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Measuring the Economic Benefits of Industrial Natural Gas Use in South Korea

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Received: 30 May 2018; Accepted: 25 June 2018; Published: 29 June 2018

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Abstract: Natural gas (NG) is an important input used in the industrial production of South Korea. Therefore, the government requires quantitative information to be provided about the economic benefits of industrial NG (ING) use to decide whether to invest in expanding the supply of ING or not. This manuscript tries to measure the economic benefits of NG use in the manufacturing industry by using a specific case in South Korea. For this purpose, a trans-log production function is estimated using the data collected from a national survey of 1100 firms in South Korea. Of them, 299 firms used ING. For a representative manufacturing firm, the point estimated for the economic benefits of ING use is obtained as KRW 2409 (USD 2.07) per m^3, which is statistically meaningful. The average price of ING, which is defined as the total expenditure on ING purchased in 2016 and divided by the total amount of ING purchased in 2016, was KRW 667 (USD 0.57) per m^3. Therefore, the economic benefits of ING use are 3.61 times as great as the average price of ING. This implies that ING produces more value than its price in South Korea.

Keywords: industrial natural gas; input; value of marginal product; economic benefits; trans-log production function

1. Introduction

Natural gas (NG) is a crucial input for production in the manufacturing industry of South Korea. As of 2015, a total of 15,044 industrial companies utilized NG for their industrial production. Since NG is a cleaner fuel than other energy sources such as coal or oil, the consumption of industrial NG (ING) has been steadily increasing from about 1000 million cubic meters in 1996 to 7329 million cubic meters in 2015 [1–4]. Although liquefied petroleum gas, which is a substitute for NG, has recently replaced NG. The South Korean government expects that the consumption of ING will gradually increase since the government encourages manufacturing firms to use ING instead of coal or oil to reduce air pollutants and carbon dioxide emissions [5].

The government requires the provision of quantitative information about the economic benefits of ING use to decide whether to invest in expanding the supply of ING or not. Information about the economic benefits of ING use is useful in various aspects. For example, it can be utilized in the economic evaluation of new projects regarding the ING supply and the appropriate distribution of NG among various applications and industrial sectors.

Usually, the production inputs playing the role of independent variables in the production function are capital, labor, and intermediate [6,7]. Each input contributes to the production of a good or a service and the creation of value-added. ING can also be an important input used in industrial production as a form of heat or steam and fuel itself [8,9]. This note has a particular interest in analyzing the role of ING as a production input. The value of marginal product (VMP) derived from the production function indicates the economic benefits of ING use. In the context of microeconomics, inverse demand function for ING use can be obtained from the VMP curve [10,11]. The economic benefits of ING use are defined as the area below the demand curve for ING use. We can usually value the benefits by first estimating the demand function and then computing the area [12–15]. Therefore, we estimate the production function where the dependent variable is value-added of each firm. Independent variables are four inputs of labor, capital, intermediate, and ING use and then derive the VMP of ING.

There is scarce empirical evidence on the economic benefits of ING use. This paper attempts to contribute to the existing literature by providing some empirical findings from South Korea on the issue. The rest of this manuscript consists of four sections. A review of the literature and methods are summarized in the next section. The model adopted in this paper is presented in the third section. The data used in this paper and the results are explained in the fourth section. Conclusions are offered in the final section.

2. A Brief Review of the Literature and Methods of Measuring the Economic Benefits of ING Use

2.1. A Brief Literature Review

We reviewed the literature concerning the measurement of the economic benefits of industrial or residential energy or natural resources use extensively and found some previous related studies. A summary of them is presented in Table 1. There are three methods including the production function approach, the demand function approach, and the stated preference methods such as contingent valuation and choice experiment, which will be explained below in detail. The production function approach has been most widely applied. For example, the economic benefits of industrial water [16,17], industrial electricity [18,22], and ING [19] were measured using the production function approach. Therefore, the method adopted in this study is consistent with that in some former studies.

Table 1. Summary of some previous related studies.

