An Empirical Study on the Effects of Public Procurement on the Productivity and Survivability of SMEs: Case of the Korean Mining and Manufacturing Sectors

By WOO HYUN CHANG*

This paper empirically studies the effect of public procurement on small and medium-sized enterprises (SMEs) in the Republic of Korea using firm-level data. Public procurement, the purchase of goods and services from private firms by the public sector, is regarded as an important policy measure for providing support to firms, particularly SMEs. This study uses establishment-level panel data of the mining and manufacturing sectors from the Korean National Bureau of Statistics (Statistics Korea) and procurement history from the Korean Public Procurement Service to empirically estimate the effects of public procurement on firms' productivity (total factor productivity) and survivability. Using a propensity score matching estimation method, we find that participating firms showed higher productivity than non-participating ones in the control group only for the year of participation, that is, 2009. After two years, in 2011, they exhibited significantly lower productivity. In contrast, establishments that participated in public procurement for SMEs in 2009 were more likely to survive than those that did not do so in 2011. These results can be interpreted as the negative consequences of government intervention. The market's efficiency enhancement is hindered if underserving companies survive owing to government intervention but fail to improve efficiency.

* Fellow, Korea Development Institute (e-mail: chang.woohyun@gmail.com)

I. Introduction

The public sector purchases goods and services from private-sector firms in order to operate. The primary objective of public procurement, the purchase of goods and services from private firms by the public sector, is similar to any optimizing entity in an economy: to purchase quality goods and services that are required at as low a price as possible. However, because public procurement decisions are controlled by the government, which is also responsible for other public policies, public procurement is regarded as an important policy measure for other policy purposes, such as supporting firms, particularly small and medium-sized enterprises (SMEs).

However, there are few studies and little empirical evidence to demonstrate that public procurement indeed achieves its intended goals. Considering the significant size of the public procurement market and the number of contracts provided to SMEs, it is very important to evaluate the effectiveness of public procurement with regard to improving the performance capabilities of SMEs.

To this end, on the basis of available information, the present study analyzes the impact of the public procurement support program of the government of the Republic of Korea (hereafter "Korea") for SMEs on productivity, more specifically total factor productivity (TFP) and the survivability of individual establishments. This paper is organized as follows. Section II describes the data and provides a basic data analysis. Section III explains the computation of TFP as a performance measure. Section IV details the estimation process and provides the estimation result. Section V concludes the paper.

II. Data and Basic Data Analysis

A. *Data to Measure the Performance of Establishments:*
Mining and Manufacturing Survey (*2008–2011*)

This study uses Mining and Manufacturing Survey (MMS) data from Statistics Korea, the central government organization for statistics in Korea, to measure the performance of establishments. Chang (2014) used the same database to evaluate the effects of public financial support programs for SMEs. This study shares both the basic dataset from that study and the TFP computed using the Levinsohn–Petrin production function.

The MMS covers every establishment with ten or more employees in manufacturing and mining every year. Although it has the limitation of excluding establishments in non-manufacturing sectors such as services, it has the advantage of enabling the researcher to analyze the effectiveness of public procurement for SMEs in the mining and manufacturing sectors comprehensively. Table 1 (Chang, 2014) summarizes the descriptive statistics for the years 2008 and 2011 as well as the differences between the two years.

TABLE 1—MANUFACTURING AND MINING SECTORS, 2008–2011

2008						
GDP Deflator 2008:93.6 2011:101.6	# of Establishments	Sales	Profit	Man	Payment	P/M
Continuing	32,964	792,775,131	69,947,591	1,578,228	55,838,114	35.38
Exited	25,236	416,703,202	48,099,603	839,056	25,836,348	30.79
Entered	-	-	-	-	-	-
Sum	58,200	1,209,478,332	118,047,195	2,417,284	81,674,492	33.79

2011						
GDP Deflator 2008:93.6 2011:101.6	# of Establishments	Sales	Profit	Man	Payment	P/M
Continuing	32,964	1,144,721,039	108,540,224	1,761,578	70,228,397	39.87
Exited	-	-	-	-	-	-
Entered	25,419	296,745,516	23,083,206	766,676	19,799,333	25.82
Sum	58,383	1,441,466,555	131,623,430	2,528,254	90,027,730	35.61

2011-2008, Difference						
	$ of Establishments	Sales	Operating Profit	Employment	Payment	Payment/ Person
Continuing	0	351,945,908	38,592,663	183,350	14,390,253	4.49
Exited	-25,236	-416,703,202	-48,099,603	-839,056	-25,836,348	-30.79
Entered	25,419	296,745,516	23,083,206	766,676	19,799,333	25.82
Sum	183	231,988,223	13,576,235	110,970	8,353,238	1.82

Note: Values are in millions of KRW and are presented in 2011 prices; this includes establishments appearing both in the MMS and the Census of Establishments in 2008 and 2011. "Continued" indicates that firms existed both in 2008 and 2011. "Exited" means that firms existed in 2008 but had exited by 2011. "Entered" means that firms did not exist in 2008 and entered between 2008 and 2011. 1 USD (United States Dollar) is about 1,135 KRW in 2010.

Source: Mining and Manufacturing Survey (MMS; cited in Chang, 2014).

According to Table 1, the Korean mining and manufacturing sectors are rather dynamic in terms of exits, entries and reallocations of resources. Among 58,200 establishments reported in the MMS in 2008, only 32,964 (56.64%) continued to be operational in 2011. Altogether, 25,419 new establishments appeared, replacing 25,236 establishments that had halted their operations by the time of the 2011 survey.

