

KDI *Journal of Economic Policy*

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

.....Woo Hyun Chang

The Relationship Between Monetary and Macprudential Policies

.....Jong Ku Kang

The Public-Private Partnerships and the Fiscal Soundness of
Local Governments in Korea

.....Hojun Lee

Copyright Royalty Regulation and Competition in the Music Retail Market

.....Yong Hyeon Yang

KDI Journal of Economic Policy

Statement of Purpose

The KDI Journal of Economic Policy (KDI JEP) is a professional journal published on a quarterly basis. The Journal publishes papers on the academic and policy issues related to the development of Korea's economy. The KDI Journal of Economic Policy welcomes innovative and insightful academic papers on all areas of economics with an emphasis on empirical analysis that contain solid policy implications. KDI JEP is published in English starting in 2015, volume 37 number 1.

The Journal aims to disseminate research outcomes and policy recommendations not only to experts at academia and research institutes but also to policy-makers and the general public. First published in March 1979, the original objective was to circulate ongoing- and past researches conducted in KDI, a leading economic think-tank of South Korea. Starting in August, 2001, the Journal has accepted manuscripts from outside in order to provide the readers more diverse perspectives on Korea's policy initiatives. The Journal now actively seeks and welcomes submissions by researchers at home and from abroad who have genuine interests in the Korean economy.

The contents of papers published in KDI JEP contain personal views of the authors, and thus do not represent the objectives of the Journal or the mission statements of KDI.

Editorial Board

Editor-in-Chief:	Baek, Ehung Gi	(Professor at Sangmyung University)
Managing Editor:	Lee, Jinkook	(Fellow at KDI)
	Lee, Taejun	(Professor at KDI School)
Editors:	Choi, Yongseok	(Professor at KyungHee University)
	Chun, Youngjun	(Professor at HanYang University)
	Chun, Hyunbae	(Professor at Sogang University)
	Chung, Wankyo	(Professor at Seoul National University)
	Eun, Cheolsoo	(Professor at Georgia Institute of Technology)
	Hahn, Chinhee	(Professor at Gachon University)
	Joh, Sungwook	(Professor at Seoul National University)
	Kim, Daeil	(Professor at Seoul National University)
	Kim, Jungwook	(Fellow at KDI)
	Kim, Taejong	(Professor at KDI School)
	Kim, Woonchan	(Professor at Korea University)
	Kim, Jongil	(Professor at Dongguk University)
	Lee, Chulhee	(Professor at Seoul National University)
	Lee, Sanghyop	(Professor at University of Hawaii at Manoa)
	Park, Changgyun	(Professor at Chung-Ang University)
	Park, Won-Am	(Professor at Hongik University)
	Shin, Kwanho	(Professor at Korea University)
	Shin, Sukha	(Professor at Sookmyung Women's University)
	Song, Youngnam	(Professor at Chonbuk National University)
Administration:	Oh, Junseok	(Research Associate at KDI)

KDI Journal of Economic Policy

February 2017

VOL. 39, NO. 1

Articles

- An Empirical Study on the Effects of Public Procurement on
the Productivity and Survivability of SMEs:
Case of the Korean Mining and Manufacturing Sectors
Woo Hyun Chang 1
- The Relationship Between Monetary and Macroprudential Policies
Jong Ku Kang..... 19
- The Public-Private Partnerships and the Fiscal Soundness of
Local Governments in Korea
Hojun Lee 41
- Copyright Royalty Regulation and Competition in the Music Retail Market
Yong Hyeon Yang 83

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.

Key Word: Public Procurement, Policy Evaluation, SME Policy,
Total Factor Productivity, Propensity Score Matching
JEL Code: D24, H57, L50, L60

* Fellow, Korea Development Institute (e-mail: chang.woohyun@gmail.com)
* Received: 2016. 3. 28
* Referee Process Started: 2016. 3. 29
* Referee Reports Completed: 2016. 9. 26

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

¹In 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,

²In 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.

³Either 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

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

$Y_{i,t}$: 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.

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

⁵TFP 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.

⁶For 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

⁷OLS 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.

⁸For 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: $(Y_1^i, Y_0^i) \perp T_i | X$

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: $0 < P(T_i = 1 | X_i = x) < 1$

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

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

$P(x)$ 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.

⁹See 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 classification¹² 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 0¹⁴ 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

¹⁰Large 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.

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

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

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

¹⁴No probability was less than 1.00e-06.

¹⁵No 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	-0.0663	0.02198	-3.02	0.003	-0.1094	-0.0232
ATET						

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	0.03457	0.01377	2.51	0.012	0.0076	0.0616
ATET						

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	0.1067	0.01615	6.61	0.000	0.075	0.1384
ATET						

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.

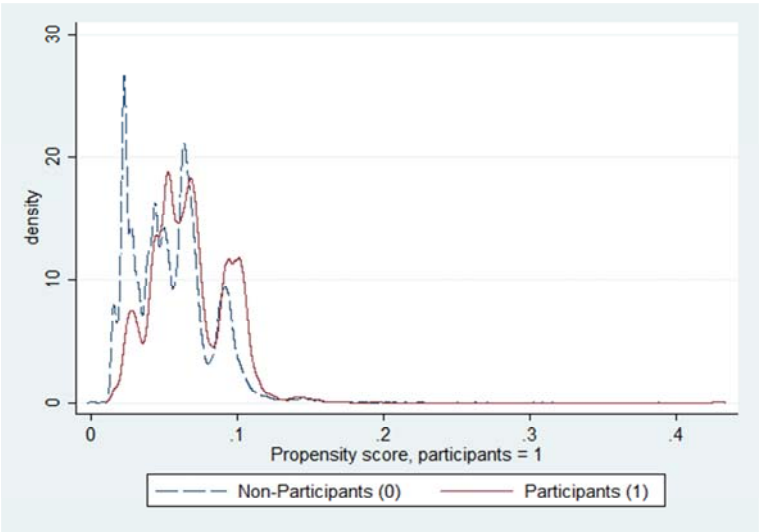


FIGURE 1. PROPENSITY SCORES FOR 2009 PUBLIC PROCUREMENT PARTICIPATION

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 fell 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	-0.1005	0.0402	-2.50	0.012	-0.1793	-0.0217
ATET						

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	0.0958	0.0234	4.09	0.000	0.0498	0.1417
ATET						

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	0.1221	0.0302	4.04	0.000	0.063	0.1812
ATET						

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.

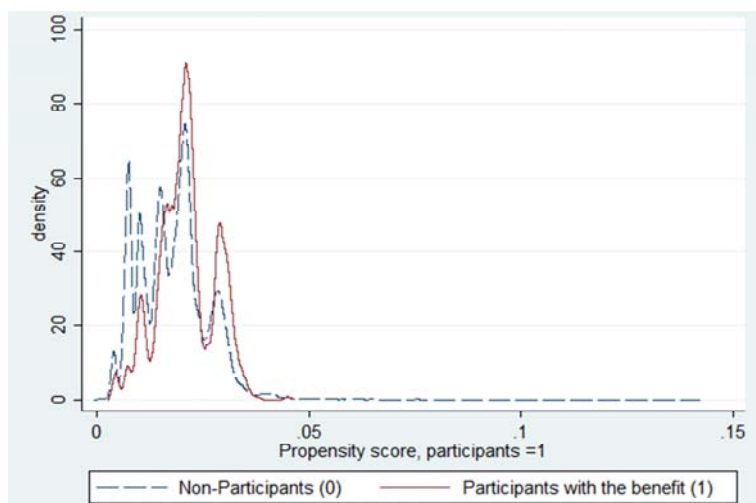


FIGURE 2. PROPENSITY SCORES FOR 2009 PUBLIC PROCUREMENT PARTICIPATION
(WITH THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

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	-0.0068	0.00264	-0.26	0.796	-0.0585	0.0449
ATET						

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	0.0398	0.0164	2.43	0.015	0.0077	0.0719
ATET						

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	0.0945	0.0195	4.84	0.000	0.0562	0.1329
ATET						

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.

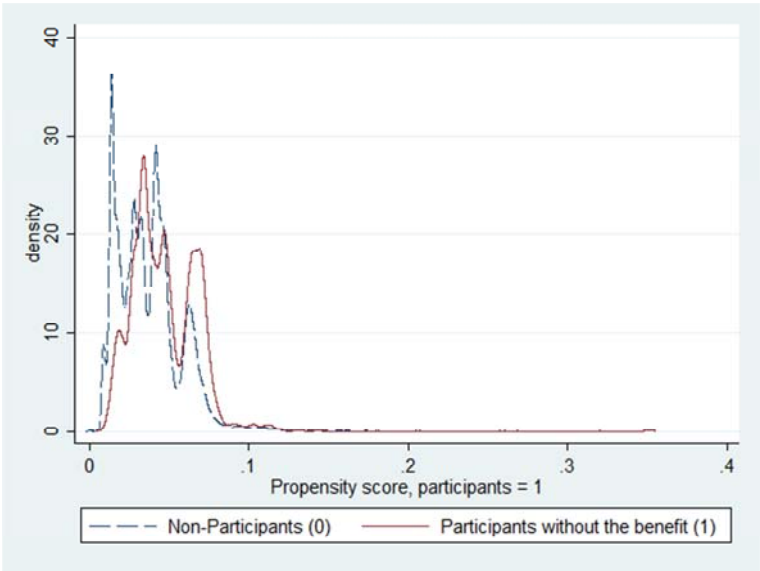


FIGURE 3. PROPENSITY SCORES FOR 2009 PUBLIC PROCUREMENT PARTICIPATION (WITHOUT THE BENEFIT OF SME-EXCLUSIVE COMPETITION)

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	Coef.	S.E.	All Contracts		95% C.I.	
			t	p		
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 TFP growth	All Contracts					
	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 TFP growth	SME-exclusive bidding					
	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 TFP growth	SME-exclusive bidding					
	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.

REFERENCES

- Ahearne, A. and N. Shinada. 2005. "Zombie Firms and Economic Stagnation in Japan." *International Economics and Economic Policy* 2: 363–381.
- Berger, A. and G. Udell. 1998. "The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle." *Journal of Banking and Finance* 22.
- Caballero, R., T. Hoshi, and A. Kashyap. 2008. "Zombie Lending and Depressed Restructuring in Japan." *American Economic Review* 98: 1943–1977.
- Chang, Woo Hyun. 2014. "Improving the Efficiency of SME Policy." NEAC-KDI-KOSBI Joint Seminar. Presentation Material (*in Korean*).
- Chang, Woo Hyun, Joo-Hoon Kim, Yong Hyeon Yang, and Seokjin Woo. 2013. "Measures to Strengthen SME Support Eligibility Screening and Facilitate SME Ecosystem." Ministry of Strategy and Finance. Commissioned Paper. Korea Development Institute (*in Korean*).
- Chang, Woo Hyun, Yong Hyeon Yang, and Seokjin Woo. 2013. *Study on the Enhancement of the Small and Medium-sized Enterprises (SMEs) Policy in Korea (I)*. Research Monograph 2013-08. Korea Development Institute (*in Korean*).
- Chang, Woo Hyun, Yong Hyeon Yang, and Seokjin Woo. 2014. *Study on the Enhancement of the Small and Medium-sized Enterprises (SMEs) Policy in Korea (II)*. Research Monograph 2014-10. Korea Development Institute (*in Korean*).
- Imbens, G. 2004. "Nonparametric Estimation of Average Treatment Effects under Exogeneity: A Review." *The Review of Economics and Statistics* 86 (1): 4–29.
- Kim, Hyeon-Wook. 2004. "The Effects of Policy Lending Programs for Korean SME, Korea Development Institute." Policy Study 2004-05. Korea Development Institute (*in Korean*).
- Levinsohn, J. and A. Petrin. 2003. "Estimating Product Functions Using Inputs to Control for Unobservables." *Review of Economic Studies* 70: 317–341.
- Rosenbaum, P. and D. Rubin. 1983. "The Central Role of the Propensity Score in Observational Studies for Causal Effects." *Biometrika* 70: 41–50.

LITERATURE IN KOREAN

- 김현욱. 2004. 「중소기업 정책금융 지원효과에 관한 연구: 재정자금을 이용한 중소기업 정책금융을 중심으로」. 정책연구시리즈 2004-05. 한국개발연구원.
- 장우현. 2014. 「중소기업 정책 효율성 제고방안」. 국민경제자문회의·한국개발연구원·중소기업연구원 공동 세미나 발표자료.
- 장우현·김주훈·양용현·우석진. 2013. 『중소기업지원대상 선별기능 강화와 중소기업생태계 활성화 방안』. 기획재정부 용역보고서. 한국개발연구원.
- 장우현·양용현·우석진. 2013. 『중소기업지원정책의 개선방안에 관한 연구(Ⅰ)』. 연구보고서 2013-08. 한국개발연구원.
- 장우현·양용현·우석진. 2014. 『중소기업지원정책의 개선방안에 관한 연구(Ⅱ)』. 연구보고서 2014-10. 한국개발연구원.

The Relationship Between Monetary and Macroprudential Policies[†]

By JONG KU KANG*

This paper analyzes the interaction between monetary and macroprudential policies mainly in the context of the non-cooperation among policy authorities. Each policy authority's optimal response is to tighten its policy measures when other authorities' policy measures are loosened. This indicates that the two policies are substitutes for each other. This result still holds when an additional financial stability mandate is assigned to the central bank. The condition for the response functions to converge to a Nash equilibrium state is analyzed along with the speed of convergence, showing that they depend on the authorities' preferences and the number of mandates assigned to policy authorities. If the financial supervisory authority (FSA) assigns greater importance to the output gap or a stronger financial stability mandate is assigned to the central bank (CB), the probability of non-convergence increases and the speed of convergence declines even when the condition of convergence is satisfied. Meanwhile, if the CB considers output stability as an important task, the probability of convergence and the speed of converging to a state of equilibrium are high. Finally, when a single mandate or small number of mandates is/are assigned to each authority, stability is more quickly restored as compared to when many mandates are assigned.

Key Word: Monetary Policy, Central Banking, Financial Regulation
JEL Code: E52, E58, G28

I. Introduction

Since the global financial crisis, many central banks around the world have introduced financial stability as one of their key mandates. This is mainly driven by the change in policymakers' views that a central bank's role is very important in achieving macroprudential soundness in the economy. Especially

* Economic Research Institute, The Bank of Korea (e-mail: jongku@bok.or.kr)

* Received: 2016. 2. 18

* Referee Process Started: 2016. 2. 23

* Referee Reports Completed: 2016. 12. 19

[†] The author is grateful to Woon Gyu Choi, Jin-Su Park, Jinill Kim, Myeongsu Lee, and the two anonymous reviewers for their thoughtful comments and suggestions.

when there is either too much or too little credit supply in financial markets, there has been a growing demand for aggressive actions by central banks.

On the other hand, it is expected that policy authorities around the world will introduce counter-cyclical capital buffers (CCB) in the near future. The main purpose of a CCB is to accumulate a capital buffer during boom periods, which can be used to protect banks and help them carry out their financial intermediation functions steadily, even during periods of recession. One of the other important aims of a CCB is to reduce the build-up of financial risk in advance.

As the levels of required CCB can vary over business cycles or credit cycles, it is evident that the CCB policy affects output and inflation, which are the main target variables for monetary policy. This makes the coordination between macroprudential policy and monetary policy one of the most important tasks for policymakers.

There has been some research on the coordination between monetary and macroprudential policies. Several studies have analyzed the coordination issue with DSGE models. For example, Angelini *et al.* (2012), using a DSGE model with the banking sector, analyze the European financial market and argue that macroprudential policies are beneficial, especially when there are shocks in the financial or housing markets as opposed to shocks from the supply side. Beau *et al.* (2012), with a DSGE model for the euro area, find that macroprudential policies have either a limited or a stabilizing effect on inflation. Paoli and Paustian (2013) set a DSGE model with nominal rigidities and credit constraints, finding that if faced with cost-push shocks, policy authorities must cooperate and commit to a given course of action to maximize the level of social welfare.

Though these DSGE models are capable of measuring the relative effectiveness of macroprudential policies compared to monetary policies, they have limitations when used to analyze one policy authority's response to another's actions, not to mention the fact that the results depend on the details of parameter calibration.

The second strand of studies in this area directly derives agents' response functions. Cecchetti and Kohler (2014), using a simple model, analyze the behavior of policy authorities. In the full cooperation situation, they find that capital adequacy requirements and policy interest rates can substitute for each other to meet the objective of stabilizing prices and output volatility levels,¹ whereas the relationship does not hold when policymakers try to achieve financial stability as well as price and output stability at the same time. Hence, they argue that policymakers need to coordinate macroprudential and monetary policies. Using a model with fiscal and monetary authorities, Davig and Gürkaynak (2015) demonstrate that if the fiscal authority has an additional mandate that is unrelated to social welfare, then social welfare maximum cannot be achieved. On the other hand, Smets (2014) notes that if macroprudential instruments are not effective, then monetary policy instruments can be used to stabilize the financial market.

In many papers, including those by Cecchetti and Kohler (2014) and Paoli and Paustian (2013), loan interest rates or the gap between loan interest rates and the

¹This means that when the regulatory capital ratio rises, the central bank must reduce the policy interest rate and when the policy interest rate cut the financial supervisory agency needs to raise the regulatory capital ratio to maximize their utility functions.

policy interest rate are used as a financial stability indicator. What brings about a financial market crisis is an excessive expansion of the credit supply rather than credit demand. Considering that the gap between loan interest rates and the policy interest rate tends to expand when the loan supply as well as loan demand increase, responding to changes in the gap may mislead policymakers. As a financial stability indicator, this paper employs the credit-to-GDP ratio.² Drehmann *et al.* (2011) and Drehmann and Juselius (2013) from the BIS suggest that it is desirable to use the credit-to-GDP ratio, as it performs better than any other indicator when predicting a financial crisis. When the level of credit demand expands, both the numerator and denominator of the credit-to-GDP ratio tend to increase simultaneously, leaving the ratio relatively stable. These authors also propose that in order to remove the effects of structural changes in the financial market, the cyclical components of the credit-to-GDP ratio must be used as an indicator of financial stability.

This paper considers whether the two policy response functions converge to an equilibrium point and examines the factors affecting the stability of equilibrium and the speed of convergence to equilibrium. These issues considered in this paper were not examined in earlier work which studied the relationships between policies, including Cecchetti and Kohler (2014), Davig and Gürkaynak (2015) and others. In Cecchetti and Kohler's (2014) non-cooperation situation, each agency assumes that the other agency's policy is fixed and does not change. Thus, each agency's optimal policy does not depend on the other agency's action, and there is no interaction between policy authorities. This makes Cecchetti and Kohler (2014) unable to examine the stability of equilibrium and the speed of convergence.

The main results of this paper are as follows: First, the paper examines whether the two policy response functions converge to a single point, finding that the condition of convergence depends on policymakers' objectives and on the structure of the economy. A non-convergence outcome can arise when the FSA places too much emphasis on output gap stability in its loss function or when a stronger financial stability mandate is assigned to the CB, which does not have proper macroprudential tools besides the policy interest rate.

Second, this paper compares the effectiveness of assigning mandates to each of the policy authorities, which have a limited number of policy measures. It finds that assigning a small number of mandates is more desirable than assigning a large number of them, as equilibrium can be more quickly restored in the former case than in the latter. Previous studies examining the assigning of mandates to agencies are rare. Davig and Gürkaynak (2015) examine the relationship between fiscal and monetary policies. They show that if the fiscal authority focuses only on reducing output volatility and the central bank concentrates on reducing inflation volatility, then social welfare, i.e., minimizing output volatility and inflation volatility, can be maximized. They also show that if the fiscal authority has the additional objective of minimizing tax rate volatility, then social welfare cannot be maximized even when the central bank attempts to minimize both inflation volatility and output

²The coefficient of correlation between the interest rate gap and the credit-to-GDP ratio was found to be -0.161 from the Korean data for the period of 2000.1q to 2015.4q. This low coefficient implies that using the credit-to-GDP ratio as an indicator of financial stability can be useful.

volatility. This result is not surprising, as Davig and Gürkaynak (2015) assume that the fiscal authority's new objective, minimizing tax rate volatility, is not related to social welfare. In addition, this assumption cannot be regarded as reasonable because a mandate that does not improve social welfare is assigned to an agency in such a case. They also assume that the fiscal authority takes into account the CB's response function while the CB does not consider the fiscal authority's response function. This indicates that their result comes from a model of the fiscal authority as a leader and the CB as a follower.

This paper does not introduce any mandate unrelated to social welfare and derives the result in the context of a non-cooperative situation. As all of the assigned mandates are related to social welfare in this paper, social welfare optimum can be achieved at equilibrium. Thus, this paper does not compare the levels of social welfare between different settings of mandates in a state of equilibrium. Instead, the paper compares differences in the speed of restoring equilibrium between the different settings of mandates among agencies. The speed of restoring equilibrium is important in the sense that it is closely related to dynamic movements of social welfare. Maximum social welfare can be achieved when policy measures such as the policy interest rate and the regulatory capital ratio are in equilibrium. The further the policy measures deviate from equilibrium, the smaller the social welfare. In addition, the longer the period policy measures are not in equilibrium, the greater the loss of social welfare. When external shocks occur in the economy, the policy measures need to move to a new state of equilibrium. If they swiftly converge to this new state, social welfare can be maximized speedily, reducing the loss of social welfare caused by the deviation of the policy measures from this new state.

Third, assuming a full cooperation situation, Cecchetti and Kohler (2014) find that the two policy instruments can be substituted when the agencies have two objectives, whereas they are not substitutable when the agencies have the additional objective of financial stability. This paper examines whether the two instruments are substitutable in the non-cooperation situation, finding that even when the financial stability mandate is assigned to the central bank, there is a substitution relationship between the two instruments.

This paper derives policy response functions from a simple model, as in the second strand of studies. The model is composed of the IS curve equation, the Phillips curve equation, and the credit-to-GDP ratio equation. There are two types of policy authorities: monetary and financial supervisory authorities. As policy instruments, the central bank (CB) has the policy interest rate and the financial supervisory authority (FSA) has the counter-cyclical capital ratio. Each policy authority has its own loss function and exercises its policy measure to minimize loss. Solving the minimization problem of each policymaker's loss function provides their policy response functions, which are expressed in terms of the inflation gap, the output gap, the credit gap and the other policymakers' policy measures.

Monetary policy can affect the real economy through many different channels. Among them, the interest rate channel and the credit channel are the most important ones. The credit channel means that the credit supply can affect the real economy (Disyatat 2010). The credit-to-GDP ratio is known to reflect the credit

supply well (Drehmann *et al.* 2011, Drehmann and Juselius 2013). The credit supply can also affect inflation as liquidity is created by credit in the banking system and liquidity itself determines inflation according to the quantity theory of money. Considering this, the credit-to-GDP ratio is included in the IS and Phillips curves.

II. Policy Authorities' Optimal Behavior

A. The Structure of the Model

To construct the model, the equations for the IS curve and the Phillips curve are used, along with the equation for the credit-to-GDP ratio. Considering that generally, economic agents forecast future inflation based on information available at a current point in time, the IS curve in equation (1) is introduced.³ Output (y_{t+1}) is affected by the real policy interest rate ($i_t - E_t[\pi_{t+1}]$) and the credit-to-GDP ratio (cyr_{t+1}), inflation (π_{t+1}) by the output gap ($(y_{t+1} - y_{t+1}^n)$) and the credit-to-GDP ratio,⁴ and the credit-to-GDP ratio by the real policy interest rate and the regulatory capital ratio (car_t).⁵ The two policy measures, the nominal policy interest rate (i_t) and the regulatory capital ratio, affect the three endogenous variables — output, inflation, and the credit-to-GDP ratio — with a time lag. Policymakers adjust their instruments preemptively on the basis of their expectations with regard to the next period's output gap, inflation gap and credit-to-GDP ratio gap (credit gap hereafter).

<IS curve>

$$(1) \quad y_{t+1} = a_0 + a_1 y_t - a_2 (i_t - E_t[\pi_{t+1}]) + a_3 cyr_{t+1} + \varepsilon_{y,t+1}$$

<Phillips Curve>

$$(2) \quad \pi_{t+1} = b_0 + b_1 \pi_t + b_2 (y_{t+1} - y_{t+1}^n) + b_3 cyr_{t+1} + \varepsilon_{\pi,t+1}$$

<Credit-to-GDP ratio (cyclical part)>

$$(3) \quad cyr_{t+1} = c_0 + c_1 cyr_t - c_2 (i_t - E_t[\pi_{t+1}]) - c_3 car_t + \varepsilon_{c,t+1}$$

After taking $E_t[\cdot]$ on both sides of equations (1)~(3), the equations are rearranged into $E_t[\pi_{t+1}]$, $E_t[y_{t+1}]$ and $E_t[cyr_{t+1}]$. They can then be expressed

³If a forward-looking IS curve is introduced, $a_1 y_t$ on the right hand side of equation (1) can then be replaced with $a_1 E_t[y_{t+2}]$. In this case, the main result of this paper will still hold, as both $E_t[y_{t+2}]$ and y_t are known variables at time t and do not change due to changes in policy instruments such as i_t and car_t .

⁴As credit and liquidity (or money) are two sides of the same coin, an increase in credit tends to increase inflation, fitting into the quantity theory of money.

⁵ x_{t+1}^n denotes the potential, natural or target value of x_{t+1} .

in terms of the two policy measures as the following equations (4)~(6).

$$\begin{aligned}
 (4) \quad E_t[\pi_{t+1}] &= (1/\Phi)(B_{\pi,0} - B_{\pi,i}i_t - B_{\pi,c}car_t) \\
 \Phi &= 1 - (b_3c_2 + b_2a_2 + b_2a_3c_2), \\
 B_{\pi,0} &= (b_0 + b_2a_0 + (b_3 + b_2a_3)c_0) + b_1\pi_t \\
 &\quad + b_2(a_1y_t - y_{t+1}^n) + c_1(b_3 + b_2a_3)cyr_t, \\
 B_{\pi,i} &= (b_3c_2 + b_2a_2 + b_2a_3c_2), \\
 B_{\pi,c} &= (b_3c_3 + b_2a_3c_3),
 \end{aligned}$$

$$\begin{aligned}
 (5) \quad E_t[y_{t+1}] &= (1/\Phi)(B_{y,0} - B_{y,i}i_t - B_{y,c}car_t) \\
 B_{y,0} &= (a_0 + a_2b_0 + a_3c_0 + a_3c_2b_0 + a_2b_3c_0 - a_0b_3c_2) \\
 &\quad + b_1(a_2 + a_3c_2)\pi_t + a_1(1 - b_3c_2)y_t \\
 &\quad - b_2(a_2 + a_3c_2)y_{t+1}^n + c_1(a_3 + a_2b_3)cyr_t, \\
 B_{y,i} &= (a_3c_2 + a_2), \\
 B_{y,c} &= (a_3c_3 + a_2b_3c_3),
 \end{aligned}$$

$$\begin{aligned}
 (6) \quad E_t[cyr_{t+1}] &= (1/\Phi)(B_{c,0} - B_{c,i}i_t - B_{c,c}car_t) \\
 B_{c,0} &= (c_0 + c_2b_0 + c_2b_2a_0 - c_0b_2a_2) + c_1(1 - b_2a_2)cyr_t \\
 &\quad + c_2b_1\pi_t + b_2c_2(a_1y_t - y_{t+1}^n), \\
 B_{c,i} &= c_2, \\
 B_{c,c} &= c_3(1 - a_2b_2)
 \end{aligned}$$

The sign of Φ in the three equations above and that of $(1 - a_2b_2)$ in equation (6) need to be positive for the effects of the policy interest rate and the regulatory capital ratio on output, inflation and the credit-to-GDP ratio to have the expected signs.

