



Korean public's perceptions on supply security of fossil fuels: A contingent valuation analysis



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HIGHLIGHTS

- This study investigates the Korean public's perceptions of the fossil fuels.
- The public's WTP will increase if their understanding of the policy is enhanced.
- Electricity charge is a promising source of funding for energy security policies.

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ABSTRACT

The supply security of fossil fuels is one of the most important policy issues in South Korea. This is because of South Korea's economic condition, geopolitical status, and lack of energy resources. This study investigates the Korean public's perceptions of the supply security of fossil fuels using the contingent valuation method. It derives the Korean public's willingness to pay (WTP) for policy measures that enhance the supply security of fossil fuels, such as overseas energy development and strategic reserves. It also compares the WTP in terms of an increase in taxes on gasoline or diesel with the WTP in terms of an increase in the tax on electricity. The results demonstrate that the WTP will increase if the Korean public's understanding of the importance of policy measures that boost the supply security of fossil fuels as well as the role of government in implementing these measures are enhanced. The comparison of the WTP shows that the Korean public will be less against an increase in the tax on electricity than an increase in the tax on gasoline or diesel. This is so even though the WTP amount for a tax increase on electricity is smaller than that for a tax increase on gasoline or diesel.

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1. Introduction

The importance of energy security has resurfaced recently because of the increased volatility of energy prices, the scarcity of fossil fuels, climate change, and geopolitical supply tensions. Energy security is generally defined as the uninterrupted availability of energy sources at an affordable price [1–3]. However, it is difficult to precisely define energy security because it is very context and perspective dependent [4,5]. The International Energy Agency

(IEA) [3] clarified that energy security consists of a physical unavailability component and a price component and discussed that the relative importance of both components differs according to the market structure in a country. Kruyt et al. [5] also pointed out that the definition of energy security can differ across countries and time periods. Thus, it is important to discuss policies for enhancing energy security in the context of a specific country.

In South Korea (hereafter Korea), energy security is defined as the “availability of a stable supply of energy at an affordable price” [6], following the IEA's definition [7]. Like many other governments, the Korean government has also implemented several policies to enhance energy security. These include renewable energy development, energy efficiency improvement, energy system reform, and supply securement of fossil fuels. However, supply securement of fossil fuels has been considered one of the most important policies on energy security in Korea for the following three reasons. First, fossil fuels such as coal, oil, and liquefied

Abbreviations: CV, contingent valuation; DBDC, double-bounded dichotomous choice; IEA, International Energy Agency; KRW, Korean won; LNG, liquefied natural gas; NOAA, National Oceanic and Atmospheric Administration; USD, United States dollars; WTP, willingness to pay.

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natural gas (LNG) accounted for 85.2% of the total primary energy consumption in 2012 [8], and fossil fuels largely had to be imported since Korea lacks energy resources. Second, it is not easy to reduce the consumption of these fossil fuels, because most are consumed for industrial materials or transportation [8]. Energy-intensive industries (such as petrochemicals and basic metals) that use fossil fuels as primary industrial materials are crucial to the Korean national economy. Conditions in Korea for cultivating crops for biofuel production are also unfavorable. Thus, supply disruptions and price change risks have a negative impact on the Korean national economy. Third, a relevant geopolitical factor is that Korea can be regarded as an island although it is located in the southern part of the Korean Peninsula. This implies that Korea is vulnerable to supply interruptions in a crisis.

To internalize the externality occurring when the stable supply of fossil fuels at affordable prices is threatened [2], the Korean government has implemented several measures based on taxes collected from the purchases of petroleum products, such as gasoline and diesel [9]. These measures include overseas energy development and strategic reserves; however, an insufficient budget has hindered the promotion of these measures. Motivated by this policy problem, this study attempts to examine the Korean public's perceptions of the supply security of fossil fuels by applying the contingent valuation (CV) method. This method enables us to analyze the Korean public's willingness to pay (WTP) for supply security of fossil fuels through overseas energy development and strategic reserves.

In particular, the following two research questions are investigated. First, what are the characteristics of the Korean public's perceptions of the supply security of fossil fuels? To answer this question, this paper discusses their awareness and opinions about supply security of fossil fuels. It also identifies the attributes that have statistically significant effects on the Korean public's WTP for such supply security of fossil fuels. Second, apart from taxing petroleum products, are there other ways of funding policy measures on the supply security of fossil fuels? To answer this question, this study compares the WTP for an increase in the tax on electricity charges with that for an increase in the tax on gasoline or diesel. Although the Korean public has paid social expenses for the supply security of fossil fuels, its perceptions on this issue have not yet been investigated. This information will help to gain an insight into the Korean public's perspectives on policy measures dealing with the supply security of fossil fuels.

