data of 6,783 manufacturing firms (47,481 observations) across 33 provinces of Indonesia. Two methods were applied in estimating the data; those methods were adjusted-autocorrelation OLS and random effect GLS. The results show that firm size has a significant positive effect on firm productivity, indicating that a large-scale firm experiences higher productivity than a small size firm. In addition, market concentration appears to have a negative impact on firm productivity, suggesting that a firm in a more concentrated industry tends to be less productive. The implication of this study suggests that a firm produces on a large scale and competes in a less concentrated market.

**Keywords:** Firm size · market concentration · productivity · Indonesian manufacturing

## 1 Introduction

A question of enduring interest within productivity analysis is whether the firm size does have an effect on firm productivity [1]. Empirical studies unveil mixed evidence, as some research shows a positive impact of firm size on productivity, whereas others find a negative effect. Those who uncover a positive effect argue that large-scale enterprises can adopt a more sophisticated technology [2, 3], employ high-skilled professionals [4, 5], and receive more spillover benefits from a foreign direct investment [6, 7], allowing them to have higher productivity. In contrast, studies that discover a negative impact argue that small and medium enterprises (SMEs) are more efficient than large firms in management decisions and organizational control [8], more effective in acquiring new capabilities [9], and more adaptable in facing the organization and economic problems [5], pushing them to be more productive.

Market concentration is another key concern concerning the studies on firm productivity. However, the empirical relationship remains unsolved, particularly in the emerging

market [10, 11]. Most empirical research finds a negative relationship between market concentration and productivity, showing that increasing market concentration level drives lower productivity of firms [3, 6, 12, 13]. In contrast, several studies find out that most firms with high power in a market are those large-scale and foreign-owned firms with high productivity, which drives the less productive firms out and gain more market power [14–16]. These divergent findings in empirical studies are argued in some research that might be due to using a simple industrial concentration measure of the Herfindahl-Hirschman Index (HHI) [17]. Adding alternative measures using the concentration ratio of the four biggest companies in an industrial market (CR4) can comprehensively analyze market concentration [15, 18, 19]. Another reason for the mixed evidence might be a variation in a method of analysis, as noted in [18, 20].

Based on the mixed evidence and the recent development in measurements and methods, this current study analyzes the impact of firm size and market concentration on firm productivity in Indonesian manufacturing using the two measurements of market concentration and two current analysis methods. The significant contribution of this current study is twofold. Firstly, it employs two complement measurements of market concentration, i.e., HHI and CR4, as suggested by the recent empirical research, to gain a comprehensive portrayal of the impact of market concentration. Secondly, it adopts two compatible methods of analysis, i.e., Adjusted Autocorrelation Ordinary Least Squared (AA-OLS) and Random Effect Generalized Least Squared (RE-GLS), which allow for a more efficient estimate.

## 1.1 Firm Size and Productivity

The theoretical framework underpinning the relationship between firm size and productivity is particularly drawn from the neoclassical production function [10, 21, 22] extends the theoretical model and shows that firm size is positively correlated with firm productivity under the market equilibrium condition.

Although theoretical literature indicates a potential positive correlation between firm size and productivity, the empirical studies find mixed evidence. Most researchers discover a positive effect of firm size on productivity through capital accumulation [23, 24], technology advancement [2, 3], skilled workers [4, 5], and foreign ownership [7, 25]. Several researchers unveil a negative impact of firm size and argue that small and medium enterprises are more productive due to their adaptability in dealing with economic downturn [5], affectivity in learning new knowledge [9], and flexibility in management decisions [8].

Following the theoretical ground as well as the empirical finding, this current study develops a hypothesis as follows:

H1: Firm size has a significant positive effect on firm productivity.

## 1.2 Market Concentration and Firm Productivity

Empirical findings on the relationship between market concentration and firm productivity are still unclear. On the one hand, the market concentration provides a low incentive

for firms to be more productive, as the market leaders tend to be very large-scale enterprises, and small firms are left behind in their technology [12, 13]. The market leaders can also steal market share from less productive firms, driving the latter to be less productive [3, 6]. On the other hand, most high-concentration markets have large-scaled and foreign-owned firms with superior productivity [10, 12, 14, 16].

Several recent studies suggest some solutions regarding the inconsistent findings in relation to alternative measurements [15, 18, 19] and alternative methods [18, 20]. Nevertheless, these inconclusive findings remain critical in examining market concentration and firm productivity.

To contribute to the existing literature and to provide light to the continuing debate, this current study develops a hypothesis as follows.

H2: Market concentration has a negative impact on firm productivity.

## 2 Empirical Model, Research Methods and Data

### 2.1 The Empirical Model

The empirical model of the current study can be written as follows:

$$\log(\text{output})_{it} = \beta_0 + \beta_1 \text{Size}_{it} + \beta_2 \text{MC}_{it} + \mu_{it} \quad (1)$$

where  $\log(\text{output})$  is the logarithmic of output value that represents output productivity,  $\text{Size}$  is the measure of firm size that is calculated from the number of labor divided by 1000,  $\text{MC}$  is a measure of market concentration of each 3-digit ISIC in the manufacturing industry, which is calculated from the output of each 3-digit industry divided by the output of manufacturing industry,  $\mu$  is disturbance variable,  $\beta_0, \beta_1, \beta_2$  are parameters to be estimated,  $i$  is the  $i$ -th firm,  $t$  is the  $t$ -th year.