Let $E_t[\tilde{x}_{t+1}]$ be the expected value of x_{t+1} at time t when $\Delta i_t = 0$ and $\Delta car_t = 0$, which means that there is no change in the policy measures from the previous period. Let Δi_t be $i_t - i_{t-1}$ and Δcar_t be $car_t - car_{t-1}$. The expected values of the three endogenous variables above can then be expressed in terms of their values in the absence of policy changes and changes in the policy variables by the following functions (7)~(9).

$$(7) \quad E_t[\pi_{t+1}] = E_t[\tilde{\pi}_{t+1}] - (B_{\pi,i}/\Phi)\Delta i_t - (B_{\pi,c}/\Phi)\Delta car_t$$

$$(8) \quad E_t[y_{t+1}] = E_t[\tilde{y}_{t+1}] - (B_{y,i} / \Phi) \Delta i_t - (B_{y,c} / \Phi) \Delta car_t$$

$$(9) \quad E_t[cyr_{t+1}] = E_t[\widetilde{cyr}_{t+1}] - (B_{c,i} / \Phi) \Delta i_t - (B_{c,c} / \Phi) \Delta car_t$$

B. Non-cooperation Equilibrium

1. The Central Bank's Behavior

In a non-cooperative situation, each policy authority observes the others' behaviors and then decides whether to maximize its own utility function. When the financial stability mandate is assigned to a CB, its objective can be described as minimizing the inflation gap, the output gap and the credit gap by means of equation (10).⁶ γ and δ refer to the weights of the output gap and the credit gap, respectively.⁷

$$(10) \quad \min LS_t^{CB} = (E_t[\pi_{t+1}] - \pi_{t+1}^n)^2 + \gamma (E_t[y_{t+1}] - y_{t+1}^n)^2 + \delta (E_t[cyr_{t+1}] - cyr_{t+1}^n)^2$$

w.r.t. Δi_t

The optimal policy interest rate, which minimizes the above loss function with respect to Δi_t , is expressed by the following equation (11) in terms of the inflation gap, the output gap, the credit gap and the regulatory capital ratio.

$$(11) \quad \Delta i_t^{CB*} = \nu_\pi (E_t[\tilde{\pi}_{t+1}] - \pi_{t+1}^n) + \nu_y (E_t[\tilde{y}_{t+1}] - y_{t+1}^n) + \nu_c (E_t[\widetilde{cyr}_{t+1}] - cyr_{t+1}^n) - \nu_{car} \Delta car_t$$

$$\begin{aligned} \nu_\pi &= (1 - \Phi)^2 \Phi / \tilde{A}, \quad \nu_y = \gamma (a_2 + a_3 c_2) \Phi / \tilde{A}, \quad \nu_c = \delta c_2 \Phi / \tilde{A}, \\ \nu_{car} &= c_3 ((1 - \Phi)(b_3 + a_3 b_2) + \gamma (a_3 + a_2 b_3)(a_2 + a_3 c_2) + \delta c_2 (1 - a_2 b_2)) / \tilde{A}, \\ \tilde{A} &= ((1 - \Phi)^2 + \gamma (a_2 + a_3 c_2)^2 + \delta (c_2)^2) \end{aligned}$$

Equation (11) shows that the CB raises the policy interest rate in response to an expansion in the inflation gap, the output gap and/or the credit gap. Moreover, as either the weight of the output gap (γ) or that of the credit gap (δ) in the loss

⁶The credit gap refers to the difference between the credit-to-GDP ratio and its long-term trend or target level set by the authorities.

⁷Curdia and Woodford (2009) note that this type of loss function can be obtained when there is financial friction. On the other hand, we can also use this type of loss function when simply assuming that the CB has the three mandates and acts according to a Taylor-type rule.

function rises, the intensity of the response of the policy interest rate to each gap (v_y, v_c) becomes stronger. When there is a rise in the regulatory capital ratio, the CB cuts its policy interest rate, which implies there is a substitutive relationship between the two policies. Contrary to the results shown by Cecchetti and Kohler (2014), the substitutive relationship holds even when the financial stability mandate is included in the CB's loss function, as the policy interest rate and the regulatory capital ratio affect the credit gap in the same manner.⁸

Compared to the situation in which the CB does not have a financial stability objective ($\delta = 0$), the intensity of the response of the policy interest rate to the output gap and the inflation gap becomes lower.⁹ By responding to the credit gap, the CB can reduce the need to respond strongly to the output gap and the inflation gap, as the shrinkage of the credit gap tends to reduce the other two gaps. Meanwhile, the intensity of the response of the policy interest rate to changes in the regulatory capital ratio (v_{car}) becomes larger when the financial stability objective is included.¹⁰

2. The Financial Supervisory Authority's Behavior

The FSA may have different objectives from the CB, and its decision and optimal behavior tend to vary depending on its objectives. This section considers three cases according to how many objectives the FSA has.

(a) FSA objective 1: Achieving Financial Stability

When the FSA has a single objective of lessening the volatility of the credit gap, its loss function can be determined by the following equation (12):

$$(12) \quad \min LS_t^{FS} = \left(E_t[cyr_{t+1}] - cyr_{t+1}^n \right)^2 \\ \text{w.r.t. } \Delta car_t$$

The optimal regulatory capital ratio is derived as a function of the credit gap and the policy interest rate.

$$(13) \quad \Delta car_t^{FS*} = \frac{\Phi \left(E_t[\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) - c_2 \Delta i_t}{c_3 (1 - a_2 b_2)}$$

Equation (13) shows that as the effect of the regulatory capital ratio on the

⁸Cecchetti and Kohler (2014) use the gap between loan interest rates and the policy interest rate as an indicator of financial stability. In their model, a rise in the policy interest rate reduces the gap, while a rise in the regulatory capital ratio expands the gap.

⁹The value of \tilde{A} in equation (11) becomes larger when $\delta(c_2)^2$ is included.

¹⁰ $\partial v_{car} / \partial \delta = a_2 c_2 c_3 \Phi(b_2(1 - \Phi) + \gamma(a_2 + a_3 c_2)) / (\tilde{A})^2 > 0$

credit-to-GDP ratio (c_3) increases, the intensity of the responses of the regulatory capital ratio to the credit gap and to the policy interest rate decreases. The FSA reduces its regulatory capital ratio when the policy interest rate is raised because a rise in the policy interest rate can bring about a reduction in the credit gap. With the CB's policy interest rate and the FSA's regulatory capital ratio changes affecting each other, the movements can either converge to equilibrium or diverge over time. The condition for converging to equilibrium can be expressed by the following equation (14). The speed of convergence increases as the value of equation (14) increases.¹¹

$$(14) \quad 1 - \left(\frac{\partial \Delta i_t^{CB*}}{\partial \Delta car_t} \right) \left(\frac{\partial \Delta car_t^{FS*}}{\partial \Delta i_t} \right) > 0$$

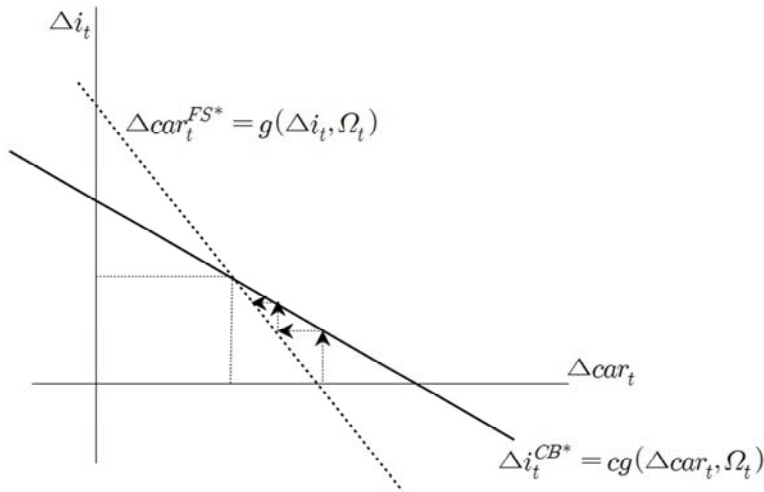


FIGURE 1. THE RESPONSE FUNCTIONS OF THE CB AND THE FSA

Note: The solid (dotted) line is the response function of the CB (the FSA), and Ω_t is the set of information available at time t .

In this situation, where the FSA focuses on reducing credit gap volatility, the condition of convergence is satisfied as the following equation (15) is always positive.

$$(15) \quad 1 - \left(\frac{\partial \Delta i_t^{CB*}}{\partial \Delta car_t} \right) \left(\frac{\partial \Delta car_t^{FS*}}{\partial \Delta i_t} \right) = \frac{a_2 b_2 (1 - \Phi) + \gamma a_2 (a_2 + a_3 c_2)}{\tilde{A} (1 - a_2 b_2)} > 0$$

As the FSA uses one instrument to achieve one goal in this case, at equilibrium,

¹¹For convergence, the slope of the response function of the policy interest rate ($= \partial \Delta i_t^{CB*} / \partial \Delta car_t$) in Figure (1) must be smaller than that of the regulatory capital ratio ($= 1 / (\partial \Delta car_t^{FS*} / \partial \Delta i_t)$), meaning that the relationship of $\partial \Delta i_t^{CB*} / \partial \Delta car_t < 1 / (\partial \Delta car_t^{FS*} / \partial \Delta i_t)$ must hold. Meanwhile, as the difference between the slopes of the two response functions expands, the value of equation (14) and speed of convergence both increase.

the credit gap converges to zero. The speed of convergence, however, can differ depending on the preferences and parameter values. If the weight of the output gap (γ) in the CB's loss function increases or that of the credit gap (δ) decreases, the speed of convergence increases.¹²

(b) Objective 2: Achieving Financial and Output Stability

In this case, the FSA's loss function is expressed as a function of the output gap volatility as well as the credit gap volatility.

$$(16) \quad \min LS_t^{FS} = \left(E_t[y_{t+1}] - y_{t+1}^n \right)^2 + \kappa \left(E_t[cyr_{t+1}] - cyr_{t+1}^n \right)^2$$

w.r.t. Δcar_t

When the FSA has keen interest in maintaining microprudential stability, supporting individual banks' profitability is important, which can again be backed by improving business activity overall. In this sense, the FSA may have a great deal of interest in reducing the output volatility relative to the credit volatility, causing the value of κ in equation (16) to decrease.¹³ The solution of the loss-minimizing function (16) produces the optimal regulatory capital ratio in terms of the credit gap, the output gap and the policy interest rate.

$$(17) \quad \Delta car_t^{FS*} = \frac{(a_3 + a_2 b_3) \left(E_t[\tilde{y}_{t+1}] - y_{t+1}^n \right) + \kappa (1 - a_2 b_2) \left(E_t[\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) - \tau_i \Delta i_t}{c_3 \kappa \left[(1 - a_2 b_2)^2 + (a_3 + a_2 b_3)^2 \right]}$$

$$\tau_i = \kappa c_2 (1 - a_2 b_2) + (a_3 + a_2 b_3) (a_2 + a_3 c_2)$$

The condition for convergence of the response functions can be expressed by equation (18). This condition is met only when the value of $\kappa \varphi_1$ in the numerator on the right-hand side of equation (18) is greater than the value of φ_2 .

$$(18) \quad 1 - \left(\frac{\partial \Delta i_t^{CB*}}{\partial \Delta car} \right) \left(\frac{\partial \Delta car_t^{FS*}}{\partial \Delta i_t} \right) = \frac{a_2 \Phi(\kappa \varphi_1 - \varphi_2)}{\tilde{A} [\kappa (1 - a_2 b_2)^2 + (a_3 + a_2 b_3)^2]}$$

$$\varphi_1 = (1 - a_2 b_2) \left[(\gamma + (b_2)^2) (a_3 c_2 + a_2) + b_2 b_3 c_2 \right]$$

$$\varphi_2 = (a_3 + a_2 b_3) \left[(b_3)^2 c_2 + a_2 b_2 b_3 + a_3 b_2 b_3 c_2 + \delta c_2 \right]$$

When the FSA has more interest in output stability than in financial stability, the

¹²The partial derivatives on the right-hand side of equation (15) with respect to γ and δ have a positive sign and a negative sign, respectively.

¹³As the FSA is a government body, which is influenced by national elections in the country, it may have short-sighted views, assigning greater importance to output growth than to financial market stabilization.

value of κ decreases, increasing the possibility of non-convergence.¹⁴ This result implies that it is desirable for macroprudential measures to be used primarily for lessening the credit gap, but not for lessening the output gap. Meanwhile, when the CB has a strong mandate of financial stability, the values of δ and φ_2 in equation (18) increase, increasing the likelihood of non-convergence. Either an increase in the value of δ or a decrease in κ also tends to reduce the speed of convergence to equilibrium.¹⁵ A large value of γ indicates that the CB considers output stability as an important task. The relationship in equation (18) indicates that if the value of γ increases, the probability of convergence and the speed of converging to equilibrium tend to rise.

(c) Objective 3: Achieving Financial, Output, and Inflation Stability

In this case, the FSA has the same loss function as the CB, as in equation (10), and it uses the regulatory capital ratio to minimize the function. The FSA's optimal regulatory capital ratio is determined by equation (19).

$$\begin{aligned}
 (19) \quad \Delta car_t^{FS*} &= \rho_\pi \left(E_t [\tilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \rho_y \left(E_t [\tilde{y}_{t+1}] - y_{t+1}^n \right) \\
 &\quad + \rho_c \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) - \rho_i \Delta i_t \\
 \rho_\pi &= (b_3 + a_3 b_2) \Phi / \tilde{C}, \quad \rho_y = \gamma (a_3 + a_2 b_3) \Phi / \tilde{C}, \quad \rho_c = \delta (1 - a_2 b_2) \Phi / \tilde{C}, \\
 \rho_i &= \left[(b_3 + b_2 a_3) (a_2 b_2 + c_2 (b_3 + b_2 a_3)) + \gamma (a_2 b_3 + a_3) (a_3 c_2 + a_2) \right. \\
 &\quad \left. + \delta c_2 (1 - a_2 b_2) \right] / \tilde{C}, \\
 \tilde{C} &= c_3 \left((b_3 + a_3 b_2)^2 + \gamma (a_2 b_3 + a_3)^2 + \delta (1 - a_2 b_2)^2 \right)
 \end{aligned}$$

When each of the three gaps expands and the policy interest rate falls, the FSA raises the regulatory capital ratio. In this case, with the same objective function, the condition for convergence of the response functions is expressed by the following equation, and the condition is satisfied.

$$(20) \quad 1 - \left(\frac{\partial \Delta i_t^{CB*}}{\partial \Delta car_t} \right) \left(\frac{\partial \Delta car_t^{FS*}}{\partial \Delta i_t} \right) = \frac{c_3 (a_2 \Phi)^2 (\gamma \delta + \gamma (b_3)^2 + \delta (b_2)^2)}{\tilde{A} \tilde{C}} > 0$$

¹⁴In the model, the regulatory capital ratio directly affects the credit-to-GDP ratio, while the policy interest rate directly affects the output level as well as the credit-to-GDP ratio. This gives the policy interest rate a comparative advantage over the regulatory capital ratio in lessening the output gap and the inflation gap, and the regulatory capital ratio has this advantage over the policy interest rate in lessening the credit gap. Thus, it is not effective for the regulatory capital ratio to be used for controlling the output gap, as the regulatory capital ratio needs to change by a large amount to have a significant influence on the output gap. If the regulatory capital ratio moves in such a manner, the credit gap changes significantly, in which case the policy interest rate would also need to move greatly because the policy interest rate is not an effective instrument for controlling the credit gap compared to the regulatory capital ratio. This chain reaction can lead to non-convergence.

¹⁵The partial derivative of the right-hand side of equation (18) with respect to δ has a negative sign, while those with respect to κ and γ have positive signs.

3. Assigning Mandates to Agencies

This section examines whether assigning a small number of mandates to authorities is more effective than assigning a large number of them when the policy authorities act in non-cooperative situations. Davig and Gürkaynak (2015) used the context of a lead-follower situation to study additional objectives of the fiscal agency which are unrelated to social welfare. This setting naturally leads to the outcome of a suboptimal level of social welfare at equilibrium. Unlike Davig and Gürkaynak (2015), this paper considers the case where all of objectives assigned to the agencies are related to social welfare in a non-cooperative situation. As all of the objectives are related to social welfare, the social welfare optimum can always be achieved in equilibrium. The speeds of restoring equilibrium, however, differ with different settings of mandates. Comparing the speeds of restoring equilibrium, this paper evaluates the effectiveness of assigning mandates to agencies.

For this analysis, two situations are considered: one with a single objective for each policy authority and the other with multiple objectives. In both situations, the CB has the policy interest rate as its own instrument, and the FSA has the regulatory capital ratio. In the first situation, the CB's objective is to reduce inflation gap volatility while the FSA's objective is to reduce credit gap volatility. With one objective and one policy measure for each policymaker, each gap becomes zero at equilibrium. The CB's optimal policy interest rate is Δi_t^* that satisfies $\partial (E_t[\pi_{t+1}] - \pi_{t+1}^n)^2 / \partial \Delta i_t = 0$, and the FSA's optimal regulatory capital ratio is Δcar_t^* that satisfies $(E_t[cyr_{t+1}] - cyr_{t+1}^n)^2 / \partial \Delta car_t = 0$.

In the second situation, each authority has two objectives: reducing inflation gap volatility and credit gap volatility with its own instrument. As the economy in this situation has two objectives and two policy measures as a whole, each gap converges to zero at equilibrium following the Tinbergen rule. Thus, in a state of equilibrium in the second situation, the same outcome can be obtained as in the first situation. Let the CB and the FSA have the following equations (21) as their objective functions. The CB's optimal policy interest rate, Δi_t^* , must satisfy the relationship of $\partial LS_t^{CB} / \partial \Delta i_t = 0$ and the FSA's optimal regulatory capital ratio, Δcar_t^* , needs to do the same for $\partial LS_t^{FS} / \partial \Delta car_t = 0$.

$$(21) \quad \begin{aligned} \min LS_t^{CB} &= (E_t[\pi_{t+1}] - \pi_{t+1}^n)^2 + \delta (E_t[cyr_{t+1}] - cyr_{t+1}^n)^2 \\ \min LS_t^{FS} &= (E_t[\pi_{t+1}] - \pi_{t+1}^n)^2 + \kappa (E_t[cyr_{t+1}] - cyr_{t+1}^n)^2 \end{aligned}$$

For each of the two situations, the policy response functions and the speed of convergence to equilibrium can be derived. The optimal policy is expressed by the following equations (22) ~ (25).

(Optimal policy with a single objective)

$$(22) \quad \Delta i_t^* = \frac{\Phi \left(E_t \left[\tilde{\pi}_{t+1} \right] - \pi_{t+1}^n \right) - c_3 (b_3 + b_2 a_3) \Delta car_t}{(1 - \Phi)}$$

$$(23) \quad \Delta car_t^* = \frac{\Phi \left(E_t \left[\widetilde{cyr}_{t+1} \right] - cyr_{t+1}^n \right) - c_2 \Delta i_t}{c_3 (1 - a_2 b_2)}$$

(Optimal policy with multiple objectives)

$$(24) \quad \Delta i_t^* = \frac{\Phi (1 - \Phi) \left(E_t \left[\tilde{\pi}_{t+1} \right] - \pi_{t+1}^n \right) + \delta c_2 \Phi \left(E_t \left[\widetilde{cyr}_{t+1} \right] - cyr_{t+1}^n \right) - \psi_{car} \Delta car_t}{(1 - \Phi)^2 + \delta (c_2)^2}$$

$$\psi_{car} = c_3 \left((b_3 + a_3 b_2) (1 - \Phi) + \delta c_2 (1 - a_2 b_2) \right)$$

$$(25) \quad \Delta car_t^* = \frac{\iota_\pi \Phi \left(E_t \left[\tilde{\pi}_{t+1} \right] - \pi_{t+1}^n \right) + \iota_c \Phi \left(E_t \left[\widetilde{cyr}_{t+1} \right] - cyr_{t+1}^n \right) - \iota_i \Delta i_t}{c_3 \left((b_3 + a_3 b_2)^2 + \kappa (1 - a_2 b_2)^2 \right)}$$

$$\iota_\pi = (b_2 a_3 + b_3), \quad \iota_c = \kappa (1 - a_2 b_2),$$

$$\iota_i = (b_3 + a_3 b_2) (1 - \Phi) + \kappa c_2 (1 - a_2 b_2)$$

The speed of convergence for each situation is derived using the following equations (26)~(27). The higher the following value is, the faster the speed becomes.

(The speed of convergence with a single objective)

$$(26) \quad 1 - \left(\frac{\partial \Delta i_t^*}{\partial \Delta car_t} \right) \left(\frac{\partial \Delta car_t^*}{\partial \Delta i_t} \right) = \frac{a_2 b_2 \Phi}{(1 - \Phi) (1 - a_2 b_2)} > 0$$

(The speed of convergence with multiple objectives)

$$(27) \quad 1 - \left(\frac{\partial \Delta i_t^*}{\partial \Delta car_t} \right) \left(\frac{\partial \Delta car_t^*}{\partial \Delta i_t} \right) = \frac{a_2 b_2 \Phi (\kappa \widetilde{\Gamma}_1 - \delta \widetilde{\Gamma}_2)}{\widetilde{\Gamma}_3} > 0 \quad \text{if} \quad \kappa \widetilde{\Gamma}_1 > \delta \widetilde{\Gamma}_2$$

$$\widetilde{\Gamma}_1 = (1 - \Phi) (1 - a_2 b_2),$$

$$\widetilde{\Gamma}_2 = c_2 (b_3 + a_3 b_2),$$

$$\widetilde{\Gamma}_3 = \left((1 - \Phi)^2 + \delta (c_2)^2 \right) \left((b_3 + a_3 b_2)^2 + \kappa (1 - a_2 b_2)^2 \right)$$

The difference between the speed of convergence with a single objective and that with multiple objectives is expressed by equation (28).

$$(28) \quad \frac{a_2 b_2 \Phi (\Psi_1 + \Psi_2 + \Psi_3)}{(1 - \Phi)(1 - a_2 b_2) \bar{\Gamma}_3} > 0$$

$$\Psi_1 = \delta \kappa (c_2 (1 - a_2 b_2))^2,$$

$$\Psi_2 = (b_3 + a_3 b_2)^2 (1 - \Phi)^2,$$

$$\Psi_3 = \delta \left((c_2)^2 (2 - a_2 b_2) (b_3 + a_3 b_2) \right)^2 + a_2 b_2 c_2 (b_3 + a_3 b_2) (1 - a_2 b_2)$$

The speed of convergence to equilibrium is faster in the first situation than in the second situation, while the equilibrium outcomes are identical. This implies that the first situation with a single objective for each policy authority is a more desirable means of achieving the objective compared to the second situation.

Another weakness with multiple objectives is that the policy response functions, as shown in equations (24)~(25), have more complex expressions than in the single-objective situation. Thus, it may be more difficult for policy authorities to find an optimal level of policy instruments, as many parameters are involved in the multiple-objective situation.¹⁶

At this stage, we consider the difference between assigning one objective to each institution and assigning one to an institution and two to the other. It is found that the former way still more quickly arrives at the equilibrium point. Let the speed of convergence when assigning one objective to each institution be SW11, let assigning two objectives to the CB and one to the FSA be SW21, and let assigning one to the CB and two to the FSA be SW12.¹⁷ The differences between SW11 and SW21 and between SW11 and SW12 are then expressed by (29) and (30), respectively.

$$(29) \quad SW11 - SW21 = \frac{\delta a_2 b_2 (c_2)^2 \Phi}{(1 - \Phi)(1 - a_2 b_2) \left[(1 - \Phi)^2 + \delta (c_2)^2 \right]} > 0$$

$$(30) \quad SW11 - SW12 = \frac{a_2 b_2 (b_3 + a_3 b_2)^2 \Phi}{(1 - \Phi)(1 - a_2 b_2) \left[(b_3 + a_3 b_2)^2 + \kappa (1 - a_2 b_2)^2 \right]} > 0$$

There are several caveats with regard to this result. If the objective of the CB is to reduce credit gap volatility while the objective of the FSA is to reduce inflation gap volatility, then the policy response functions do not converge — a situation that

¹⁶Changes in the structure of an economy tend to bring about changes in the parameters and the way policy instruments are operated. This adverse effect would be more significant in the multiple-objective situation than in the single-objective case.

¹⁷When one mandate is given to the CB (or the FSA), reducing the inflation (or credit) gap mandate is assigned.

may be less effective than the multiple-objective situation. Another caveat is that if there is uncertainty in either the effectiveness of the policy instruments or the objectives of each policy authority, then it is more effective for each authority to pursue multiple objectives than a single objective, as mentioned by Smets (2014).¹⁸ Finally, there may be differences between the CB's evaluation of the gaps and the FSB's evaluation. As the CB has more information about the macro-economy than does the FSB, the CB is more likely than the FSA to assess the gaps accurately. In this case, assigning multiple objectives would produce a better outcome.

C. Full Cooperation Equilibrium

If the CB and the FSA have the same objective, they can then decide fully to coordinate and exercise the two instruments simultaneously in order to achieve their common goal. This full cooperation equilibrium can also be applied to a case in which the CB can exercise the regulatory capital ratio as its instrument. The two authorities' common loss function is expressed by equation (31).

$$(31) \quad \min LS_t = \left(E_t[\pi_{t+1}] - \pi_{t+1}^n \right)^2 + \gamma \left(E_t[y_{t+1}] - y_{t+1}^n \right)^2 + \delta \left(E_t[cyr_{t+1}] - cyr_{t+1}^n \right)^2$$

w.r.t. $\Delta i_t, \Delta car_t$

In the case of full cooperation, the optimal policy interest rate and the optimal regulatory capital ratio are expressed in terms of the output gap, the inflation gap and the credit gap as equations (32) ~ (33).

(Optimal policy interest rate)

$$(32) \quad \Delta i_t^* = \frac{\theta_\pi \left(E_t[\tilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \theta_y \left(E_t[\tilde{y}_{t+1}] - y_{t+1}^n \right) + \theta_c \left(E_t[\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right)}{a_2 \left(\gamma \delta + \gamma (b_3)^2 + \delta (b_2)^2 \right)}$$

$$\theta_\pi = \left(\delta b_2 (1 - a_2 b_2) - \gamma b_3 (a_3 + a_2 b_3) \right),$$

$$\theta_y = \gamma \left(b_3 (b_3 + a_3 b_2) + \delta (1 - a_2 b_2) \right),$$

$$\theta_c = -\delta \left(\gamma (a_3 + a_2 b_3) + b_2 (b_3 + a_3 b_2) \right)$$

¹⁸Davig and Gürkaynak (2015) also state that the FSA may be slow to act for various reasons, such as political considerations and the time lag in gathering and analyzing information.

(Optimal regulatory capital ratio)

$$(33) \Delta car_t^* = \frac{\mu_\pi \left(E_t [\tilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \mu_y \left(E_t [\tilde{y}_{t+1}] - y_{t+1}^n \right) + \mu_c \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right)}{c_3 a_2 \left(\gamma \delta + \gamma (b_3)^2 + \delta (b_2)^2 \right)}$$

$$\mu_\pi = \gamma b_3 (a_2 + a_3 c_2) - \delta b_2 c_2,$$

$$\mu_y = -\gamma (b_3 (a_2 b_2 + b_3 c_2 + a_3 b_2 c_2) + \delta c_2),$$

$$\mu_c = \delta \left((a_2 + a_3 c_2) (\gamma + (b_2)^2) + b_2 b_3 c_2 \right)$$

Equation (32) shows that the optimal policy interest rate rises either when the output gap expands ($\theta_y > 0$) or when the credit gap shrinks ($\theta_c < 0$). As the regulatory capital ratio rises when the credit gap expands, it may be effective for the CB not to raise the policy interest rate in response to the credit gap expansion and to focus on the other objectives instead. The CB's response to the inflation gap (θ_π) varies depending on the preferences and the values of the parameters. When either the effect of the output gap on inflation (b_2) is large or when the weight of the output gap in the loss function (γ) is relatively small compared to that of the credit gap (δ), the optimal policy interest rate rises in response to the widening inflation gap ($\theta_\pi > 0$).

While the optimal regulatory capital ratio rises in equation (33) either when the credit gap expands ($\mu_c > 0$) or when the output gap shrinks ($\mu_y < 0$), its response to the inflation gap (μ_π) depends on the parameter values. This result implies that monetary policy and macroprudential policy must be focused on areas where they have a comparative advantage over each other in exercising policy measures.

In this case, the loss function can be expressed in terms of the three gaps by equation (34). This indicates that when the three gaps converge to zero, so does the value of the loss function.

$$(34) \quad \left(LS_t | \Delta i_t = \Delta i_t^*, \Delta car_t = \Delta car_t^* \right) = \frac{\gamma \delta \left(\left(E_t [\tilde{\pi}_{t+1}] - \pi_{t+1}^n \right) - b_2 \left(E_t [\tilde{y}_{t+1}] - y_{t+1}^n \right) - b_3 \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) \right)^2}{\gamma \delta + \delta (b_2)^2 + \gamma (b_3)^2}$$

Meanwhile, when the two authorities have the same objective function, non-cooperation equilibrium converges to full cooperation equilibrium. In terms of social welfare, however, non-cooperation equilibrium may be inferior to full cooperation equilibrium, as it requires a certain period of time for convergence.

D. Leader-follower Equilibrium

1. The FSA as a Leader

An agent may act as a Stackelberg leader. Previous studies have considered the FSA as a leader and the CB as a follower, as the policy interest rate can be changed frequently while the regulatory capital ratio cannot. When the FSA is a leader, it can move first as it knows the CB's response function, which is used as one of its constraints. One of the necessary conditions for an agent to become a leader is that it needs to know the others' response functions. Monetary policy tends to follow a rule similar to the Taylor rule, while the FSA prefers to use its discretion in exercising its measures. This could make monetary policy more predictable than macroprudential policy, making it easier for the FSA to behave as a leader.