One important and interesting observation is that a great part of the sales (KRW 352 trillion out of KRW 417 trillion), operating profits (KRW 39 trillion out of KRW 48 trillion), and payments for workers (KRW 14 trillion out of KRW 26 trillion) lost from the establishments that had ceased operations were adequately replaced by the overall increase in the respective variables of those that continued. However, the employment scenario was different; 840,000 jobs were lost when the establishments ceased operations, but only 183,000 jobs were created by those that continued, with 767,000 new jobs created by entering establishments. Hence, new firms played a more important role from the perspective of employment growth.

B. *Public Procurement Data of 2009*

Public procurement data are drawn from the Korean Public Procurement Service (PPS). Although the PPS does not handle all public purchases of goods and services in Korea, it is unquestionably the most important government body for public procurement and is responsible for major procurement contracts. The dataset compiled by the PPS is one of the best available for a comprehensive empirical analysis.

This study mainly uses 2009 procurement data from the contract data provided by the PPS for the period of 2007–2015. Table 2 summarizes the number of establishments, number of contracts, total amount of the contracts, and the total number of contracts with SME exclusive bidding, which excludes large enterprises from the bidding process according to government regulations. The SME-exclusive bidding regulation can be interpreted as one of the strongest factors in favor of SMEs.

For example, in 2007, the number of establishments that participated in the procurement market mediated by the PPS was 13,617 and the total number of contracts was 759,777 with a contract value of KRW 17.32 trillion. Contracts of KRW 2.51 trillion were awarded to SMEs with various SME-specific advantages during the bidding process. Note that the value of the SME-exclusive bidding contract increased significantly over time, reaching KRW 13.73 trillion in 2015.

TABLE 2—SUMMARY OF THE PUBLIC PROCUREMENT DATABASE FROM
THE PUBLIC PROCUREMENT SERVICE (PPS)

Year	# of Est.	# of Contracts	Amount	Amount, SME-Exclusive
2007	13,617	759,777	17,318	2,513
2008	13,350	888,018	18,269	3,915
2009	13,835	1,193,147	28,317	5,467
2010	14,112	1,026,330	24,171	5,636
2011	13,838	929,492	20,474	7,761
2012	14,161	994,680	23,109	9,610
2013	14,469	1,015,448	26,145	12,046
2014	14,722	1,008,748	27,604	12,295
2015	15,658	1,023,838	29,796	13,730

Note: Contract amounts are in billions of KRW.

Source: Data provided by the PPS.

C. *Merged Dataset*

According to the merged dataset, 3,096 establishments from the mining and manufacturing sectors were awarded KRW 13,244,109 million in public procurement contracts in 2009. A total of 3,012 SMEs secured KRW 5,649,387 million in public procurement contracts that year.[1] In addition, 84 large establishments from the mining and manufacturing sectors supplied the public

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[1] In this study, SMEs are defined as establishments that satisfy the following conditions: sales of less than 100 KRW billion and fewer than 300 employees.

TABLE 3—NUMBER OF SMEs, NUMBER OF SMEs AWARDED
PUBLIC PROCUREMENT CONTRACTS, AND NUMBER OF SMEs THAT
WON WITH SME- EXCLUSIVE BIDDING PREFERENCES

	Total # of est.	# of est. awarded	SME-exclusive bidding
2007	60,195	2,753 (4.57%)	576 (0.96%)
2008	56,656	2,740 (4.84%)	562 (0.99%)
2009	56,273	3,012 (5.35%)	977 (1.74%)
2011	60,938	3,061 (5.02%)	1,668 (2.74%)

sector with KRW 7,594,722 million worth of goods and services.

One important observation is that the number of establishments, including SMEs, is relatively small in the public procurement market. There were 56,273 SMEs with ten or more employees in 2009, but only 3,012 SMEs were awarded a contrast in the public procurement market. Among those, 977 SMEs won SME-exclusive bids.

III. Estimating TFP as a Performance Indicator

This section estimates an establishment-level production function using empirical data. The Levinsohn–Petrin (2003) approach to estimating production functions requires panel data with establishment-level capital, labor, and intermediate inputs. This paper uses panel data drawn from the MMS for the years 2007, 2008, 2009, and 2011.[2]

The MMS, conducted by Statistics Korea, is a complete, enumeration-based survey of establishments with at least ten employees in mining and manufacturing. It contains a sufficient number of the variables to estimate TFP values. In particular, the MMS includes variables related to the firms' production costs, such as their power and water costs, which are proxies for the intermediate inputs needed to estimate the Levinsohn–Petrin production function. This makes the MMS one of the most appropriate databases for this paper's methodology.

For the capital variable, we use tangible assets owned by the establishment; however, we exclude land, which does not depreciate over time following the definition used in economics. For the labor variable, we use the number of employees for each establishment, whereas their power and water costs are used as proxies for intermediate inputs.[3]

Although both value-added and revenue can be used as output measures when using the Levinsohn–Petrin production function method, we use the former given that it is a more general choice when the required information is available.

The raw data include nominal values and therefore require a price adjustment over each time period. Because different variables may need different price indices, we use the producer price index for the output variables including value-added,

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[2]In 2010, the MMS was replaced by the Economic Census, which uses different standards from those used by the MMS. This made it difficult to employ a consistent treatment of capital stock at the establishment level. Therefore, data pertaining to 2010 was excluded from this paper's analysis.

