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Do competent managers increase labor productivity? Evidence from Korea

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Abstract
This study investigates the effect of managerial ability on labor productivity by analyzing various methods in the firm-year panel data of listed firms in South Korea from 2002 to 2019. Managerial ability was analyzed using the measurement method of Demerjian *et al.* (2012), while labor productivity was analyzed using value-added and sales. The authors find that managerial ability has a positive effect on labor productivity. In other words, the productivity of employees improves with the appointment of a manager with higher abilities. The study's findings suggest that firms should consider managerial ability as a means of improving labor productivity.

Keywords Managerial ability, Managerial efficiency, Labor productivity, Value added, Data envelopment analysis, Dynamic panel model

Paper type Research paper

1. Introduction

Improving labor productivity is one of the core objectives of firms. Although employees understand the need to improve labor productivity, they nevertheless regard it as a source of strained labor management relations. A reason for this is their belief that attempts to improve their productivity only causes problems related to increased labor intensity and fairness in distribution. In 2002, South Korea made the disclosure of employee wages mandatory for first time. The National Statistics Office also conducts a quarterly or half year employment survey by region (formerly, The Manpower Survey) to gather information on the number of employees by industry and wage, along with other labor-related information.

Firms have introduced gain sharing, incentives and welfare systems to efficiently increase labor productivity. For instance, they have encouraged employees to participate in stock investment and have expanded such participation, leading to productivity effects (Cin, 2003). Other policies are more directly related to wages, incentivizing the improvement of labor productivity. A minimum wage increase rate is set, and when the firm achieves its target value, employee performance is rewarded in the form of cash, stocks and welfare funds (Chrisman *et al.*, 2017; Kim *et al.*, 2006). However, adopting a different perspective, some firms have opted to increase the proportion of welfare expenses. Unlike wages which are determined by designation and tenure, an increase in welfare expenses can be distributed

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equally regardless of designation and helps stabilize employees' standard of living (Shin, 2017). A recent trend is the establishment by firms of a non-profit corporation with an intra-firm labor welfare fund, which is managed directly by employees and to which firms contribute a percentage of their profits, instead of paying welfare expenses. Such a fund dissuades staff from leaving the firm and helps to stabilize labor management relations because employees receive tax-free income and carry-forward from the fund as long as they stay with the firm (Kim and Yoon, 2020).

The ability of managers in terms of corporate decision-making is important in improving labor productivity in various organizations. As existing studies show that labor productivity increases firm performance, it is necessary to pay attention to the relationship between managerial ability, which refers to the overall management of a firm, and labor productivity. Various methods, such as industry-adjusted stock returns and the level of media exposure, have been used to measure managerial ability. One study, for instance, analyzes the demand for managers in the market by regarding stock price management as a measure of managerial ability (Fee and Hadlock, 2003). Another analyzes the situation in which managers are incentivized based on their reputation, such as designing their salaries based on stocks (Milbourn, 2003). Another study demonstrates that competent managers are more likely to be mentioned and recognized in the media and that the return on assets (ROA) is also likely to be higher in firms with competent managers (Rajgopal *et al.*, 2006).

Subsequent studies argue that managerial ability can be measured using the residual obtained after subtracting the firm's characteristic factors from its total output (Demerjian *et al.*, 2012). As this approach measures overall managerial ability while overcoming the weaknesses of existing fragmentary measures of managerial ability, it is increasingly being used in research on managerial ability, firm value and performance (Gan and Park, 2017; Ko *et al.*, 2013; Rajgopal *et al.*, 2006; Yim and Kim, 2018).

Few studies focus on the relationship between managerial ability and labor productivity; a more comprehensive understanding of such a relationship is necessary. The growth and development of a firm greatly depend on managerial ability because effective labor allocation and management strategy depend on managerial ability. While existing research on productivity focuses on the relationship between managerial ability, firm performance and firm value, the present study clarifies the relationship between managerial ability and labor productivity using production capacity per employee. Labor productivity is calculated more precisely using the difference generalized method of moments (GMM) and system GMM methods. The study seeks to help improve the trust between labor and management by considering the fairness of distribution through an analysis of value-added labor productivity, which implies the meaning of managerial ability and distribution of performance. In addition to establishing an efficient firm management policy for improving labor productivity, the study also discusses ways to improve and stabilize labor-management relations.

The remainder of this paper is structured as follows. Chapter 1 explains the background and the purpose of the study, after which Chapter 2 provides a literature review and develops the study's hypotheses. In Chapter 3, the data structure and collection method are explained, and the research model is presented. In Chapter 4, the results of the empirical analysis are discussed. Finally, in Chapter 5, conclusions and implications are presented.

2. Literature review and hypothesis development

2.1 Managerial ability

In their study which measures managerial ability by industry-adjusted stock returns, Fee and Hadlock (2003) examined S&P 500 firms from 1993 to 1998 and found that managers with high managerial ability have more employment offers from other firms and receive higher wages.

Measuring managerial ability by degree of media exposure, Milbourn (2003) studied S&P 500 firms from 1993 to 2001 and argued that the higher the managerial ability, the greater the sensitivity of performance-based compensation. Studying US-listed firms from 1993 to 1998, Rajgopal *et al.* (2006) measured managerial ability by adding media exposure and industry-adjusted ROA and found that the higher the managerial ability, the wider a manager's external employment opportunities are. Francis *et al.* (2008) studied S&P 500 firms from 1992 to 2001 and found that managers with a good reputation reduce the quality of earnings.

Demerjian *et al.* (2012) were the first to propose a study that measures managerial ability through the residual, which is obtained by subtracting a firm's characteristic factors from its maximum output. They found a negative relation between managerial ability and stock price when managers change and a positive relation between managerial ability and firm performance. Demerjian *et al.* (2013) then studied the effect of managerial ability on the quality of earning from 1989 to 2009 and found that higher managerial ability has a positive effect on firm profitability and managerial judgment. Demerjian *et al.* (2017) studied US-listed firms from 1995 to 2013 and found that managers with high managerial ability are more likely to contribute to earnings smoothing to stabilize profit fluctuations and that such intervention increases operational performance. Gan and Park (2017) found that as managerial ability increases, the marginal value of cash significantly increases, and the value of shareholders' interests in a company's cash holdings also increases. Studying US-listed firms from 1995 to 2006, Mishra (2019) measured managerial ability using two categories strategic and operational abilities. The results reveal that both types of managerial ability have a positive relationship with firm innovativeness.