Sources	The Goods to Be Valued	Country	Methods	Main Results
Wang [16]	Industrial water	China	Production function approach	2.6 times more than the price
Ku and Yoo [17]	Industrial water	Korea	Production function approach	2.9 times more than the price
Lim and Yoo [18]	Industrial electricity	Korea	Production function approach	3.1 times more than the price
Park and Yoo [19]	Industrial natural gas	Korea	Production function approach	10.9 times more than the price
Lee and Yoo [2]	Residential natural gas	Korea	Demand function approach	2.2 times more than the price
Lim et al. [20]	Residential electricity	Korea	Contingent valuation	1.2 times more than the price
Kim and Cho [21]	Industrial electricity	Korea	Contingent valuation	1.3 times more than the price
London Economics [22]	Industrial and residential electricity	United Kingdom	Production function approach, contingent valuation, and choice experiment	3.4 times more than the price

2.2. Methods That can Be Applied to Measuring the Economic Benefits of ING Use

In an economics sense, when a function of the market supplies a good or service, its economic benefit is derived from the demand curve. The area under the demand curve shows the economic benefits of a good or service. However, in some cases, it is impossible or quite difficult to obtain the demand curve. Moreover, a market failure can exist or the function of the price does not work well because of governmental intervention. In these cases, alternative approaches can be applied even though they may be based on somewhat restrictive assumptions or cause overestimation/underestimation in terms of economic theory. We looked at various related papers, reports, and textbooks and found that some methods can be applied toward measuring the economic benefits of ING use e.g., [23–26]. Table 2 presents them and their strength and weakness.

The methods are classified into two categories including non-economic and economic methods. The first category is based on the non-economic approach. In other words, it does not use the economic theory. The category includes the residual imputation approach, the alternative cost approach, the replacement cost approach, and the value-added approach. These methods are easier to empirically apply in terms of time and money than the methods belonging to the first category. However, they also have some weakness. The most important criticism is that they do not have any theoretical background. A more practical complication faced by researchers is that the values obtained by applying the methods differ greatly from those obtained by applying the methods contained in the first category. For example, the value-added approach usually overestimates the economic benefits of ING use. This is because the approach assumes that the ING use utilizes ING as a production input. In addition, since the alternative cost approach and the replacement cost approach reflects the costs involved in providing other alternative or replaceable output values obtained through the two approaches, which does not imply the economic benefits of ING use basically.

The second category utilizes the economic theory, estimates the demand function and then estimates the area under the demand function. Concerning this category, there are three approaches including the demand function approach, the cost function approach, and the production function approach. They originate from microeconomic theory. First, the demand function approach is to collect data on ING consumption, ING price, and factors affecting ING consumption, estimate the demand function for ING using the data, and then calculate the area under the demand function [27]. Second, the cost function approach estimates the cost function for the ING-utilizing firms, derives the demand function employing Shepard's lemma given in the microeconomic theory, and then computes the area under the demand function [28]. The production function approach estimates the production function for the ING-utilizing firms, derives the demand function adopting the concept of the marginal product presented in the microeconomic theory, and then computes the VMP of ING using the demand function [16–19].

If sufficient data are available and the market is sufficiently competitive, the demand function approach is not only theoretically sound but also fairly easy to apply. However, when applied to data collected in markets, where the function of price for NG are not working well, the estimated coefficients do not conform to economic theory and may produce unexpected results. For example, the coefficient for the price term in a demand function should be estimated to be negative, according to the law of demand. However, if it is estimated to be a positive number or statistically significant, the estimated demand function is difficult to accept, and it is complex to derive the economic benefits from the estimated demand function. In this case, it is difficult to estimate the economic benefits defined as the area under the demand curve. Unfortunately, we used time series data to estimate the demand functions for ING, but the estimated coefficient for the price term was not statistically significant. Therefore, it was impossible to estimate the economic benefits of ING consumption by applying the demand function approach.

Table 2. Methods that can be applied to measuring the economic benefits of industrial natural gas (ING) use.