Many studies on national energy security have focused on policy issues from the perspective of the government, the principal agent of policy measures on energy security. Gracceva and Zeniewski [10], Yao and Chang [11], Sharifuddin [12], and Portugal-Pereira and Esteban [13] assessed the level of energy security of the national energy system. Augutis et al. [14], Martchamadol and Kumar [15], and Wu et al. [16] developed methodologies for measuring the level of energy security. Jun et al. [17] measured the cost of energy security in terms of supply disruption and price volatility, considering the degree of concentration in energy supply and demand. Månsson et al. [18] and Gouveia et al. [19] assessed the effects of renewable resources on the supply security of energy. In those studies, how energy users (i.e., the beneficiaries of the positive externality of energy security) recognize the effect of an improvement in energy security has not received sufficient attention. Thus, this study attempts to measure the effect of an improvement in energy security from the perspective of energy users.

Some studies have investigated national energy security from the perspective of energy users based on stated preference methods, such as CV. Damigos et al. [20] derived Greek households' WTP for securing a continuous flow of gas to the Greek electricity system using a CV approach. Chou et al. [21] examined European consumers' preferences for supply security of gas based on the

choice experiment method. Demski et al. [22] compared public perceptions of energy security risks with those on climate change risks in the United Kingdom, focusing on their level of concern with such risks. Li et al. [23] measured US households' WTP for research and development (R&D) investment in energy sources not reliant on fossil fuels using the CV approach. Jensen et al. [24] examined consumers' preferences for ethanol-blended fuel considering energy security in the United States using the contingent choice model. Jang et al. [25] investigated Koreans' WTP for a reliable LNG supply through a policy measure for improving the natural gas storage rate. Thus, these studies justify using the CV approach in this study. On the other hand, this study differs from those that use stated preference methods, because it attempts to measure the value of the supply security of fossil fuels through overseas energy development and strategic reserves, which have been the primary policy measures for improving the supply security of fossil fuels in Korea.

This study contributes to the assessment of policy measures for securing the supply of fossil fuels using the public's perspective. The supply security of fossil fuels has received relatively little attention because it is a less important measure for enhancing energy policy in many other countries. As shown for previous studies, renewable energy development, energy efficiency improvement, and energy system reform are all alternatives to the supply security of fossil fuels in the sense that they all enhance energy security. However, the supply security of fossil fuels is critical for some Northeast Asian countries (e.g., Korea, Japan, and Taiwan) because of their economic conditions, geopolitical status, and lack of energy resources. Thus, this paper contributes to the body of policy literature concerning energy security in these countries. In addition, this study contributes to existing work on survey-based valuation of energy security as it compares WTPs with different payment vehicles. The results will be useful for countries where policy measures on energy security are funded by taxes.

The remainder of this paper is organized as follows. Section 2 discusses Korean policy measures on the supply security of fossil fuels. Section 3 demonstrates the survey design and the value-eliciting method employed in this study. Section 4 describes the survey results and responses to value-eliciting questions. Section 5 presents the WTP estimation results and discusses the two research questions. Section 6 concludes.

2. Policy measures on the supply security of fossil fuels in Korea

After the two oil crises of the 1970s, the Korean government has implemented two policy measures, i.e., promoting overseas energy development and building up strategic reserves, to protect the country from price risks and supply disruptions. The importance of these measures was reinforced during the period of high oil prices in the mid-2000s.

To promote overseas energy development, the Korean government legislated the "Act on Overseas Energy and Resources Development Business" [26] in 1983. It has also implemented the "Master Plan for Overseas Energy and Resources Development" [27] as a guideline as of 2001.² Overseas energy development projects have been conducted by national energy corporations (e.g., Korea National Oil Corporation and Korea Gas Corporation) and private enterprises. The Korean government has supported overseas energy development projects by giving loans or by issuing a sovereign financial guarantee for debt. From 1981 to 2012, Korean national energy corporations and private enterprises participated

² This master plan has been renewed every three years. Now, in 2014, the fifth plan is about to be announced.

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