In the Korean context, Ko *et al.* (2013) studied listed firms from 2003 to 2011 and found that the higher the managerial ability, the higher the firm's future economic performance. Their results also showed that firm performance becomes higher after replacing a manager with considerable managerial ability. Ko and Jung (2016) studied listed firms from 2002 to 2013 and found that managerial ability has a positive effect on managerial compensation. Chung *et al.* (2017) studied listed firms from 2005 to 2014, confirming that the higher the managerial ability, the lesser the over-investment or under-investment and therefore the higher the investment efficiency. Yim and Kim (2018) studied domestic-listed firms from 2004 to 2016, using two groups with high and low managerial abilities. They argued that compensation gap has a negative effect on firm performance in the group with low managerial ability. Yim (2019) studied listed firms from 2002 to 2017 and measured productivity by sales per employee and total factor productivity. The results reveal a negative relationship between compensation gap and productivity in firms with low managerial ability. Ghosh *et al.* (2020) suggested that managers differ in their ability to treat management processes and human capital in ways that improve employee productivity and that more competent managers are associated with higher employee productivity. In addition, by dividing employee productivity into the employee efficiency factor and the employee cost factor, a significant positive correlation was found with the employee efficiency factor. The difference between this paper and our paper is whether the management process dealing with data and human capital is considered as part of corporate policy. Fenizia, A. (2022) uses new Italian administrative data to study the influence of managers in the public sector of public administration. A 1 standard deviation increase in talent through rotation of managers increases office productivity by 10%. It mainly follows the departure of older workers who retire when they cycle into productive managers and also found that placing better managers in the most productive sectors increased output by at least 6.9%.

In summary, managerial ability has been traditionally measured through indicators such as industry-adjusted stock returns and media exposure levels, but such measurements can be limited in their scope. As such, to obtain a more comprehensive measurement of managerial ability, the study present study uses the residual measurement method of Demerjian *et al.* (2012), which is a new approach that compensates for the fragmentariness of previous measures.

2.2 Labor productivity

Measuring labor productivity based on value-added, Cin (2003) analyzed listed Korea manufacturing firms from 1993 to 1999 and found employee participation in ownership shares had a positive effect on labor productivity independently of production factors. Won (2011) studied Korean public firms from 2007 to 2009 using the value-added ratio, labor productivity based on value-added and capital productivity based on value-added as indicators of productivity, finding that labor productivity based on value-added has a positive effect on financial ratios.

Measuring labor productivity based on sales, Kim *et al.* (2006) suggested that the results of a 2005 Ministry of Labor annual salary and gain-sharing system survey reveal that the gain-sharing system has a positive relationship with labor productivity. Kang (2012) studied firms listed in the Korea Securities Dealers Automated Quotation (KOSDAQ) from 1998 to 2009 and found that SME innovation has a positive effect on labor productivity. Chrisman *et al.* (2017) studied family and nonfamily firms using data from the 2007 US employer survey and suggested that incentive compensation in family businesses improves labor productivity.

Measuring labor productivity based on value-added per employee and sales per employee, Nho and Chae (2009) argued that education and training costs have a positive relationship with sales, but no relationship with value-added. Brav *et al.* (2015) studied US firms from 1994 to 2007 and found that hedge fund activities increase labor productivity by improving the efficiency of assets. Shin (2017) revealed that in information technology (IT) firms from 2011 to 2016 by setting labor productivity as sales and value-added, a positive relationship exists between firm welfare and labor productivity. Kim and Yoon (2020) examined the Korea Composite Stock Price Index (KOSPI) 200 manufacturing firms from 2002 to 2018 and confirmed that an intra-firm labor welfare fund has a positive effect on labor productivity.

Thus, the current literature demonstrates the existence of a relationship between labor productivity as measured by sales and value-added on the one hand and the characteristics and systems of firms on the other hand. As such, this study considers various methods of measuring labor productivity using both sales and value-added. In addition, by controlling for the effects of education and training costs and research and development (R&D) expenses on the productivity of each employee, this study determines the effect of managerial ability on labor productivity more accurately.

2.3 Hypothesis development

Managers need the ability to analyze a firm's current situation and devise an appropriate strategy to generate maximum performance vs input. Firm policies such as the distribution strategy of labor input factors and intra-firm welfare are some of the areas where managerial abilities are exercised. Thus, assuming that employees' abilities are constant, the higher the managerial abilities, the higher the productivity of labor, thereby resulting in the maximum output with the same number of inputs (considering the number of employees and wages as given). The method of Demerjian *et al.*'s (2012) measuring managerial ability derives the residual by removing the effect of the characteristics of the firm from its relative efficiency of the firm. Firm policy and culture, decision-making efficiency and the synergy in place for achieving the firm's goals are among the dimensions considered under managerial abilities, instead of firm characteristics. Previous studies suggest motivation, incentives and firm welfare as factors that increase labor productivity. Labor intensity is also important. The lower the labor input per production, the higher the management ability of the manager and the higher the possibility of labor productivity improvement when the worker handles the right amount of work smoothly in a more efficient environment. These factors can be seen as part of firm policy and culture and as an element determined by managerial ability. Thus, in this study, we predict that the higher the managerial ability, the higher the labor productivity of employees, as a result specifically of more efficient firm policy and decision-making. Accordingly, the study's core hypotheses are as follows:

H1. Managerial ability has a positive effect on labor productivity as measured by value-added.

H2. Managerial ability has a positive effect on labor productivity as measured by sales.

3. Empirical analysis

3.1 Model specification

To analyze the relationship between managerial ability and labor productivity, we estimate the following model by considering the labor productivity measurement method and the control variables beyond the model suggested by Cin (2003) and Yim (2019). To control for the effect of the year and the characteristics of the firm, a year dummy (YD_t) and industry dummy (ID_j) are included. Winsorization is performed on all variables at the 1% level. The pooled-ordinary least squares (OLS) model used in this study is shown in Equation (1).

$$LP_{i,t} = \alpha_0 + \beta_1 MA_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 (K/L)_{i,t} + \beta_4 LEV_{i,t} + \beta_5 LEDU_{i,t} + \beta_6 AW_{i,t} + \beta_7 LRND_{i,t} + \beta_8 INCO_{i,t} + \beta_9 YD_t + \beta_{10} ID_j + \varepsilon_{i,t} \quad (1)$$

$LP_{i,t}$ = Labor productivity of firm i in year t ($LP1_{i,t}$ or $LP2_{i,t}$)

$MA_{i,t}$ = Managerial ability of firm i in year t

$SIZE_{i,t}$ = Size of firm i in year t

$(K/L)_{i,t}$ = Capital intensity of firm i in year t

$LEV_{i,t}$ = Debt ratio of firm i in year t

$LEDU_{i,t}$ = Education and training expenses per employee of firm i in year t

$AW_{i,t}$ = Average wage per employee of firm i in year t

$LRND_{i,t}$ = R&D expenses per employee of firm i in year t

$INCO_{i,t}$ = Industrial competitiveness of firm i in year t

YD_t = Year dummy

ID_j = Industry dummy

As Equation (1) shows, although the year dummy (YD_t) and industrial dummy (ID_j) are controlled for in the pooled-OLS model, certain unique characteristics may not be observed at the firm level, and these are called fixed effects. The existence of fixed effects may prevent, accurate results from being obtained through the pooled-OLS model, as the main variables may have a correlation with the fixed effects, thereby causing an endogeneity problem. A firm's unique characteristics and infrastructure do not change easily over time, but they can affect labor productivity. This effect is called the time-invariant fixed effect, and the model is estimated after removing the mean value from the equation by performing the within transformation. Accordingly, if the fixed effect is removed from Equation (2), representing the fixed-effects model, we obtain Equation (3).