Here, we assume that the loss function of the FSA is LS_t^{FS} and that the CB's response function is $\Delta i_t^{CB*} = cg(\Delta car_t, \Omega_t)$. The FSA then derives the optimal regulatory capital ratio to minimize its loss function, as in equation (35).

$$(35) \quad \min LS_t^{FS} = f(\Delta car_t, \Delta i_t^{CB*}, \Omega_t) = f(\Delta car_t, cg(\Delta car_t, \Omega_t), \Omega_t) \\ \text{w.r.t. } \Delta car_t$$

When the FSA's objective is to minimize credit gap volatility, as shown in equation (12), its optimal policy is expressed by equation (36), which shows that the optimal regulatory capital ratio depends not only on the credit gap but also on the inflation gap and the output gap.

$$(36) \quad \Delta car_t^* = \frac{\psi_c \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) + \psi_\pi \left(E_t [\widetilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \psi_y \left(E_t [\widetilde{y}_{t+1}] - y_{t+1}^n \right)}{a_2 c_3 ((1 - \Phi) b_2 + \gamma (a_3 c_2 + a_2))} \\ \psi_c = (1 - \Phi)^2 + \gamma (a_3 c_2 + a_2)^2, \\ \psi_\pi = -c_2 (1 - \Phi), \\ \psi_y = -\gamma c_2 (a_3 c_2 + a_2)$$

The FSA raises the regulatory capital ratio when the credit gap expands ($\psi_c > 0$) and lowers it when the inflation gap and the output gap expand ($\psi_\pi < 0$ and $\psi_y < 0$). As it expects that the CB will raise the policy interest rate in response to the expansion of the inflation gap and the output gap, the FSA focuses on reducing the credit gap, which is its sole objective. The FSA's response to the gaps depends on the CB's preferences and on other parameters. If a stronger mandate for output stability is given to the CB, the FSA's response to the credit gap and the inflation gap becomes weaker and the response to the output gap becomes

greater.¹⁹ This implies, as Davig and Gürkaynak (2015) predict, that an agent's response to its objectives is affected by the structure of other agents' loss functions.

On the other hand, when the FSA's objective is to reduce both the output gap and the credit gap, the FSA raises the regulatory capital ratio in response to credit gap expansion and output gap shrinkage, while its response to the inflation gap depends on the parameter values (refer to the Appendix).²⁰

2. The CB as a Leader

As information advantage enables an agent to become a leader, the CB may become a leader under certain circumstances. If the counter-cyclical capital ratio is exercised under a pre-committed rule, the CB could know the FSA's response function, making it easier for the CB to become a leader. If the CB acts as a leader, it will minimize its loss function, as in equation (10), predicting the FSA responses according to equation (13) if the FSA's objective is to reduce credit gap volatility. The CB's optimal policy can be obtained by substituting equation (13) for the regulatory capital ratio (Δcar_t) in its loss function and minimizing it.²¹ This process produces the CB's optimal policy in the form of equation (37). The policy interest rate rises when either the inflation gap or the output gap expands, and it falls when the credit gap expands. Table 1 in the Appendix shows that a leader is not trying to reduce all of the three gaps, leaving a follower to bear the burden.

$$(37) \quad \Delta i_t^* = \frac{\tau_\pi \left(E_t [\tilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \tau_y \left(E_t [\tilde{y}_{t+1}] - y_{t+1}^n \right) + \tau_c \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right)}{a_2 (b_2)^2 + \gamma}$$

$$\tau_\pi = b_2 (1 - a_2 b_2),$$

$$\tau_y = \gamma (1 - a_2 b_2)$$

$$\tau_c = -(\gamma (a_2 b_3 + a_3) + b_2 (a_3 b_2 + b_3))$$

When the two policy authorities know each other's response functions, both of them may try to become a leader. This situation can be referred to as a "leader-leader model." In this situation, there is no convergence of response functions, and each authority sets its own instrument to maximize its utility function.

Figure 2 shows an example of the response functions and indifference curves for each authority. The authority's indifference curves have an oval shape as the loss function of an institution has the form of $\sum_{j=1}^n \left(E_t [GAP_{j,t+1}] - \alpha_{1,j} \Delta i_t - \alpha_{2,j} \Delta car_t \right)^2$.²²

¹⁹This relationship can be verified by determining $\partial \Delta car_t^* / \partial \gamma$ with equation (36). Let DM_{36} be the denominator of equation (36). It is then found that $\partial(\psi_c / DM_{36}) / \partial \gamma < 0$, $\partial(\psi_\pi / DM_{36}) / \partial \gamma > 0$ and $\partial(\psi_y / DM_{36}) / \partial \gamma < 0$.

²⁰The coefficient of the regulatory capital ratio's response on the inflation gap is more likely to have a negative sign as the weight of the credit gap in the FSA's loss function (κ) increases (see the Appendix).

²¹If the FSA's objective is to reduce the volatility of the output gap as well as the credit gap, then equation (17) can be used for the substitution.

²²If an authority has a single objective, then her indifference curve is expressed as a straight line.

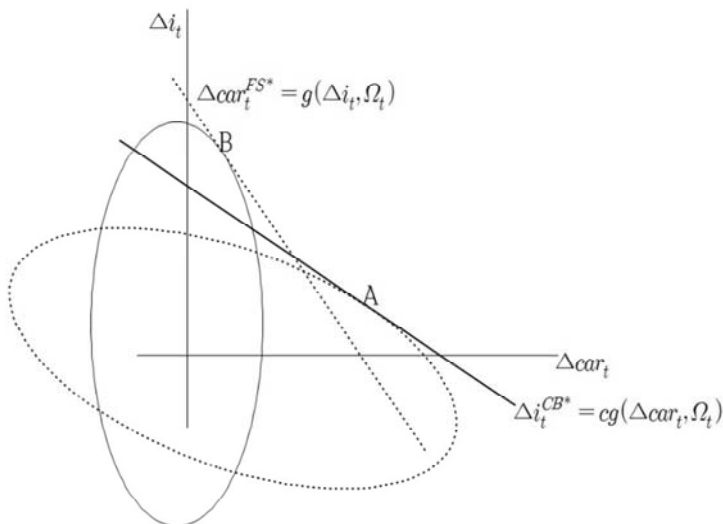


FIGURE 2. THE RESPONSE FUNCTIONS AND INDIFFERENCE CURVES

Note: The solid (dotted) straight line is the response function of the CB (the FSA). The solid (dotted) ellipse is the indifference curve of the CB (the FSA). Ω_t denotes the set of information available at time t .

An authority's utility increases as the ellipse becomes smaller. If the FSA is a leader, it will set the regulatory capital ratio at point A, and if the CB is a leader, the policy interest rate is set at point B. Point A is optimal for the FSA in the long run. The FSA may temporarily increase its utility by moving leftward and downward from point A. Such moves, however, cause the CB to move alongside its response function line, eventually decreasing the FSA's utility at that point compared to that at point A.

III. Conclusion

Using the IS curve, the Phillips curve, the credit-to-GDP ratio equation and policymakers' objective functions, this paper examines the interaction between monetary and macroprudential policies with different levels of cooperation between two policy authorities, i.e., non-cooperation, full cooperation, and the leader-follower relationship. When the policy authorities have the same objectives, then it is more likely that the authorities engage in full cooperation. If one of the policy authorities has more information about the other's response function, it may act as a Stackelberg leader. In the model, the CB and the FSA can exercise the policy interest rate and the regulatory capital ratio, respectively, as their policy instruments.

In the non-cooperation situation, each policy authority's optimal response is to tighten its policy measures when the other authority's policy measure is loosened. This substitutive relationship holds even when the CB has as its objective financial stability as well as inflation and output stability.

Whether the policy response functions converge to equilibrium depends on the authorities' preferences and the parameter values in the model. As the FSA places greater emphasis on output stability or when a stronger financial stability mandate is assigned to the CB, the possibility of non-convergence becomes higher and the speed of convergence to equilibrium tends to decrease, adding costs to policy operations. Meanwhile, if the CB considers output stability as an important task, the probability of convergence and the speed of converging to equilibrium are high.

When the CB has the financial stability objective, the intensity of the response of the policy interest rate to the output gap and the inflation gap decreases compared to when the CB does not have a financial stability mandate.

In the context of non-cooperation, this paper analyses the effectiveness of the manner in which mandates are assigned to authorities. Assigning multiple objectives to authorities with a limited number of policy measures may be less desirable when seeking to restore stability quickly as compared to assigning a small number of objectives. This condition arises because, in the situation with multiple objectives, more time is required for the policy response functions to reach a state of Nash equilibrium. It is also more difficult in such a case for policymakers to find the proper levels of policy measures, as the optimal policy response functions have more complex forms.

When the policy authorities fully cooperate with each other, their responses to each gap are different. In response to the widening of the output gap, monetary policy tightening and macroprudential policy loosening are optimal. In the case of a credit gap expansion, the optimal responses would be a tightening of macroprudential policy and a loosening of monetary policy. The direction of optimal responses to the widening of the inflation gap depends on the economic structure and the preferences of the policymakers.

An information advantage over the other party enables an agent to act as a Stackelberg leader. If the FSA acts as a leader, it raises the regulatory capital ratio in response to an expansion in the credit gap and to shrinkage in the output gap. On the other hand, if the CB is a leader, it raises the policy interest rate when the inflation gap and the output gap expand and when the credit gap contracts. In either of the above two cases, a leader attempts to reduce only one or two gaps among the three.

APPENDIX

FSA's Optimal Response when acting as a leader with two objectives

$$(38) \Delta car_t^* = \frac{\omega_c \left(E_t [\widetilde{cyr}_{t+1}] - cyr_{t+1}^n \right) + \omega_\pi \left(E_t [\widetilde{\pi}_{t+1}] - \pi_{t+1}^n \right) + \omega_y \left(E_t [\widetilde{y}_{t+1}] - y_{t+1}^n \right)}{c_3 a_2 (\kappa (N_1 + \gamma N_2) + \delta N_3 + N_4)}$$

$$\omega_c = \kappa \left[(1-\Phi)^3 b_2 + \gamma (a_2 + a_3 c_2) \left((a_2 + a_3 c_2)^2 (\gamma + 2(b_2)^2) + 3a_3 b_2 b_3 (c_2)^2 + (b_3 c_2)^2 + 3a_2 b_2 b_3 c_2 \right) \right]$$

$$+ \delta c_2 (a_3 c_2 + a_2) \left[b_2 b_3 (a_3 c_2 + a_2) + (b_3)^2 + \delta c_2 \right] > 0$$

$$\omega_\pi = -\kappa (1-\Phi) c_2 \left[(1-\Phi) b_2 + \gamma (a_2 + a_3 c_2) \right]$$

$$+ (1-\Phi) \left[(a_2 + a_3 c_2) ((1-\Phi) b_3 + \delta c_2) \right],$$

$$\omega_y = -\kappa \gamma \left[(1-\Phi) (a_2 + a_3 c_2) b_2 c_2 + \gamma c_2 (a_2 + a_3 c_2)^2 \right] - (1-\Phi)^3 b_3$$

$$- \delta c_2 \left[(b_2)^2 (a_2 + a_3 c_2)^2 + (c_2)^2 (\delta + 2(b_3)^2) + 3b_2 b_3 c_2 (a_2 + a_3 c_2) \right] < 0,$$

$$N_1 = (1-\Phi)^2 (b_2)^2,$$

$$N_2 = (a_3 c_2 + a_2) \left((2(b_2)^2 + \gamma) (a_3 c_2 + a_2) + 2c_2 b_3 b_2 \right),$$

$$N_3 = c_2 (2b_3 c_2 (b_3 + b_2 a_3) + 2b_3 b_2 a_2 + \delta c_2),$$

$$N_4 = (1-\Phi)^2 (b_3)^2$$

TABLE A1—OPTIMAL POLICY COMBINATION

Relationship between policy authorities	Policies	Widening of the inflation gap	Widening of the output gap	Widening of the credit gap
Non Cooperation	Monetary Policy	Tightening	Tightening	Tightening
	MP Policy	Tightening ¹⁾	Tightening ²⁾	Tightening
Full Cooperation	Monetary Policy	t/l ³⁾	Tightening	Loosening
	MP Policy	t/l ³⁾	Loosening	Tightening
The FSA is a leader ⁴⁾	Monetary Policy	Tightening	Tightening	Tightening
	MP Policy	Loosening ⁵⁾	Loosening	Tightening
The CB is a leader ⁴⁾	Monetary Policy	Tightening	Tightening	Loosening
	MP Policy	No response	No response	Tightening

Note: 1) If the FSA does not have the mandate of reducing inflation gap volatility, then this changes to “no response.” 2) If the FSA does not have the mandate of reducing output gap volatility, then this changes to “no response.” 3) This depends on the parameter values. As the impact of the output gap on inflation becomes larger or the authorities consider output stability less important and financial stability more important, the optimal monetary policy and the optimal macroprudential policy become tightening and loosening policies, respectively. 4) This result is obtained in cases when the FSA's objective is to reduce volatility in the credit gap. 5) If the FSA's objective is to lessen output volatility as well as credit volatility, this changes to “depends on the situation.”

REFERENCES

- Angelini, P., S. Neri, and F. Panetta. 2012.** “Monetary and Macprudential Policies.” ECB Working Paper No. 1449.
- Beau, Denis, Laurent Clerc, and Benoit Mojon 2012.** “Macro-Prudential Policy and the Conduct of Monetary Policy.” Mimeo. Bank of France.
- Cecchetti, Stephen and Marion Kohler. 2014.** “When Capital Adequacy and Interest Rate Policy Are Substitutes (And When They Are Not).” *International Journal of Central Banking* 10 (3): 295–231.
- Cúrdia, Vasco and Michael Woodford. 2009.** “Credit Frictions and Optimal Monetary Policy.” BIS Working Papers No. 278.
- Davig, Troy and Refet Gürkaynak. 2015.** “Is Optimal Monetary Policy Always Optimal?” *International Journal of Central Banking* 11: 353–384.
- Drehmann, Mathias, Claudio Borio, and Kostas Tsatsaronis. 2011.** “Anchoring Countercyclical Capital Buffers: The Role of Credit Aggregates.” BIS Working Papers No. 355.
- Drehmann, Mathias and Mikael Juselius. 2013.** “Evaluating Early Warning Indicators of Banking Crises: Satisfying Policy Requirements.” BIS Working Papers No. 421.
- Disyatat, Piti. 2010.** “The Bank Lending Channel Revisited.” BIS Working Papers No 297.
- Paoli, Bianca and Matthias Paustian. 2013.** “Coordinating Monetary and Macprudential Policies.” Federal Reserve Bank of New York Staff Reports No. 653.
- Smets, Frank. 2014.** “Financial Stability and Monetary Policy: How Closely Interlinked?” *International Journal of Central Banking* 10 (2): 263–300.

The Public-Private Partnerships and the Fiscal Soundness of Local Governments in Korea

By HOJUN LEE*

This paper studies the risks associated with local finance in Korea by identifying the financial status of each local government, including the financial burdens of PPP projects, and examined governmental future burdens related to PPP projects. We reviewed all fiscal burdens associated with projects, such as, for BTL (Build-Transfer-Lease) types of projects, facility lease and operating expenses, and, for the BTO (Build-Transfer-Operate) types of projects, construction subsidies that are paid at the construction stage, MRG (Minimum Revenue Guarantee) payments and the government's share of payment. Furthermore, we compared the annual expenditures of local governments on PPP projects against their annual budgets and checked if the 2% ceiling rule could be applied.

Key Word: Public Private Partnership (PPP), Fiscal Burden,
2% Ceiling Rule, Fiscal Soundness, Local Government
JEL Code: H54, H63, H72

I. Introduction

Large-scale development projects are closely tied to the political interests of the region in which they occur. A politician who is elected through the elections tends to respond very sensitively to these political interests. According to Kim and Lee (2012), the chances of the head of a local government successfully to be re-elected significantly increases as the overall scale of the large-scale public investment projects she attracts during her term increases. This shows that there is a strong incentive for the heads of local governments to promote large-scale projects to increase their re-election chances and to strengthen their political positions.

However, there is a limit when local governments directly lead public investment projects which are funded by the central government in Korea. Because

* Fellow, Korea Development Institute (e-mail: hojunlee@kdi.re.kr)

* Received: 2016. 3. 28

* Referee Process Started: 2016. 3. 29

* Referee Reports Completed: 2016. 8. 10

the central government, including the Ministry of Strategy and Finance (MoSF), manages the public investment plans and measures their financial soundness from a national perspective, even if the local government wishes to carry out a project, it is often not approved by the finance ministry. On the other hand, in order to meet continuously increasing welfare demands, budget expenditures in the social welfare sector are expected to grow. Thus, the promotion of large-scale development projects within the budgets of local governments is limited.

For these reasons, local governments often seek to carry out large-scale development projects through what is termed a PPP (Public-Private Partnership). This enables them to carry out projects without major funding from the central government and without placing a greater short-term financial burden on local governments. Nonetheless, because most PPP projects require large amounts of spending over time frames measured in decades, the financial burden of each project must be carefully examined from a long-term perspective before a decision is made to proceed.

In cases where one is more focused on achieving political benefits through short-term project performance, as opposed to long-term financial risk, there is a possibility that politicians, especially the heads of local governments, would promote a project excessively and cause serious financial harm. This is especially true for certain smaller local governments, as the performances of even small PPP projects can damage the financial liquidity of such local governments.

Therefore, it is crucial to manage PPP projects sustainably given a certain level of financial risk, as the best advantages of public-private partnerships, such as the effective sharing of project risks, short-term relief of financial burdens, and the leveraging of the private sector's creativity and efficiency throughout the phases of designing, constructing, and operating, can be achieved only when financial risks are managed well.

However, thus far the overall management of PPP projects by local governments in Korea has not been entirely satisfactory. The central government authority that oversees all PPP projects is the Ministry of Strategy and Finance (MoSF). However, the central government authority that oversees local finances is the Ministry of the Interior. Therefore, collective management at the governmental level of agendas such as those related to the impacts of PPP projects on local finances is challenging.

This paper focuses on analyzing the level of risks faced by those managing local finances by identifying the financial status of each local government, including the financial burdens of PPP projects. This requires a close examination of the nature of financial burdens related to PPP projects. The governments' burdens related to PPP projects are, in the case of BTL (Build-Transfer-Lease) projects, facility leases and operating expenses, while for BTO (Build-Transfer-Operate) projects, construction subsidies that are paid at the construction stage², MRG (Minimum

²In this research, discussion on local governments' construction subsidy payments will be excluded, as most construction subsidies paid by local governments come from the central government. Even for projects run by local municipalities, depending on the project types, often the central government supports certain portions from MoSF as a construction subsidy, and there is rarely a case where a local government pays such amounts alone. Moreover, despite the fact that construction grants are deemed payable by local governments, detailed information such as the payment schedule is not provided. For these reasons, this study does not investigate the financial burdens of local government as regards construction subsidies.

Revenue Guarantee) payments³ and government's share of the payment constitute the main costs for the government. All of the related payment rules are determined by the type of contract, also known as the concession agreement.

The accounting methods used to for an accurate measurement of the financial burdens of governments in relation to PPP projects have been debated over the last few years. There is some debate over whether or not to include definite government payments, such as facility lease payments for BTL projects, as part of the debt. In this regard, some argue that along with changing the government accounting standard to the Accrual and Double-Entry Bookkeeping Accounting System, accounting method used to measure PPP investments also needs to be strengthened. In the case of Korea, in 2009 the government accounting system was converted from a cash basis system to an accrual basis system, and the double-entry bookkeeping accounting system was also adopted. Before the conversion, under the cash basis system, the governments' payments on public projects were recognized as expenditures and were not counted as government assets or liabilities. After the conversion to the accrual basis, more claimed that PPP facilities should be counted as assets in accordance with the concept of contributed acceptance and that the payments should be counted as debt as well.

More importantly, after the adoption of the new government accounting system, the symmetry between corporate and governmental accounting systems become more evident. With corporate accounting systems, most recognize BTL projects as bonds with secured rights to future lease fees from the government in accordance with contributed acceptance. Considering the symmetry in accounting systems, the claim that the leases should be recognized as a liability is compelling.

Taking this into the consideration, the Ministry of Strategy and Finance announced that it would include lease payments to private partners for BTL projects as liabilities in starting in 2011, recognizing this situation as the acquisition of real assets.⁴ Moreover, the Local Finance Act was revised in 2014 and included lease payments related to BTL projects as debt management items. The revised Act also counted lease payments for BTL projects as among local government's liabilities, which serves as a key indicator for use when measuring local bond issuance amount limits.

Despite the fact that there exist various opinions regarding how to account for BTL lease payments, this study aims to analyze BTL-related lease payments as a governmental burden in accordance with the accounting guidance set by central and local governments at present. Moreover, this research will attempt to include the government's share of fixed payments related to BTO-type projects as local governments' liabilities. In this way, this study aims to analyze how the fiscal risk of each local government can change.

On the other hand, with regard to government payments that are decided upon

³The government was found to be taking too much demand risk; therefore, the Minimum Revenue Guarantee system was gradually abolished. Starting with new projects in 2009, it was completely discontinued.

⁴Until the Local Finance Act was revised in 2014, local government liabilities were limited to municipal bond borrowings, debt instruments and guaranteed liabilities. Especially the local governments' PPP projects have high possibilities to cause long-term financial burdens by nature. However, as payments derived from PPP investment were not counted as the local liabilities, there has been a limit to accurately replicate financial burdens of local municipalities.

after the completion of the project, it would be difficult to count these as among the liabilities directly. However, it would be important continuously to monitor the fiscal burdens of local governments that may stem from these payments. Therefore, this research will estimate these potential government payments based on the past financial records of each type of projects. Such payments will include costs, such as the operation costs of BTL-type projects and the MRG payments of BTO-type projects. Through these steps, this research aims to investigate the potential fiscal burdens of governments, with these then used as reference data while determining project decisions regarding future projects.

Furthermore, this paper aims to measure the annual fiscal burdens of governments against the annual governmental budget. Most international organizations, such as the International Monetary Fund (IMF), recommend that government spending on public projects remain under 2% of the government's annual expenditure budget. The Ministry of Strategy and Finance also set their guidance at 2% and with continuously monitoring, such that annual expenditures on public projects are within 2% of the central government's annual revenue-expenditure budget. However, such guidance is not yet considered for local governments. Therefore, we will compare the annual expenditures of local governments on PPP projects against their annual budgets. Thus, the present study examines whether the 2% guidance level can be implemented within all local governments or whether any local government would have difficulties meeting this guidance level.⁵

We feel that this paper is significant in that it offers a full-scale analysis of the relationship between PPP projects and the financial burdens of local governments, which has not been addressed in detail. It will broaden the horizons of fiscal risk analysis by investigating the fiscal impact of PPP project investments on local governments, especially the debt level.⁶ Fiscal risk is analyzed with several assumptions about the economic environment in the future as well as the conditions of the agreements. We think this analysis is meaningful in public economics and accounting, area as it deals with the issue of a discounting rate which is used to derive the present value of the fiscal burden in the future. How to determine the discount rate is related to the characteristics of the individual projects as well as the overall economic conditions.

⁵The 2% guidance is recommended to central governments, but we apply the guidance to the local government in this paper as a separate guidance for the local governments has not prepared. We need to set up guidance for small local government in the future research.

⁶This research was limited when used to analyze the liabilities of local governments, and we were not able to include an active analysis of the financial earnings and estimates, fiscal power, and demand for fiscal expenditures. As local governments financial burdens for the future can be adjusted due to future financial earnings trends and fiscal power, though it is important to note that limits apply here. Although all municipalities' public investments and the financial burdens caused by these investments on local governments can be accessed, various factors that could impact local finances were not all taken into consideration. Therefore, it is difficult to define potential fiscal risks for local governments based on this research. However, it remains highly significant to note that this is the first attempt to analyze the risks for local finance derived by the financial burdens from the public investments.

II. Relevant Systems and Previous Literature

Since the National Finance Act was revised in 1963, various systems have been introduced in an effort to sustain the fiscal soundness of local governments. With the moratorium announcement by Seongnam City in Kyeonggi province in 2010, the central government started to bolster the management of local finances. Establishing the Local Government Financial Risk Alert System through the adoption of the Fiscal Risk Management System (December, 2010) is one such example. An overview of this risk management system, which was legalized during the Local Finance Act⁷ revision carried out in 2011, is shown in Table 1.

Every year, key fiscal indicators related to local finances are monitored; after these assessments, the levels of riskiness are categorized into three groups: ‘Normal’, ‘Warning’, and ‘Critical’. If any local government is categorized into the “Warning” or “Critical” group, it is advised to take actions to improve its local finances. The key objective of the system is a properly assessment of fiscal riskiness before any organization faces critical stages and to give each local government the opportunity to improve the soundness of its local finances.

When accessing the fiscal riskiness of each local government, it is very important to choose the proper financial indicators that show the financial status. It is also crucial grade the level of riskiness properly. As of 2014, according to the Local Government Finance Risk Alert System Operational Guidelines established by the Ministry of Security and Public Administrations (currently the Ministry of the Interior) on March 25, 2013, the monitoring guidelines pertaining to indicators are very detailed, categorized by the consolidated central government balance deficit percentages, the debt-to-budget ratio, the debt service ratio, local tax collection status, remaining balances, the public enterprise debt ratio, and other factors. The following guideline shows how each case is categorized into either the “Warning” or “Critical” group after the monitoring stage.

TABLE 1—OVERVIEW OF
LOCAL GOVERNMENT FINANCIAL RISK ALERT SYSTEM OPERATION STANDARDS

Monitoring		Financial Risk Pre-emergency Alert		Risk Management Solutions by Level of Riskiness
<ul style="list-style-type: none"> · Tax Deficit · Capital Balance · Local Debts · Profligate expenditure 	⇒ Integrated Diagnostics	<ul style="list-style-type: none"> · Tax Deficit · Capital Balance · Local Debts · Profligate expenditures 	⇒ In-depth Diagnostics (Financial Risk Management Committee)	<ul style="list-style-type: none"> ○ Warning Group <ul style="list-style-type: none"> · Annual Expenditure / Debts Adjustment · Self-Endeavor Recommended ○ Critical Group <ul style="list-style-type: none"> · Assigned as a group with fiscal risk · Fiscal Normalization Program is Activated

⁷The Local Finance Act

Article 55-2 (Designation of Local Governments in Financial Crisis)

<This Article was Newly Inserted by Act No. 10439, March 8, 2011>

- (1) The Minister of Public Administration and Security may designate a local government deemed in the serious level of financial risk on the basis of the results, or other measures of a financial analysis and financial examination conducted under Article 55 (1) and (2)
- (2) The Standards and procedures, for instance, used to designate a local government in financial crisis, shall be prescribed by Presidential Decree

TABLE 2—LOCAL GOVERNMENT FINANCIAL RISK ALERT SYSTEM OPERATIONAL GUIDELINES

Orders	Indicators	‘Warning’ Category	‘Critical’ Category
Chapter 65 Article 2-1, Item 1	Consolidated central government balance deficit percentage	Over 25%	Over 30%
Chapter 65 Article 2-1, Item 2	Debt-to-Budget Ratio	Over 25%	Over 40%
Chapter 65 Article 2-1, Item 3	Debt Service Ratio	Over 12%	Over 17%
Chapter 65 Article 2-1, Item 4	Local Tax Collection Status	Below 50%	Below 0%
Chapter 65 Article 2-1, Item 5	Remaining Balances	Below 20%	Below 10%
Chapter 65 Article 2-1, Item 6	Public Enterprise’s Debt Ratio	Over 400%	Over 600%

Source: Ministry of Security and Public Administration, Order 1, 2013. 3. 25.

In order to maintain fiscal soundness in local governments, the Ministry of Security and Public Administration suggests a guideline for the issuance of local bonds, the “Guidance on Local Bond Issuance Plan.” The financial status of a local government has a significant impact on measurements of its local bond issuance capability. Therefore, assessments of indicators which represent the state of liabilities, such as a government’s payments for PPP project investments, most significantly for the BTL types of projects, have been strengthened in recent years.⁸ In 2012, the government payments arising from BTL projects were excluded when determining the limit of the local bond issuance amount.⁹ However, in 2013, in order to enhance the effectiveness of the local bond system, the regulation was revised to count BTL payments which have been confirmed for local municipalities to pay private partners.¹⁰ Moreover, in 2014, the category of ‘BTL payments’ was revised to ‘BTL Lease Payments’ to define these payments as the total amount local governments must pay private partners as part of the lease. As a result, among all BTL project-related government payments, only leases, which tend to be counted as definitive payments, are recognized as liabilities.

On the other hand, there exist gaps between the accounting systems of central governments and local governments with regard to PPP projects, making it very difficult to measure the level of the financial burden appropriately. However, the financial burdens stemming from PPP investments are gradually shifting to be accounted for as liabilities at present.

The Accounting Guidelines for PPP projects (BTO·BTL), issued by the Ministry of Strategy and Finance in 2011, set the full annual lease payment as a liability. It recognizes the lease amounts derived from BTL-type projects as a fiscal gain on real assets and accounts for these payments in accordance with the acquisition on a deferred payment basis. However, for lease payments, the nominal value is accounted for as debt and the operational expenses are only counted at the point of the payment, as they do not meet the requirements of the liability category.

Under the Guidelines for Local Governments Fiscal Accounting System, set by the Ministry of Security and Public Administration in 2009, BTL-type project investments of local governments are counted as finance leases. However, the 2013 Handbook for Local Finance Analysis (the Ministry of Security and Public Administration) revised the accounting guidelines to include only the remaining

⁸The Ministry of Security and Public Administration (2011).

⁹The Ministry of Security and Public Administration (2012).

¹⁰The Ministry of Security and Public Administration (2013).

lease payments for BTL-type projects as liabilities and issued a revised the manual which includes related analysis indicators. Through this revision, in terms of regularity, the gaps between accounting guidelines set by the central government and local governments were narrowed.