Methods		Contents	Strength	Weakness
Residual imputation approach		Allocate the value of the output to the input where the market exists and assigns the residual value to the ING	Conceptually intuitive	Strong assumptions are needed, errors can lead to inaccurate results. If there is market distortion, it cannot be used.
Alternative cost approach		The cost difference between the current low-cost production process and the high-cost production process that uses less ING and is treated as the value of ING	Available when there is no demand curve for ING	The need for precise cost structure concerning methods of ING use and substitute goods. Alternative method required.
Replacement cost approach		Measuring the value of ING as an alternative facility cost to supply ING	It is possible to use the value of ING where the market does not exist	Difficult to determine the capacity of alternative facilities
Production function approach		Treat the ING production cost as the value of ING	ING and ING production cost data are available	The lower limit of the ING value does not reflect the willingness to pay for ING
Value-added approach		Divide value-added by ING usage	The value of ING can be easily estimated using available statistical data	Although other elements of production contribute to the value-added, there is a risk of overestimating the value of water only
Demand function approach	In case market about ING exists	Since the area under the demand curve for ING is the total benefit, the value of ING can be calculated	Easy to use data on the price of ING, the elasticity of demand, and quantity demanded. It can be used in other studies.	It is difficult to estimate the maximum price of ING for measuring the benefit of ING
	In case market about ING does not exist (Revealed preference technique)	Using the data that shows the behavior of economic units. Indirectly deriving the consumer's willingness to pay for ING, which is non-market goods calculating the economic benefit of ING.	Even if the ING market does not exist, the value of ING can be estimated	Estimated willingness to pay cannot be applied to other uses or regions
	In case market about ING does not exist (Stated preference technique)	Directly deriving the consumer's willingness to pay for ING which is non-market goods using questions, calculating the economic benefit of ING	Even if the ING market does not exist, the value of ING can be estimated	Estimated willingness to pay cannot be applied to other uses or regions. It is difficult to set questions.

One more point to note is that the demand for ING means the demand for intermediate goods is more pivotal than the demand for final goods. In this regard, ING use is different from residential NG use. Therefore, in the economics sense, the demand for ING indicates derived demand. In this case, the cost function and the production function approaches are more adequate for the purpose of this study than the demand function approach. Usually, the third approach is easier to apply and more frequently found in the literature than the second one. Moreover, accordingly to the microeconomics, the third approach is dual to the second one. This implies that researchers can obtain similar results by applying either approach. Most of the studies in the literature measure the economic benefits of goods utilizing the production function approach [16–19]. Some studies in the literature evaluate the economic benefits of the commodity using the cost function. However, to the best of the authors' knowledge, there is no research that dealt with the economic benefits of industrial goods for employing the cost function in the literature. Therefore, this study seeks to employ the third approach.

3. Model

As the first stage of estimating the production function, we need to specify its functional form. A simple Cobb-Douglas function is frequently applied in the literature. However, the trans-log production function suggested by Christensen et al. [29] is known to be more flexible than the Cobb-Douglas production function and also has been widely employed in empirical studies. However, there are other types of production functions. However, this study will adopt the trans-log production function for two reasons and compare the results with those applying the Cobb-Douglas production function. First, the trans-log production function has been widely employed in the literature as far as the authors are aware. For example, all the former studies in Table 1 utilized the trans-log production function. Second, since the prime purpose of this study is not to obtain the production function but the VMP of ING. It should not be difficult to derive the first derivative of the production function. It seems to be difficult for researchers to derive the first derivative from some more complicated forms of production functions. However, the trans-log production function does not suffer from the difficulty.

Therefore, the authors believe that the results of estimating the trans-log production function can provide not only some insights into the economic benefits of ING use in South Korea but also meaningful contribution to the current literature on the economic benefits of ING use. The trans-log production function includes the Cobb-Douglas production function as a special case and a specification test of the first versus the second can be easily performed even though the trans-log production function is more complicated than the Cobb-Douglas production function. Therefore, we will estimate the two production functions and conduct the specification test.

Let Y, K, L, M, and G be the output, capital input, labor input, intermediate input, and ING input, respectively. The production function is usually specified as $Y = f(K, L, M, G)$. Accordingly to microeconomics, the economic benefits of an input use can be measured by estimating the VMP of the input. The marginal product of ING is usually defined as $\partial Y/\partial G$. When the output, Y, is expressed in a monetary unit rather than a physical unit, the VMP of ING can be the VMP of ING. Moreover, if the output is measured in value-added rather than sale amount, the VMP of ING can be the economic benefits of ING use. Hereinafter, Y indicates valued-added.

The trans-log production function where inputs are capital, labor, intermediate, and ING is formulated below.

$$\begin{aligned}\ln Y = \beta_0 &+ \beta_1 \ln K + \beta_2 \ln L + \beta_3 \ln M + \beta_4 \ln G + \beta_5 \ln K \ln L \\ &+ \beta_6 \ln K \ln M + \beta_7 \ln K \ln G + \beta_8 \ln L \ln M + \beta_9 \ln L \ln G \\ &+ \beta_{10} \ln M \ln G + \beta_{11} (\ln K)^2 + \beta_{12} (\ln L)^2 + \beta_{13} (\ln M)^2 \\ &+ \beta_{14} (\ln G)^2\end{aligned} \tag{1}$$

where ln means the natural logarithm and β's are the parameters to be estimated. When $\beta_5 = \beta_6 = \beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = \beta_{13} = \beta_{14} = 0$, the trans-log production function is identical to the Cobb-Douglas function.