$$LP_{i,t} = \alpha_0 + \beta_1 MA_{i,t} + \sum_{k=2}^{8} \beta_k Cont_{k,i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

$$LP_{i,t} - \overline{LP_i} = \beta_1 \left(MA_{i,t} - \overline{MA_i} \right) + \sum_{k=2}^{8} \beta_k \left(Cont_{k,i,t} - \overline{Cont_{k,i}} \right) + \left(\varepsilon_{i,t} - \overline{\varepsilon_i} \right) \quad (3)$$

$LP_{i,t}$ = Labor productivity of firm i in year t ($LP1_{i,t}$ or $LP2_{i,t}$)

$MA_{i,t}$ = Managerial ability of firm i in year t

$Cont_{k,i,t}$ = Control variables of firm i in year t (firm size, capital intensity, debt ratio, education and training expenses per employee, average wage per employee, R&D cost per employee and industrial competitiveness)

μ_i = Fixed effect

$\varepsilon_{i,t}$ = Intrinsic error

Using a fixed-effects model allows the possibility of removing some of the endogeneity by disregarding firm characteristics that do not change over time. However, the endogeneity that changes over time remains. To eliminate this endogeneity, this study employs a dynamic panel model that uses a parallax variable as an instrumental variable. The instrumental variable is used with a one-year lag in labor productivity and should not be correlated with the error term. Overidentification results when the number of instrumental variables is more than the number of panel groups. Since GMM indicates a relationship within an individual entity, we disregard cross-sectional variation, but consider time series correlation (auto correlation). However, the characteristics of the year that can affect labor productivity are naturally tightly controlled. The GMM used in this study includes the past lag variable of the dependent variable and measured value of labor productivity as an explanatory variable, as shown in Equation (4).

First uses the difference GMM estimation method proposed by Arellano and Bond (1991). The difference GMM is analyzed using the generalized momentum method, with the past value of the dependent variable taken as an instrumental variable after removing the fixed effect by differentiating Equation (4). Both first- and second-stage estimations are performed. Between the first and second-stage estimators, the latter is more efficient. Subsequently, to check whether there is an autocorrelation or heteroscedasticity problem exists, an autocorrelation test is performed, and a clustered robust standard error is used. Lastly, unlike in the first-stage estimator, in the second-stage estimator, the Sargan (1958) and Hansen (1982) tests are performed to determine whether to reject the null hypothesis that "overidentification is valid." By doing so, this study verifies whether the number of instrument variables used in the overidentification model is greater than necessary. The difference GMM model is shown in Equation (5).

$$LP_{i,t} = \alpha_0 + \gamma_1 LP_{i,t-1} + \beta_1 MA_{i,t} + \sum_{k=2}^{8} \beta_k Cont_{k,i,t} + \mu_i + \varepsilon_{i,t} \quad (4)$$

$$\Delta LP_{i,t} = \alpha_0 + \gamma_1 \Delta LP_{i,t-1} + \beta_1 \Delta MA_{i,t} + \sum_{k=2}^{8} \beta_k \Delta Cont_{k,i,t} + \Delta \varepsilon_{i,t} \quad (5)$$

$LP_{i,t}$ = Labor productivity of firm i in year t ($LP1_{i,t}$ or $LP2_{i,t}$)

$LP_{i,t-1}$ = Instrumental variable using the lag of the dependent variable (labor productivity) for firm i in year t-1

$MA_{i,t}$ = Managerial ability of firm i in year t

$Cont_{k,i,t}$ = Control variables of firm i in year t (firm size, capital intensity, debt ratio, education and training expenses per employee, average wage per employee, R&D cost per employee and industrial competitiveness)

μ_i = Fixed effect

$\varepsilon_{i,t}$ = Intrinsic error

Δ = Differential

The system GMM model is analyzed using the estimation method proposed by Blundell and Bond (1998). This method does not differentiate the model, but uses the level GMM and difference GMM methods, which in turn involves the past value of the differential dependent variable as an additional instrumental variable, obtained by differentiating the dependent variable. The system GMM can be a more efficient estimator by increasing the number of instrumental variables and becomes uncorrelated with past variables. After the analysis, a clustered robust standard error is used to verify heteroscedasticity, and the AR-test is performed for autocorrelation.

3.2 Data

This study analyzed firms listed on KOSPI and KOSDAQ from 2002 to 2019. For the precise calculation of labor productivity and other variables, the study period was set to start in 2002, when the disclosure of the wages paid to executives and employees began after the introduction of the electronic disclosure system in 2001.

The financial data used for the analysis and the data used to measure managerial ability and labor productivity were all collected from the Listed Companies Association DB TS2000. The settlement month is December; the sample does not include financial industries, whose accounting data differ from those of general firms. Delisted firms were included for diversity of past data, but new firms listed after December 2019 were excluded. For the data envelopment analysis (DEA) and tobit regression analysis, firms with low degrees of freedom, which make it impossible to generate meaningful analysis, and firms with missing data values were removed, leaving a panel data consisting of 24,103 firms-year samples.

3.3 Variable definition

3.3.1 Labor productivity. Labor productivity is a ratio representing the relationship between input and output and is defined as the amount of output per unit of labor input. Labor productivity is measured in a variety of ways. In this study, we will use two representative methods that can utilize each firm's financial data. It can be divided into value-added labor productivity, which represents the ratio of value-added to the amount of labor input and material labor productivity, which represents the amount of material output relative to that of labor input.