Moreover, the revision of the Local Finance Act¹¹ echoed the sentiments of the Ministry of Security and Public Administration's efforts in strengthening the level of local fiscal soundness. The scope of manageable liabilities was expanded and the fiscal soundness management plan was developed and carried out. The scope of manageable liabilities included BTL-type project lease payments, as mentioned above, and also included the liabilities of local public companies and sovereign funded institutions.

In addition, the amendment of the Local Finance Act regulates the provision of finance information to residents from their perspective while also disclosing as much finance information as possible. The amendment requires information such as the total debt, contingent debt, investment review project, itemized statements on subsidiaries, investigation results from the Board of Audit and Inspection, and local subsidy reductions in financial disclosures, as well as a consolidated analysis, evaluation and announcement of each local government's finances by the Minister of Security and Public Administration for a better comparison among local governments. Moreover, so that residents can easily assess the local finances overall, the head of each local autonomous entity will now draft and finalize a consolidated publication referred to as the "Integrated Local Finance Statistics," including data regarding the local government, local public corporations, investment agencies and the local education agency, which are to be managed separately.

As presented above, the regulations affecting local financial management have been evolving to strengthen each local government's financial soundness. These positive changes have included (1) intensifications of financial crisis prediction abilities, (2) an extension of the range of local financial management, and (3) an expansion of financial information disclosures. At present, continuous management efforts are essential to make these improvements effective.

For example, the financial burden on local governments for PPP projects requires management by regulation; however, many local autonomous entities in fact have not included any items under the debt management category. Lease fees for BTL-type projects, in the middle of the transition period, are not included when identifying organizations which may be at financial risk.

Moreover, financial burdens in various forms, alongside lease payments for BTL-type projects, are expected to be imposed upon the government in the future. These potential burdens, however, are not being actively managed, as they do not fully qualify as debts. Although not managed as forms of debt, the scope of these burdens must be understood to be utilized for future financial decision-making activities.

As previously discussed, the local financial management regulations of the Republic of Korea have been improving to strengthen the financial soundness of

¹¹The Revision of the Local Finance Act passed at the National Assembly Plenary Meeting, April 2014.

local governments. Nonetheless, it is difficult to conclude that the regulations have been settled, and there is room for improvement. This section looks at various domestic and international case studies in to understand financial management methods for local governments' PPP projects as recommended by different organizations. The section also aims to find ways to settle and improve current regulations.

Domestic studies thus far have mostly proposed the necessity of improving the accounting standards regarding the government's share of PPP project lease payments. Choi (2007) emphasized the necessity of a budget management method to secure financial stability in the provision of public services through PPP projects for leases, where the loan is a major premise and does not allow for a continuous expansion of the project scope. As a solution, Choi proposed the establishment of an annual ceiling for government subsidization (1~2% of the total expenditures) and emphasized that restraints such as reviews of local councils are essential for local autonomous entity-driven PPP projects that exceed a certain size. Subsequently, Choi (2008) focused on the necessity of systematically managing the share of PPP projects within the government's long-term financial plan, specifically public and SOC (social overhead capital) investments. In calling for a managerial system, Choi posited that local autonomous entities' direct executions of PPP projects, without the central government's support, could potentially build a blind spot for finance regulation. As of 2008, funding for BTL projects was recognized as extra-budgetary debts, but not categorized as national debt; it appeared necessary to review the inclusion of for-lease PPP projects when establishing strategies to manage national contingent debt.

The Korean Institute for Local Administration (2008) highlighted the limits in evaluating the level of the contribution local finance analyses and diagnoses at the time was making to the prevention of and restoration after a financial crisis, while emphasizing the need for a legal basis to instigate and systematically manage financial crisis management regulations. Min (2009), similar to previous studies, argued that BTL projects should be included in the debt takeover identified in the Local Finance Act. In detail, Min suggested that local debt management be strengthened by amending the Ministry of Public Administration and Security's "regulation on establishing an upper limit for the local bond system and management of local loans."

Choi (2010) looked at the status of the local finance analysis system, finding that its function was as a comprehensive examination system and not as a set of regulations that intensively analyzes and diagnoses pressure and crisis in local finances. Choi noted that improving the budget and accounting system and installing a control system are important, while arguing that the local finance analysis system must be revised to cover the financial information of local public enterprises and the third sector. Regarding the regulation of financial crisis management, Choi also posed the need to enact a regulation of the financial crisis management of autonomous entities (tentative) rather than amending the existing legislation.

Both Suh (2010) and Jung (2012) suggested the need to recognize all government funds for projects of autonomous entities as debts, forecasting the financial burden to increase continuously in the future. Specifically, Jung (2012 & 2013) called for

factors in not only BTL leases but also BTO allowances for bad debt or losses. Jung also argued that debts from PPP projects should be connected from a macro perspective and that residents' rights to know should be met by disclosing detailed information regarding BTL and BTO projects in financial reports.

Additionally, Min (2013) noted the recent accounting management methods of the Ministry of Strategy and Finance and changes in perception toward debts by the Ministry of Government Administration and Home Affairs have made it clear that BTL project-related rental fees are local debts. However, Min pointed out that there is a gap in the financial management between the "Financial Management of PPP projects" (Ministry of Strategy and Finance, 2011) and the "Operation Regulation for Financial Accounting" (Ministry of Government Administration and Home Affairs), which must be unified as the guidelines of the Ministry of Strategy and Finance. Min also argued that it is necessary publicly to notify residents of comprehensive BTL project-related data such as financial statistics.

Kwak (2013) pointed out the limited possibility of defaults on monetary debt caused by contingency debt, as the current total upper limit ceiling of guaranty debt (payment guarantee) for local loans is not controlled properly. The current system does take into consideration items regarding an organization's planning and execution to strengthen its financial soundness during a financial crisis, but it focuses more on functional execution as a "pre-warning system" and is less effective as a crisis management tool for local finances at a stage where a financial crisis has already broken out. Therefore, a set of management regulations for local financial crises is essential as compared to the current pre-warning system for local financial crises. Jung *et al.* (2013) argued that leases from BTL-type PPP projects must be clearly reflected as debts and that there should be a stoppage of debt trajectories as well as a definite application of standards for future financial burden management (2%).

According to Kim *et al.* (2007), it was forecasted that the fiscal burden of central-government-level PPP projects in Korea would demand approximately 2.1~2.3% of the annual budget under certain scenarios. Thus, they suggested the need for stronger fiscal management of PPP projects.

Most previous studies highlighted the need to include PPP projects by local autonomous entities, especially BTL-type projects, as local debts for comprehensive management. Different arguments regarding a comprehensive management method included a call for in-depth verification via a procedure by the national assembly for projects of a certain size, as well as a call for more proactive public notifications of PPP project-related financial statistics and the provision of this information to residents.

These arguments are similar to the standards of financial management of developed countries and international organizations. According to the International Financial Reporting Standard (IFRS), whether a fund is reported in a government's financial statement is determined by whom among the contracted parties control and manage the services provided by the PFI/PPP funds. More specifically, the International Financial Reporting Interpretation Committee (IFRIC) states this in its 12th Service Concession Arrangements on the financial management regulations

of PFI/PPP projects.¹²

The UK has ensured that the financial standards of its central government are identical to the IFRS standards for the private sector since 2009-2010, also doing so for local governments since 2010-2011. The UK government financial regulations for PPP/PFI projects (HM Treasury, “Tangible Non-Current Assets,” Financial Report Manual, 2009-2010) manages PPP/PFI funds as governmental assets and related liabilities if they fall under all five of the categories below:

- (1) The government controls and regulates the type of service, user and price of the infrastructure.
- (2) The government controls a core part of the remaining share such as ownership and beneficiary rights of the infrastructure at the end of the service contract.
- (3) The operator has built or obtained the establishment from a third party for the service contract, or the establishment has been recognized as the operator’s asset in the past.
- (4) In unitary payment, portions related to property security are categorized as debt, separate from the service costs and interests.
- (5) Service costs and interests are treated as annual expenditures.

In addition, the standards of the UK are similar to the “Financial Management Regulations on BTO and BTL Projects” (Ministry of Strategy and Finance, 2011) and coincide with the arguments in various Korean studies where BTL facilities are treated as assets and the related rental fees as debts.

On the other hand, EU nations, unlike the UK, do not manage PPP-related government funds as government debts. Countries such as France treat PPP projects for service sale as annual expenditures in the form of operating leases, and do not show changes in their perspective toward government financial management regulations for PPP projects for service sales. The Manual on Government Deficit and Debt, 4th Edition (March 2012) by Eurostat included no changes to its financial regulations, implying that EU nations will follow Eurostat standards for their governments’ financial management until the International Public Sector Accounting Standards (IPSAS) are separately available. However, organizations such as the IMF and the European Central Bank report that the Eurostat standards are too generous, and the regulations of the International Public Sector Accounting Standards Board (IPSASB) should be adopted.

Specifically, the IMF states that all information such as costs and contingent liabilities for PPP projects should be transparent. The IMF (2007) also holds that PPP projects (or similar types) should provide notification of the contracted requirements (including government subsidiaries) and its impact on the financial earnings and expenses as well as the national debt in the government budget and financial statements. The IMF also argues that there is a need to set an upper limit depending on the capabilities of the country in question.

Many, including the UK which introduced the concept of PPP projects, which

¹²Regarding influence, although a financial management strategy for private investors may be established, it must comply within the government’s financial management method.

have become globally popular, as well as major international organizations, emphasize the importance of managing government funds for PPP projects. Their arguments regarding the need to establish an upper limit for government funds toward PPP projects is similar to the perspective in earlier Korean studies.

Considering this, it can be said that Korea should also understand the government burden and prepare financial management solutions for PPP projects. Specifically, the scale of the financial burden on local autonomous entities and its influence on local finance should be grasped, especially targeting entities that have not received a thorough analysis of government subsidiaries. The next part of this paper looks at the scale of the governmental financial burden from PPP projects of local autonomous entities as well as its impact on local finance. Regulatory solutions in managing the PPP projects of local autonomous entities are also studied.

III. Estimation of the Change in the Debt Burden from PPP Projects of Local Autonomous Entities and an Analysis of Its Impact on the Soundness of Local Finance

This chapter estimates the remaining balance of rental fees from BTL-type projects among PPP projects of local autonomous entities. As previously discussed, including rents from BTL PPP projects in debt is consistent with the improvement strategy of regulations, considering the accounting management methods of the Ministry of Strategy and Finance, regulation improvement strategies of the Minister of Security and Public Administration, the policy of UK Department of the Treasury, and the IMF recommendations. Therefore, the remaining balance of BTL PPP projects should be included in the debt of the pertaining local autonomous entity. Despite the recent regulation changes, this work has not begun, posing limits to how each entity's financial soundness changes depending on the rents of their PPP projects.

In this Part, how each local autonomous entity's accounting status changes by factoring in the estimated rents to the existing debt of the entity. The change in the degree of financial risk at each entity is looked at based on the standards of the pre-warning system for local financial crisis.

In addition, some BTO-type projects resulted in direct payment of costs from the government. Among these cases are projects that included fixed charges for the government to pay fixed amounts of funds to private investors on a fiscal basis. In cases which a fixed amount is regularly paid is virtually considered a debt. Although the current accounting management standards does not specify directly, this study attempts to consider the characteristics of the 'fixed charges' and reflect them on debts to look at the financial soundness of the local autonomous entities.¹³

¹³Many variables, aside from the debt status, should be included in the analysis to assess the risk of local finance. The degree of risk can be different for local autonomous entities that hold the same size of debt depending on the future financial earnings and expenses, budget changes and fiscal capacity of each entity. Due to the limited resources, not all of variables possible could be considered for financial risk analysis. Therefore, it is necessary to take caution not to be conclusive in judging the future financial risk of the local autonomous entities as estimated

A. Estimation of the BTL Project Balances of Local Governments¹⁴

As of the end of 2013, 134 local autonomous-entity-managed projects (government funded)¹⁵ of 79 low-level local governments^{16, 17} receive local payments as facility leases among their government subsidiaries for BTL projects. Among these, 96 projects have commenced and 38 projects have not been started.

The total facility rental fees for the contract projects amounted to 13 trillion, 213.7 billion KRW (present value) and 663.7 billion KRW (present value) annually, among which approximately 451.1 billion KRW (present value) in leases is estimated for payment for the year 2013 for 96 projects under contract.

The status of facility leases by project type is shown in Table A1 in the appendix. The table above visualizes the contracted facility leases of each local autonomous entity's PPP projects. In terms of the size of the annual lease by project, a number of projects exceed an annual rental fee of over 10 billion KRW, including Pohang-si (14.2 billion KRW annually) and Pyeongtaek-si (11.3 billion KRW annually).

BTL-type PPP projects are structured for the private investor to invest funds in the construction process for the establishment of social infrastructure, and to earn a certain amount of profit from the long-term lease amounts paid by the government for operation, collecting the funds (the total PPP investment). The rental fee is set by contract, and the government pays the rental fee to the private investor under normal circumstances. The facility lease is calculated as shown below:

$$\text{Facility lease} = \frac{\text{Total PPP investment} \times \text{Rate of return}}{1 - (1 + \text{rate of return}) - (\text{period of rent})}$$

TABLE 3—STATUS OF BTL PROJECTS (GOVERNMENT FUNDED) POST CONTRACT

Category	Contract	Pre-commencement	Post-commencement	Total
Culture and tourism		3	25	28
Welfare		5	5	10
Information and communications	1		2	3
Environment	2	27	64	93
Grand total	3	35	96	134

TABLE 4—STATUS OF BTL PROJECTS' LEASES (GOVERNMENT FUNDED) POST CONTRACT

Category	Number of projects managed by local autonomous entities (government funded)	Number of low-level local governments*	Total amount of the facility lease (present value)	Annual facility lease (present value)
	134	79	13,213.7 trillion KRW	600.6 trillion KRW per Annum

Note: * The projects executed by metropolitan city headquarters are appropriated as separate local autonomous entities.

based on the change in the entities' debts.

¹⁴The Infracore DB (Ministry of Strategy and Finance) is utilized for all PPP project-related information for this study. Projects only in the stage of post-contract are included.

¹⁵Projects only in the stage of post-contract are included.

¹⁶The headquarters of each local autonomous entity is assumed as a separate low-level local government.

¹⁷Educational facility BTL projects of local autonomous entities were excluded in this study as the leases are paid by the Ministry of Education.

As shown above, the BTL-type lease follows the equation of the principal and interest method by dividing and paying the investment principal and interest, which reflects the rate of return on top of the total PPP investment by a PPP project operator, into equal amounts annually. Therefore, the annual facility lease to be paid is virtually settled when the total amount of PPP investment is decided. The BTL-type rental fees are considered to be similar to fixed debts.

Additionally, considering the fact that a lease set by contract has never been deducted due to problems during the operation time,¹⁸ it can be presupposed that the private investor or the government will pay the set rent, as fixed by contract, during the time of the project. Thus, to estimate the size of the BTL lease to be placed as a burden on local autonomous entities, it is fair to use the method of subtracting the lease payment made by the government through 2013 from the total lease laid out in each contract. As the payment is made via the equation of the principal and interest method on a fiscal basis, the total lease is divided by the rental period to calculate the annual rent, which can then be applied to the remaining project period to calculate the size of the future BTL rent.

This study assumes that the government has made payments as contracted through the end of 2013, as each local autonomous entity does not have actual information about the lease payments made. As this study focuses on local finance, the amount to be paid by each entity is separately calculated and combined by categorizing the payer within the government subsidiaries for BTL projects. In short, the lease payment data (divided into national treasury and local cost), as recorded in the Infracore DB, was utilized to calculate the share of local costs paid by local autonomous entities for facility leases of projects, which was then applied to the annual facility lease to calculate the balance of the lease between the end of 2013 and the end of the completion of each project.

By using this method to calculate the lease balance of 134 projects after 2014, the local burden on local autonomous entities was estimated to be 4 trillion 773.8 billion KRW (present value) in total. When the lease balance for current BTL projects was categorized according to the local autonomous entities, Jeju Special Self-Governing Province recorded the highest level at 340.9 billion KRW (present value), followed by Gwangju-si at 264.2 billion KRW and Daejeon-si at 250.3 billion KRW. Table 5 below and Table A2 in the appendix indicate the total lease amounts and the remaining balance of payments after 2014 by each local entity more in detail.

¹⁸In BTL projects, the government pays the total of the rental and operation costs to the private investor on a fiscal basis. Even if the government subsidiary is reduced due to construction problems during operation and paid to the SPC instead, it is customary for the SPC to treat this as an operation problem and normally pay the contractor, of relatively supreme status, while decreasing the operation cost payment to the operator. Regardless of the fairness of this procedure, the lease must be paid as stipulated in the contract. As this study focuses on an analysis of the impact PPP projects have on local finances, the structural problem in BTL projects where the responsibilities are shifted to the operator, not considering construction problems, is not discussed.

TABLE 5—ESTIMATED BALANCE OF BTL FACILITY LEASES (LOCAL FUNDS) BY LOCAL AUTONOMOUS ENTITIES

Competent authority (Lower level)		Sum of total lease by local autonomous entity	Sum of remaining lease by local autonomous entity as of year-end, 2013	Competent authority (Lower level)		Sum of total lease by local autonomous entity	Sum of remaining lease by local autonomous entity as of year-end, 2013
Seoul Metropolit- an City	Gangnam-gu (2)	990	537	Jeollabuk- do (11)	Iksan-si (4)	3,713	1,417
	Haeundae	238	191		Gimje-si (2)	1,815	545
Busan Metro- politan City (6)	Buk-gu/Saha-gu	216	122		Gunsan-si	1,433	376
	Headquarters	2,309	1,559		Wanju-gun	910	232
Daegu Metropolitan City		986	502		2,309 1,559	1,987	811
Incheon Metro- politan City (3)	Bupyeong-gu	670	519		Jeongeup-si	1,050	221
	Headquarters	1,848	1,246		Jinan-gun	499	119
Gwangju Metropolitan City (2)		3,911	2,642	Jeollanam- do (14)	Gangjin-gun (2)	1,357	600
Daejeon Metropolitan City (2)		3,839	2,503		Wando-gun	305	150
Ulsan Metropolitan City (3)		4,685	2,218		Headquarters	602	281
Gyeonggi- do (10)	Paju-si (3)	3,166	951		Hampyeong-gun	103	49
	Yongin-si (2)	2,610	725		Hwasun-gun	290	145
	Gimpo-si	1,627	488		Mokpo-si (3)	3,047	811
	Anseong-si	1,219	363		Yeosu-si (2)	1,694	464
	Ansan-si (2)	278	206		Naju-si	1,207	344
	Pyeongtaek-si	2,854	907		Damyang-gun	480	91
	Gangneung-si	1,305	281		Jangheung-gun	681	175
Gang- won-do (4)	Wonju-si	2,104	572	Gyeong- sang buk-do (20)	Gyeongju-si (3)	4,547	1,968
	Chuncheon-si	1,902	570		Andong-si	951	489
	Hongcheon-gun	621	158		Uiseong-gun	207	101
		2,841	880		Sangju-si (2)	2,336	567
Chung Cheong buk-do (14)	Jecheon-si (4)	897	216		Pohang-si (3)	6,128	1,838
	Jincheon-gun (2)	682	182		Goryeong-gun	530	99
	Goesan-gun	353	72		Gimcheon-si (2)	1,915	636
	Boeun-gun	402	100		Mungyeong-si	1,749	478
	Okcheon-gun	856	215		Yeongdeok-gun	708	168
Chung Cheong nam-do (19)	Eumseong-gun	337	78		Yeongju-si (2)	2,169	651
	Jeungpyeong-gun	1,748	470		Yecheon-gun	820	246
	Chungju-si	518	238		Uljin-gun	1,200	327
	Cheongju-si	1,153	526		Chilgok-gun	1,603	445
	Headquarters	1,117	487		Uiryeong-gun	74	32
	Gyeryong-si (2)	5,106	2,213		Gimhae-si (3)	4,121	1,128
	Cheonan-si (6)	1,132	354		Yangsan-si (2)	1,618	390
	Dangjin-si (2)	2,248	759		Jinju-si (2)	3,091	887
	Asan-si (3)	653	169		Geochang-gun	587	119
	Geumsan-gun	641	152		Changwon-si (2)	2,741	790
	Nonsan-si	641	152		Sacheon-si	227	108
	Boryeong-si	718	212		Tongyeong-si	1,696	494
	Seosan-si	1,366	388	Jeju Special Self-Governing Province (10)		9,840	3,409
	Seocheon-gun	598	159				
	Hongseong-gun	1,361	405				

Note: 1) “()” Indicates the number of projects. 2) The total facility rental fee is the national treasury and local funds combined by contract at the present value. 3) The lease balance is calculated based on the local share within the total facility rental fee.

*B. Change in Debt the Ratio Based on
the Financial Status and BTL Rental Fee by
Local Autonomous Entity*

The aim here is to sum up the debt and BTL lease balance of each local autonomous entity in an effort to understand the impact of the previously calculated BTL lease balance on local finances. First, the financial status of each local autonomous entity shows a total of 28 trillion 296 billion KRW in total local debt as of the end of 2013, with 21 trillion 665.4 billion KRW in metropolitan city debt and 6 trillion 923.2 billion KRW in city, country and district debt. Table 6 shows the sum of local city, country and district debt by each metropolitan city. The balance of local loans is the highest in the order of Seoul (approximately 5 trillion 300 billion KRW), Gyeonggi-do (approximately 4 trillion KRW) and Incheon (approximately 3 trillion 300 billion KRW).

On the other hand, the previously estimated BTL balance is the sum of all rental fees (present value) to be paid by local autonomous entities annually after 2014. However, to factor this in as debt, present value must be applied in a way similar to how debt is calculated. According to National Accounting Standards Article 46 Clause 1, in cases when the gap between the nominal value and the present value is important in transactions of long-term deferred payment terms, present value is used to evaluate value.

On the other hand, which discount rate is applied can have an important influence on the result of calculating the remaining BTL rental fees at present value. According to National Accounting Standards Article 46 Clause 2, the effective

TABLE 6—BALANCE OF LOCAL LOANS BY ACCOUNTING
(INCLUSIVE OF CITIES, COUNTRIES AND DISTRICTS)

Category	Sum	General accounting	Other special accounting	Public enterprise special accounting	Fund
Grand total	282,960	109,935	84,182	88,614	229
Seoul Metropolitan City	52,822	5,130	46,121	1,571	-
Busan Metropolitan City	27,781	14,079	11,034	2,637	31
Daegu Metropolitan City	19,597	11,930	5,845	1,822	-
Incheon Metropolitan City	32,764	12,423	12,333	8,008	-
Gwangju Metropolitan City	8,026	3,730	-	4,296	-
Daejeon Metropolitan City	6,990	2,970	-	4,004	16
Ulsan Metropolitan City	5,295	743	-	4,533	19
Sejong Special Self-Governing City	1,245	1	-	1,244	-
Gyeonggi-do	39,572	18,729	1,584	19,233	26
Gangwon-do	11,226	6,912	464	3,850	-
Chungcheongbuk-do	6,676	2,301	304	4,071	-
Chungcheongnam-do	9,989	2,903	3,320	3,753	13
Jeollabuk-do	10,293	5,521	498	4,274	-
Jeollanam-do	12,712	5,020	1,074	6,546	72
Gyeongsangbuk-do	13,388	6,959	711	5,718	-
Gyeongsangnam-do	17,657	6,795	671	10,141	50
Jeju Special Self-Governing Province	6,927	3,789	223	2,913	2

Note: "Local loan status as of end of 2013" (<http://lofin.mospa.go.kr>)

National Accounting Standards Article 46
(Evaluation based on the present value of bonds and debts)

- (1) When the difference between nominal value and present value is important in the bonds and debts resulting from transactions of long-term deferred payment terms, long-term cash loans or other similar transactions are evaluated in terms of present value.
- (2) The equivalent value of the total amount of earnings or payment for bonds and debts, according to Clause 1, is determined after discounting effective interest rate of the transaction. (If the effective interest rate is difficult to identify, apply the Korean National Treasury distributed profits rate.)

interest rate of the transaction is to be discounted. The effective interest rate can be viewed as the rate of profit in BTL projects. However, considering the fact that there was no virtual reduction in BTL rental fees, and that the private operators of the BTL projects during the operation phase assume the rental fee to be at the same level of risk of the national debt, there is a limit when viewing the total PPP investment applied as taxation as fair value. Moreover, if the total PPP investment cannot easily be viewed at fair value, the effective interest rate cannot be viewed as profit. Therefore, this study applied 3.38%, the average yield of Korean Treasury bonds (five-year maturity) over the past three years, as a “Korean National Treasury distributed profits rate of similar requirements in case the effective interest rate is difficult to identify,” as stated in the National Accounting Standards.

When the remaining balance of BTL leases (present value) is added to the local debt amount under these assumptions, the total debt of 41 low-level local governments that are planning or operating BTL projects increases by approximately 22%, and the debt-to-budget ratio increases by approximately 3.4%p compared to the exiting ratio. The debt-to-budget ratio for some local autonomous entities increased dramatically. Specifically, the debt ratio of local entities, including Gyeryong-si of Chungnam (20.48%p), Gangjin-gun of Jeonnam (14.32%p), Gyeongju-si of Gyeongbuk (12.31%p), Cheonan of Chungnam (12.10%), Jecheon-si of Chungbuk (11.23%p) and Iksan-si of Jeonbuk (10.04%p), increased tremendously.

As shown above, facility leases during BTL projects can pose a major burden on local finance, and BTL rental fees must be considered when managing local finance in the future. Due to these needs, the “Local Bond Plan Standards” (Ministry of Security and Public Administration, 2014) has identified the balances of BTL leases to be managed as debt, but they are not included in the monitoring of the identification of organizations at risk of financial crisis.¹⁹

¹⁹It can be considered for inclusion during the monitoring of the identification of organizations at risk of a financial crisis, as BTL lease balances have a major impact on local finances. With this intention, the Board of Audit and Inspection told the Ministry of Security and Public Administration to reflect the BTL lease balance in the “Pre-Warning System Operation Regulation for Local Financial Crisis” during its audit in August of 2014. However, instead of simply applying the sum of the BTL lease balances to the existing debt while keeping the current Pre-Warning System standards (“Caution” if the debt-to-budget ratio is more than 25%; “Serious” if it is over 40%), introducing new standards in reflecting BTL lease amounts can be considered through a comprehensive review, considering the future status of local finance.

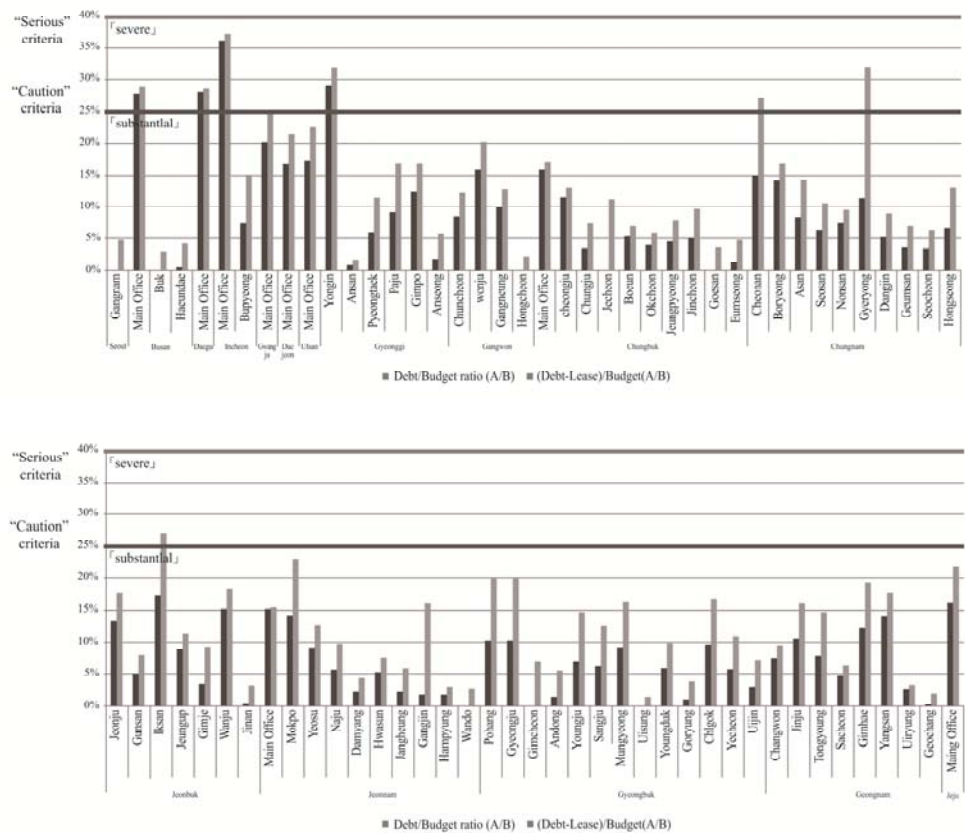


FIGURE 1. CHANGE IN THE DEBT RATIO WHEN INCLUDING THE BTL LEASE BALANCE OF LOW-LEVEL LOCAL GOVERNMENTS

TABLE 7—REVIEW OF DESIGNATION STANDARDS OF ORGANIZATIONS IN FINANCIAL CRISIS				
Category	Local government	Debt-to-budget ratio (Existing)	Debt-to-budget ratio (Inclusive of BTL lease balance)	Change after including BTL lease balance
Busan	Headquarters	27.80%	28.92%	“Caution”
Daegu	Headquarters	28.10%	28.69%	“Caution”
Incheon	Headquarters	36.10%	37.13%	“Caution”
Gyeonggi	Yongin-si	29.00%	31.93%	“Caution”
Chungnam	Cheonan-si	15.00%	27.10%	“Caution”
	Gyeryong-si	11.40%	31.88%	“Caution”
Jeonbuk	Iksan-si	17.20%	27.24%	“Caution”

Note: The grades for Busan, Daegu and Incheon Metropolitan City were originally “Caution,” and none had changes.