[3]Either the number of employees or the labor costs can be used as the labor variable. This paper uses the former; robustness checks show that the results remain largely unchanged when using labor costs.

whereas we use the consumer price index for all labor costs.[4] We use the final capital price index from the domestic supply price indices for all of the capital goods in the data. We use the power, gas, and water price indices from the producer price index to deflate the variables of the power and water costs.

To compare the results of production functions, we initially conduct a baseline model regression analysis and then a regression analysis under restrictive conditions assuming a homogeneous function of degree 1, in addition to the Levinsohn–Petrin estimation.

The baseline model regression analysis is based on the following specifications:[5]

$$\text{In } Y_{i,t} = \alpha \text{ In } N_{i,t} + \beta \text{ In } K_{i,t} + TFP_{i,t}$$

$Y_{i,t}$: Value-added produced by establishment i at time t

$N_{i,t}$: Number of employees for establishment i at time t

$K_{i,t}$: Value of tangible assets owned by establishment i at time t
    (excluding non-depreciating assets)

$TFP_{i,t}$: Total factor productivity of establishment i at time t

Unlike the Levinsohn-Petrin model, this baseline model assumes that the establishment's employment level is independent of productivity. This may lead to endogeneity, as productive firms are likely to employ more workers.

Another model for the A regression analysis under restrictive conditions assuming a homogeneous function of degree 1 adds the condition $\alpha + \beta = 1$ to the above specification. This specification follows the assumption that the original Cobb–Douglas production function is a homogeneous function of degree 1.

Table 4 summarizes the estimation results of the three production functions discussed above.

TABLE 4—ESTIMATION RESULTS OF PRODUCTION FUNCTIONS

	Levinsohn-Petrin	OLS	OLS with Constraints
Log Labor Coefficient (α)	0.76 (0.000)	0.94 (0.000)	0.77 (0.000)
Log Capital Coefficient (β)	0.19 (0.000)	0.22 (0.000)	0.23 (0.000)

Note: Calculated by the author using MMS data of 2007, 2008, 2009, and 2011; P values in parentheses that show lower values indicate that the results are more statistically significant. The sample size for the Levinsohn–Petrin production function is 134,788 observations with information available on power and water costs from the MMS for 2007, 2008, 2009, and 2011, whereas the sample size for the other regression models is 238,365.6.

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[4]Given that the estimation results use the number of employees, the consumer price index is used only for robustness checks.

[5]TFP of establishment i at time t; TFP is a residual term in the regression analysis where the dependent variable is the establishment's value-added and labor, whereas capital inputs are independent variables. It consists of an intercept and an individual residual.

[6]For the reference, if we only use 134,788 observations with power and water cost information for the OLS estimation, the log labor coefficient is 0.90 and the log capital coefficient is 0.24, with these values both statistically significant at P values of 0.000. For OLS with constraints, the log labor coefficient is 0.75 and the log capital coefficient is 0.25, also statistically significant with P values of 0.000

Table 4 shows that the baseline regression model overestimates the contribution of labor as a variable factor of production as compared to the Levinsohn–Petrin model. This is consistent with the expected result after considering the endogeneity problem that arises when firms with higher TFP levels use more variable inputs.

IV. Procurement Policy Evaluation

A number of econometric techniques have been developed for the policy evaluations. Among them, this study uses that known as propensity score matching estimation (PSME), which has been widely used in policy evaluations recently. Because the PSME is a non-parametric estimation technique, it can identify policy effects even when the variables have non-linear relationships. In addition, it produces credible results for policy evaluations because it only estimates the effects for the range where a control group that is similar to the treated group can be constructed. We also performed a multiple regression analysis as a robustness check.[7]

Two assumptions underpin the use of the PSME. The first is that the treatment and control groups are equally likely to be assigned once their observational characteristics are properly controlled. This is based on the premise that observational variables capture the traits of each establishment effectively. Second, the probability of receiving the treatment cannot be 0 or 1 in individual observations. In other words, the PSME cannot be used when a certain condition always leads to treatment or non-treatment. For example, government financial support for households above a certain income level cannot be analyzed with the PSME.

The MMS data used in this analysis satisfy the stipulations of the first assumption, as this data include diverse observable variables such as establishment-level capital, revenue, sales, profits, as well as the number of regular and total employees. In addition, these surveys enable the researcher to compute industry-level variables to control for the heterogeneity of industries. The data also meet the second assumption, as they can restrict the sample to those establishments that can receive support from the government.[8]

To illustrate the PSME, we set the outcome of interest, the firm's performance after policy intervention, as Y, which takes a value of 1 when the firm participates in the program and 0 otherwise. Firm performance Y_1^i indicates the performance of firm i when it participates in the government assistance program. Y_0^i indicates the performance of firm i when it does not do so. τ_i indicates the policy impact of this program, and it can be expressed as $\tau_i = Y_1^i - Y_0^i$.

The most fundamental challenge during a policy evaluation is the observation of

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[7]OLS produces estimates for the range even when there is insufficient data based on a linear model. In contrast, PSME excludes the range when matching scores are not significant.

[8]For the analysis here, we checked if any of these assumptions were violated by inspecting the propensity matching distribution and excluded observations with lower probabilities after calculating the propensity score.

either Y_1^i or Y_0^i for firm i. If a firm participates in a government assistance program, its performance under no assistance cannot be observed. Likewise, if it does not participate in the program, its performance when receiving assistance cannot be observed.