To measure value-added, the addition method is used in terms of total value-added, because the addition method includes the distribution of performance, where the value-added created by the firm is passed on to the participants. Value-added is calculated by adding operating profit, labor costs, interest(financial) expenses, tax and public dues, depreciation costs and rents. In other words, the calculation of labor input is not limited to operating profit, but includes calculations attributed to stake holders. Value-added, which implies that the output is larger, encompasses the value generated in the process of labor production. Unfortunately, Korea did not provide working hours data for individual firms, so it could not be used as one of the measures of labor productivity. The measurement of labor productivity based on value-added is shown in Equation (6).

$$LP1_{i,t} = ln\left(\frac{VA_{i,t}}{LT_{i,t}}\right) \quad (6)$$

$LP1_{i,t}$ = Labor productivity based on value-added

$LT_{i,t}$ = Number of employees of firm i in year t

$VA_{i,t}$ = Value-added (Operating profit (Loss before income tax expenses) + Labor cost + Interest cost + Tax and public dues + Depreciation cost + Rental)

Material labor productivity is measured by dividing sales by the number of employees, as shown in Equation (7).

$$LP2_{i,t} = ln\left(\frac{SALES_{i,t}}{LT_{i,t}}\right) \quad (7)$$

$LP2_{i,t}$ = Labor productivity measured based on sales

$SALES_{i,t}$ = Sales

$LT_{i,t}$ = Number of employees

3.3.2 Managerial ability. Measuring managerial ability involves a two-step method (Demerjian *et al.*, 2012; Ko and Jung, 2016; Yim and Kim, 2018). In the first step, DEA is performed, and in the second, the residual value is obtained by subtracting the measure of firm characteristics from the firm's relative efficiency score calculated in the first step.

In the first step, DEA is conducted using a decision-making unit (DMU) to derive the relative efficiency of a firm. A value of 1 is given to the most efficient firm, and values between 0 and 1 are assigned to firms according to their relative efficiency.

The firms compared in this study are taken from the same industry, using the Korean Standard Industrial Classification Intermediate Classification proposed by the National Statistics Office as the industry classification standard. To measure the relative efficiency of a firm for each year, the firm's sales ($SALES_{i,t}$) are used as output and cost of goods sold ($COGS_{i,t}$), sales and management expenses ($SAE_{i,t}$) R&D expenses ($RND_{i,t}$), tangible assets ($TAN_{i,t-1}$) and intangible assets ($INTAN_{i,t-1}$) are used as inputs. The R&D expenses are the sum of both R&D expenses and ordinary development expenses, as some firms have only R&D expense data and others only ordinary development expense data. In addition, as R&D expenses are included in sales and management expenses, the value obtained by subtracting R&D expenses from sales and management expenses is defined as sales and management expenses. Demerjian *et al.* (2012) additionally classified intangible assets into goodwill and other intangible assets and added operating lease, R&D expenses. However, the paper follows Yim (2019) methodology modified for the Korean market. The measurement of the relative efficiency of a firm is shown in Equation (8).

$$max\ \theta_{i,t} = \frac{SALES_{i,t}}{v_1 COGS_{i,t} + v_2 SAE_{i,t} + v_3 RND_{i,t} + v_4 TAN_{i,t-1} + v_5 INTAN_{i,t-1}} \quad (8)$$

$\theta_{i,t}$ = Relative efficiency of firm i in year t

$SALES_{i,t}$ = Sales of firm i in year t

$COGS_{i,t}$ = Sales cost of firm i in year t

$SAE_{i,t}$ = Sales and management expenses of firm i in year t

$RND_{i,t}$ = R&D expenses of firm i in year t

$TAN_{i,t-1}$ = Tangible assets of firm i in year t-1

$INTAN_{i,t-1}$ = Intangible assets of firm i in year t-1

In the second step, managerial ability is measured by removing firm characteristics from the relative efficiency of the firm as measured by DEA. Variables are used in consideration of customer bargaining power, cash utilization, initial investment cost, various industries and complexity of foreign exchange transactions. For this, tobit regression is performed, and firm characteristics are measured as follows: Firm size ($SIZE_{i,t}$) is measured as the natural log of the total assets of firm i in year t. Market share ($MSH_{i,t}$) is calculated by dividing the sales of firm i in year t by the sum of the sales in year t of all firms in the industry to which firm i belongs. Free cash flow ($FCF_{i,t}$) is calculated by subtracting the sum of changes in capital expenditure and working capital from the sum of the net income and depreciation expenses of firm i in year t. A dummy variable is set to 0 for negative numbers and to 1 for positive numbers. Firm age ($AGE_{i,t}$) is calculated by taking the natural log of the value obtained by subtracting the year of establishment from the current year and adding 1. The degree of diversification ($DIVER_{i,t}$) is obtained by calculating the number of business units. Foreign currency translation account ($FC_{i,t}$) is calculated by dividing the sum of the absolute values of foreign currency translation gains and losses and foreign exchange gains and losses by the sales of firm i in year t. The tobit regression model used to measure managerial ability is shown in Equation (9).

$$FE_{i,t} = \alpha_0 + \beta_1 SIZE_{i,t} + \beta_2 MSH_{i,t} + \beta_3 FCF_{i,t} + \beta_4 AGE_{i,t} + \beta_5 DIVER_{i,t} + \beta_6 FC_{i,t} + \varepsilon_{i,t} \quad (9)$$

$FE_{i,t}$ = The efficiency of firm i in year t

$SIZE_{i,t}$ = The size of firm i in year t

$MSH_{i,t}$ = Market share of firm i in year t

$FCF_{i,t}$ = Free cash flow dummy for firm i in year t

$AGE_{i,t}$ = The age of firm i in year t

$DIVER_{i,t}$ = Degree of diversification of firm i in year t

$FC_{i,t}$ = Foreign currency translation account of firm i in year t

Tobit regression is used to analyze data with a limited range of values. In measuring the efficiency score in the first step, the score can take any value between 0 and 1 and assume the characteristics of both a continuous and discrete variable. Thus, the normal distribution assumed for general regression analysis and OLS analysis does not apply, as this may result in a biased and inconsistent measurement and therefore yield problematic results. Tobit regression analysis is suitable for estimating a limited range of dependent variables.

In this study, the value predicted through tobit regression is subtracted from the actual value of the firm efficiency measured by DEA with reference to previous studies and is used as the value of managerial ability. Table 1 shows the measured value of industry-specific labor productivity and managerial ability. Among the industries, manufacturing has the most observations.

3.3.3 Control variables. Control variables are set following previous studies. Capital intensity ($(K/L)_{i,t}$) is the value of firm i in year t capital per employee, which is the natural log of the property, plants and equipment divided by the number of employees. Capital investment and facility improvement are controlled for because they have a positive effect on labor productivity. Debt ratio ($LEV_{i,t}$) is the value of the debt of firm i in year t divided by assets. Firm size ($SIZE_{i,t}$) is measured as the natural log of the total assets of firm i in year t, controlling for

Industry	$MA_{i,t}$ Means	N	$LP1_{i,t}$ Means	N	$LP2_{i,t}$ Means	N
Construction	−0.0293	832	11.3189	832	13.6442	832
Education	−0.1082	269	10.9737	269	12.4975	269
Wholesale and retail trade	−0.0093	1,922	11.3527	1,922	13.4104	1,922
Business facilities management and business support services; rental and leasing activities	−0.0871	203	10.4989	203	11.7693	203
Transportation and storage	−0.0245	402	11.2727	402	13.3454	402
Electricity, gas, steam and air conditioning supply	−0.0806	218	12.0514	218	14.0640	218
Professional, scientific and technical activities	−0.0334	1,393	11.7215	1,393	13.0986	1,393
Information and communication	−0.0415	2,467	11.0151	2,467	12.5698	2,467
Manufacturing	−0.0088	16,397	11.0639	16,397	13.0155	16,397
Total	−0.0170	24,103	11.1354	24,103	13.0266	24,103