C. The Need to Reflect the Debt of Fixed Charges in BTO Environmental Projects

Certain BTO environmental projects contracted between the years 2001 and 2004 have regulated fixed charges, and nine projects were confirmed to be paying fixed charges.²⁰ These fixed charges are in fact similar to debts, as they work as an agreement for the government to pay fixed amounts to PPP projects every fiscal year. Therefore, this study estimated the total fixed charges to be paid by the government until the completion of future operations of the projects that are currently receiving the fees. The estimation was then reflected in terms of debt.

To do so, the unchangeable, contract-based fixed charges of the relevant projects were utilized to estimate the remaining fixed charges to be paid after 2014 through to the conclusion of the projects' operations. The current fixed charges of 2014 were calculated based on the actual prices as of 2013 (2010 equivalent to an index of 100), and a 3% annual inflation rate was assumed for the charges thereafter until completion. The same method was used to calculate the remaining fixed charges of BTO environmental projects, and the calculated balance was included as local government debt. As a result, Chilgok-gun was degraded to receive the grade of "Caution," while Pohang-si (23.35%) was very close to this grade as well.

TABLE 8—LEASE BALANCE + FIXED CHARGES BALANCE

(UNIT: 100 MIL. KRW)

Category	Local government	Debt	Budget (Grand total including fund)	Debt-to- budget ratio	Debt ratio including lease balance	Balance of environmental fixed charges	Rent balance + fixed charges balance debt	Rent balance + fixed charges balance debt ratio
		(A)	(B)	(A/B) (%)	(A'/B)	(Present value)	(A'')	(A''/B)
Busan	Headquarters	28,670	103,085	27.80%	28.92%	1,326	31,136	30.20%
Incheon	Headquarters	31,981	88,593	36.10%	37.13%	651	33,542	37.86%
Gyeonggi	Pyeongtaek-si	719	11,956	6.00%	11.50%	693	2,068	17.30%
Gyeonggi	Hwaseong-si	1,715	14,050	12.20%	12.20%	582	582	16.35%
Jeonbuk	Headquarters	7,546	53,235	14.20%	14.20%	2,143	9,689	18.20%
Jeonnam	Bosung-gun	0	3,942	0.00%	0.00%	118	118	3.00%
Gyeongbuk	Pohang-si	1,414	13,678	19.99%	19.99%	459	3,193	23.35%
Gyeongbuk	Chilgok-gun	446	4,614	16.75%	16.75%	459	1,231	26.69%

Note: 1) Hwaseong-si and Bosung-gun, Jeollabuk-do had no remaining BTL rents. Only remaining fixed charges would be generated. 2) 3.38%, the average yield of Korean Treasury bonds (five-year maturity) over the past three years, is applied as the discount rate of the present value.

²⁰The projects that were to be paid at the beginning of operation were excluded, as the payment period has expired.

TABLE 9—FIXED CHARGES OF ENVIRONMENTAL PROJECTS

Competent authority		Name of project	Operation completion date	Fixed charges (Unchangeable, 1 mil. KRW/yr)	Current fixed charges in 2014 (100 mil. KRW /yr)	Total balance of fixed charges (100 mil. KRW)
Gyeonggi-do	Pyeongtaek-si	Pyeongtaek-si Sewage Treatment Equipment (Tongbok, Jangdang, Hyeondeok of Anjung)	June 30, 2026	Tongbok+Jangdang 2,561.99 mil. KRW/yr Hyeondeok 1,453.24 mil. KRW/yr	59	873
	Hwaseong-si	Hwaseong-si Sewage Treatment Equipment	June 30, 2026	3,379 mil. KRW/yr	49	733
Gyeongsangbuk-do	Chilgok-gun	Waegwan Terminal Sewage Disposal Plant (Stage 1 of extension)	March 31, 2026	2,636.1 mil. KRW/yr	40	575
	Pohang-si	Pohang Terminal Sewage Disposal Plant Stage 2 (Extension)	October 31, 2022	3,866 mil. KRW/yr	54	542
Busan Metropolitan City		Dongbu Terminal Sewage Disposal Plant	October 26, 2021	7,682 mil. KRW/yr	113	983
		Yongdo Terminal Sewage Disposal Plant	December 31, 2020	4,900 mil. KRW/yr	71	548
Incheon Metropolitan City		Geomdan Terminal Sewage Disposal Equipment	February 18, 2028	272.874 mil. KRW/yr	49	844
Jeollanam-do	Bosung-gun	Beolgyo and Hoecheon Terminal Sewage Disposal Plants	December 1, 2021	861 mil. KRW/yr 237 mil. KRW/yr (Ecology park)	16	137
Jeollabuk-do		Building and operation of Jeollabuk-do Basic Environmental Treatment Facility	June 24, 2028	10,854 mil. KRW/yr	157	2,795

D. Estimation of Further Government Payments and Analysis of Local Financial Burdens Regarding Local Governments' PPP Projects

Government payments for PPP projects are generated in various forms aside from lease fees for BTL projects and fixed charges for certain BTO projects. The minimum revenue guarantee payment for BTO projects and operation costs for BTL projects are some of the typical payment forms. However, these forms were not discussed in the preceding section as they do not satisfy the requirements of debt in terms of government payment methods. Nonetheless, in order to grasp the effect of government payments for PPP investments on the finances of local governments, it is necessary continuously to forecast the scale and amount of government payments and feed the results of such an analysis into regulations, even if some payment forms cannot be categorized as debt. Therefore, this part of the study estimates future MRG payment amounts for BTO projects and operation costs for BTL projects, which are not considered as debt funds but which can have a tremendous impact on the finances of local governments. In doing so, we can come to understand the anticipated scale of the burden to be carried by each local government for private sector investments in addition to BTL leases and BTO fixed charges, as previously discussed.

First, based on year-end data recorded as of 2013, there are 19 local government projects and five Korean cash-reserve subsidized projects that are forecasted to need future MRG payments, as explained in detail below:

TABLE 10—PROJECTS SUBJECT TO MRG

Category	Project
Local government projects	The following 19 projects: the Busan Sujeongsan Tunnel, Daegu Buman Road, Gwangju Second Circulation Section 3-1, Gwangju Second Circulation Section 4, Incheon Munhaksan Tunnel, Incheon Manweolsan Tunnel, Incheon Wonjeoksan Tunnel, Yeosu-si Food Disposal Facility, Boryeong River Sewage System, Mungyeong Gaeun Sewage Treatment Plant, Yangju Sincheon Sewage System, Gangwon Misiryeong Road, Gyeryong-Si Waste Incineration Facility, Icheon-Si Sewage System, Gunpo-Si Daeya Sewage System, Gyeongju-Si OedongGeoncheon Sewage System, Gongheung Doyang Sewage Treatment Plant, Pocheon Sludge Fluidized Bed Incineration Facility, and the Gongju Yugu Gongam Donghaksa Sewage System
Korean government-subsidized projects	The following five projects: Gwangju Second Circulation Section 1, Seoul Umyeonsan Tunnel, Seoul Metro Line 9, Gyeonggi Ilsan Bridge, and Gyeongnam Machang Bridge

TABLE 11—ASSUMPTIONS FOR THE ANALYSIS

Category	Assumption
Base year	December 31, 2013
Inflation rate	Through 2013: CPI record After 2014: Apply annual rate of 3%
Discount rate	Apply annual rate of 3.38% (the average yield of five-year Korean Treasury bonds over the past three years)
Actual operation income	Apply a weighted average ratio of actual income from user charges to the anticipated income from user fees at the time of the contract for the past three years (2011-2013)
Minimum responsibility management standard	Reflect the future MRG estimation if the minimum responsibility management standard exists where MRG is not paid in case the achieved actual operation income does not exceed a certain proportion of the contracted operation income
Assumed charges	If the actual income from user charges is calculated based on the assumed charges at a certain ratio to the charges decided upon at the time of the contract in assessing the MRG amount, apply a weighted average of the ratio between the actual traffic and charges at the time of the contract to the actual traffic and charges for the past three years. This method is used rather than applying the ratio between the anticipated income from charges to the actual income from charges for the past three years in order to apply the traffic factor (Q) and the user charge unit (P) separately.

Note: The weighted average is calculated at the ratio of (2013:2012:2011) = (3:2:1).

Furthermore, the assumptions below were made to estimate the MRG amount to be generated for the projects after 2014. The base point was the end of 2013, and a 3% future annual inflation rate was applied. Moreover, the future income from user charges was forecasted based on the actual charges earned during the past three years, where the income from 2013 was given more weight than that of 2011; the weighted average income from each year was calculated at a ratio of 3:2:1.²¹

The forecasted MRG amount based on the above suppositions are shown in the table below. The MRG payment to be issued after 2014 for government-subsidized local projects is estimated to be approximately 100 billion KRW per year for a total of 200 billion KRW. However, local governments are recently easing or abolishing the MRG for the projects that are anticipated to generate excessive MRG payments, targeting the restructuring of the process to result in both low risk and low profit levels. The currently posed burden of the MRG is expected to become lighter if these new attempts succeed.

In addition, similar to the rental fee calculations of BTL projects, the remaining balances of the operation costs were estimated per project and then summed by the local government. Moreover, based on the above data, the sum total of BTL project rental fees, operation costs, estimated MRG amounts for BTO projects, and fixed charges are presented in Table A5 in the appendix.

²¹The payment forecast based on the assumptions in this analysis is a simplified means of forecasting which differs from the forecasting method of the IMF's PFRAM (PPP Fiscal Risk Assessment Model).

TABLE 12— ESTIMATION OF THE MRG AMOUNT TO BE GENERATED IN THE FUTURE

(UNIT: 100 MIL. KRW)

Category	Name of project	Estimated MRG generation after 2014	Estimated MRG generation after 2014 (Present value)	Payment period for remaining MRG after 2014	Annual average of MRG paid during the remaining period
Local government projects	Busan Sujeongsan Tunnel	1,012	758	15	67
	Daegu Buman Road (4)	-	-	-	-
	Gwangju Second Circulation Section 3-1	2,297	1,470	21	109
	Gwangju Second Circulation Section 4	-	-	20	-
	Incheon Munhaksan Tunnel	667	502	9	74
	Incheon Manweolsan Tunnel (3)	-	-	-	-
	Incheon Wonjeoksan Tunnel (3)	-	-	-	-
	Yeoju-si Food Disposal Facility	5	3	9	1
	Boryeong River Sewage System	81	60	12	7
	Mungyeong Gaeun Sewage Treatment Plant	52	42	11	5
	Yangju Sincheon Sewage System (1)	-	-	-	-
	Gangwon Misiryeong Road	1,033	657	23	45
	Gyeryong-Si Waste Incineration Facility	-	-	8	-
	lcheon-Si Sewage System	-	-	6	-
	Gunpo-Si Daeya Sewage System	106	74	16	7
	Gyeongju-Si OedongGeoncheon Sewage System	-	-	5	-
	Gongheung Doyang Sewage Treatment Plant	4	3	12	-
	Pocheon Sludge Fluidized Bed Incineration Facility	-	-	8	-
	Gongju Yugu Gongam Donghaksa Sewage System (2)	-	-	12	-
	Sub-total	5,258	3,569	187	315
Korean government-subsidized projects	Gwangju Second Circulation Section 1	4,940	3,704	15	329
	Seoul Umyeonsan Tunnel	1,425	1,034	21	68
	Seoul Metro Line 9 (3)	-	-	-	-
	Gyeonggi Ilsan Bridge	3,535	2,225	25	141
	Gyeongnam Machang Bridge	6,688	4,160	25	268
	Sub-total	16,587	11,123	86	806
	Grand total	21,846	14,692	273	1,121

Note: 1) Changed into financial projects as Yangju-si took over PPP projects. 2) The MRG amount is calculated by simply carrying over the unchangeable estimated income by contract, which only came into effect as of January of 2006, for 10 months. 3) The MRG is abolished for these projects due to reasons including changes in contracts.

Establishing an upper ceiling for annual government spending for PPP projects is one of the solutions proposed to manage the government's financial risk. This solution involves managing the total annual spending on PPP projects, typically including rental fees for BTL projects, operation costs, MRG payments for BTO projects and fixed charges, by holding it to within 2% of the total annual expenditure budget (a 2% ceiling rule).²² This study estimates the annual government

²²The 2% ceiling rule, however, is proposed for the central government level, and there has not been a suggested rule for the local level. In this paper, we consider each local government as an independent central government and apply the 2% ceiling rule. Even if the 2% rule in this paper is restrictive, our approach is not excessive because each local government with its own budget takes all responsibility for its PPP contracts with private partners. Regarding the relative size of the local government budget, the rule should be tightened. Moreover, the rule was initially proposed based upon the case of the U.K., where the fiscal risk is relatively well managed and the PPP management history is longer than in any other country. Thus, the rule cannot be applied to

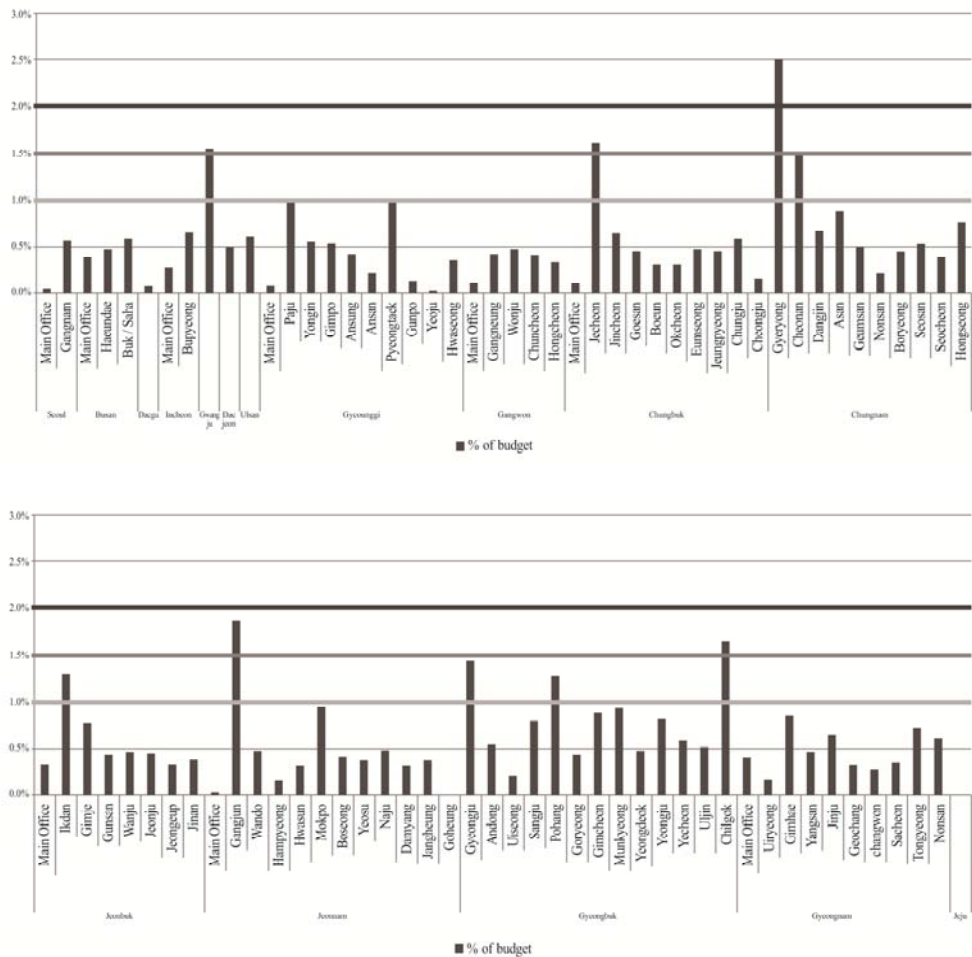


FIGURE 2. RATIO BETWEEN ANNUAL EXPENDITURES AND BUDGETS BY LOW-LEVEL LOCAL GOVERNMENTS

expenditure on PPP projects by local governments and attempts to determine the ratio with regard to the budget. This methodology allows us to examine whether each local government is effectively managing its financial risk in PPP projects based on the 2% ceiling rule. To do this, it was necessary to gather the annual expenditures of various types of government spending, as previously calculated. Due to limited resources, however, annual lease and operation costs were utilized as indicated in contracts, and the average amount of annual payments is presented for the MRG. Therefore, there is a possibility of a gap compared to the actual annual spending. Nonetheless, the analysis used here assumed that the available data was sufficient to understand the scale of the financial burden placed on each

any country, and it must be stricter for countries where fiscal risk is not well maintained. Therefore, the 2% rule is not the only reference, and local governments should not feel comfortable only because the 2% rule is met in their cases.

local government due to PPP projects compared to the original budget.

The results of the analysis conducted here found that the annual spending on PPP projects by Gyeryong-si, Chungnam (2.50%) exceeded 2%, while four local governments, in this case Gangjin-gun in Jeonnam (1.75%), Chilgok-gun in Gyeongbuk (1.64%), and Jecheon-si (1.61%) and Gwangju-si (1.54%) in Chungbuk, recorded annual spending amounts which exceeded 1.5%. These local governments are thus shown to be burdened with excessive financial responsibilities for PPP projects compared to their budgets. The analysis calls for some efforts to ease the financial burdens on local governments from various perspectives as well as a cautious approach for a better execution of new projects in the future.²³

E. Conclusion

The scale of the burden on local finance posed by the PPP investment system pursued by local governments was estimated and changes in financial risk levels were examined. It was a common understanding that local finance does not face a high level of risk if rental fees for BTL and fixed charges for BTO, which carry the features of debt, are included in local government finances. In contrast, the study showed that there are in fact some local governments that have financial risk.

In addition, the estimated annual payment as various government subsidiaries for PPP projects, aside from the payment forms that fall under the debt category, were calculated. These results showed that most local autonomous entities, with an exception of a few, are managing the expenditure within the aforementioned 2% rate of their annual budgets.

This paper differs from earlier work for the following reasons. First, earlier works mainly studied the institutional or policy aspects of PPP projects and did not include a quantitative analysis. At best, some of them merely reviewed one or two PPP projects of a local government to derive policy implications. This paper overcame these limitations and analyzed all of the PPP projects at the local level. Secondly, this paper adopts the Accrual and Double-Entry Bookkeeping Accounting System and considers the lease payment of local governments as government debt. It is unique, in Korea, to sum all lease payments as government debt and consider the fiscal risk of each local government, though doing so is closer to global standards. Thirdly, this work also represents the first attempt to include fixed charges of BTO projects in the analysis. At the earlier stage of Korean PPP, fixed charges were introduced to relieve the risk of the private sector. However, previous works did not include them when considering the fiscal risks of local governments. The characteristics of the charges are very similar to those of the lease fee of BTL projects because the payment of fixed charge is confirmed by agreements. Thus, we included these charges in our analysis. Fourthly, papers related to the fiscal burden from MRG have been published in the literature, but the studies were done mainly at the central level. The present paper can be considered to be the first attempt to analyze all of the fiscal burdens from MRG at the local level and then to provide important policy implications for each local government.

²³See Tables A6 and A7 of the appendix for details.

Finally, the paper is the first to apply the 2% ceiling rule to local governments. With this approach, we can easily check and compare the levels of fiscal risk from the PPP projects of each local government.

PPP projects must be carefully examined before their execution, as they may develop long-term financial risks while lessening the financial burdens. Only considering the fact that PPP projects do not pose short-term burdens may increase the long-term financial risks for local governments, which ultimately can imperil the national financial status. A detailed review and analysis of the financial risk forecast is required for both national and local government-managed PPP projects. Decision making for project execution also requires consideration of the possible financial risks that may harm local governments. In doing so, this study presents the three suggestions below.

First, it is necessary to examine potential financial burdens during the early stage of PPP project execution, which usually includes the steps of eligibility investigation, proposal review, and validation. This will provide an institutional tool as a reference to use when determining a project's validity and eligibility by reviewing the financial burdens during the planning process.

Second, information on the financial risk level, based on the financial status of the local government and project in question, must be studied according to the process of the PPP project review board. A comprehensive review would not only examine the validity of a project but also the potential effects of the project on local finances. Furthermore, the fiscal impact of a PPP project on a smaller local governments can be higher, which should be considered during the project selection process.

Third, it is necessary to consider the extension of the 2% ceiling rule, which is now only applicable to projects managed by central governments, to those managed by local governments. Continuous management is essential for holding estimated expenditures below the 2% ratio relative to the annual budget, whether it is considered as debt or not. Focusing only on debt funds for government subsidiaries may result in some financial risk stemming from MRG payments or BTL operation costs. Therefore, local governments must closely examine the scale of annual government funds for current PPP projects. In addition, it is important to examine the possibility of managing the share of annual government funds within 2% of the annual budget for long-term financial risk management, especially when planning new projects.

A concerted effort to manage the financial risk of PPP projects will ultimately increase the sustainability of and stabilize the PPP investment system. Indiscrete execution of PPP projects that only consider short-term relief of financial burdens and political interests harm the safety of the system and foster negative perspectives toward PPP projects in the long run. We expect a stable, long-term advancement of the PPP investment system through rigorous management of the financial risks of PPP investments based on the suggestions presented here.

APPENDIX

TABLE A1—FACILITY LEASE STATUS BY PROJECT TYPE (PRESENT VALUE)

(UNIT: 100 MIL. KRW)

Competent authority (Lower level)		Name of project	Total facility lease (present value)	Annual facility lease (present value)
Seoul Metropolitan City (2)	Gangnam-gu	Gangnam Geriatric Hospital	686	34
		Establishment of Daechi Reservoir Themed Sports Park	305	15
Busan Metropolitan City (6)	Haeundae-gu	Haeundae New Town Library	238	12
	Buk-gu/Saha-gu (Multiple) Headquarters	Hwamyong Library and Dadae Library	216	11
		Establishment of the 4 th Busan City Geriatric Hospital	154	8
		Establishment of Busan Information Highway	180	23
		Busan Metropolitan City (Gamjeonbun-gu) Sewer Maintenance 2011	1,067	53
		Busan Metropolitan City (Samrak-gu & Deokcheon-gu) Sewer Maintenance 2012	908	45
Daegu Metropolitan City	Headquarters	Daegu City Art Museum	986	49
Incheon Metropolitan City (3)	Bupyeong-gu	Bupyeong Culture & Art Center (Bupyeong Art Center)	670	33
	Headquarters	Relocation of Incheon City Library	339	17
		Incheon Metropolitan City Sewer Maintenance	1,509	75
Gwangju Metropolitan City (2)	Headquarters	Gwangju Metropolitan City Sewer Maintenance 2007	2,272	114
		Gwangju Metropolitan City Sewer Maintenance 2008	1,639	82
Daejeon Metropolitan City (2)	Headquarters	Daejeon Metropolitan City Sewer Maintenance 2006	2,246	112
		Daejeon Metropolitan City Sewer Maintenance 2008	1,593	80
Ulsan Metropolitan City (3)	Headquarters	Ulsan Museum	840	42
		Ulsan Metropolitan City Sewer Maintenance 2006	1,906	95
		Ulsan Metropolitan City Sewer Maintenance 2008	1,940	97
Gyeonggi-do (10)	Paju-si (3)	Paju Kyoha Library	204	10
		Paju-si Sewer Maintenance 2011	1,508	75
		Paju-si Sewer Maintenance	1,454	73
	Yongin-si (2)	Yongin-si Sewer Maintenance 2009	819	41
		Yongin-si Sewer Maintenance	1,791	90
	Gimpo-si	Gimpo-si Sewer Maintenance	1,627	81
	Anseong-si	Anseong-si Sewer	1,219	61
	Ansan-si (2)	Safe Ansan Secure Ansan U-City Establishment Stage 2	98	12
		Establishment of High-Tech Ansan U-City Broadband Information Network	180	18
	Pyeongtaek-si	Pyeongtaek Sewer Maintenance	2,854	143

TABLE A1—FACILITY LEASE STATUS BY PROJECT TYPE (PRESENT VALUE) (Continued)

Competent authority (Lower level)		Name of project	Total facility lease (present value)	Annual facility lease (present value)
Gangwon-do (4)	Gangneung-si	Gangneung-si Sewer Maintenance	1,305	65
	Wonju-si	Wonju-si Sewer Maintenance	2,104	105
	Chuncheon-si	Chuncheon-si Sewer Maintenance	1,902	95
	Hongcheon-gun	Hongcheon-gun Sewer Maintenance	621	31
Chungcheongbuk-do (14)	Jecheon-si (4)	Excellent Herbal Medicine Retail Support Facility	181	9
		Herbal Medicine Life Science Center	321	16
		Jecheon-si Sewer Maintenance 2007	1,391	70
		Jecheon-si Sewer Maintenance 2009	948	47
	Jincheon-gun (2)	Jincheon-gun Sewer Maintenance 2005	360	18
		Jincheon-gun Sewer Maintenance 2006	537	27
	Goesan-gun	Goesan-gun Sewer Maintenance	682	34
	Boeun-gun	Boeun-gun Sewer Maintenance	353	18
	Okcheon-gun	Okcheon-gun Sewer Maintenance	402	20
	Eumseong-gun	Eumseong-gun Sewer Maintenance	856	43
	Jeungpyeong-gun	Jeungpyeong-gun Sewer Maintenance	337	17
	Chungju-si	Chungju-si Sewer Maintenance	1,748	87
	Cheongju-si	Cheongju-si Sewer Maintenance	518	26
	Headquarters	Relocation of Chungju-si Medical Center	1,153	58
Chungcheongnam-do (19)	Gyeryong-si (2)	Gyeryong Culture Multiplex	417	21
		Gyeryong-si Sewer Maintenance	700	35
	Cheonan-si (6)	Cheonan-si Sewer Maintenance (Stage 1)	2,198	110
		Cheonan-si Sewer Maintenance (Stage 2)	942	47
		Establishment of North Cheonan Library	253	13
		Cheonan Life Sports Park	231	12
		Cheonan Hong Dae Yong Science Museum	336	17
		Cheonan Culture & Art Multiplex	1,145	57
	Dangjin-si (2)	Dangjin-si Sewer Maintenance	781	39
		Establishment of Dangjin Education, Culture & Sports Center	350	18
	Asan-si (3)	Asan Indoor Life Sports Center	422	21
		Asan Sewer Maintenance	1,583	79
		Asan Jang Young Sil Science Museum	243	12
	Geumsan-gun	Geumsan-gun Sewer Maintenance	653	33
	Nonsan-si	Nonsan-si Sewer Maintenance	641	32
	Boryeong-si	Boryeong-si Sewer Maintenance	718	36
	Seosan-si	Seosan-si Sewer Maintenance	1,366	68
	Seocheon-gun	Seocheon-gun Sewer Maintenance	598	30
	Hongseong-gun	Hongseong-gun Sewer Maintenance	1,361	68

TABLE A1—FACILITY LEASE STATUS BY PROJECT TYPE (PRESENT VALUE) (Continued)

Competent authority (Lower level)		Name of project	Total facility lease (present value)	Annual facility lease (present value)
Jeollabuk-do (11)	Iksan-si (4)	Establishment of Iksan Culture Multiplex	647	32
		Iksan City Mohyun Library	219	11
		Iksan-si Sewer Maintenance 2006	1,279	64
		Iksan-si Sewer Maintenance 2009	1,568	78
	Gimje-si (2)	Gimje-si Sewer Maintenance 2009	1,223	61
		Gimje-si Sewer Maintenance	592	30
	Gunsan-si	Gunsan-si Sewer Maintenance	1,433	72
	Wanju-gun	Wanju-gun Sewer Maintenance	910	45
	Jeonju-si	Jeonju-si Sewer Maintenance	1,987	99
	Jeongeup-si	Jeongeup-si Sewer Maintenance	1,050	53
	Jinan-gun	Jinan-gun Sewer	499	25
Jeollanam-do (14)	Gangjin-gun (2)	Establishment of Gangjin Culture & Welfare Town	753	38
		Gangjin-gun Sewer	604	30
	Wando-gun	Wando Customized Culture Multiplex	305	15
	Headquarters	Relocation of Gangjin Hospital	602	30
	Hampyeong-gun	Hampyeong-gun Public Geriatric Medical Care Hospital	103	5
	Hwasun-gun	Hwasun Geriatric Hospital	290	15
	Mokpo-si (3)	Mokpo-si Sewer Maintenance 2005	1,101	55
		Mokpo-si Sewer Maintenance 2006	1,302	65
		Mokpo-si Sewer Maintenance 2009	643	32
	Yeosu-si (2)	Yeosu-si Sewer Maintenance 2008	926	46
		Yeosu-si Sewer Maintenance 2005	768	38
	Naju-si	Naju-si Sewer Maintenance	1,207	60
	Damyang-gun	Damyang-gun Sewer Maintenance	480	24
	Jangheung-gun	Jangheung-gun Sewer Maintenance	681	34
Gyeongsangbuk-do (20)	Gyeongju-si (3)	Establishment of Gyeongju Culture & Art Center	1,338	67
		Gyeongju-si Sewer Maintenance 2005	1,785	89
		Gyeongju-si Sewer Maintenance 2008	1,424	71
	Andong-si	Andong Culture & Art enter	951	48
	Uiseong-gun	Uiseong-gun Public Hospital for Dementia	207	10
	Sangju-si (2)	Sangju-si Sewer Maintenance 2005	1,405	70
		Sangju-si Sewer Maintenance 2006	932	47
	Pohang-si (3)	Pohang-si Sewer Maintenance 2007	2,862	143
		Pohang-si Sewer Maintenance 2009	1,537	77
		Pohang-si Sewer Maintenance 2010	1,730	86

TABLE A1—FACILITY LEASE STATUS BY PROJECT TYPE (PRESENT VALUE) (Continued)

Competent authority (Lower level)		Name of project	Total facility lease (present value)	Annual facility lease (present value)
Gyeongsangbuk-do (20)	Goryeong-gun	Goryeong-gun Sewer Maintenance	530	27
	Gimcheon-si (2)	Gimcheon-si Sewer Maintenance	1,347	67
		Gimcheon Green Future Science Museum	568	28
	Mungyeong-si	Mungyeong-si Sewer Maintenance	1,749	87
	Yeongdeok-gun	Yeongdeok-gun Sewer Maintenance	708	35
	Yeongju-si (2)	Yeongju-si Sewer Maintenance 2010	744	37
		Yeongju-si Sewer Maintenance	1,425	71
	Yecheon-gun	Yecheon-gun Sewer Maintenance	820	41
	Uljin-gun	Uljin-gun Sewer Maintenance	1,200	60
	Chilgok-gun	Chilgok-gun Sewer Maintenance	1,603	80
Gyeongsangnam-do (13)	Uiryeong-gun	Uiryeong Geriatric Hospital	74	4
	Gimhae-si (3)	Gimhae-si Sewer Maintenance 2005	1,599	80
		Gimhae-si Sewer Maintenance 2006	1,470	74
		Gimhae-si Sewer Maintenance 2008	1,052	53
	Yangsan-si (2)	Yangsan-si Sewer Maintenance 2006	958	48
		Yangsan-si Sewer Maintenance 2008	660	33
	Jinju-si (2)	Jinju-si Sewer Maintenance 2006	1,333	67
		Jinju-si Sewer Maintenance 2008	1,758	88
	Geochang-gun	Geochang-gun Sewer	587	29
	Changwon-si (2)	Changwon-si Masan Sewer Maintenance	2,207	110
		Changwon Science Experience EXPO	534	27
	Sacheon-si	Sacheon High-Tech Aviation Space Science Museum	227	11
	Tongyeong-si	Tongyeong Sewer Maintenance	1,696	85
Jeju Special Self-Governing Province (10)		Establishment of Jeju Culture Multiplex	270	13
		Jeju Special Self-Governing Province Art Museum	288	14
		Seogwipo Hospital	744	37
		Seogwipo-si Country & Town Sewer Maintenance 2006	1,719	86
		Jeju-si Country & Town Sewer Maintenance 2006	1,135	57
		Jeju-si (East) Sewer Maintenance 2006	1,045	52
		Jeju-si (East) Sewer Maintenance 2008	1,201	60
		Jeju-si Country & Town Sewer Maintenance 2008	1,776	89
		Jeju-si Country & Town Sewer Maintenance 2009	893	45
		Jeju-si Country & Town Sewer Maintenance 2010	771	39
Total			132,139	6,634

Note: 1) “()” Indicates the number of projects. 2) Total facility rental fee is the national treasury and local funds combined by contract at the present value.