As noted above, the PSME introduces two key assumptions to address this problem. The first assumption is conditional independence, whereby the assignment of firms to the government program is determined by observables. This takes the following form:

Assumption 1: $(Y_1^i, Y_0^i) \perp T_i \big| X$

X denotes the observables of the firms and T_i is a variable that takes a value of 1 when firm i participates in the government assistance program and 0 otherwise. This assumption implies that the assignment of firms is as good as random after controlling for observables. In the context of SME promotion policy, this means that there is no systematic difference between participating and non-participating firms in the government program once the firm's observable financial indicators, such as their capital, revenue, sales, profit, number of employees, wage levels, and the industry characteristics, are properly controlled.

The second assumption is that within the data, some firms participate in the government program while others with similar characteristics do not. In other words, the probability of a firm participating should not be either 0 or 1 with reference to observables. This leads to the following equation:

Assumption 2: $0 < P(T_i = 1 \big| X_i = x) < 1$

If a firm has a probability of 1 to participate in a program given certain characteristics, firms with those characteristics always participate. Consequently, it is impossible to construct a non-participating firm with similar characteristics as a counterfactual for the treated group. If a firm has a probability of 0 to participate, it creates the same issue when attempting to produce a match.

The following condition is met under the first assumption, illustrating a highly practical advantage of the PSME.[9]

$$(Y_1^i, Y_0^i) \perp T_i \big| P(x), \text{ where } P(x) = P(T_i = 1 \big| X_i = x)$$

$P(x)$ is referred to as the propensity score, which is the probability that a firm with a characteristic x participates in a government assistance program. This condition is important because participating and non-participating firms can be compared on the basis of their propensity scores alone, thereby reflecting diverse variables. When more characteristics are controlled and these characteristics become more continuous, it becomes more difficult to find firms with identical characteristics. The propensity score technique helps mitigate this problem.

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[9]See Rosenbaum and Rubin (1983).

In this study, we adopted the following steps:

Step 1: We combined the establishment's inclusion in government support programs in 2009 and the corporate financial information for 2008 and 2011 using the business registration number of the establishment. This allows for a comparison of the effects of public procurement at the establishment level.

Step 2: We excluded data not relevant to this study's analysis; we omitted firms with annual revenue greater than KRW 100 billion and with more than 300 employees, as they are not eligible for government support to SMEs.[10]

Step 3: We chose the characteristics of the control group to be used for matching with the treated group. This analysis includes the TFP, revenue, sales, profit, economic capital, the number of employees, the number of regular employees, the annual average payment per employee, and the annual average payment per regular employee for each establishment in 2008.[11] We also included industry-wide averages for these variables on the basis of the two-digit standard industrial classification[12] in order to capture industry characteristics.[13]

Step 4: We analyzed the policy effects after matching individual establishments on the basis of the propensity score calculated from the characteristics chosen in the previous steps. A logit model was employed to estimate the propensity score. To match treated observations to untreated observations, we chose the nearest neighbor (NN) matching algorithm. We then estimated the average treatment effect on treated (ATET) with regard to policy intervention with the matched sample. The performance indicator for the evaluation was based on the establishment-level TFP, and it measures the growth in TFP between 2008 and 2011. Standard errors were calculated using the method suggested by Imbens (2004).

Step 5: We checked if the probability of receiving treatment was 0[14] in the support and also visually inspected the propensity score distribution by recipients and non-recipients to ensure that the second assumption for the PSME was met.[15]

Tables 5, 6, and 7 as well as Graph 1 summarize the estimation result of the effects of the public procurement policy in 2009 on the productivity and survivability of SMEs. While the SME participants in public procurement in 2009 enjoyed 10.67% higher productivity growth on average than those of the counterfactual situation for the same year, they show a lower TFP growth rate by 6.63% and a higher survival rate by 3.45% compared to those of the hypothetical non-participants in 2011. Thus, public procurement had a positive effect only in the

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[10]Large establishments have zero probability of receiving government procurement advantages for SMEs. Including them in the sample also violates one of the assumptions of the analysis.

[11]For economic capital, we use tangible assets excluding non-depreciating assets such as land.

[12]This is based on the ninth standard industry classification by Statistics Korea.

[13]This allows for utilizing firms in a similar industry as a control group.

[14]No probability was less than 1.00e-06.

[15]No propensity score distribution graph shows a violation of the PSME assumption.

TABLE 5—DIFFERENCE IN TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT

	TFP growth	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	-0.0663	0.02198	-3.02	0.003	-0.1094	-0.0232

Note: Each small and medium-sized enterprise awarded a procurement contract in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 6—DIFFERENCE IN THE SURVIVAL RATE BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT

	Survival Rate	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.03457	0.01377	2.51	0.012	0.0076	0.0616

Note: Each small and medium-sized enterprise awarded a procurement contract in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 7—DIFFERENCE IN THE TOTAL FACTOR PRODUCTIVITY (TFP)
GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN 2008 AND 2009 FOR 2009 PUBLIC PROCUREMENT

	TFP growth	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.1067	0.01615	6.61	0.000	0.075	0.1384

Note: Each small and medium-sized enterprise awarded a procurement contract in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