After taking a partial differentiation of Equation (1) and arranging it, the VMP of ING can be easily derived, which is shown below.

$$\frac{\partial Y}{\partial G} = (\beta_4 + \beta_7 \ln K + \beta_9 \ln L + \beta_{10} \ln M + 2\beta_{14} \ln G)\frac{Y}{G} \quad (2)$$

For the purpose of obtaining a point estimate of the VMP of ING, VMP_G, we should know the values for Y, K, L, M, and G. For this purpose, this paper uses their sample averages. Therefore, VMP_G can be estimated by the equation below.

$$VMP_G = (\hat{\beta}_4 + \hat{\beta}_7 \ln \overline{K} + \hat{\beta}_9 \ln \overline{L} + \hat{\beta}_{10} \ln \overline{M} + 2\hat{\beta}_{14} \ln \overline{G})\frac{\overline{Y}}{\overline{G}} \quad (3)$$

where $\hat{\beta}_4$, $\hat{\beta}_7$, $\hat{\beta}_9$, $\hat{\beta}_{10}$, and $\hat{\beta}_{14}$ are the estimates for β_4, β_7, β_9, β_{10}, and β_{14}, respectively. $\overline{Y}$, $\overline{K}$, $\overline{L}$, $\overline{M}$, and $\overline{G}$ are the sample averages for Y, K, L, M, and G, respectively.

4. Results

4.1. Data

To estimate the economic benefits of ING use, micro data on the ING use of individual companies are required. The authors conducted extensive investigations into whether such data were available, but they could not find the appropriate data. Therefore, they decided to implement a survey of manufacturing firms directly during June and July 2017. One complication involved in doing so is that it is quite expensive to administer such a survey in South Korea. The authors were able to secure a budget to investigate about 1100 manufacturing companies. Of them, 299 firms reported that they consumed ING as a production input. For this reason, the final number of observations used in this study is 299. However, the authors think that the appropriate sample size should be 1000 at least since the Korea Ministry of Strategy and Finance recommended the use of 1000 observations for policy analysis. At the second stage of this study, more observations should be added to the analysis in the near future.

One more point is needed to be addressed. In the questionnaire, the authors asked questions about ING usage, production amount, sales amount, labor input, capital input, and intermediate input from 2014 to 2016. However, some companies were founded in 2016. Moreover, other companies could not report some necessary information prior to 2016. Therefore, in order to maintain the consistency of time in analyzing the data of 299 companies, the authors utilized the data on ING consumption only for the 2016 year.

A total of 27.2% of the sampled firms consumed NG for industrial production in 2016. Some variables utilized in this paper are explained in Table 3. The dependent variable used here, Y, is value-added rather than the sales amount. This variable is measured over the entire year of 2016. K, L, M, and G indicate capital stock in 2016 (unit: million KRW), labor used in 2016 (unit: persons), intermediate input in 2016 (unit: million KRW), and NG consumed in 2016 (unit: m^3), respectively.

Table 3. Description of the variables used in this note.

Variables	Definitions	Mean	Standard Deviation
Y	Value-added in 2016 (unit: million KRW)	7868.81	19,750.31
K	Capital stock in 2016 (unit: million KRW)	16,262.22	28,400.45
L	Labor used in 2016 (unit: persons)	80.77	118.75
M	Intermediate input in 2016 (unit: million KRW)	27,854.43	54,701.82
G	Natural gas consumed in 2016 (unit: cubic meter)	348,861.64	659,787.38

4.2. Estimation Results of the Production Function

The results of estimating the Cobb-Douglas production function and the trans-log production function are presented in Table 4. The coefficient estimates for the Cobb-Douglas function are all statistically significant except for constant term and $\ln K$. The adjusted-R^2 is 0.689, which means that the estimated Cobb-Douglas function explains about 68.9% of the variability in the dependent variable. In the trans-log production function, the estimates for $\ln L$, $\ln M$, $\ln G$, $\ln L \ln M$, $\ln L \ln G$, and $(\ln M)^2$ terms are statistically significant. However, those for other terms are not. The adjusted-R^2 for the trans-log production function is 0.708, which indicates that the estimated trans-log function explains about 70.8% of the variability in the dependent variable. This value is higher than the value for the Cobb-Douglas production function. Therefore, the goodness-of-fit of the trans-log production function is higher than that of the Cobb-Douglas production function in our data.