TABLE A2—ESTIMATED BALANCE OF BTL LEASES BY LOCAL AUTONOMOUS ENTITIES

(UNIT: 1 MILLION KRW)

Headquarters		Total Amount of Lease	Lease payments expected from 2014
Seoul	Gangnam	98,974	53,701
Busan	Haeundae	23,782	19,139
	Buk/Saha	21,621	12,181
	Main Office	230,940	155,895
Daegu		98,576	50,202
Incheon	Bupyeong	66,983	51,860
	Main Office	184,779	124,636
Gwangju		391,102	264,179
Daejeon		383,886	250,315
Ulsan		468,527	221,802
Gyeonggi	Paju	316,618	95,120
	Yongin	261,002	72,458
	Gimpo	162,652	48,795
	Ansung	121,867	36,253
	Ansan	27,788	20,647
	Pyungtaek	285,446	90,695
Gangwon	Gangneung	130,538	28,142
	Wonju	210,423	57,207
	Chunchun	190,153	57,048
	Hongchun	62,054	15,825
Chungbuk	Jecheon	284,123	88,019
	Jincheon	89,684	21,564
	Goisan	68,222	18,217
	Boeun	35,309	7,207
	Ogchen	40,208	9,999
	Umsung	85,642	21,517
	Jeungpyung	33,655	7,994
	Chungju	174,766	46,966
	Cheongju	51,837	23,762
	Main Office	115,340	52,623
Chungnam	Gyeryong	111,732	48,703
	Cheonan	510,570	221,256
	Dangjin	113,194	35,368
	Asan	224,801	75,947
	Geumsan	65,340	16,906
	Nonsan	64,147	15,153
	Boryung	71,789	21,219
	Seosan	136,587	38,754
	Seocheon	59,759	15,911
	Main Office	975	17,807

TABLE A2—ESTIMATED BALANCE OF BTL LEASES BY LOCAL AUTONOMOUS ENTITIES (*Continued*)

(UNIT: 1 MILLION KRW)

Headquarters		Total Amount of Lease	Lease payments expected from 2014
Jeonbuk	Iksan	371,259	141,743
	Gimje	181,507	54,450
	Gunsan	143,285	37,611
	Wanju	90,987	23,199
	Jeonju	198,710	81,135
	Jeongup	105,020	22,071
	Jinan	49,928	11,897
Jeonnam	Gangjin	60,181	28,084
	Wando	135,660	60,015
	Main Office	30,456	14,991
	Hampyung	10,274	4,880
	Hwasun	28,995	14,532
	Mokpo	304,662	81,060
	Yeosu	169,376	46,398
	Naju	120,679	34,393
	Damyang	48,032	9,127
	Janheung	68,104	17,535
Gyeongbuk	Gyeongju	454,659	196,817
	Andong	95,112	48,889
	Uisong	20,711	10,101
	Sanju	233,648	56,715
	Pohang	612,819	183,840
	Goryung	53,040	9,869
	Gimcheon	191,498	63,590
	Mungyung	174,914	47,767
	Youngduk	70,783	16,810
	Youngju	216,877	65,064
	Yecheon	82,025	24,607
	Uljin	120,009	32,700
	Chilgok	160,268	44,472
Gyeongnam	Uiryeong	7,409	3,222
	Gimhae	412,131	112,800
	Yongsan	161,776	38,968
	Jinju	309,096	88,731
	Geochang	58,708	11,873
	Changwon	274,123	79,021
	Sacheon	22,743	10,801
	Tongyeong	169,644	49,407
Jeju		984,048	340,932

TABLE A3—CHANGE IN DEBT RATIO WHEN INCLUDING THE BTL LEASE BALANCE

(UNIT: 100 MIL. KRW, %)

Category	Low-level local government	Debt (A)	Budget (Grand total including fund) (B)	Debt-to-budget ratio (A/B) (%)	Rent balance of BTL project (Present value)	Debt including BTL lease balance (A')	Debt-to-budget ratio (A'/B)
Seoul	Gangnam-gu	0	8,333	0/00	398	398	4.77%
Busan	Headquarters	28,670	103,085	27.80	1,140	29,810	28.92%
	Buk-gu	1	3,116	0.00	93	94	3.01%
	Haeundae	25	4,123	0.60	146	171	4.14%
Daegu	Headquarters	19,379	68,877	28.10	382	19,761	28.69%
Incheon	Headquarters	31,981	88,593	36.10	910	32,891	37.13%
	Bupyeong-gu	384	5,169	7.40	396	780	15.09%
Gwangju	Headquarters	7,987	39,787	20.10	1,918	9,905	24.89%
Daejeon	Headquarters	6,687	40,003	16.70	1,834	8,521	21.30%
Ulsan	Headquarters	5,215	30,461	17.10	1,647	6,862	22.53%
Gyeonggi	Yongin-si	5,211	17,993	29.00	535	5,746	31.93%
	Ansan-si	187	21,092	0.90	181	368	1.75%
	Pyeongtaek-si	719	11,956	6.00	656	1,375	11.50%
	Paju-si	833	9,185	9.10	701	1,534	16.70%
	Gimpo-si	981	7,941	12.40	351	1,332	16.77%
Gangwon	Anseong-si	122	6,600	1.80	261	383	5.80%
	Chuncheon-si	910	10,812	8.40	410	1,320	12.21%
	Wonju-si	1,563	9,810	15.90	419	1,982	20.20%
	Gangneung-si	736	7,449	9.90	213	949	12.74%
	Hongcheon-gun	0	5,265	0.00	119	119	2.26%
Chungbuk	Headquarters	6,105	38,384	15.90	388	6,493	16.92%
	Cheongju-si	1,482	12,847	11.50	181	1,663	12.94%
	Chungju-si	303	8,715	3.50	348	651	7.47%
	Jecheon-si	0	5,753	0.00	646	646	11.23%
	Boeun-gun	165	3,116	5.30	55	220	7.05%
	Okcheon-gun	157	3,921	4.00	76	233	5.93%
	Jeungpyeong-gun	85	1,878	4.50	61	146	7.78%
	Jincheon-gun	170	3,460	4.90	164	334	9.66%
	Goesan-gun	0	3,711	0.00	134	134	3.61%
Chungnam	Eumseong-gun	65	4,798	1.40	164	229	4.78%
	Cheonan-si	2,033	13,534	15.00	1,634	3,667	27.01%
	Boryeong-si	857	6,067	14.10	157	1,014	16.72%
	Asan-si	777	9,413	8.30	570	1,347	14.31%
	Seosan-si	429	6,737	6.40	283	712	10.57%
	Nonsan-si	433	5,745	7.50	116	549	9.56%
	Gyeryong-si	199	1,746	11.40	358	557	31.88%
	Dangjin-si	358	7,023	5.10	269	627	8.92%
	Geumsan-gun	129	3,611	3.60	127	256	7.08%
	Seocheon-gun	138	4,016	3.40	118	256	6.38%
Jeonbuk	Hongseong-gun	309	4,611	6.70	292	601	13.03%
	Jeonju-si	1,917	14,335	13.40	616	2,533	17.67%
	Gunsan-si	489	9,627	5.10	280	769	7.99%
	Iksan-si	1,780	10,324	17.20	1,032	2,812	27.24%
	Jeongeup-si	594	6,749	8.80	168	762	11.29%
	Gimje-si	219	6,359	3.40	371	590	9.27%
	Wanju-gun	827	5,443	15.20	174	1,001	18.40%
	Jinan-gun	18	3,326	0.50	88	106	3.18%

TABLE A3—CHANGE IN DEBT RATIO WHEN INCLUDING THE BTL LEASE BALANCE (*Continued*)

(UNIT: 100 MIL. KRW, %)

Category	Low-level local government	Debt (A)	Budget (Grand total including fund) (B)	Debt-to-budget ratio (A/B) (%)	Rent balance of BTL project (Present value)	Debt including BTL lease balance (A')	Debt-to-budget ratio (A'/B)
Jeonnam	Headquarters	10,683	69,987	15.30	206	10,889	15.56%
	Mokpo-si	953	6,717	14.20	602	1,555	23.14%
	Yeoju-si	916	9,923	9.20	341	1,257	12.67%
	Naju-si	344	6,041	5.70	251	595	9.85%
	Damyang-gun	78	3,446	2.30	70	148	4.29%
	Hwasun-gun	261	4,900	5.30	108	369	7.54%
	Jangheung-gun	80	3,523	2.30	131	211	6.00%
	Gangjin-gun	55	3,140	1.80	451	506	16.12%
	Hampyeong-gun	60	3,309	1.80	36	96	2.89%
Gyeongbuk	Wando-gun	0	4,223	0.00	114	114	2.69%
	Pohang-si	1,414	13,678	10.30	1,321	2,735	19.99%
	Gyeongju-si	593	12,008	4.90	1,475	2,068	17.22%
	Gimcheon-si	0	6,791	0.00	467	467	6.87%
	Andong-si	130	8,951	1.50	370	500	5.58%
	Yeongju-si	395	5,820	6.80	467	862	14.82%
	Sangju-si	423	6,771	6.20	428	851	12.57%
	Mungyeong-si	454	4,943	9.20	349	803	16.25%
	Uiseong-gun	0	4,879	0.00	73	73	1.50%
	Yeongdeok-gun	199	3,318	6.00	129	328	9.87%
	Goryeong-gun	33	2,889	1.10	74	107	3.71%
	Chilgok-gun	446	4,614	9.70	327	773	16.75%
Gyeongnam	Yecheon-gun	210	3,552	5.90	177	387	10.89%
	Ulsan-gun	159	5,575	2.90	241	400	7.18%
	Changwon-si	2,013	27,307	7.40	593	2,606	9.54%
	Jinju-si	1,215	11,584	10.50	645	1,860	16.06%
	Tongyeong-si	398	5,083	7.80	358	756	14.87%
	Sacheon-si	232	4,813	4.80	79	311	6.46%
	Gimhae-si	1,419	11,645	12.20	839	2,258	19.39%
	Yangsang-si	1,122	7,926	14.20	290	1,412	17.81%
Jeju	Uiryeong-gun	96	3,651	2.60	24	120	3.29%
	Geochang-gun	8	5,014	0.20	88	96	1.92%
	Headquarters	6,927	42,914	16.10	2,504	9,431	21.98%

Note: 1) 3.38%, the average yield of Korean Treasury bonds (five-year maturity) over the past three years, is applied as the discount rate of the present value. 2) Although Buk-gu and Saha-gu, Busan, are multiple competent authorities in charge of the Hwamyeong Library and Dadae Library projects, the comparison is made under Buk-gu, as it is difficult to identify each local government's share due to limited resources. 3) Local governments that have a debt-to-budget ratio exceeding 20% are in bold.

TABLE A4—ESTIMATED OPERATION COST BALANCE OF
BTL PROJECTS BY LOCAL GOVERNMENTS

Competent authority (Lower level)		Estimation of average annual operation cost by local government	Estimation of remaining operation cost as of year-end 2013	Competent authority (Lower level)		Estimation of average annual operation cost by local government	Estimation of remaining operation cost as of year-end 2013
Seoul Metro- politan City	Gangnam-gu (2)	15	264	Jeolla buk-do (11)	Iksan-si (4)	44	837
Busan Metro- politan City (6)	Haeundae	7	117		Gimje-si (2)	17	316
	Buk-gu/ Saha-gu	11	169		Gunsan-si	16	280
	Headquarters (4)	37	513		Wanju-gun	9	151
Daegu Metropolitan City		12	194		Jeonju-si	8	133
Incheon Metro- politan City (3)	Bupyeong-gu	0.018	3		Jeongeup-si	6	98
	Headquarters	40	736		Jinan-gun	5	87
Gwangju Metropolitan City (2)		36	699	Jeolla nam-do (14)	Gangjin-gun (2)	7	124
Daejeon Metropolitan City (2)		58	1,101		Wando-gun	19	332
Ulsan Metropolitan City (3)		54	969		Headquarters	9	144
Gyeonggi- do (10)	Paju-si (3)	39	704		Hampyeong-gun	2	43
	Yongin-si (3)	58	1,060		Hwasun-gun	5	88
	Gimpo-si	17	333		Mokpo-si (3)	15	272
	Anseong-si	8	167		Yeosu-si (2)	13	243
	Ansan-si (2)	13	91		Naju-si	10	194
	Pyeongtaek-si	18	354		Damyang-gun	5	79
Gangwon- do (4)	Gangneung-si	13	219		Jangheung-gun	3	48
	Wonju-si	15	278		Gyeongju-si (3)	52	896
	Chuncheon-si	14	280	Gyeong sang buk-do (20)	Andong-si	19	309
	Hongcheon-gun	9	147		Uiseong-gun	5	91
					Sangju-si (2)	18	299

TABLE A4—ESTIMATED OPERATION COST BALANCE OF
BTL PROJECTS BY LOCAL GOVERNMENTS (*Continued*)

Competent authority (Lower level)		Estimation of average annual operation cost by local government	Estimation of the remaining operation cost as of year-end 2013	Competent authority (Lower level)		Estimation of the average annual operation cost by local governments	Estimation of the remaining year-end operation cost as of 2013
Chung cheong buk-do (14)	Jecheon-si (4)	45	797	Chung cheong nam-do (19)	Pohang-si (3)	31	610
	Jincheon-gun (2)	8	129		Goryeong-gun	8	135
	Goesan-gun	7	122		Gimcheon-si (2)	23	422
	Boeun-gun	5	79		Mungyeong-si	16	293
	Okcheon-gun	6	100		Yeongdeok-gun	5	85
	Eumseong-gun	9	154		Yeongju-si (2)	19	387
	Jeungpyeong-gun	3	50		Yecheon-gun	7	143
	Chungju-si	23	419		Uljin-gun	10	190
	Cheongju-si	3	52		Chilgok-gun	13	236
Chung cheong nam-do (19)	Headquarters	10	178		Uiryeong-gun	3	51
	Gyeryong-si (2)	15	262		Gimhae-si (3)	26	474
	Cheonan-si (6)	77	1,393		Yangsan-si (2)	17	296
	Dangjin-si (2)	25	403		Jinju-si (2)	26	495
	Asan-si (3)	37	648		Geochang-gun	5	94
	Geumsan-gun	8	140		Changwon-si (2)	18	300
	Nonsan-si	3	52		Sacheon-si	7	137
	Boryeong-si	8	141		Tongyeong-si	14	272
	Seosan-si	15	292		Jeju Special Self-Governing Province (10)	100	1,824
	Seocheon-gun	6	108				
	Hongseong-gun	14	282				

Note: 1) “()” indicates the number of projects. 2) All operation costs are paid by local governments.

TABLE A5—ESTIMATION TOTAL OF
FUTURE PAYMENT AMOUNTS (PRESENT VALUES) REGARDING
PPP PROJECTS BY LOCAL GOVERNMENTS

(UNIT: 100 MIL. KRW)

Competent authority (Lower level)		Estimation of BTL lease balance by local governments	Estimation of BTL operation cost balance by local governments	Estimation of MRG balance by local governments	Estimation of fixed charges balance by local governments	Total
Seoul Metropolitan City	Headquarters			1,425		1,425
	Gangnam-gu	537	264			801
Busan Metropolitan City	Headquarters	1,559	513	1,012	1,531	4,615
	Haeundae-gu	191	117			308
	Buk-gu/Saha-gu	122	169			291
Daegu Metropolitan City			502	194		696
Incheon Metropolitan City	Headquarters	1,246	736	667	844	3,494
	Bupyeong-gu	519	3			521
Gwangju Metropolitan City		2,642	699	7,237		10,578
Daejeon Metropolitan City		2,503	1101			3,604
Ulsan Metropolitan City		2,218	969			3,187
Gyeonggi-do	Headquarters			3,535		3,535
	Paju-si	951	704			1,655
	Yongin-si	725	1060			1,784
	Gimpo-si	488	333			821
	Anseong-si	363	167			530
	Ansan-si	206	91			297
	Pyeongtaek-si	907	354		873	2,134
	Gunpo-Si			106		106
	Yeoju-si			5		5
Gangwon-do	Hwaseong-si				733	733
	Headquarters			1,033		1,033
	Gangneung-si	281	219			501
	Wonju-si	572	278			850
	Chuncheon-si	570	280			851
	Hongcheon-gun	158	147			306
Chungcheong buk-do	Headquarters	526	178			704
	Jecheon-si	880	797			1,677
	Jincheon-gun	216	129			345
	Goesan-gun	182	122			304
	Boeun-gun	72	79			151
	Okcheon-gun	100	100			200
	Eumseong-gun	215	154			369
	Jeungpyeong-gun	80	50			130
	Chungju-si	470	419			888
	Cheongju-si	238	52			290
	Gyeryong-si	487	261			749
	Cheonan-si	2,213	1393			3,606
Chungcheong nam-do	Dangjin-si	354	403			757
	Asan-si	759	648			1,407
	Geumsan-gun	169	140			309
	Nonsan-si	152	52			204
	Boryeong-si	212	141	81		434
	Seosan-si	388	292			680
	Seocheon-gun	159	108			268
	Hongseong-gun	405	282			687

TABLE A5—ESTIMATION TOTAL OF
FUTURE PAYMENT AMOUNTS (PRESENT VALUES) REGARDING
PPP PROJECTS BY LOCAL GOVERNMENTS (*Continued*)

(UNIT: 100 MIL. KRW)

Competent authority (Lower level)		Estimation of BTL lease balance by local governments	Estimation of BTL operation cost balance by local governments	Estimation of MRG balance by local governments	Estimation of fixed charges balance by local governments	Total
Jeollabuk-do	Headquarters				2,795	2,795
	Iksan-si	1,417	837			2,254
	Gimje-si	545	316			861
	Gunsan-si	376	280			656
	Wanju-gun	232	151			383
	Jeonju-si	811	133			944
	Jeongeup-si	221	98			318
Jeollanam-do	Jinan-gun	119	87			206
	Headquarters	281	124			405
	Gangjin-gun	600	332			932
	Wando-gun	150	144			294
	Hampyeong-gun	49	43			92
	Hwasun-gun	145	88			233
	Mokpo-si	811	272			1,082
	Bosung-gun				137	137
	Yeosu-si	464	243			707
	Naju-si	344	194			538
	Damyang-gun	91	79			170
	Jangheung-gun	175	48			223
	Goheung-gun			4		4
Gyeongsang buk-do	Gyeongju-si	1,968	896			2,865
	Andong-si	489	309			797
	Uiseong-gun	101	91			192
	Sangju-si	567	299			866
	Pohang-si	1,838	610		542	2,991
	Goryeong-gun	99	135			233
	Gimcheon-si	636	422			1,058
	Mungyeong-si	478	293	52		823
	Yeongdeok-gun	168	85			253
	Yeongju-si	651	387			1,038
	Yecheon-gun	246	143			389
	Uljin-gun	327	190			517
	Chilgok-gun	445	236		575	1,255
	Headquarters			6,688		6,688
Gyeongsang nam-do	Uiryeong-gun	32	51			83
	Gimhae-si	1,128	474			1,602
	Yangsan-si	390	296			686
	Jinju-si	887	495			1,382
	Geochang-gun	119	94			213
	Changwon-si	790	300			1,090
	Sacheon-si	108	137			245
	Tongyeong-si	494	272			766
Jeju Special Self-Governing Province		3,409	1,824			5,233

TABLE A6—RATIO BETWEEN ANNUAL EXPENDITURE AND
BUDGET BY LOW-LEVEL LOCAL GOVERNMENTS

Local government (Basics)		Ratio to budget Annual Gov't Payment/Budget ratio
Seoul	Main Office	0.03%
	Gangnam	0.54%
Busan	Main Office	0.37%
	Haeundae	0.46%
	Buk/Saha	0.58%
Daegu		0.06%
Incheon	Main Office	0.26%
	Bupyeong	0.63%
Gwangju		1.54%
Daejeon		0.48%
Ulsan		0.59%
Gyeonggi	Main Office	0.08%
	Paju	1.00%
	Yongin	0.55%
	Gimpo	0.52%
	Ansung	0.40%
	Ansan	0.21%
	Pyungtaek	1.02%
	Gunop	0.13%
	Yeoju	0.01%
Gangwon	Hwasung	0.34%
	Main Office	0.09%
	Gangneung	0.41%
	Wongju	0.46%
	Chunchun	0.39%
Chungbuk	Hongchun	0.34%
	Main Office	0.10%
	Jecheon	1.61%
	Jincheon	0.62%
	Goisan	0.44%
	Boeun	0.30%
	Okcheon	0.31%
	Umsung	0.46%
	Jengpyung	0.44%
	Chungju	0.57%
Chungnam	Cheongju	0.14%
	Gyeryong	2.50%
	Chenan	1.47%
	Dangjin	0.67%
	Asan	0.87%
	Geumsan	0.50%
	Nonsan	0.22%
	Boryung	0.44%
	Seosan	0.53%
	Seocheon	0.38%
	Hongsung	0.75%

TABLE A6—RATIO BETWEEN ANNUAL EXPENDITURE AND
BUDGET BY LOW-LEVEL LOCAL GOVERNMENTS (*Continued*)

Local government (Basics)		Ratio to budget Annual Gov't Payment/Budget ratio
Jeonbuk	Main Office	0.29%
	Iksan	1.15%
	Gimje	0.69%
	Gunsan	0.39%
	Wanju	0.41%
	Jeonju	0.40%
	Jeungup	0.29%
Jeonnam	Jinan	0.34%
	Main Office	0.03%
	Gangjin	1.75%
	Wando	0.42%
	Hampyung	0.15%
	Hwasun	0.27%
	Mokpo	0.90%
	Bosung	0.39%
	Yeosu	0.39%
	Naju	0.47%
Gyeongbuk	Damyang	0.31%
	Jangheung	0.37%
	Goheung	0.01%
	Gyeongju	1.39%
	Andong	0.54%
	Uisung	0.20%
	Sangju	0.77%
	Pohang	1.29%
	Goryung	0.48%
	Gimcheon	0.84%
	Mungyeong	0.92%
	Youngduk	0.48%
	Youngju	0.74%
Gyeongnam	Yecheon	0.55%
	Uljin	0.51%
	Chilgok	1.64%
	Main Office	0.35%
	Uiryung	0.13%
	Gimhae	0.78%
	Yangsan	0.49%
	Jinju	0.63%
	Geochang	0.24%
Jeju Special Self-Governing Province	Changwon	0.24%
	Sacheon	0.27%
	Tongyoung	0.78%
Jeju Special Self-Governing Province		0.66%

TABLE A7—TOTAL ANNUAL EXPENDITURE ON PPP PROJECTS COMPARED TO THE BUDGET BY LOCAL GOVERNMENTS

(UNIT: 100 MIL. KRW)

Competent authority (Lower level)		Budget (Grand total including funds)	Annual BTL lease	Fixed charges in 2013	Annual BTL operation cost	Average annual MRG payments	Total	Ratio to budget (%)
Seoul Metropolitan City	Headquarters	260,345				68	68	0.03%
	Gangnam-gu	8,333	31		15		45	0.54%
Busan Metropolitan City	Headquarters	103,085	96	183	37	67	383	0.37%
	Haeundae-gu	4,123	12		7		19	0.46%
	Buk-gu	3,116	8		10		18	0.58%
Daegu Metropolitan City		68,877	31		12		43	0.06%
Incheon Metropolitan City	Headquarters	88,593	66	48	40	74	229	0.26%
	Bupyeong-gu	5,169	33		0.18		33	0.63%
Gwangju Metropolitan City		39,787	137		36	439	612	1.54%
Daejeon Metropolitan City		40,003	134		58		193	0.48%
Ulsan Metropolitan City		30,461	125		54		180	0.59%
Gyeonggi-do	Headquarters	174,935				141	141	0.08%
	Paju-si	9,185	53		39		92	1.00%
	Yongin-si	17,993	40		58		98	0.55%
	Gimpo-si	7,941	24		17		41	0.52%
	Anseong-si	6,600	18		8		27	0.40%
	Ansan-si	21,092	30		13		43	0.21%
	Pyeongtaek-si	11,956	46	58	18		122	1.02%
	Gunpo-Si	4,963				7	7	0.13%
	Yeoju-si	3,731				1	1	0.01%
Gangwon-do	Hwaseong-si	14,150		49			49	0.34%
	Headquarters	48,461				45	45	0.09%
	Gangneung-si	7,449	17		13		30	0.41%
	Wonju-si	9,810	31		15		45	0.46%
	Chuncheon-si	10,812	29		14		43	0.39%
	Hongcheon-gun	5,265	9		9		18	0.34%
Chungcheong buk-do	Headquarters	38,384	29		10		39	0.10%
	Jecheon-si	5,753	48		45		92	1.61%
	Jincheon-gun	3,460	13		8		21	0.62%
	Goesan-gun	3,711	10		7		16	0.44%
	Boeun-gun	3,116	4		5		9	0.30%
	Okcheon-gun	3,921	6		6		12	0.31%
	Eumseong-gun	4,798	13		9		22	0.46%
	Jeungpyeong-gun	1,878	5		3		8	0.44%
	Chungju-si	8,715	26		23		50	0.57%
	Cheongju-si	12,847	15		3		18	0.14%
Chungcheong nam-do	Gyeryong-si	1,746	28		15		44	2.50%
	Cheonan-si	13,534	122		77		199	1.47%
	Dangjin-si	7,023	22		25		47	0.67%
	Asan-si	9,413	45		37		82	0.87%
	Geumsan-gun	3,611	10		8		18	0.50%
	Nonsan-si	5,745	10		3		13	0.22%
	Boryeong-si	6,067	12		8	7	26	0.44%
	Seosan-si	6,737	20		15		36	0.53%
	Seocheon-gun	4,016	9		6		15	0.38%
	Hongseong-gun	4,611	20		14		35	0.75%