FIGURE 1. PROPENSITY SCORES FOR 2009 PUBLIC PROCUREMENT PARTICIPATION

Note: Each small and medium-sized enterprise awarded a procurement contract in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.
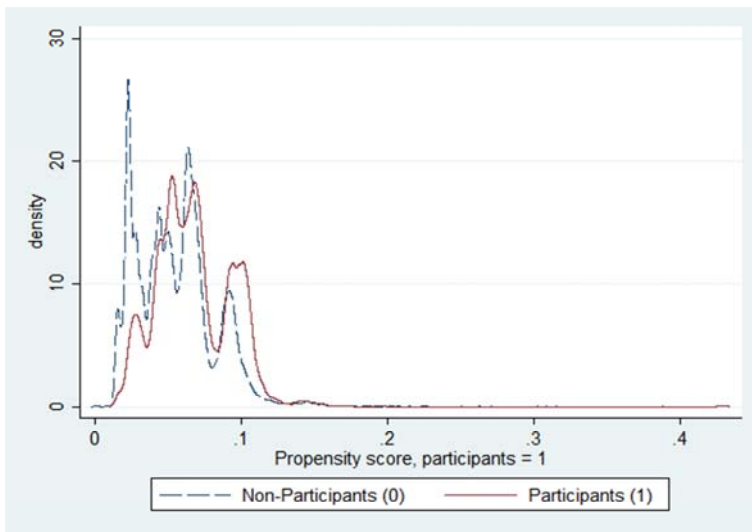
year they produced goods and services for the public sector; after two years, it had a negative effect on the productivity of establishments awarded contracts, where the survivability is increased by the procurement factor.

Next, we conducted estimations for two sub-cases, i.e., between SMEs with an explicit benefit and those without a benefit, as a comparison. In the first case, we included only in the treatment group SMEs that explicitly enjoyed benefits in bidding by competing only with other SMEs, in line with government regulations intended to prevent large establishments from bidding. The other case was the complement of the first case, where SMEs win the bid without such support from the government. Therefore, we can check whether government regulations were better or worse with regard to their achieving the goal of helping SMEs to grow beyond normal competition.

Tables 8, 9, and 10 indicate that the TFP growth of SMEs was indeed lower than the general estimate for SMEs when the SMEs had the explicit benefit of exclusive competition.

The SMEs awarded a public procurement contract with the benefit of governmental regulation in 2009 showed a 12.21% increase in TFP for the year of the contract, 2009, but the productivity feel to −10.05% in two years. In contrast, the survivability increased by 9.58%, indicating that the SMEs could survive without improving their productivity as required by the market.

TABLE 8—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT (SME-EXCLUSIVE COMPETITION)

	TFP growth	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	-0.1005	0.0402	-2.50	0.012	-0.1793	-0.0217

Note: Each SME awarded a procurement contract in 2009 with the benefit of SME-exclusive competition was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 9—DIFFERENCE IN THE SURVIVAL RATE BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT PARTICIPATION (SME-EXCLUSIVE COMPETITION)

	Survival Rate	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.0958	0.0234	4.09	0.000	0.0498	0.1417

Note: Each SME awarded a procurement contract in 2009 with the benefit of SME-exclusive competition was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 10—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2009 FOR 2009 PUBLIC PROCUREMENT (SME-EXCLUSIVE COMPETITION)

	TFP growth	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.1221	0.0302	4.04	0.000	0.063	0.1812

Note: Each SME awarded a procurement contract in 2009 with the benefit of SME-exclusive competition was matched with a control establishment according to a propensity score with the characteristics of 2008.
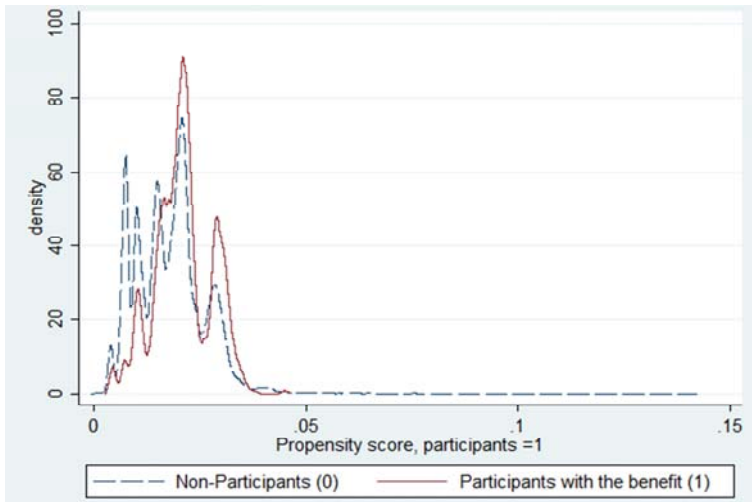
FIGURE 2. PROPENSITY SCORES FOR 2009 PUBLIC PPROCUREMENT PARTICIPATION
(WITH THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

Note: Each small and medium-sized enterprise (SME) awarded a procurement contract with the benefit of SME-exclusive competition in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 11—DIFFERENCE IN THE TFP GROWTH RATE BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT
(WITHOUT THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

	Survival Rate	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	-0.0068	0.00264	-0.26	0.796	-0.0585	0.0449

Note: Each SME awarded a procurement contract without the benefit of SME-exclusive competition in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

TABLE 12—DIFFERENCE IN THE SURVIVAL RATE BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT PARTICIPATION
(WITHOUT THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

	Survival Rate	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.0398	0.0164	2.43	0.015	0.0077	0.0719

Note: Each SME awarded a procurement contract without the benefit of SME-exclusive competition in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

At this stage, we examine the complementary group, that is, SMEs awarded a procurement contract without the benefit of exclusive competition. Tables 11, 12, and 13 summarize the estimation results.