Table 4. Estimation results of the production function.

	Cobb–Douglas Production Function		Trans-Log Production Function	
Variables	**Coefficient Estimates**	***t*-Values**	**Coefficient Estimates**	***t*-Values**
Constant	0.1347	0.34	8.5321	3.35 #
$\ln K$	0.0547	1.28	−0.2218	−0.50
$\ln L$	0.1567	2.27 **	2.1700	3.26 #
$\ln M$	0.6723	13.08 #	−1.0620	−1.97 **
$\ln G$	0.0431	1.72 *	−0.5251	−1.90 *
$\ln K \ln L$			0.0951	1.41
$\ln K \ln M$			−0.0231	−0.48
$\ln K \ln G$			0.0114	0.45
$\ln L \ln M$			−0.2788	−3.23 #
$\ln L \ln G$			−0.0822	−1.97 **
$\ln M \ln G$			0.0421	1.30
$(\ln K)^2$			0.0009	0.03
$(\ln L)^2$			0.0882	1.30
$(\ln M)^2$			0.1354	3.23 #
$(\ln G)^2$			0.01769	1.51
Adjusted R-squared	0.689		0.708	
F-value (*p*-value) [a]	166.43 (0.000)		52.70 (0.000)	
Ramsey's RESET2 (*p*-value) [b]	1.25 (0.264)		0.89 (0.348)	
Number of observations	299		299	
Value of marginal product of natural gas per cubic meter	KRW 971 (USD 0.83)	1.72 *	KRW 2409 (USD 2.07)	2.42 **

Note: The dependent variable is the natural logarithm of value added created in 2016. *K*, *L*, *M*, and *G* indicate capital stock in 2016 (unit: million KRW), labor used in 2016 (unit: persons), intermediate input in 2016 (unit: million KRW), and natural gas consumed in 2016 (unit: cubic meter), respectively. *, **, and # imply statistical significance at the 10%, 5%, and 1% levels. [a] The null hypothesis is that all coefficients except for the constant term are zero. [b] Ramsey's RESET2 specification test is given in Ramsey [30] and the null hypothesis is that the model is correctly specified.

In order to validate the model and ascertain the appropriateness of the estimation results, we perform three versions of the specification test for the trans-log production function. First, the null hypothesis that all coefficients except for the constant term are zero can be rejected since the *F*-value computed under the null hypothesis is 52.70 and its corresponding *p*-value is 0.000. Therefore, the estimated Equation is statistically meaningful at the 1% level. Second, we employ a specification test given in Ramsey [30] to check for any omitted variable bias and model specification error. The test statistic calculated under the null hypothesis is that the model is correctly specified at 0.89 and its corresponding *p*-value is 0.348. Therefore, the null hypothesis cannot be rejected at the 1% level. It is clear that the estimated trans-log production function does not suffer from mis-specification. Third, we perform a specification test of the trans-log production function versus the Cobb-Douglas production function. The *F*-statistic computed under the null hypothesis that Cobb-Douglas production function is correctly specified and its corresponding *p*-value are 2.90 and 0.002, respectively. Accordingly, the null hypothesis can be rejected at the 1% level. The trans-log function performs better than the Cobb-Douglas production function. One can proceed to assess the VMP of ING employing the estimation results of the trans-log production function.

4.3. Estimation Results of the VMP of ING

Using Equation (3) and the sample means for the 299 observations, an estimate for the VMP of ING use is obtained as KRW 2409 (USD 2.07) per m^3, which is shown in the last row of Table 4. We need to check the statistical significance of the point estimate. One complication in doing so is that some coefficient estimates of the trans-log production function are not statistically significant. However, the VMP of ING, which is derived as a combination of the coefficients' estimates of the trans-log production function, can be statistically significant. Our primary interest is not the individual coefficient estimate of the trans-log production function but the VMP of ING use. For the purpose of obtaining the standard error of the VMP estimate, we apply the delta method. Fortunately, the *t*-value of the VMP estimate is computed to be 2.42. This value is much larger than 1.96 and, therefore, the estimated VMP of ING is statistically meaningful at the 5% level.

The average price of ING, which is defined as the total expenditure on ING purchased in 2016 divided by the total amount of ING purchased in 2016, was KRW 667 (USD 0.57) per m^3. The VMP of ING use is about 3.61 times as great as the average price of ING. This implies that ING produces much more value-added data than its price in South Korea. Moreover, the VMP of ING is interpreted as the economic benefits of ING use. The stable provision of ING to manufacturing firms is very important for their industrial production since ING consumed in the manufacturing industry produces much more value-added information than its price. In this regard, the governmental policy of increasing the supply of ING appears to be economically sound.