TABLE A7—TOTAL ANNUAL EXPENDITURE ON PPP PROJECTS COMPARED TO THE BUDGET BY LOCAL GOVERNMENTS (*Continued*)

(UNIT: 100 MIL. KRW)

Competent authority (Lower level)		Budget (Grand total including funds)	Annual BTL lease	Fixed charges in 2013	Annual BTL operation cost	Average annual MRG payments	Total	Ratio to budget (%)
Jeollabuk-do	Headquarters	53,235	0	155			155	0.29%
	Iksan-si	10,324	74		44		119	1.15%
	Gimje-si	6,359	27		17		44	0.69%
	Gunsan-si	9,627	21		44		65	0.68%
	Wanju-gun	5,443	14		9		23	0.41%
	Jeonju-si	14,335	50		8		58	0.40%
	Jeongeup-si	6,749	14		6		20	0.29%
	Jinan-gun	3,326	6		5		11	0.34%
Jeollanam-do	Headquarters	69,987	15		7		22	0.03%
	Gangjin-gun	3,140	35		19		55	1.75%
	Wando-gun	4,223	9		9		18	0.42%
	Hampyeong-gun	3,309	3		2		5	0.15%
	Hwasun-gun	4,900	8		5		13	0.27%
	Mokpo-si	6,717	46		15		61	0.90%
	Bosung-gun	3,942	0	15			15	0.39%
	Yeosu-si	9,923	25		13		38	0.39%
	Naju-si	6,041	18		10		28	0.47%
	Damyang-gun	3,446	6		5		11	0.31%
	Jangheung-gun	3,523	10		3		13	0.37%
	Goheung-gun	5,557				0.36	0	0.01%
Gyeongsang buk-do	Gyeongju-si	12,008	115		52		167	1.39%
	Andong-si	8,951	29		19		48	0.54%
	Uiseong-gun	4,879	5		5		10	0.20%
	Sangju-si	6,771	34		18		52	0.77%
	Pohang-si	13,678	92	54	31		176	1.29%
	Goryeong-gun	2,889	6		8		14	0.48%
	Gimcheon-si	6,791	34		23		57	0.84%
	Mungyeong-si	4,943	25		16	5	46	0.92%
	Yeongdeok-gun	3,318	11		5		16	0.48%
	Yeongju-si	5,820	23		19		43	0.74%
	Yecheon-gun	3,552	12		7		19	0.55%
	Uljin-gun	5,575	18		10		28	0.51%
	Chilgok-gun	4,614	24	39	13		76	1.64%
Gyeongsang nam-do	Headquarters	76,969				268	268	0.35%
	Uiryeong-gun	3,651	2		3		5	0.13%
	Gimhae-si	11,645	64		26		90	0.78%
	Yangsan-si	7,926	22		17		39	0.49%
	Jinju-si	11,584	46		26		72	0.63%
	Geochang-gun	5,014	7		5		12	0.24%
	Changwon-si	27,307	46		18		65	0.24%
	Sacheon-si	4,813	6		7		13	0.27%
Jeju Special Self-Governing Province	Tongyeong-si	5,083	25		14		39	0.78%
		42,914	185		100		285	0.66%

REFERENCES

- Cho, Ki-hyun.** 2010. "Improvement Solutions of Local Debt Management System for Advancement of Local Finance." Local Finance and Local Taxes Local Finance Association, Book 30, 61–88.
- Choi, Seok-jun.** 2007. "Direction of Finance Management of BTL Projects: Focusing on the Evaluation Criteria of Determining National Debt and Management Solutions in Terms of Finance." *Journal of Economic Policy* 29 (1): 137–175.
- Choi, Seok-jun.** 2008. "The Problems of BTL Projects and Its Influence on Financial Integrity." Debate Reference, National Assembly Budget Office.
- Eurostat.** 2012. "Manual on Government Deficit and Debt." 4th Edition.
- IASB (International Accounting Standards Board).** "International Financial Reporting Standard (IFRS)." <http://www.ifrs.org>
- IMF.** 2007. "Public Investment and Public-Private Partnerships."
- Jung, Sung-ho.** 2012. "Consideration of Potential Financial Risks of Metropolitan City and Province Local Autonomous Entities: A Comprehensive Debt Management Solution." Local Finance 2012 6th Issue, 74–101.
- Jung, Sung-ho.** 2013. "A Comprehensive Debt Management for Improvement of Financial Integrity: Relationship Between the Finance of Local Metropolitan City and Province Local Autonomous Entities, Public Enterprises and PPP projects (BTO, BTL)." Korean Journal of Local Finance Book 18 1st Issue, 131–162.
- Jung, Sung-ho et al.** 2013. "Tasks of and Solutions to Financial Crisis of Local Governments." Korean Association for Public Administration Summer Symposium Journal 2013 Issue, 1880–1911.
- Kwak, Chae-gi.** 2013. "Operation Results and Re-structuring Measures of the Early Warning System for Local Finance Risk." Local Finance Association, Local Finance 2013 1st Issue, 100–125.
- Min, Ki.** 2009. "The Financial Management System of Local Government on BTL (Build-Transfer-Lease) Project Finance." *Local Government Studies* 13 (3): 207–222.
- Min, Ki.** 2013. "The Financial Management of Public-Private Partnerships for the Fiscal Soundness of Local Government." *Korean Journal of Local Finance Book* 18:1–24.
- PPP/PFI.** 2009-2010. "HM Treasury, 'Tangible Non-Current Assets'." Financial Report Manual.
- Suh, Jeong-sub.** 2010. "Current Situation and Limitations of Local Finance Risk Management System." Local Finance and Local Taxes Local Finance Association, Book 34, pp.22–42.
- The Korea Research Institute for Local Administration.** 2008. "Improving the Management System of Local Government Finance: Focusing on Local Financial Crisis Solutions." Research Report Book 421, 1–191.

Copyright Royalty Regulation and Competition in the Music Retail Market[†]

By YONGHYEON YANG*

Price control can restore efficiency in some cases, but an uncarefully designed policy fails to restore efficiency, yields side effects, or even exacerbates efficiency losses. This paper shows that the copyright royalty rule, which takes the greater of ad valorem royalties and per-unit royalties, tends to fix the prices of final goods at a specific level. Such a rule weakens competition as it prevents prices from decreasing even when market conditions change, having negative effects on social welfare as well as consumer surplus. Counterfactual analyses using estimation results in the Korean online music service industry show that firms could have profitably reduced prices if the ad valorem rule had been applied instead, although they did not have an incentive to do so under the original combination rule.

Key Word: Price Control, Copyright Royalty, Royalty Regulation,
Ad valorem Rule, Per-unit Rule, Combination Rule,
Online Music Service Industry

JEL Code: D43, L43, L51

I. Introduction

Price control is known to cause deadweight losses in general, as the transaction volume cannot reach the socially optimal level. On the other hand, there are some cases in which price control can restore efficiency, such as under a natural monopoly, for public goods, and/or when externalities exist. For these reasons, the Korean government tries to control price in many industries. However, in some cases, an uncarefully designed policy fails to restore efficiency, yields side effects, or even exacerbates efficiency losses. For instance, Cho (2014) and Cho (2015) show that price control in the book sales industry has a negative impact on social welfare.

This paper investigates the Korean online music service industry, showing that copyright royalty rules used to be designed to fix the price of the final good at a

* Fellow, Korea Development Institute (e-mail: yangyh@kdi.re.kr)

* Received: 2016. 9. 30

* Referee Process Started: 2016. 10. 6

* Referee Reports Completed: 2016. 12. 13

specific level, which weakens competition as it prevents prices from decreasing even when market conditions change. Copyright royalties are set by copyright trust management associations, but must be approved by the government. The purpose of the regulation is to keep the royalties from increasing above a reasonable level, as excessively high royalties would suppress the efficient use of creative works. Copyright trust management associations are granted a monopoly power in the copyright market and therefore have an incentive to set monopoly prices if not regulated. An ideal regulation for this purpose would be a price cap so that the royalties cannot exceed a certain level.

In practice, the Ministry of Culture, Sports and Tourism determines copyright royalties by itself, which is the strongest version of royalty regulation. The government claims that it tries to balance between copyright holders and consumers. The government, however, does not have competitiveness in choosing efficient price levels compared to the private sector. Therefore, it needs to refrain from choosing copyright royalties by itself. Instead, it can contribute by not approving anticompetitive copyright royalty rules submitted by copyright trust management associations. In other words, the government needs to compare the submitted rules with the existing rules and reject a submittal if the former are more anticompetitive than the latter. It can advise, but not force, copyright trust management associations to change their rules in a less anticompetitive manner.

The Ministry of Culture, Sports and Tourism used to do the opposite by employing anticompetitive copyright royalty rules by itself. More specifically, the royalties are set proportional to prices of final goods (*ad valorem*), but are guaranteed at a minimum amount (*per-unit*). This paper shows that such a rule yields lower consumer surplus as well as lower overall surplus. As the actual royalties are determined at the maximum of *ad valorem* and *per-unit* royalties (the combination rule, hereafter), firms are inclined to stick to the price level at which the two rules give the same royalties. This occurs because firms must pay more royalties when raising prices but the same royalties when lowering prices, and thus will not change their prices in the event of a marginal shock. Price stickiness yields a less efficient volume of transactions in some cases, which leads to lower consumer surplus. A theoretical analysis in Section 3 shows that the equilibrium price would be lower if the *ad valorem* rule applies instead, so the transaction volume, consumer surplus, and overall surplus are smaller under the combination rule.

Real-world data confirm the above argument. The combination rule was applied to all products in the online music service industry by the end of 2012, and it is currently applied only to streaming services. Prices were mostly set at a level that equates *per-unit* royalties with *ad valorem* royalties in 2012, but differences began to appear in 2013. Counterfactual analyses using estimation results in Section 4 show that firms could have profitably reduced prices if the *ad valorem* rule had been applied, although they did not have an incentive to do so under the combination rule.

This paper is organized as follows. The next section provides an overview of how copyright royalties are determined in the Korean music industry, and discusses anticompetitiveness of the rules related to these processes. Section 3 shows theoretical results that the combination rule causes firms with different cost

structures to choose identical prices and that the combination rule is dominated by the ad valorem rule in terms of social welfare. In Section 4, counterfactual analyses support the theoretical results by showing that the equilibrium price would have been lower under the ad valorem rule. A demand function is estimated using a random utility model for this purpose. Section 5 concludes the paper.

II. Copyright Royalty Rules for Music in Korea

Copyright royalty rules are made by copyright trust management associations. There are four associations who operate copyright trust management businesses in the Korean music industry. The Korea Music Copyright Association (KOMCA) and the Korean Society of Composers, Authors, and Publishers (KOSCAP) manage the copyrights of composers and authors. The Federation of Korean Music Performers (FKMP) manages performers' copyrights, and the Recording Industry Association of Korea (RIAK) manages music record producers' copyrights. There are other institutions who manage copyrights on behalf of copyright holders; these are known as copyright agency and brokerage business operators. A critical difference between copyright trust management businesses and other copyright management businesses is that copyright royalties received by the former must be approved by the Minister of Culture, Sports and Tourism. Article 105, Paragraph (5) of the Copyright Act states that:

“ ... the rate and amount of usage fee ... shall be determined by the copyright management service provider after he/she obtains approval from the Minister of Culture, Sports and Tourism: provided, that the same shall not apply to the person who has reported on the copyright agency and brokerage business.”

The reason why copyright trust management associations must obtain approval from the government is that the associations have market power which allows them to set copyright royalties at an excessively high level. If copyright royalties are too high, fair use of creative works will be hampered, leading to fewer transactions than the socially optimal level. As collective management of copyrights was introduced to foster the efficient use of creative works by reducing transaction costs, it is reasonable to restrain copyright trust management associations from setting copyright royalties too high. One rationale behind such a government intervention would be that the government grants a monopoly right to the associations and therefore has a duty to keep prices at reasonable levels. Although non-governmental agencies can take over such responsibilities, the government determines copyright royalties in many countries, akin to the Copyright Royalty Board in the United States.

A distinct feature of the Korean system is that the government can change copyright royalty rules even against the intent of copyright trust management associations. Article 105, Paragraphs (6) and (8) of the Copyright Act state:

“(6) As for approval under paragraph (5), the Minister of Culture, Sports and Tourism ... may approve after specifying a period of time or correcting the content in the application if necessary.”

“(8) Where it is necessary ..., the Minister of Culture, Sports and Tourism may change the content of approval pursuant to the provisions of paragraph (5).”

Although it is necessary to control copyright royalties, this does not mean that the government needs to set the royalty level. The only role that the government has to play is to supervise the system and to reject applications which attempt excessive increases in copyright royalties. The government appears to intervene by taking a more regulatory approach in Korea than is required. Such an intervention occasionally has an unintended impact on the market, as noted by Rhee and Yoon (2014).

Another feature of the Korean government intervening too excessively is that the government attempts to control the prices of final goods in the online music service industry. Prices are controlled via the copyright royalty rules approved by the government, which may cause firms to choose the same prices. For example, the current copyright royalty rules of KOMCA for streaming services are as follows:¹

“Article 23. (On-Demand Streaming Services) (1) The copyright royalty for streaming services of music is determined by the following if consumers pay in proportion to the number of streaming times.

1.4 won \times the number of streaming times \times the management ratio²

(2) The copyright royalty for streaming services of music is determined by the greater of the following two if consumers pay a monthly fee regardless of the number of streaming times.

(i) 0.7 won \times the number of streaming times \times the management ratio

(ii) sales volume \times 10% \times the management ratio”

Two ways to calculate copyright royalties are presented in Article 23, Paragraph (2). The first (i) is the per-unit rule: users pay in proportion to the number of transactions. The second (ii) is the ad valorem rule: users pay in proportion to the price of the good. The copyright royalty rules for streaming services combine these two rules, setting copyright royalties at the greater of the two. I call it the combination rule. Using the combination rule causes online service providers (OSPs) to set the price of streaming services at the level which makes the per-unit royalties coincide with the ad valorem royalties. This occurs because OSPs face a different incentive structure when increasing prices from when decreasing prices. At the price where the per-unit rule and the ad valorem rule give identical copyright royalties, OSPs pay more royalties when raising prices, but the same amount of royalties when cutting prices. Thus, OSPs would not deviate from the price level in the event of a small shock. A deeper analysis will be provided in the

¹The copyright royalty rules of FKMP and RIAK are described in a similar way.

²The management ratio is the ratio of music copyrights that KOMCA manages on behalf of composers and authors.

TABLE 1—PRICES OF SELECTED PRODUCTS ACROSS OSPs (SEP 2016)

(UNIT: 1,000 WON)

	Melon	KT music	Genie music	Soribada	Bugs	Mnet
Unlimited streaming	8.4	7.0	6.0	8.4	7.9	7.4
Monthly rent	11.4	9.0	7.0	—	9.9	10.4
Download 30 files	9.5	9.0	6.0	9.4	8.9	9.4
Download 100 files	20.5	18.0	9.0	20.4	19.9	20.4
Download 30 files and unlimited streaming	13.5	11.0	9.0	11.4	10.9	11.4
Download 100 files and unlimited streaming	24.5	20.0	12.0	22.4	21.9	22.4

Source: websites of OSPs.

next section.

In fact, the copyright royalty rules for streaming services had been even worse before they were revised in March of 2013. In the former version, copyright royalties were based on the number of consumers and not on the number of streaming times, and KOMCA set the royalties for streaming services at 400 won or 10% of the price of the good per consumer, whichever was greater. Before the revision, prices showed little dispersion across OSPs, ranging from 5,500 won to 6,000 won, but in September of 2016, prices ranged from 6,000 won to 8,400 won across OSPs, as can be seen in Table 1.

The effect of replacing the combination rule by other rules can be identified by observing changes in the prices of the products other than streaming services. The prices of those products were nearly identical across OSPs when the combination rule was applied to them. Currently there is some variation across OSPs as the per-unit rule is applied. For example, the price for on-demand download services of 40 music files was 5,000 won per month for all the OSPs by the end of 2012, but in September of 2016, download services of 30 music files are sold at 6,000 won to 9,500 won depending on the OSP.³ There are discount offers as well, and consumers can even buy the same services at 3,900 won.⁴ In fact, if consumers download 30 files, the copyright royalties paid to copyright holders exceed the price of the services, as 180 won must be paid per download in total. But OSPs know by experience that consumers typically do not exhaust their download options; thus, they can charge as little as 3,900 won for their services. Changing copyright royalty rules must have affected competition between OSPs.

III. Theoretical Analysis

This section shows that a combination of the ad valorem rule and the per-unit rule causes firms to freeze prices under changing circumstances.

³The download services of 40 music files were sold by only two OSPs as of September of 2016; hence, there is not much variation in the price of this product.

⁴Even less expensive promotion opportunities exist, but with some constraints.

A. Numerical Example

To illustrate, I begin with a toy model of two firms. To focus on pricing, I employ a differentiated product model. Suppose firms 1 and 2 face the following demand functions.

$$q_1 = a_1 - p_1 + bp_2$$

$$q_2 = a_2 - p_2 + bp_1$$

q_i denotes the demand for firm i 's product, and p_i denotes its price. Let r_i denote firm i 's copyright royalties, which are determined by

$$r_i = \max\{\alpha p_i, u\}$$

where $\alpha \in (0, 1)$ is the ad valorem royalty rate and $u \geq 0$ is the per-unit royalty. Assuming that firm i 's marginal cost c_i is constant, firm i 's profit is given by $\pi_i(p) = [p_i - c_i - r_i(p_i)]q_i(p)$. Assume firms optimize à la Bertrand competition, that is, they regard each other's prices as given. Profit maximizing conditions are then given by $d\pi_i / dp_i = 0$, which is

$$p_i = \begin{cases} q_i + \frac{c_i}{1-\alpha} & \text{if } \alpha p_i \geq u \\ q_i + c_i + u & \text{if } \alpha p_i < u \end{cases}$$

Consequently, there are four possible candidates of equilibria. One is

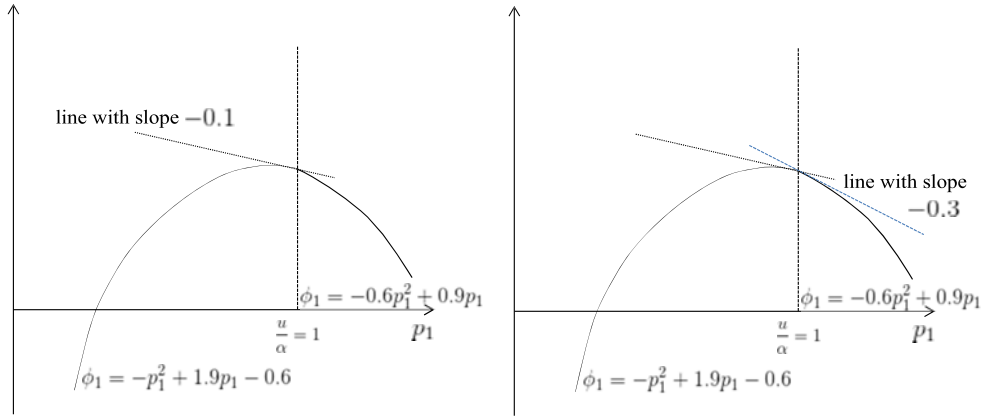
$$(1) \quad p_1 = \frac{1}{2+b} \left(a_1 + \frac{c_1}{1-\alpha} \right) + \frac{b}{4-b^2} \left(a_1 + a_2 + \frac{c_1 + c_2}{1-\alpha} \right)$$

$$p_2 = \frac{1}{2+b} \left(a_2 + \frac{c_2}{1-\alpha} \right) + \frac{b}{4-b^2} \left(a_1 + a_2 + \frac{c_1 + c_2}{1-\alpha} \right)$$

when $\alpha p_1 \geq u$ and $\alpha p_2 \geq u$, and another is

$$(2) \quad p_1 = \frac{1}{2+b} (a_1 + c_1 + u) + \frac{b}{4-b^2} (a_1 + a_2 + c_1 + c_2 + 2u)$$

$$p_2 = \frac{1}{2+b} (a_2 + c_2 + u) + \frac{b}{4-b^2} (a_1 + a_2 + c_1 + c_2 + 2u)$$

FIGURE 1. BEST RESPONSE OF FIRM 1 UNDER DIFFERENT LEVELS OF c_1 WHEN $p_2 = 1$

when $\alpha p_1 \leq u$ and $\alpha p_2 \leq u$. The other two cases are omitted as I focus on a symmetric example below, but in fact there is only one equilibrium for a reason I explain later.

To see that firms may retain a specific price even when market conditions change, suppose $a_1 = a_2 = 1$, $b = 0.5$, $\alpha = 0.4$, and $u = 0.4$. When $c_1 = c_2 = 0.3$, the equilibrium is characterized by (1), yielding $p_1 = p_2 = 1$, in which case $\alpha p_1 = \alpha p_2 = u$. When $c_1 = c_2 = 0.1$, the equilibrium is characterized by (2), yielding $p_1 = p_2 = 1$, in which case $\alpha p_1 = \alpha p_2 = u$. As costs are in between, that is $c_1, c_2 \in (0.1, 0.3)$, (1) yields $p_1 < 1$ and $p_2 < 1$, but this violates the conditions $\alpha p_1 \geq u$ and $\alpha p_2 \geq u$ and therefore cannot be an equilibrium. Meanwhile, (2) yields $p_1 > 1$ and $p_2 > 1$, but this violates the conditions $\alpha p_1 \leq u$ and $\alpha p_2 \leq u$. Therefore, when $c_1, c_2 \in [0.1, 0.3]$, the only equilibrium is always $p_1 = p_2 = 1$.

To understand why this happens, fix $p_2 = 1$ and write π_1 in terms of p_1 and c_1 as

$$\pi_1(p_1, 1) = \begin{cases} -p_1^2 + (1.9 + c_1)p_1 - 0.6 - 1.5c_1 & \text{if } p_1 < 1 \\ -0.6p_1^2 + (0.9 + c_1)p_1 - 1.5c_1 & \text{if } p_1 \geq 1 \end{cases}$$

It is easy to see that $\pi_1(p_1, 1)$ is concave in p_1 , implying that there is a unique p_1 that maximizes $\pi_1(p_1, 1)$. There is a kink in $\pi_1(p_1, 1)$ at $p_1 = 1$, and $c_1 \in [0.1, 0.3]$ makes $p_1 = 1$ maximize $\pi_1(p_1, 1)$. To see this in a graph, define $\phi_1(p_1) = [p_1 - r_1(p_1)]q_1(p_1, 1)$, then $\pi_1(p_1, 1) = \phi_1(p_1) - c_1q_1(p_1, 1)$ is maximized

when, to roughly say, $\phi_1(p_1)$ has a slope identical to that of $c_1 q_1(p_1, 1)$. Note that $\phi_1(p_1) = -p_1^2 + 1.9p_1 - 0.6$ if $p_1 < 1$, and $-0.6p_1^2 + 0.9p_1$ if $p_1 \geq 1$, and $c_1 q_1 = c_1(1.5 - p_1)$ is a linear function of p_1 with a slope $-c_1$. As shown in Figure 1, $\pi(p_1, 1)$ is maximized at $p_1 = 1$ when $c_1 \in [0.1, 0.3]$.

Let us now see how the result changes when the ad valorem rule or the per-unit rule is employed. If royalties are determined by rates only, as c_1 and c_2 decrease from 0.3 to 0.1, the equilibrium price decreases from 1 to 7/9. The current copyright royalty rules prevent firms from lowering prices when marginal costs decrease. To see the deadweight loss, the price is higher by 2/9, and the quantities sold by two firms are lower by 2/9, indicating that the overall surplus is lower by 2/81 under the combination rule than under the ad valorem rule. The consumer surplus is lower by 20/81 under the combination rule as $q_1 + q_2 = 1$ consumers suffer from high prices and the deadweight loss is solely a loss for consumers who give up purchasing.

If royalties are determined by per-unit only, as c_1 and c_2 increase from 0.1 to 0.3, the equilibrium price increases from 1 to 17/15. The overall surplus is higher under the combination rule than under the per-unit rule in this case, but the situation is opposite as costs rise. For example, suppose $c_1 = c_2 = 0.7$. The equilibrium price is $p_1 = p_2 = 7/5$ under the per-unit rule, but it is $p_1 = p_2 = 13/9$ under the combination rule. Thus, the overall surplus is higher under the per-unit rule when costs are high.

The above illustration shows that using the combination rule makes firms reluctant to change their prices. There is a range of marginal costs in which firms stick to the same price, which equates ad valorem royalties with per-unit royalties. When costs are low, the ad valorem rule yields higher consumer surplus and higher overall surplus than the combination rule. When costs are high enough, the per-unit rule yields higher consumer surplus and higher overall surplus than the combination rule.

To summarize, the combination rule makes the price of the final good rigid, thus lessening competition, and gives lower consumer surplus than the ad valorem rule and the per-unit rule under some circumstances. This can be shown in a more general context. The following subsection deals with a generalized model.

B. Generalization

Suppose n firms are competing in a differentiated product model. Each firm optimizes à la Bertrand competition, that is, each firm regards others' prices as given. Copyright royalties are determined by $r_i = \max\{\alpha p_i, u\}$, and each firm's profit function is given by $\pi_i(p) = [p_i - c_i - r_i(p_i)]q_i(p)$. Suppose the market is in the equilibrium with p^* satisfying $\alpha p_i^* = u$ for all i . If firm i is raising its price p_i , its marginal profit would be

$$(3) \quad \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = (1 - \alpha)q_i(p^*) + (p_i^* - c) \frac{\partial q_i(p^*)}{\partial p_i} - \alpha p_i^* \frac{\partial q_i(p^*)}{\partial p_i}$$

If firm i is reducing its price, its marginal profit would be

$$(4) \quad \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = q_i(p^*) + (p_i^* - c) \frac{\partial q_i(p^*)}{\partial p_i} - u \frac{\partial q_i(p^*)}{\partial p_i}$$

Note that $\alpha p_i^* = u$; accordingly, it is clear that⁵

$$\lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} < \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*}$$

This implies that firms may not want to change their prices even when a demand shift or a supply shock arises. In particular, firms would not change their prices in the event of a marginal shock if and only if

$$(5) \quad \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} < 0 < \lim_{p_i \rightarrow -p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*}$$

The above can be summarized by the following proposition.⁶

Proposition 1: Suppose the demand $q(p)$ is given, satisfying $2\partial q_i / \partial p_i + \sum_{j \neq i} \partial q_i / \partial p_j < 0$.

If copyright royalties are determined by $r_i = \max\{\alpha p_i, u\}$, there exists a non-singleton set of cost profiles c under which all firms choose p^* such that $\alpha p_i^* = u$.

The above proposition implies that firms with different production costs may choose the same price. This can be verified from the actual data. Figure 2 shows the price dispersion of six products across five online service providers (OSPs) from January of 2012 to June of 2014. The six products were sold during the overall data period. The price dispersion is measured by the standard deviation of the price divided by the mean of the price. Five out of the six products show no price dispersion in 2012, in which year the combination rule was applied to all products. Those products were priced exactly at the level which equates ad valorem royalties with per-unit royalties. For example, the price of streaming services was

⁵This shows why there exists a unique equilibrium. Given p_{-i} , π_i is concave in p_i in the region of $p_i < p_i^*$ as well as in the region $p_i > p_i^*$. At the kink, the right derivative of the profit function is less than its left derivative, so π_i is universally concave in p_i . This implies that firm i 's best response is uniquely defined by a function of p_{-i} .

⁶Equivalently, the proposition can be rewritten that given costs, there exists a non-singleton set of demand functions under which firms choose p^* , or even that there exists a non-singleton set of cost profiles and demand functions.