The SMEs awarded a contract without the benefit of governmental regulation showed a 9.45% increase in their TFP for the year of the contract (2009), and though the productivity increase eroded in two years, the productivity change was

TABLE 13—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2009 FOR 2009 PUBLIC PROCUREMENT
(WITHOUT THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

	TFP growth	Standard Error	Z	p	95% Confidence Interval	
PSME ATET	0.0945	0.0195	4.84	0.000	0.0562	0.1329

Note: Each SME awarded procurement contract without the benefit of SME-exclusive competition in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.

FIGURE 3. PROPENSITY SCORES FOR 2009 PUBLIC PROCUREMENT PARTICIPATION
(WITHOUT THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

Note: Each SME awarded a procurement contract without the benefit of SME-exclusive competition in 2009 was matched with a control establishment according to a propensity score with the characteristics of 2008.
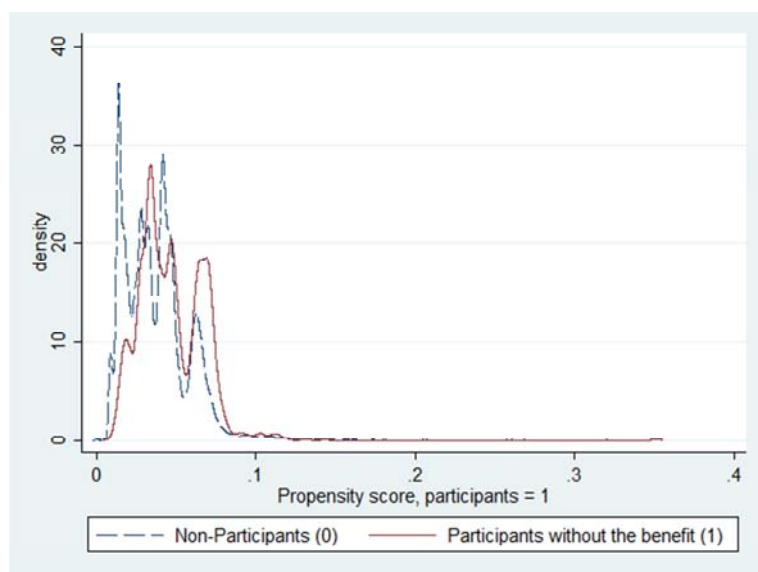
not as significantly negative as it was for the SMEs with this benefit. The survivability rose by 3.98%.

The estimation results presented in this section strongly support the moral hazard hypothesis. In other words, if SMEs enjoy an additional benefit from the public procurement market to survive without the fierce competition they would otherwise face in the market, they may lower their efforts to improve their productivity. This can be interpreted as a type of moral hazard.

Although the PSME model is a more legitimate model and is the main model used in this study, we also estimated multiple regression models for TFP as a robustness check. The results mostly concur with the PSME result, except for the fact that SMEs without exclusive contracts also showed significantly lower productivity than in the counterfactual result. However, this outcome (−4.81%) was lower than it was for SME-exclusive contracts (−11.57%) or

general cases (−7.31%).

We used the following specification for the multiple regression analysis:

$$\Delta Y_{i,2011-2008} = \alpha T_{i,2009} + X_{i,2008}\beta_1 + I_{i,2008}\beta_2 + \varepsilon_i$$

where

$\Delta Y_{i,2011-2008}$: Establishment i's log TFP difference (TFP growth rate) between 2008 and 2011

$T_{i,2009}$: Policy dummy variable; 1 if establishment i had a procurement contract in 2009 and 0 otherwise

$X_{i,2008}$: Characteristics of establishment i in 2008

$I_{i,2008}$: Industry control variables, characteristics of the two-digit level industry in which establishment i is in as of 2008

ε_i : $i.i.d.$ error for each establishment i.

Table 14~19 summarizes the same three cases (all procurement contracts, SME-exclusive bidding, and non-SME-exclusive bidding) analyzed with the PSME for the effects of a procurement contract in 2009 on 2009 and 2011.

The estimation results from Table 14 and Table 15 are consistent with the results from the PSME. The productivity increased (10.43%p) for the very year (2009) they won the procurement bid, but the growth of the productivity for the recipients firms was even lower (-7.31%p) than that of other similar SMEs which did not win the bid after two years (2011).

The estimation results from Table 16 and Table 17 are also consistent with the PSME results. The productivity went up (11.77%p) for the very year (2009) the firms won the procurement bid with the advantage of exclusive bidding, but the growth in productivity for these recipient firms was even lower (-11.57%p) than that by other similar SMEs which did not win the bid after two years (2011).

TABLE 14—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009, ALL PROCUREMENT CONTRACTS

2011~2008 TFP growth	All Contracts					
	Coef.	S.E.	t	p	95% C.I.	
Procurement (2009)	-0.0731	0.0136	-5.39	0.000	-0.0997	-0.0465
TFP (2008)	-0.0052	0.0001	-56.05	0.000	-0.0054	-0.0051
Number of Workers (2008)	0.0001	0.0001	0.77	0.439	-0.0002	0.0004
Payment/Worker (2008)	-0.0041	0.0004	-10.28	0.000	-0.0049	-0.0033
Capital (2008)	0.0000	0.0000	4.69	0.000	0.0000	0.0000
Sales (2008)	0.0000	0.0000	10.74	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-10.21	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	-0.0000	0.0000	-0.81	0.421	0.0000	0.0000
O.P., Industry avg. (2008)	0.0001	0.0000	6.93	0.000	0.0000	0.0001
# of Workers, Ind. avg. (2008)	-0.0000	0.0005	-0.02	0.985	-0.0011	0.0011
Payment/worker, Ind. avg. (2008)	0.0112	0.0013	8.50	0.000	0.0086	0.0138
Capital, Industry avg. (2008)	0.0000	0.0000	1.70	0.090	0.0000	0.0000
Constant	0.0967	0.0288	3.36	0.001	0.0402	0.1532
Adj R-squared	0.1703					
D. of F.	27,987					