### 2.2 Research Methods

Two methods were utilized in the current research, namely Adjusted Autocorrelation Ordinary Least Squared (AA-OLS) and Random Effect Generalized Least Squared (RE-GLS). These two methods have an advantage in dealing with autocorrelation in panel data. The process of adjusted autocorrelation in OLS is presented clearly in [27], whereas the random effect GLS is presented in detail in [28]. The adjusted autocorrelation OLS and the random effect GLS procedure follow these two references.

### 2.3 Data

The data used in this study were constructed from a survey of medium and large manufacturing enterprises across 33 provinces in Indonesia. The constructed panel data consists of 6,783 firms for 7 years from 2007 to 2013, so the total observations are 47,481. The procedure to construct a balanced panel follows [7]. This balanced panel data is used for estimations under the two models (AA-OLS and RE-GLS). Supplementary data includes wholesale price indexes to deflate the output values.

### 3 Results and Discussion

From the constructed panel data, the impact of firm size (*Size*) and market concentration (*MC*) are estimated. Before presenting the estimation results, Table 1 shows the statistical summary of each variable. The logarithmic output has an average value of 6.4424 or equivalent to IDR 10,907,715 thousand, with a minimum value 4.9609 and a maximum value 8.6850. The firm size ranges from 0.02 to 15.232, whereas the market concentration is on average 0.4509.

The estimations on the dataset under the empirical model (1) using the two chosen methods are presented in Table 2. The upper part of Table 2 portrays the results under adjusted autocorrelation OLS (AA-OLS), while the lower part of the table pictures the results under random effect GLS (RE-GLS).

The AA-OLS results show that firm size has a positive and significant effect on log(output) at a 5% level, implicating that larger firms have higher productivity. The possible interpretation of these findings is that large firms are more advanced in capital accumulation, technology progress, skilled labor, and assets, enabling them to be more productive than small firms. These findings are in line with findings in [2–5, 7, 23, 25].

Market concentration (MC) is found to have a negative and significant impact on log(output) at a 5% level. A high market concentration industry reduces firm productivity. Two possible explanations for this finding are that: (1) a high concentration industrial market provides a low incentive for firms to be more productive, as the market leader tends to operate in very efficient large-scale production, and (2) the market leader can steal the market share of other firms, pushing them to be less efficient and even forcing them out of the market. These findings are similar with [6, 12, 13, 26].

The magnitude of each coefficient cannot be directly interpreted as the marginal effect on firm productivity as the coefficients of adjusted autocorrelation OLS have been going through a functional transformation from the initial OLS, as stated in [27].

The RE-GLS model results are similar to AA-OLS in terms of the sign and the significance; only the magnitude of coefficients is larger in the former. Interpretation of the impacts of each variable on productivity is the same. Firm size induces a significant positive effect on firm productivity, whereas market concentration provides a significant negative impact on firm productivity.

The similarity in sign and significance between the two models ensures the robustness of the estimations under two independent variables of firm size and market concentration.

**Table 1.** Statistic Summary of Variables

Variable	Obs.	Mean	SD	Min	Max
Log(output)	47,481	6.4424	0.6978	4.9609	8.6850
Size	47,481	0.1255	0.2881	0.0200	15.232
MC	47,481	0.4509	0.2137	0.0003	0.9998

Source: Calculated from the constructed panel data of the Indonesian Annual Survey of Medium and Large Enterprises.

**Table 2.** Estimation Results

1. First Model: OLS adjusted Autocorrelation			
Dependent var.: Log(output)	Coefficient	Standard Error	z-value
Constant	14.8931***	0.0169	880.50
Size	0.8661***	0.0197	43.89
MC	-0.3390***	0.0178	-18.97
R-Squared	0.1686		
Chi-Squared	2291.91***		
Observations	47,481		
2. Second Model: RE GLS			
Dependent var.: Log(output)	Coefficient	Standard Error	z-value
Constant	14.8011***	0.0178	829.59
Size	0.9034***	0.0192	47.13
MC	-0.1780**	0.0196	-9.10
R-Squared	0.1939		
Chi-Squared	2307.66***		
Observations	47,481		

Source: Estimation results on the constructed panel data from the Indonesian Annual Survey of Medium and Large Enterprises.

## 4 Conclusion

This study analyzes the effect of firm size and market concentration on firm productivity of 6,783 manufacturing across 33 provinces in Indonesia from 2007 to 2013. It is found that firm size has a positive and significant effect on firm productivity, implicating that a larger firm has higher productivity than a smaller firm. In contrast, market concentration generates a positive and significant impact on firm productivity, showing that firms in the highly concentrated market are less productive. These findings suggest that firms produce on a large scale and compete in a less concentrated market.

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