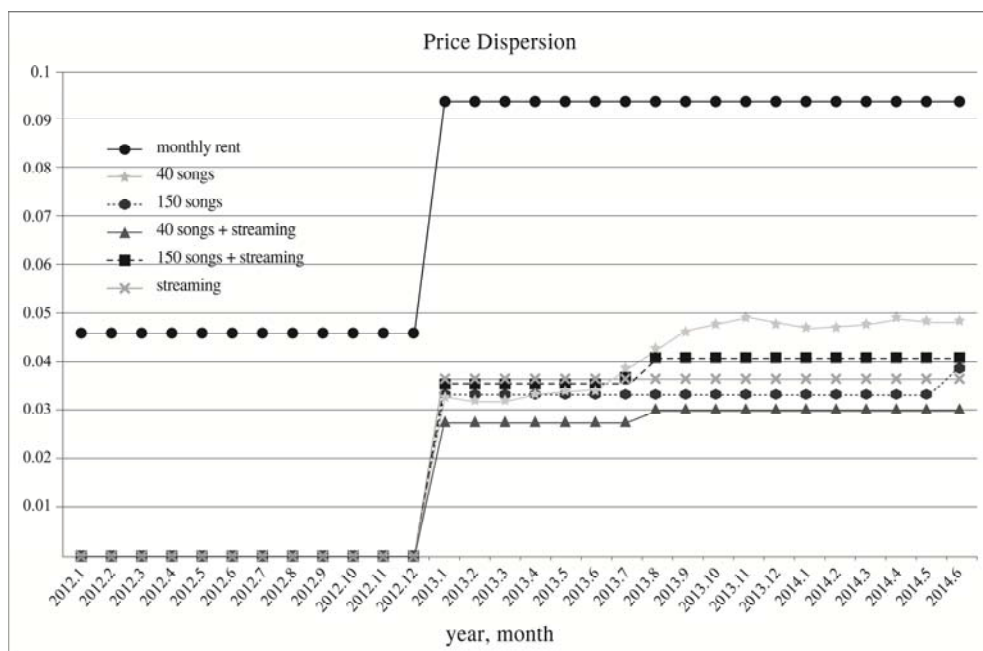


FIGURE 2. PRICE DISPERSION OF SIX PRODUCTS FROM FIVE OSPs

3,000 won in 2012, and royalties were the greater of 150 won and 5% of the price to composers and authors, the greater of 75 won and 2.5% of the price to performers, and the greater of 1,050 won and 35% of the price to music record producers. Download services of 40 songs were priced at 5,000 won in 2012, and royalties were the greater of 410 won and 8.2% of the price to composers and authors, and similarly determined to other copyright holders.

It seems, however, that OSPs had different cost structures in that the price dispersion increases in January of 2013, i.e., as soon as the revised copyright royalty rules became effective. The combination rule was substituted by the per-unit rule for all the products except for streaming services, after which OSPs began to set different prices for the same product, implying differences in profit maximization conditions. Therefore it is suspected that OSPs chose the same price in 2012 even though their marginal costs were different.⁷

Interestingly, the price dispersion of streaming services also increased though the combination rule was maintained for streaming services. In fact, the prices of streaming services increased far beyond the level where ad valorem royalties meet per-unit royalties. As the prices of other products rose due to increases in copyright royalties for them, OSPs increased the prices of streaming services as well. The price of streaming services was set around 6,000 won and not at 4,000 won which makes ad valorem royalties and per-unit royalties identical.⁸ Consequently, only

⁷Alternatively, OSPs may have faced different demand functions, which also leads them to choose different prices under the per-unit rule.

⁸Copyright royalties for streaming services were 400 won to composers and authors, or 10% of the price if greater than 400 won, and they were similarly determined to other copyright holders in 2013.

the ad valorem rule was applied to determine copyright royalties, so it seems that prices were set differently across OSPs, reflecting differences in cost structures.

One may wonder about the welfare effect when the combination rule is replaced by the per-unit rule, or by the ad valorem rule. As the actual data indicate that prices of all products increased as soon as the per-unit rule went into effect in 2013, it is reasonable to ask whether increases in prices resulted from the adoption of the per-unit rule. If the combination rule causes firms to choose identical prices but at a lower level than the per-unit rule, or the ad valorem rule, consumers may prefer the combination rule to the per-unit rule and the ad valorem rule. The answer is that prices went up due to increased royalties rather than the adoption of the per-unit rule. For example, the price for download services of 40 songs increased from 5,000 won in 2012 to approximately 6,900 won in 2013, and royalties for it increased from 2,635 won to 4,558 won. It is necessary to see how prices would have changed if royalties had not increased.

The numerical example discussed in the previous subsection provides a clue. When the combination rule is replaced by the per-unit rule, prices may increase or decrease. Hence, the welfare effect is ambiguous in this case. When the ad valorem rule replaces the combination rule, prices decrease and consumers are better off in the previous numerical example. I show that this is always the case below. I begin with the case where all the firms choose p^* satisfying $\alpha p_i^* = u$ under the combination rule. To see that consumer surplus is lower under the combination rule than under the ad valorem rule, note that the condition under which firms choose p^* such that $\alpha p_i^* = u$ implies

$$0 > \lim_{p_i \rightarrow +p_i^*} \frac{\pi_i(p_i, p_{-i}^*) - \pi_i(p^*)}{p_i - p_i^*} = \frac{\partial [p_i - c_i - \alpha p_i] q_i(p)}{\partial p_i} \Big|_{p=p^*}$$

As the marginal profit is negative at p_i^* under the ad valorem rule, firms would choose a lower price at equilibrium. As the price is lower, the equilibrium quantity is greater, so consumer surplus will be higher under the ad valorem rule.

A similar argument can be made with regard to the case where firms do not choose p^* . When firms' costs are high, the combination rule yields the same equilibrium with the ad valorem rule, and thus prices and consumer surplus are the same under both rules as well. When costs are low, prices will be low so that firms need to pay per-unit royalties under the combination rule, greater than ad valorem royalties, and thus prices are higher under the combination rule. Consumer surplus is weakly lower under the combination rule, as prices are always weakly higher. The following proposition describes this result.

Proposition 2: *The equilibrium price cannot be lower under the combination rule than under the ad valorem rule. Hence, consumer surplus cannot be higher under the combination rule than under the ad valorem rule.*

Proof Let π_i^c and π_i^a denote firm i 's profit function under the combination rule and under the ad valorem rule, respectively. Also let p^c and p^a denote the equilibrium price under the combination rule and under the ad valorem rule, respectively. When $\alpha p^c > u$, it is clear that $p^c = p^a$. When $\alpha p^c \geq u$ with equality holding for some i , those firms with $\alpha p_i^c = u$ have

$$0 > \lim_{p_i \rightarrow +p_i^c} \frac{\pi_i(p_i, p_i^c) - \pi_i(p^c)}{p_i - p_i^c} = \frac{\partial[p_i - c_i - \alpha p_i]q_i(p)}{\partial p_i} \Big|_{p=p^c},$$

so $p_i^c \geq p_i^a$ for those firms. The other firms will also set no lower price as competing firms set higher prices, which implies $p^c \geq p^a$. When $\alpha p^c \leq u$ with equality holding for some i , those firms with $\alpha p_i^c = u$ have

$$0 > \lim_{p_i \rightarrow +p_i^c} \frac{\pi_i(p_i, p_i^c) - \pi_i(p^c)}{p_i - p_i^c} = \frac{\partial[p_i - c_i - \alpha p_i]q_i(p)}{\partial p_i} \Big|_{p=p^c},$$

so $p_i^c \geq p_i^a$ for those firms. The other firms with $\alpha p_j^c < u$ have

$$0 = \frac{\partial[p_j - c_j - u]q_j(p)}{\partial p_j} \Big|_{p=p^c} > \frac{\partial[p_j - c_j - \alpha p_j]q_j(p)}{\partial p_j} \Big|_{p=p^c},$$

where the last inequality holds given that (3) is less than (4), even when $\alpha p_j^c < u$. Accordingly, $p_j^c \geq p_j^a$ as well. When $\alpha p_i^c > u$ for some i and $\alpha p_j^c < u$ for some j , the above argument applies as well, and thus $p^c \geq p^a$. ■

Between the ad valorem rule and the per-unit rule, one does not dominate the other. When costs are high, the ad valorem rule yields the same equilibrium with the combination rule, and thus higher prices than the per-unit rule in some cases. When costs are low, the ad valorem rule yields lower prices than the combination rule which yields lower prices than the per-unit rule.

The above discussion implies that the combination rule tends to maintain prices at a higher level. This would benefit producers to the detriment of consumers. Copyright holders may benefit by earning more royalties but by sacrificing consumer surplus. There exists a deadweight loss as the transaction volume is lower than the socially optimal level. Therefore, employing the combination rule to determine copyright royalties should be avoided. I suggest the use of the ad valorem rule, as it is always better in terms of overall surplus.

IV. Empirical Tests

In this section, I empirically test the hypothesis that the combination rule prevents online service providers (OSPs) from changing prices. A straightforward way to prove it would be to see whether the cost structures of OSPs fall into the range in which price stickiness arises. More specifically, it suffices to see whether the cost structures satisfy (5). Unfortunately, I could not obtain supply side data, meaning that cost structures cannot be estimated. As an alternative method, I calculate changes in the profits of OSPs upon a marginal change in the price. (5) is satisfied if OSPs' profits decrease both when the price increases and when it decreases. To do this, I first estimate a demand function using the actual data. Then I predict market shares as if OSPs change the prices of their products, and calculate changes in profits to see that price is indeed sticky. Moreover, by comparing changes in profits to those under the counterfactual situation where only the ad valorem rule applies, I show that the combination rule restrained OSPs, which would have lowered prices under the ad valorem rule, from doing so.

A. Data

Data are monthly, spanning from January of 2012 to June of 2014, and contain sales data from five OSPs (Melon, KT music, Soribada, Bugs, and CJ E&M). Data are obtained from several sources. Listed prices, the average discount rate, and the number of consumers of each product were obtained for Melon and KT Music with the help of the Ministry of Culture, Sports and Tourism. The actual usage data (downloads, streaming) of each product were obtained from KOMCA, FKMP, and RIAK for the five OSPs for the entire period. The number of consumers of each product was obtained from FKMP and RIAK for the five OSPs for a subset of the data period. The characteristics of each product were obtained at the website of each OSP.

To estimate a demand function, the number of consumers or the market share of each product is necessary. I do not have this information for the entire period and therefore extrapolated the variable to the former and the later period. Specifically, as I have the number of consumers for all the products from June of 2012 to April of 2013, I calculated the average number of streaming times per consumer for streaming services from June of 2012 to October of 2012 and divided the number of streaming times by the average number of streaming times per consumer to obtain the extrapolated number of consumers for streaming services from January of 2012 to May of 2012. To obtain the number for May of 2013 to June of 2014, I used the average number of streaming times from December of 2012 to April of 2013. Here, I implicitly assumed that the average number of streaming times remained stable during the data period. There is some variation in the average number of streaming times, but the volatility is not high since the maximum to minimum ratio is less than 1.3. For download-only products, the number of download times was used. The data from FKMP and that from KOMCA do not coincide exactly, but the difference was only within 1% of the magnitude of the variables. I used data from FKMP mostly, as it includes the number of consumers.

B. Demand Estimation

A random utility model with a logit error is used to estimate the demand function. I adopt the estimation methodology of Berry (1994), which begins with an indirect utility function

$$u_{ij} = x'_j \beta_x - \beta_p p_j + \xi_j + \varepsilon_{ij},$$

which is the utility that consumer i obtains from purchasing product j with observable characteristics x_j , price p_j , and unobserved quality $\xi_j \in \mathbb{R}$. ε_{ij} is an idiosyncratic utility term that i has for j in addition to x_j, p_j , and ξ_j . ε_{ij} follows a type-I extreme value distribution. There are products from the five OSPs and an outside option. An outside option is denoted by product 0, and its utility is normalized to $u_{i0} = \varepsilon_{i0}$; that is $\xi_0 = 0$. The market share of product $j = 0, \dots, n$ is calculated by

$$s_j = \frac{\exp(x'_j \beta_x - \beta_p p_j + \xi_j)}{1 + \sum_{m=1}^n \exp(x'_m \beta_x - \beta_p p_m + \xi_m)}$$

and especially

$$s_0 = \frac{1}{1 + \sum_{m=1}^n \exp(x'_m \beta_x - \beta_p p_m + \xi_m)}.$$

Therefore,

$$\frac{s_j}{s_0} = \exp(x'_j \beta_x - \beta_p p_j + \xi_j)$$

and taking the log gives

$$\log s_j - \log s_0 = x'_j \beta_x - \beta_p p_j + \xi_j$$

This equation is used for the estimation. It is assumed that $E[\xi_j | x_j] = 0$, but $E[p_j \xi_j] \neq 0$. Consequently, a two-stage least squares (2SLS) estimation is conducted using instrumental variables. Following Berry *et al.* (1995), the average characteristics of the other products of the same OSP, and the average characteristics of the products of the competing OSPs were used as instrumental variables for the price. These variables are closely related to prices, as prices are determined through competition among products but would not be correlated with

TABLE 2—ESTIMATION RESULTS

Variables	OLS	2SLS	OLS	2SLS
	w/o trend	w/o trend	w/ trend	w/ trend
Price (1,000 won)	−0.2902***	−0.3355***	−0.3436**	−0.5384***
(SE)	(0.025)	(0.0317)	(0.0313)	(0.0497)
download	0.002801	0.005313**	0.005913**	0.01692***
(SE)	(0.001599)	(0.001930)	(0.001938)	(0.002922)
Monthly rent dummy	1.5738***	1.7160***	1.7811***	2.4456***
(SE)	(0.1636)	(0.1743)	(0.1788)	(0.2231)
Streaming dummy	1.2229***	1.3317***	1.3648***	1.8510***
(SE)	(0.1057)	(0.1155)	(0.1167)	(0.1520)
trend			0.01751**	0.04077***
(SE)			(0.006188)	(0.007751)
OSP dummies	included	included	included	included
adjusted R ²	0.5091	0.5108	0.5115	0.5014

Note: *** indicates significant at the 0.1% level, ** at the 1% level, and * at the 5% level.

unobserved quality.

Estimation results are given in Table 2. The price coefficient is negatively significant in all the settings, but the 2SLS method gives bias-corrected estimates. The results are consistent with the theory that the coefficient estimate may be positively biased under OLS when the variable is positively correlated with error terms. The coefficients of the observed characteristics are positively significant in the two 2SLS estimation results. The model is estimated with a trend variable excluded and included. Given the increase in the total number of consumers over the data period, it can be regarded as reasonable to include a trend variable. Indeed, the coefficient of the trend variable is estimated to be significant and positive. On the other hand, it is also reasonable to let the unobserved quality ξ_j capture the increase in the attractiveness of products over time, as a trend variable is not a characteristic of products and does not precisely capture an increase in attractiveness although they are correlated. The adjusted R^2 is greater for the second column without a trend variable as compared to that in the fourth column. For this reason, I perform a counterfactual analysis using both results: one from the second column, and the other from the fourth column.

C. Counterfactual Analysis

A counterfactual analysis is carried out as follows. I first change the price of streaming services, to see if such a deviation is profitable to OSPs. If it is not for both an increase and a decrease in the price, price is proven to be sticky. I then apply a different copyright royalty rule to see if such a deviation would have been profitable. If this is the case, it proves that the combination rule prevented OSPs from changing prices, which would have occurred under a different rule.

December of 2013 is chosen as the base period, as most products are sold around that month. The number of products doubled in January of 2013 when the new copyright royalty rule became effective, and KT Music stopped selling two products in August of 2013 and one product in June of 2014. When new products are introduced or when certain products exit a market, the demand for those

TABLE 3—CHANGES IN PROFITS WHEN
THE PRICE OF STREAMING SERVICES DECREASES BY 1%

OSP	Δ profit under the combination rule		Δ profit under the ad valorem rule	
	streaming services	all products	streaming services	all products
CJ E&M	-0.17%	-0.18%	1.77%	1.04%
Melon	-0.91%	-1.70%	1.37%	0.56%
KT music	0.58%	0.46%	2.13%	1.73%
Bugs	0.55%	0.07%	2.17%	0.34%
Soribada	0.69%	0.18%	2.24%	0.59%

Note: The estimation result with a trend variable was used for a counterfactual analysis.

products may not be stable. Hence, I use the data from December of 2013 for a counterfactual analysis to see the price effect when the market condition is relatively stable.

I focus on streaming services because the combination rule was applied only to streaming services in December of 2013. Other products were charged royalties by the per-unit rule, which does not dominate, nor is dominated by, the combination rule as discussed in the previous section. Copyright royalties for streaming services were the greater of 3.6 won per streaming and 60% of the price in total in December of 2013, effective from May of 2013. Although this type of combination rule does not limit setting prices of final goods as much as the combination rule discussed above, the government revised the copyright royalty rule considering that the price of streaming services was mostly 6,000 won in 2013, and that the average number of streaming times per consumer is 1,000 times.⁹ Therefore, those OSPs which set the prices of streaming services at 6,000 won paid 3,600 won for copyright royalties in either case and therefore were effectively restrained by the combination rule.

Table 3 summarizes the results of a counterfactual analysis using the estimation result with a trend variable. The cases of CJ E&M and Melon prove that they would have profitably lowered prices under the ad valorem rule. If CJ E&M cut the price of its streaming services by 1%, its profit from streaming services decreases by 0.17%, but if the ad valorem rule had been applied, the profit would have increased by 1.77%. As prices drop, demand for this product increases by 2.80%, and revenue from it increases by 1.77%, but copyright royalties increase by 2.80%, a growth rate identical to that of demand, under the combination rule.¹⁰ However, if the ad valorem rule had been applied, copyright royalties would have increased only by 1.77%, a growth rate identical to that of revenue. Therefore, cutting prices would have led to greater profits for CJ E&M. While reducing the price of streaming services leads to decreases in sales of other products and thus decreases in profits from those products as well, the total profit would have increased by 1.04% under the ad valorem rule. A similar argument applies to Melon's case as well.

When KT music reduces the price of streaming services, however, its profit turns out to increase under the combination rule. A decrease in the price of streaming

⁹See the press release by the Ministry of Culture, Sports and Tourism on March 18th, 2013.

¹⁰Here, I implicitly assume that OSPs do not incur more costs when they serve an additional 3% of consumers. If they do incur more costs, the decrease in price would reduce the profit under the combination rule by a greater amount.

TABLE 4—CHANGES IN PROFITS WHEN
THE PRICE OF STREAMING SERVICES INCREASES BY 1%

OSP	Δ profit under the combination rule		Δ profit under the ad valorem rule	
	streaming services	all products	streaming services	all products
CJ E&M	0.09%	0.13%	-1.76%	-1.03%
Melon	0.80%	1.61%	-1.37%	-0.57%
KT music	-2.10%	-1.70%	-2.10%	-1.70%
Bugs	-0.62%	-0.08%	-2.13%	-0.34%
Soribada	-2.20%	-0.58%	-2.20%	-0.58%

Note: The estimation result with a trend variable was used for a counterfactual analysis.

TABLE 5—CHANGES IN THE TOTAL PROFIT WHEN
THE PRICE OF STREAMING SERVICES CHANGES BY 1%

OSP	Δ profit when price decreases		Δ profit when price increases	
	Combination	Ad valorem	Combination	Ad valorem
CJ E&M	-0.77%	0.41%	0.72%	-0.41%
Melon	-2.04%	0.09%	1.98%	-0.10%
KT Music	-0.50%	0.76%	-0.76%	-0.76%
Bugs	-0.12%	0.15%	0.11%	-0.15%
Soribada	-0.14%	0.26%	-0.26%	-0.26%

Note: The estimation result without a trend variable was used for a counterfactual analysis.

services by 1% leads to an increase in its profit from streaming services by 0.58%, and an increase in the total profit by 0.46%.¹¹ One possibility is that OSPs colluded to earn more profit.¹² OSPs may earn more profit by cutting prices alone but earn less profit by reducing prices together. Indeed, when all of the OSPs cut the prices of streaming services by 1%, all of them lose profits. Under the ad valorem rule, however, some OSPs would have earned more profit even if all of the OSPs reduced the prices of their streaming services by 1%. Such a deviation would have increased Melon's profit by 0.21%, KT Music's by 1.05%, and CJ E&M's by 0.45%. Therefore, these OSPs have an incentive to deviate from collusion.

Table 4 shows whether OSPs have an incentive to increase their prices of streaming services. Under the combination rule, some OSPs have an incentive to increase prices, but no OSP does under the ad valorem rule. Comparing Table 3 with Table 4, it is interesting to note that under the combination rule, the magnitude of the price effect is different when prices decrease from when prices increase, especially in the cases of KT Music and Soribada. This proves that the combination rule presents OSPs with a different incentive structure when raising prices as opposed to when lowering price. This is not the case under the ad valorem rule, as the effect of a price decrease is nearly identical in terms of magnitude but only opposite in direction relative to that of a price increase for all the OSPs.

Table 5 summarizes the results of a counterfactual analysis using the estimation result without a trend variable. Reducing the price is not profitable for any OSP under the combination rule, but is profitable for all the OSPs under the ad valorem rule. Therefore, this result reinforces the claim that the combination rule prevented

¹¹If the ad valorem rule had been applied, the increase in the total profit would have been 1.73%, so it can be claimed that the ad valorem rule pushes KT Music harder to reduce prices than the combination rule.

¹²Another possibility is that the assumption of no additional cost fails, so KT Music indeed earns less considering an increase in costs.

OSPs from reducing prices, which would have occurred if the ad valorem rule had been in force. For KT Music and Soribada, raising prices as well as reducing prices is unprofitable under the combination rule, which satisfies (5). This proves again that the combination rule causes some OSPs to keep their price level at 6,000 won, which equates ad valorem royalties with per-unit royalties. On the other hand, CJ E&M, Melon and Bugs set their prices of streaming services at less than 6,000 won, which is why (5) is not satisfied in those cases. In fact, they are tempted to raise prices under the combination rule, which implies that the combination rule causes OSPs to choose identical prices, i.e., those which make ad valorem royalties and per-unit royalties equal.

V. Concluding Remarks

Price control may have side effects that firms retain the current price level even when market conditions change. A combination of the ad valorem and the per-unit copyright royalty rules is a weak version of price control. This paper shows that the combination rule makes firms inclined to choose a specific price level, which equates ad valorem royalties with per-unit royalties. It is also shown that the equilibrium price is no lower and overall surplus (as well as consumer surplus) is no larger under the combination rule than under the ad valorem rule. A counterfactual analysis implies that some online service providers (OSPs) in the online music service industry would have reduced price if the ad valorem rule had been applied, which is consistent with a theoretical prediction. Thus, employing the combination rule weakens competition.

The combination rule may also be exploited for tacit collusion. Firms may implicitly agree not to deviate from a specific price level in order to earn more profits together, even when a unilateral deviation would be profitable. One of the counterfactual analyses shows that some OSPs could have profitably deviated to a lower price level, given that the indirect utility function is correctly specified. One possible reason why they did not do so is that they had an incentive to hold prices steady, as they would have earned less if all the OSPs had lowered prices. The problem is that such tacit collusion is difficult to detect, as choosing such a price is in the competition equilibrium in many cases under the combination rule. Obtaining data would be the most challenging part with regard to detection, but even if the data are available, it would be difficult to prove that firms implicitly colluded in all the possible scenarios. Indeed, using a different specification for the indirect utility function in the above counterfactual analysis justifies the pricing behavior of OSPs as competitive, as the price is in the Bertrand competition equilibrium.

To summarize, the combination rule by itself causes firms to set prices at higher levels, thus reducing consumer surplus, and this may be exploited by way of tacit collusion in some cases. Therefore, replacing the combination rule with the ad valorem rule is strongly recommended. In the online music service industry, the combination rule is currently not applied to most products, but only a weak version of the combination rule is applied to streaming services. I have two remarks for the copyright royalty rule policy in this matter.

First, it would promote competition to switch to the ad valorem rule for streaming services. Copyright holders and their associations have an objection to switching to the ad valorem rule, as they are worried about the possibility that some OSPs such as Apple music may cut prices aggressively to attract more consumers. The government should not consider their concerns too much, keeping in mind that using the combination rule may harm consumers. If minimum per-unit royalties need to be specified in order to avoid abuse by OSPs, they must be determined at a low level that is not binding in most cases.

Second, bringing the combination rule back to other products must be avoided. The per-unit rule is mostly applied to other products according to the current copyright royalty rules. Copyright holders want to apply the combination rule that would give more royalties when prices increase. For instance, they argued that the minimum rate provision must be restored when it was removed in June of 2012. Although the combination rule is not worse than the per-unit rule in terms of overall surplus, as proven above, bringing the combination rule back would clearly be worse than switching to the ad valorem rule. Thus, the government can retain the current per-unit rule or alternatively switch to the ad valorem rule, but should not restore the combination rule.

A remark pertaining to the welfare of copyright holders is in order. As claimed in the introduction, the government should make a decision in terms of anticompetitiveness rather than balance between copyright holders and consumers. In evaluating anticompetitiveness, however, it is necessary to consider the dynamic effects of copyright royalties that stimulate the production of creative works. When copyright holders are able to earn more royalties, they would create more art products, which in turn increases consumer welfare. Therefore, if the combination rule gives copyright holders more royalties, there can be a positive dynamic effect that might be considered. Incorporating the dynamic effect into the model would not only complicate the analysis much but also make the result sensitive to assumptions, so I leave it to a future research topic.

One thing to note, however, is that copyright holders may not be better off under the combination rule than under the ad valorem rule. Royalties per transaction are higher, but the transaction volume is lower under the combination rule, so the effect on the total amount of royalties earned by copyright holders is ambiguous. More assumptions are necessary for an accurate analysis of how much each stakeholder, including copyright holders, will be affected by changes in copyright royalty rules. Measurement of the effect on each stakeholder would help the government make policy decisions. This is left as a future research topic.

REFERENCES

- Berry, S.** 1994. "Estimating Discrete-Choice Models of Product Differentiation." *RAND Journal of Economics* 25: 242–262.
- Berry, S., J. Levinsohn, and A. Pakes.** 1995. "Automobile Prices in Market Equilibrium." *Econometrica* 63: 841–890.
- Cho, Sung Ick.** 2014. *Pricing Capability of Retailers and the Effect of e-Commerce: the Case of the Book Retail Market*. KDI Policy Study 2014-03 (in Korean).

- Cho, Sung Ick.** 2015. *Study on the Economic Effect of Enhanced Fixed Book Pricing Scheme*. KDI Policy Study 2015-08 (in Korean).
- Rhee, Kyoungwon and Kyoungsoo Yoon.** 2014. "The Effect of Quantity Discount Regulation of Digital Music Transmission Fee." *Korean Journal of Industrial Organization* 22 (4): 21–49 (in Korean).

OTHER REFERENCE SOURCES

- The Ministry of Culture, Sports and Tourism.** March 18, 2013. "Copyright Royalties for Streaming Services Switch to Per-Streaming Based Fee." Press Release.
- The Ministry of Culture, Sports and Tourism.** 2016. "Copyright Royalty Rules of Copyright Trust Management Associations." http://www.mcst.go.kr/web/s_notice/notice/noticeView.jsp?pSeq=10763 (accessed on September 26, 2016).

LITERATURE IN KOREAN

- 이경원·윤경수.** 2014. 「음원전송사용료의 다량할인 규정 도입의 효과」. 『산업조직연구』. 제22권 제4호: 21–49.
- 조성익.** 2014. 『유통기업의 가격설정능력과 전자상거래의 효과: 도서유통시장 사례를 중심으로』. 정책연구시리즈 2014-03. 한국개발연구원.
- 조성익.** 2015. 『도서정가제의 경제적 효과에 관한 연구』. 정책연구시리즈 2015-08. 한국개발연구원.

KDI Book Membership Information

Exclusive Offer (Members-Only)

- All KDI publications, with the exception of those classified as confidential or limited, are to be mailed to members
 - Preferential invitations to special events hosted by KDI including seminars, policy discussion forums, public hearings, etc., are to be mailed.
 - A 10% discount on the online purchases of additional copies of the published research monographs (printed-only) from the KDI homepage.
-

KDI Publications

- Publications include books, research monographs, policy studies, KDI policy forums, KDI FOCUS, research papers and policy-information materials.
 - Three types of periodicals are available:
 - Monthly: KDI Monthly Economic Trends, KDI Review of the North Korean Economy, Economic Bulletin, Narakyungje, click-Economic Education
 - Quarterly: KDI Journal of Economic Policy
 - Biannual: KDI Economic Outlook
-

Annual Fees

- Individual Purchase: 100,000 KRW
 - Institutional Purchase: 300,000 KRW
-

Sign-Up

- You may sign up for membership via KDI homepage. Please register on the homepage by completing and submitting the registration form. Possible payment methods are as follows:
 - Bank-Transfer: Woori Bank, 254-012362-13-145 (account holder name: Korea Development Institute)
 - GIRO System: No. 6961017 (Credit Card and Mobile Payments available)
 - Direct Payment to the Research Outcome Dissemination Unit of KDI Division of External Affairs.
-

Contact

- Publication personnel in charge: Research Outcome Dissemination Unit, Division of External Affairs, KDI.
 - Tel: 82-44-550-4346 / Fax: 82-44-550-4950 / E-mail: book@kdi.re.kr
 - Sales Distributors
 - Kyobo Bookstore (Gwanghwamun Branch: Government Publications Section)
Tel: 82-2-397-3628
 - Yongpoong Bookstore (Jongno Branch: Policy & Economy Section)
Tel: 82-2-399-5632
-

***KDI Journal of
Economic Policy***

韓國開發研究

Registration Number 세종 바00002호

Printed on February, 24, 2017

Published on February, 28, 2017

Published by Joon-Kyung Kim, President of KDI

Price : 3,000 KRW

@Korea Development Institute 2017

Registered on March, 13, 1979



Korea Development Institute
263, Namsejongro, Sejong-Si, Korea | TEL 044-550-4114
FAX 044-550-4310 | www.kdi.re.kr



ISSN 1738-656X