Note(s): This thesis was analyzed in the middle category, but the title was written in the major category to help understanding
Source(s): Authors

Table 1. Managerial ability and Labor productivity by industry

the impact of firm size on labor productivity. Industrial competitiveness ($INCO_{i,t}$) is the value obtained from the Herfindahl–Hirschman index (HHI). To increase their market share in highly competitive industries, firms improve labor productivity. HHI (HHI_j) is the sum of the squared market shares of all the firms in industry j. Thus, higher-ranking firms have a greater weight than lower-ranking firms, and the higher the market share of the higher-ranking firm, the higher the HHI.

$$HHI_j = \sum_{i=1}^{n} S_i^2 \tag{10}$$

n = Number of firms in industry j

S_i = Market share of firm i in industry j

Average wage per employee ($AW_{i,t}$) is taken as the natural log of the wages divided by the number of employees of firm i in year t. The average wage per employee can be viewed as a proxy variable of employee skill level under the assumption that the higher the labor cost, the more capable employees are employed. As such, the effect of high employee skill level on labor productivity is controlled for. Education and training expenses per employee ($LEDU_{i,t}$) are measured as the natural log of the education and training expenses divided by the number of employees of firm i in year t. The employee's education and training expenses indicate the extent to which the employee participates in education and training and is an indicator that firms are investing more in employee education and training. Finally, R&D expenses per employee ($LRND_{i,t}$) is measured as the natural log of the R&D expenses divided by the number of employees of firm i in year t. If R&D expenses are increased by improving the work environment and process of employees, it has a positive effect on labor productivity. Thus, this study controls for the R&D expenses.

4. Estimation results

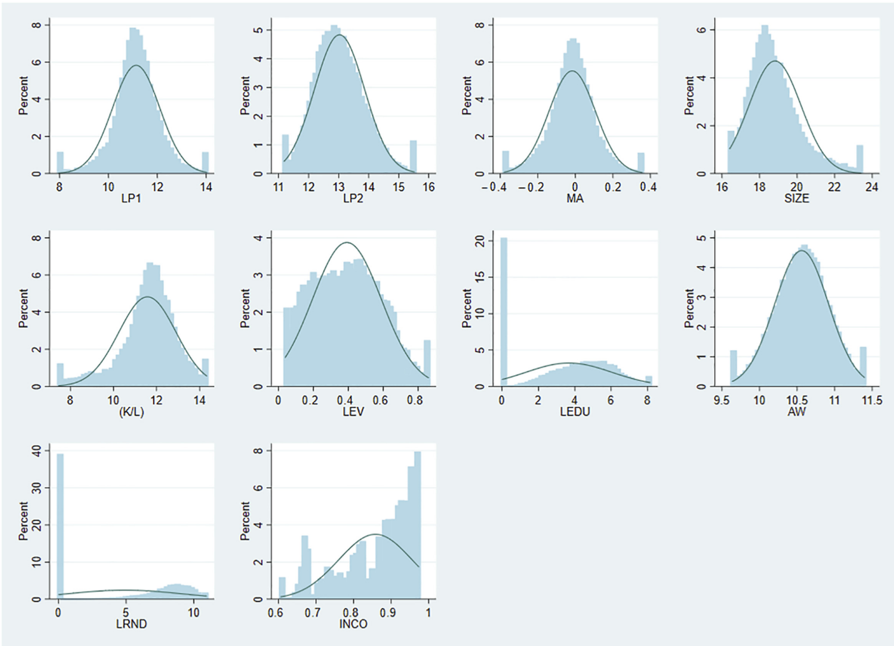
4.1 Summary statistics

The summary statistics of the main variables are shown in Table 2. The total number of final firm-year samples is 24,103. Labor productivity ($LP1_{i,t}$) is 11.13, labor productivity ($LP2_{i,t}$) is 13.03 on average and managerial ability ($MA_{i,t}$) is on average −0.02, which is close to zero. The distribution of each variable can be checked in the histogram of the variables in Figure 1.

Variable	Obs	Mean	Std	Min	Median	Max	Skew	Kurt
$LP1_{i,t}$	24,103	11.13	0.97	7.95	11.13	14.03	−0.19	4.64
$LP2_{i,t}$	24,103	13.03	0.83	11.18	13	15.53	0.42	3.22
$MA_{i,t}$	24,103	−0.02	0.12	−0.38	−0.01	0.36	−0.06	4.09
$SIZE_{i,t}$	24,103	18.82	1.38	16.40	18.58	23.42	0.98	4.13
$(K/L)_{i,t}$	24,103	11.58	1.33	7.45	11.73	14.34	−0.79	4.02
$LEV_{i,t}$	24,103	0.39	0.2	0.04	0.39	0.86	0.19	2.25
$LEDU_{i,t}$	24,103	3.67	2.35	0	4.10	8.16	−0.30	1.99
$AW_{i,t}$	24,103	10.56	0.36	9.63	10.57	11.40	−0.11	2.85
$LRND_{i,t}$	24,103	4.89	4.20	0	6.45	10.98	−0.14	1.26
$INCO_{i,t}$	24,103	0.86	0.10	0.60	0.89	0.97	−0.80	2.53

Note(s): This table reports the mean, standard deviation, minimum value, median, maximum value, skewness and kurtosis for each of the variables used in the empirical analysis for the sample of 24,103 observations for the study period 2002 to 2019
Source(s): Authors

Table 2.
Summary statistics of variables



Note(s): The average of education and training expenses per employee is 3.78, with a median of 4.21. The average of R&D expenses per employee is 4.84, with a median of 6.35, indicating a right-skewed distribution due to a larger median value than the average. Of the total number of firms, approximately 20% did not report education and training expenses, and 40% did not report R&D expenses
Source(s): Figure by authors

Figure 1.
Histogram of the variables

4.2 Correlation coefficients

In Table 3, labor productivity (*LP*1 and *LP*2) have a statistically significant positive correlation. Labor productivity (LP1) has a significant positive correlation with managerial ability (*MA*), as well as with the control variables, excluding debt ratio (*LEV*) and R&D expense per employee (*LRND*). Labor productivity (*LP*2) has a statistically significant