TABLE 15—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2009 FOR 2009 PUBLIC PROCUREMENT, ALL PROCUREMENT CONTRACTS

2009~2008	All Contracts					
TFP growth	Coef.	S.E.	t	p	95% C.I.	
Procurement (2009)	0.1043	0.0109	9.54	0.000	0.0829	0.1258
TFP (2008)	-0.0036	0.0001	-52.64	0.000	-0.0037	-0.0035
Number of Workers (2008)	0.0004	0.0001	3.79	0.000	0.0002	0.0006
Payment/Worker (2008)	-0.0049	0.0003	-16.27	0.000	-0.0055	-0.0043
Capital (2008)	0.0000	0.0000	3.21	0.001	0.0000	0.0000
Sales (2008)	0.0000	0.0000	13.12	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-12.43	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	-0.0000	0.0000	-0.04	0.970	0.0000	0.0000
O.P., Industry avg. (2008)	0.0000	0.0000	6.39	0.000	0.0000	0.0001
# of Workers, Ind .avg. (2008)	-0.0007	0.0004	-1.78	0.075	-0.0016	0.0001
Payment/worker, Ind .avg. (2008)	0.0045	0.0010	4.47	0.000	0.0025	0.0064
Capital, Industry avg. (2008)	0.0000	0.0000	6.96	0.000	0.0000	0.0000
Constant	0.1719	0.0216	7.97	0.000	0.1296	0.2142
Adj R-squared	0.1107					
D. of F.	44,642					

TABLE 16—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT, SME-EXCLUSIVE BIDDING

2011~2008	SME-exclusive bidding					
TFP growth	Coef.	S.E.	T	p	95% C.I.	
Procurement (2009)	-0.1157	0.0231	-5.00	0.000	-0.1611	-0.0704
TFP (2008)	-0.0053	0.0001	-56.15	0.000	-0.0054	-0.0051
Number of Workers (2008)	0.0001	0.0001	0.64	0.523	-0.0002	0.0004
Payment/Worker (2008)	-0.0041	0.0004	-10.22	0.000	-0.0049	-0.0033
Capital (2008)	0.0000	0.0000	4.75	0.000	0.0000	0.0000
Sales (2008)	0.0000	0.0000	10.77	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-10.14	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	-0.0000	0.0000	-0.67	0.505	-0.0000	0.0000
O.P., Industry avg. (2008)	0.0001	0.0000	6.76	0.000	0.0000	0.0001
# of Workers, Ind. avg. (2008)	0.0001	0.0005	0.14	0.885	-0.0010	0.0011
Payment/worker, Ind avg. (2008)	0.0109	0.0013	8.29	0.000	0.0083	0.0135
Capital, Industry avg. (2008)	0.0000	0.0000	1.54	0.124	-0.0000	0.0000
Constant	0.0983	0.0288	3.41	0.001	0.0418	0.1548
Adj R-squared	0.1702					
D. of F.	27,987					

TABLE 17—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT, SME-EXCLUSIVE BIDDING

2009~2008	SME-exclusive bidding					
TFP growth	Coef.	S.E.	t	p	95% C.I.	
Procurement (2009)	0.1177	0.0188	6.27	0.000	0.0809	0.1545
TFP (2008)	-0.0036	0.0001	-52.48	0.000	-0.0037	-0.0035
Number of Workers (2008)	0.0004	0.0001	3.97	0.000	0.0002	0.0007
Payment/Worker (2008)	-0.0049	0.0003	-16.35	0.000	-0.0055	-0.0043
Capital (2008)	0.0000	0.0000	3.10	0.002	0.0000	0.0000
Sales (2008)	0.0000	0.0000	13.07	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-12.51	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	0.0000	0.0000	-0.28	0.777	-0.0000	0.0000
O.P., Industry avg. (2008)	0.0001	0.0000	6.59	0.000	0.0000	0.0001
# of Workers, Ind. avg. (2008)	-0.0009	0.0004	-2.11	0.035	-0.0017	-0.0001
Payment/worker, Ind. avg. (2008)	0.0049	0.0010	4.96	0.000	0.0030	0.0069
Capital, Industry avg. (2008)	0.0000	0.0000	7.35	0.000	0.0000	0.0000
Constant	0.1697	0.0216	7.86	0.000	0.1274	0.2120
Adj R-squared	0.1097					
D. of F.	44,642					

TABLE 18—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2011 FOR 2009 PUBLIC PROCUREMENT, NON-SME-EXCLUSIVE BIDDING