5. Conclusions

ING is an important input used in industrial production as a form of heat or steam and fuel itself. This manuscript tried to assess the economic benefits of ING use in South Korea quantitatively. For the purpose of gathering micro data required in the assessment, a nationwide survey of 1100 firms was implemented. Of these firms, 299 firms consumed NG in industrial production and these observations were incorporated in this paper. The trans-log production function that contains four inputs of capital, labor, intermediate, and ING was estimated. Then the VMP of ING use was obtained as KRW 2409 (USD 2.07) per m^3. This value was statistically meaningful and about 3.61 times greater than the average price of ING in 2016 (KRW 667 per cubic meter).

This paper sought to contribute to the current literature by deriving the VMP of ING use in the Korean manufacturing industry. Although the role of NG in mitigating air pollutants and carbon dioxide emissions has been recently emphasized, there are quite a few studies dealing with this issue. We can utilize quantitative information reported in this note for NG supply-related policy analysis and investment decision. Moreover, our finding can be compared with a former finding [19] that presents an estimate of KRW 6844 (USD 5.89) per cubic meter on the VMP of ING using the data for the year 2011. Furthermore, the VMP of ING has been reduced by about 65%. This implies that the marginal contribution of NG to the value-added creation of the South Korean manufacturing industry has been diminished even though it is still larger than the price of ING.

This manuscript also presented an empirical finding that the concept of VMP based on microeconomics aligns with the economic benefits of ING use and can be usefully and easily applied to the data collected from a survey of firms. In particular, the estimated VMP of ING is indispensably needed in analyzing the economic feasibility of a new project that supplies ING. For example, the supply of ING is socially profitable when the VMP multiplied by the quantity supplied is more than the cost involved in the supply. Since the supply of ING demands a considerable amount of investments on liquefaction of NG, gasification of the liquefied NG, storage, transmission, and distribution of NG, the economic feasibility analysis, and the information about the economic benefits of ING use are indispensable inputs in the analysis.

Concerning ING consumption, there are three stakeholders including the ING-supplying industry, the ING-utilizing industry, and the government that grants or regulates the ING-supplying projects and supports the construction of ING-supplying infrastructure so that ING-utilizing firms do not have difficulty in using ING. All the three stakeholders wonder how one cubic meter of ING supply generates value-added for ING-utilizing firms. For example, an ING-supplying company can use the MV information about ING use to set the price of ING. In other words, to the extent that the production cost of ING can be recovered, the price of ING can be set lower than the MV of ING. If the price of ING is lower than the MV of ING, it would be desirable for an ING-utilizing firm to consume ING. Otherwise, it would be better for it not to consume ING. Moreover, when a public corporation pushes an ING-supplying project, if the associated costs are greater than the MV, the project is economically justified and government funds can be injected into the project.

We think that this research has room for improvement in several aspects. First, this research obtained an overall value for the manufacturing industry, but the economic benefits of ING use for each sector of the manufacturing industry need to be investigated by gathering and analyzing more data. This is because the economic benefits of ING use for the steel industry may be significantly different from that for the semiconductor industry. Second, researchers are encouraged to collect survey data every year and analyze the collected data over the years to investigate how economic benefits change over time. Third, it is also a good topic of study to investigate how economic benefits change across the region and to identify other geographical factors that affect economic benefits. Since there are few studies that dealt with the economic benefit of ING in the literature, it is difficult to compare our findings with the findings from other studies concerning economic benefits of ING. However, by comparing our results with the results from other countries and clarifying the gap with some elements influencing the gap, we can gain new insights into the economic benefits of using ING from an international standpoint. These steps could give us a new perspective on the economic benefits of using ING.

Author Contributions: All the authors participated in writing this paper. H.-J.K. proposed the key ideas and quantitatively looked into the data. S.-M.H. conducted a literature review and prepared about half of the paper and S.-H.Y. made the survey questionnaire and derived the implications of the study results.

Acknowledgments: This work was supported by the Korea Institute of Energy Technology Evaluation and Planning (KETEP) and the Ministry of Trade, Industry & Energy (MOTIE) of the Republic of Korea (No. 20164030201060).

Conflicts of Interest: The authors declare no conflict of interest.

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