Table 3. Correlation coefficients of variables

	*LP*1	*LP*2	*MA*	*SIZE*	(*K*/*L*)	*LEV*	*LEDU*	*AW*	*LRND*	*INCO*
*LP*1	1									
*LP*2	0.57***	1								
MA	0.07***	0.16***	1							
SIZE	0.39***	0.48***	−0.08***	1						
(*K*/*L*)	0.24***	0.37***	−0.06***	0.42***	1					
LEV	−0.16***	0.15***	−0.01	0.18***	0.15***	1				
LEDU	0.15***	0.10***	−0.08***	0.12***	−0.00	0.02**	1			
AW	0.38***	0.47***	−0.03***	0.54***	0.22***	−0.06***	0.08***	1		
LRND	−0.07***	−0.08***	−0.07***	0.01	−0.01**	−0.03***	0.10***	0.11***	1	
INCO	0.10***	−0.02***	0.01	−0.00	0.01**	−0.06***	0.10***	0.02***	−0.01	1

Note(s): This table presents the Pearson's correlation coefficients for the variables used in the empirical analysis. ** and *** indicate 5 and 1% levels of significance, respectively

Source(s): Authors

positive correlation with managerial ability (*MA*), as well as with the control variables excluding R&D expenses per employee (*LRND*) and industrial competitiveness (*INCO*).

4.3 Analysis of managerial ability and labor productivity

4.3.1 Panel regression results. To estimate the model using the panel data, an appropriate estimation method is selected. The most appropriate model among the pooled OLS, fixed-effects and random-effects models was selected through an F-test and a Hausman-test. Based on the Hausman-test, the p-value is < 0.05; thus, the fixed-effects model is more suitable than the random-effects model. In addition, the F-test result reveals that the p-value is < 0.05, indicating that the fixed-effects model is more suitable for estimation than the pooled OLS. We compare both methods.

Table 4 shows the results of panel regression analysis using the pooled OLS and fixed-effects models to determine the effect of managerial ability on labor productivity. Both types of labor productivity ($LP1_{i,t}$ and $LP2_{i,t}$) have a significant positive effect at the 1% level.

However, the coefficient of managerial ability in pooled OLS confirms that the possibility of overestimation is high. This can occur when the model to be estimated by the dynamic panel model is estimated by the OLS model, and the estimation coefficient may be overestimated. In confirming the fixed-effects model, managerial ability has a significant positive effect on labor productivity at the 1% level. The control variable has a positive effect on education and training expenses per employee and average wage per employee. In labor productivity ($LP1_{i,t}$), it has a significant negative effect on R&D expenses per employee($LP2_{i,t}$); it has a positive effect on the firm size, capital intensity, debt ratio, average wage per employee and education and training expenses per employee.

	$LP1_{i,t}$		$LP2_{i,t}$	
	Pooled OLS	Fixed effect	Pooled OLS	Fixed effect
$MA_{i,t}$	0.8924***	0.6600***	1.2629***	0.6648***
	(10.76)	(9.25)	(18.37)	(16.06)
$SIZE_{i,t}$	0.1476***	0.2153	0.1015***	0.1165***
	(12.58)	(8.84)	(8.86)	(6.38)
$(K/L)_{i,t}$	0.0942***	0.0265	0.0940***	0.0675***
	(6.68)	(1.76)	(7.43)	(6.18)
$LEV_{i,t}$	−1.0329***	−0.9902***	0.2606***	0.1003**
	(−17.61)	(−13.85)	(4.69)	(2.20)
$LEDU_{i,t}$	0.0320***	0.0168**	0.0221***	0.0134***
	(6.55)	(3.54)	(5.05)	(4.53)
$AW_{i,t}$	0.8334***	0.7056***	0.8964***	0.6523***
	(18.48)	(14.68)	(22.51)	(20.09)
$LRND_{i,t}$	−0.0119***	−0.0233***	−0.0074***	0.0001
	(−4.31)	(−6.35)	(−2.72)	(0.39)
$INCO_{i,t}$	0.2353	0.3777	0.5051***	0.1222
	(0.94)	(1.47)	(2.69)	(0.80)
CONS	Yes	Yes	Yes	Yes
YD_t	Yes	Yes	Yes	Yes
ID_j	Yes	Yes	Yes	Yes
Obs	24,103	24,103	24,103	24,103
R^2	0.3219	0.0970	0.5253	0.3532

Note(s): This table presents the estimation results of the panel regression of the effect of managerial ability on labor productivity using the pooled OLS and the fixed-effect models. T-statistics are in parentheses. ** and *** indicate 5 and 1% levels of significance, respectively
Source(s): Authors

Table 4.
Panel regression results

4.3.2 Difference GMM model analysis results. Table 5 shows the results of the first-stage Arellano and Bond (1991)'s estimation method of labor productivity measured based on value-added ($LP1_{i,t}$) and labor productivity based on sales ($LP2_{i,t}$). First, based on the first-stage estimation of labor productivity ($LP1_{i,t}$), Prob > χ^2 = 0.00, thereby confirming that the model is appropriate. To check the influence of the variable, it is found that the value of labor productivity in the past year ($L.LP1_{i,t}$) has a significant positive effect at the 1% significance level. It is also confirmed that managerial ability ($MA_{i,t}$) significant positive effect at the 1% significance level; thus, managerial ability has a positive effect on labor productivity. Firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$), and average wage per employee ($AW_{i,t}$) are found to have a significant positive effect on labor productivity ($LP1_{i,t}$), but debt ratio ($LEV_{i,t}$) and R&D expenses per employee ($LRND_{i,t}$) are found to have a significant negative effect. For the first-stage estimation of labor productivity ($LP2_{i,t}$), Prob > χ^2 = 0.00, thereby confirming that the model is appropriate. As for the influence of the variable, it is found that the value of labor productivity in the past year ($L.LP2_{i,t}$) has a significant positive effect at the 1% significance level. Managerial ability ($MA_{i,t}$) has a significant positive effect at the 1% significance level. Capital intensity ($(K/L)_{i,t}$), firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$), R&D expenses per employee ($LRND_{i,t}$) and average wage per employee ($AW_{i,t}$) have a significant positive effect on labor productivity ($LP2_{i,t}$).