2011~2008	Non-SME-exclusive bidding					
TFP growth	Coef.	S.E.	t	p	95% C.I.	
Procurement (2009)	-0.0481	0.016309	-2.95	0.003	-0.0801	-0.0161
TFP (2008)	-0.0052	0.0000	-56.11	0.000	-0.0054	-0.0051
Number of Workers (2008)	0.0001	0.0001	0.75	0.456	-0.0002	0.0003
Payment/Worker (2008)	-0.004	0.0004	-10.20	0.000	-0.0055	-0.0033
Capital (2008)	0.0000	0.0000	4.77	0.000	0.0000	0.0000
Sales (2008)	0.0000	0.0000	10.72	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-10.18	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	-0.0000	0.0000	-0.71	0.478	-0.0000	0.0000
O.P., Industry avg. (2008)	0.0000	0.0000	6.85	0.000	0.0000	0.0000
# of Workers, Ind. avg. (2008)	0.0000	0.0005	0.17	0.865	-0.0010	0.0011
Payment/worker, Ind. avg. (2008)	0.0109	0.0013	8.30	0.000	0.0083	0.0135
Capital, Industry avg. (2008)	0.0000	0.0000	1.49	0.136	-0.0000	0.0000
Constant	0.0965	0.0288	3.35	0.001	0.0400	0.1530
Adj R-squared			0.1697			
D. of F.			27,987			

TABLE 19—DIFFERENCE IN THE TFP GROWTH RATE (LOG TFP DIFFERENCE) BETWEEN
2008 AND 2009 FOR 2009 PUBLIC PROCUREMENT, NON-SME-EXCLUSIVE BIDDING

2009~2008	Non-SME-exclusive bidding					
TFP growth	Coef.	S.E.	t	p	95% C.I.	
Procurement (2009)	0.0928	0.0131	7.06	0.000	0.0670	0.1186
TFP (2008)	-0.0036	0.0000	-52.56	0.000	-0.0044	-0.0035
Number of Workers (2008)	0.0004	0.0001	3.78	0.000	0.000204	0.000642
Payment/Worker (2008)	-0.0049	0.0003	-16.33	0.000	-0.00548	-0.0043
Capital (2008)	0.0000	0.0000	3.11	0.002	0.0000	0.0000
Sales (2008)	0.0000	0.0000	13.15	0.000	0.0000	0.0000
Operating Profit (2008)	-0.0000	0.0000	-12.44	0.000	-0.0000	-0.0000
Sales, Industry avg. (2008)	-0.0000	0.0000	-0.15	0.879	-0.0000	0.0000
O.P., Industry avg. (2008)	0.0000	0.0000	6.42	0.000	0.0000	0.0000
# of Workers, Ind. avg. (2008)	-0.0008	0.0004	-1.99	0.047	-0.0017	-0.0000
Payment/worker, Ind. avg. (2008)	0.0047	0.0010	4.70	0.000	0.0027	0.0066
Capital, Industry avg. (2008)	0.0000	0.0000	7.25	0.000	0.0000	0.0000
Constant	0.1723	0.0222	7.98	0.000	0.1300	0.2146
Adj R-squared			0.1099			
D. of F.			44,642			

Finally, Table 18 and Table 19 shows that the productivity of the SMEs increased (9.28%p) for the very year (2009) they won the procurement bid without the advantage of exclusive bidding, whereas the growth in the productivity for the recipients firms was lower (-4.81%p) than that of other similar SMEs which did not win the bid after two years (2011). Unlike the PSME result, the effect is negative and significant here, but the value (-4.81p%) is less than that for firms with the exclusive bidding advantage (-11.57%p).

These results imply that the policy of providing SMEs with benefits to join the procurement market is not working as intended. A productive support policy for SMEs should be able to correct market failures so that SMEs can grow in a self-reliant manner; however, our evaluation shows that recipient companies display much lower productivity than those who are not helped, when compared two years after participation. As participation in procurement has a positive productivity effect during the first year as compared with the productivity of the firm in the control group, we can exclude the possibility that the procurement contract is

indeed less favorable to the firm. Further, as the productivity performance in two years is worse than that of the non-recipients in the control group, we can assume that the procurement contract causes moral hazard of the recipient firm.

In contrast, establishments that participated in public procurement for SMEs in 2009 were more likely to survive than those that did not do so in 2011. These results can be interpreted as the negative consequences of government intervention; the market's efficiency enhancement will be hindered if underserving companies survive owing to government intervention but fail to improve efficiency.

V. Conclusion

Although it is widely believed that public procurement can be a useful tool to help SMEs attain growth, we found that it can in fact harm the productivity and growth of the recipient SMEs owing to the possible moral hazard of the recipient firms.

For a SME support policy, in general, the possibility of moral hazard is surprisingly neglected: the policy can also have unintended side effects on the firm by increasing dependency on the policy and retarding efforts to improve productivity. It is clearly an empirical question to check whether the policy is working as intended to boost SMEs or whether it has a negative effect on the performance of beneficiary firms. However, few empirical studies have rigorously analyzed this issue thus far.

This paper uses of a comprehensive dataset from the PPS combined with the MMS from Statistics Korea, computes economic productivity as a performance indicator using the Levinsohn–Petrin production function estimation method, and adopts the PSME as a policy evaluation tool. These methods and databases are applied to find that public procurement for establishments with ten or more employees in the Korean mining and manufacturing sector in 2009 actually lowered the productivity of the participating establishments while the survivability of the beneficiary establishments increased in 2011. This finding supports the hypothesis that public procurement for SMEs is not functioning as intended and has impeded the market; the recipients evaded the choice between improving productivity to survive in the market and quitting to release the resources for a reorganization, instead choosing the new option of depending on the procurement market and surviving without improving their productivity to the level demanded by the market.

The study's findings suggest that the procurement policy for SMEs should be revisited and overhauled and that the government should pay more attention to the screening process of the recipients and should monitor their performance. The government tends to consider that the cost of providing firms with access to the procurement market is rather low, but the cost of distortion, as found in this study, should also be considered.

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