Table 6 shows the AR-test results, which confirm the existence of autocorrelation in the error term. The error term should have first-order autocorrelation and no second-order autocorrelation. If the null hypothesis cannot be rejected even in the second order, the error

	$LP1_{i,t}$				$LP2_{i,t}$			
	Coef	Robust std. err	z	p>|z|	Coef	Robust std. err	z	p>|z|
$L.LP_{i,t}$	0.1899	0.0198	9.61***	0.000	0.4890	0.0366	13.36***	0.000
$MA_{i,t}$	0.4065	0.0720	5.65***	0.000	0.3503	0.0471	7.43***	0.000
$SIZE_{i,t}$	0.5914	0.0672	8.80***	0.000	0.0705	0.0387	1.82*	0.068
$(K/L)_{i,t}$	0.0239	0.0260	0.92	0.358	0.0774	0.0216	3.58***	0.000
$LEV_{i,t}$	−1.9044	0.1300	−14.65***	0.000	0.0560	0.0648	0.86	0.387
$LEDU_{i,t}$	0.0140	0.0070	2.02**	0.044	0.0134	0.0046	2.89**	0.004
$AW_{i,t}$	0.6186	0.0649	9.53***	0.000	0.5660	0.0474	11.94***	0.000
$LRND_{i,t}$	−0.0097	0.0049	−1.98**	0.047	0.0170	0.0035	4.79***	0.000
$INCO_{i,t}$	0.6372	0.4014	1.59	0.112	−0.0510	0.1790	−0.29	0.775
Obs	16,801				16,801			
	Wald χ^2 (25) = 827.53				Wald χ^2 (25) = 2487.57			
	Prob > χ^2 = 0.0000				Prob > χ^2 = 0.0000			

Note(s): This table presents the estimation results for the first-stage difference GMM of labor productivity. *, ** and *** indicate 10, 5 and 1% levels of significance respectively
Source(s): Authors

Table 5. Difference GMM estimates (First-stage)

AR	$LP1_{i,t}$ z	$LP1_{i,t}$ Prob > z	$LP2_{i,t}$ z	$LP2_{i,t}$ Prob > z
1	−19.07	0.000	−11.05	0.000
2	−0.49	0.625	−0.34	0.734

Note(s): H0 means no autocorrelation
Source(s): Authors

Table 6. Arellano and Bond (1991) autocorrelation test (First-stage)

term has autocorrelation, and there is a reliability problem in the estimation results. In Table 7, both types of labor productivity ($LP1_{i,t}$ and $LP2_{i,t}$) reject the null hypothesis: there is no autocorrelation. Finally, the Sargan (1958) test is used to determine the existence of the problem of overidentification. However, the Sargan (1958) test could not be confirmed using a clustered robust standard error for heteroscedasticity problem.

Table 7 shows the results of the second-stage Arellano and Bond (1991)'s estimation method of labor productivity measured based on value-added ($LP1_{i,t}$) and based on sales ($LP2_{i,t}$). First, for the second-stage estimation of labor productivity ($LP1_{i,t}$), Prob > χ^2 = 0.00, thereby confirming that the model is appropriate. To check the influence of the variable, it is found that the value of labor productivity in the past year ($L.LP1_{i,t}$) has a significant positive effect at the 1% significance level. It is confirmed that managerial ability ($MA_{i,t}$) has a significant positive effect at the 1% significance level, meaning that managerial ability has a positive effect on labor productivity. Firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$), and average wage per employee ($AW_{i,t}$) have a significant positive effect on labor productivity ($LP1_{i,t}$). However, debt ratio ($LEV_{i,t}$) and R&D expenses per employee ($LRND_{i,t}$) have significant negative effect on labor productivity. Capital intensity ($(K/L)_{i,t}$), firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$), R&D expenses per employee ($LRND_{i,t}$) and average wage per employee ($AW_{i,t}$) have a significant positive effect on labor productivity ($LP2_{i,t}$).

Table 8 shows the AR-test results to confirm the existence of autocorrelation in the error term. It can be confirmed that there is no autocorrelation by rejecting the null hypothesis that both types of labor productivity ($LP1_{i,t}$ and $LP2_{i,t}$) have first-order autocorrelation, but no second-order autocorrelation.

Table 7. Difference GMM estimates (Second-stage)

	$LP1_{i,t}$				$LP2_{i,t}$			
	Coef	Robust Std. err	z	$p>\lvert z\rvert$	Coef	Robust Std. err	z	$p>\lvert z\rvert$
$L.LP_{i,t}$	0.1867	0.0170	11.01***	0.000	0.5092	0.0274	18.57***	0.000
$MA_{i,t}$	0.3209	0.0642	5.00***	0.000	0.3002	0.0363	8.28***	0.000
$SIZE_{i,t}$	0.5227	0.0602	8.68***	0.000	0.0631	0.0300	2.11**	0.035
$(K/L)_{i,t}$	0.0195	0.0233	0.84	0.402	0.0628	0.0162	3.88***	0.000
$LEV_{i,t}$	−1.8309	0.1204	−15.21***	0.000	0.0492	0.0533	0.92	0.356
$LEDU_{i,t}$	0.0142	0.0063	2.24**	0.025	0.0137	0.0036	3.81***	0.000
$AW_{i,t}$	0.5897	0.0601	9.81***	0.000	0.5558	0.0385	14.42***	0.000
$LRND_{i,t}$	−0.0119	0.0045	−2.68**	0.007	0.0186	0.0029	6.47***	0.000
$INCO_{i,t}$	0.2393	0.3589	0.67	0.505	0.0317	0.1502	0.21	0.833
Obs	16,801				16,801			
	Wald χ^2 (25) = 713.38				Wald χ^2 (25) = 2696.37			
	Prob > χ^2 = 0.0000				Prob > χ^2 = 0.0000			

Note(s): This table presents the estimation results for the second-stage difference GMM of labor productivity. *, ** and *** represent 10, 5 and 1% levels of significance, respectively
Source(s): Authors

Table 8. Arellano and Bond (1991) autocorrelation test (Second-stage)

	$LP1_{i,t}$		$LP2_{i,t}$	
AR	z	Prob > z	z	Prob > z
1	−18.82	0.000	−10.64	0.000
2	−0.53	0.595	−0.24	0.807

Note(s): H0 means no autocorrelation
Source(s): Authors

Table 9 shows the results of the Sargan (1958) and Hansen (1982) tests for the over-identification problem that occurs when the number of instrumental variables is greater than the endogeneity explanatory variables. Both tests cannot be used in the first-stage estimation, but they can be used in second-stage estimation. The results of the Sargan (1958) and Hansen (1982) tests confirm the existence of autocorrelation in the error term. The Sargan (1958) test rejects the null hypothesis that "the overidentification condition is appropriate" for both types of labor productivity ($LP1_{i,t}$ and $LP2_{i,t}$). The Hansen (1982) test reveals that the null hypothesis is rejected in labor productivity ($LP1_{i,t}$) but is not labor productivity ($LP2_{i,t}$). As such, there is a problem of overidentification in labor productivity ($LP1_{i,t}$).

4.3.3 System GMM model analysis results. Table 10 shows the results of the first-stage system GMM estimation of labor productivity based on added value ($LP1_{i,t}$) and based on sales ($LP2_{i,t}$). For the estimation of labor productivity ($LP1_{i,t}$), Prob > χ^2 = 0.00, confirming that the fit of the model is appropriate. To check the influence of the variable, it was found that the value of labor productivity in the past year ($L.LP1_{i,t}$) has a significant positive effect at the 1% significance level. Managerial ability ($MA_{i,t}$) has a significant positive effect at the 1% significance level, meaning that managerial ability has a positive effect on labor productivity. Firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$) and average wage per employee ($AW_{i,t}$) have a significant positive effect on labor productivity ($LP1_{i,t}$), but debt ratio ($LEV_{i,t}$) has a significant negative effect on labor productivity. For the first-stage estimation of labor productivity ($LP2_{i,t}$), Prob > χ^2 = 0.00, meaning that the fit of the model is

Test	$LP1_{i,t}$	$LP2_{i,t}$
Sargan test	χ^2 (135) = 273.48	χ^2(135) = 168.33
	Prob > χ^2 = 0.000	Prob > χ^2 = 0.027
Hansen test	χ^2 (135) = 178.62	χ^2(135) = 148.11
	Prob > χ^2 = 0.007	Prob > χ^2 = 0.208

Note(s): This table presents the results of the Sargan (1958) and Hansen (1982) tests for difference GMM. H0 means no overidentification
Source(s): Authors

Table 9. Overidentification test (Second-stage)

	$LP1_{i,t}$				$LP2_{i,t}$			
	Coef	Robust std. err	z	p>|z|	Coef	Robust std. err	z	p>|z|
$L.LP_{i,t}$	0.2420	0.0183	13.23***	0.000	0.5280	0.0326	16.18***	0.000
$MA_{i,t}$	0.4049	0.0738	5.49***	0.000	0.3601	0.0484	7.44***	0.000
$SIZE_{i,t}$	0.5187	0.0646	8.03***	0.000	0.0828	0.0386	2.15**	0.032
$(K/L)_{i,t}$	0.0260	0.0262	0.99	0.321	0.0772	0.0218	3.54***	0.000
$LEV_{i,t}$	−1.7900	0.1307	−13.70***	0.000	0.0573	0.0670	0.85	0.393
$LEDU_{i,t}$	0.0160	0.0071	2.25**	0.025	0.0133	0.0046	2.89***	0.004
$AW_{i,t}$	0.6194	0.0670	9.25***	0.000	0.5803	0.0480	12.09***	0.000
$LRND_{i,t}$	−0.0080	0.0050	−1.60	0.109	0.0154	0.0035	4.39***	0.000
$INCO_{i,t}$	0.6438	0.4264	1.51	0.131	0.0573	0.2050	−0.28	0.780
Obs		19,943				19,943		
		Wald χ^2 (25) = 1020.08				Wald χ^2 (25) = 2613.88		
		Prob > χ^2 = 0.0000				Prob > χ^2 = 0.0000		

Note(s): This table presents the estimation results for the first-stage system GMM of labor productivity. ** and *** indicate 5 and 1% levels of significance, respectively
Source(s): Authors

Table 10. System GMM estimates (First-stage)

appropriate. As for the influence of the variable, it was found that the value of labor productivity in the past year ($L.LP2_{i,t}$) has a significant positive effect at the 1% significance level. Managerial ability ($MA_{i,t}$) has a significant positive effect at the 1% significance level. Capital intensity ($(K/L)_{i,t}$), firm size ($SIZE_{i,t}$), education and training expenses per employee ($LEDU_{i,t}$), average wage per employee ($AW_{i,t}$) and R&D expenses per employee ($LRND_{i,t}$) have a significant positive effect on labor productivity ($LP2_{i,t}$).

Table 11 shows the results of AR test to confirm the existence of autocorrelation in the error term. It can be confirmed that there is no autocorrelation by rejecting the null hypothesis that both types of labor productivity ($LP1_{i,t}$ and $LP2_{i,t}$) have first-order autocorrelation, but no second-order autocorrelation. Finally, the Sargan (1958) test, which confirms the validity of overidentification, is not estimated using a clustered robust standard error.

In summary, the results of the first-stage difference GMM show that managerial ability ($MA_{i,t}$) has a positive effect on labor productivity ($LP_{i,t}$). The results of the second stage also show that managerial ability ($MA_{i,t}$) has a positive effect on labor productivity ($LP_{i,t}$). However, an overidentification problem arises in the case of labor productivity ($LP1_{i,t}$). System GMM also confirms that managerial ability has a positive effect on labor productivity; no second-order autocorrelation exists in the first stage; and moment conditions are established. Thus, Hypothesis 1 is confirmed: managerial ability has a positive effect on labor productivity measured based on value-added ($LP1_{i,t}$). Hypothesis 2 is also confirmed: managerial ability has a positive effect on labor productivity measured based on sales ($LP2_{i,t}$).

These results imply that managerial ability increases labor productivity, thereby increasing management performance, and at the same time, expanding the research of Demerjian *et al.* (2012). In addition, for managerial ability to positively influence labor productivity, managers must make appropriate judgments about profits and management, again expanding the findings of Demerjian *et al.* (2013).

5. Conclusion

Improving firm performance by improving labor productivity is a core object. However, improving labor productivity raises problems related to increased labor intensity and performance distribution, thereby leading to a potential conflict between labor and management. Most previous studies have suggested improving labor productivity through corporate welfare and participation programs, such as performance distribution and employee ownership programs. However, until a viable program that improves labor productivity is put in place, it is necessary to focus on the ability of managers to take responsibility for corporate decision-making. This study empirically analyzes the relationship between managerial ability and labor productivity. Its results indicate that managerial ability has a positive effect on labor productivity. In other words, the more capable the appointed managers are, the higher is the productivity of the employees and the firm.

Table 11. Arellano and Bond (1991) autocorrelation test (First-stage)

AR	$LP1_{i,t}$ z	Prob > z	$LP2_{i,t}$ z	Prob > z
1	−21.884	0.000	−13.005	0.000
2	0.70784	0.479	−0.1528	0.879

Note(s): H0 indicates no overidentification
Source(s): Authors

This study makes the following contributions: First, it is significant for its use of the production capacity per employee to measure labor productivity, controlling for variables that can affect labor productivity, resulting in more precise results. Second, it employs various analysis methods, such as difference GMM and system GMM, to eliminate endogenous problems by applying parallax variables, thereby enhancing the explanatory power of the analysis. Third, it measures value-added labor productivity, which considers performance distribution, to prove the effect of managerial ability on labor productivity.

This study has the following limitations: First, since South Korea does not provide data on working hours in individual firms, labor productivity cannot be measured based on them. In addition, it was difficult to reflect national level economic variables at each firms situations. Second, in the case of a small number of listed firms in South Korea, the degree of freedom is quite low, rendering DEA and tobit regression ineffective. Thus, the entire industry, including minority industries, is not accounted for. Future research can focus on the relationship between managerial ability and other measures of productivity, or supplement the method of measuring labor productivity, to obtain more meaningful results.

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