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Applying Mathematical Programming Food Supply Model for Improving Japan's Food Self-Sufficiency Ratio

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Abstract As the largest net import country of agricultural products in the world, Japan's food self-sufficiency ratio (SSR) on a calorie basis has significantly decreased from 73% in FY 1965 to about 40% in recent years. Improving the SSR has been or will be a very important policy issue for Japan. The latest Basic Plan for Food, Agriculture and Rural Areas has set a target of 50% as the SSR in FY 2020.

Using the mathematical programming food supply model, we investigate the policy strategies for improving the SSR. Our model is structurally a linear programming model aiming at a network flow optimization in order to maximize Japan's SSR. We analyze four scenarios on the policy strategies for improving the SSR; ⅰ)promoting consumption of rice, ⅱ) expanding the production of rice for feed, ⅲ) expanding the production of wheat and soybeans, and ⅳ) combination of the above-mentioned three strategies. Numerical results show that Japan's SSR could get to only 48% even if perfect import substitution of domestic product for imported one holds, given the constraint of calories consumed per day per capita per food item.

Keywords food self-sufficiency ratio; linear programming model; network flow optimization; optimal food supply; policy strategy

1 Introduction

Japan is the largest net import country of agricultural products and Japanese diet depends quite heavily on imported food and feed. Therefore, Japan's food self-sufficiency ratio (FSSR) on a calorie basis has significantly decreased to only 40% in recent years. Thus our present FSSR level is the lowest among all major OECD's countries. Global balance of food supply and demand has been influenced by continueing population growth in developing countries, increasing demand for biofuel, increasing imports of grains and oilseeds in China, the demand for agricultural products has been steadily increasing.

On the other hand, considering frequent unusual weather conditions around the world, shortage of water resources, and slowdown of growth in yield, global balance of food supply and demand would be getting tighter in the middle and long

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A Quantitative Factorial Component Analysis to Investigate the Recent Changes of Japan's Weight-Based Food Self-Sufficiency Ratio

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Abstract

We investigate the weight-based food self-sufficiency ratio (*WSSR*) for Japan over a 50-year period (1961-2011) by applying factorial component analysis technique in order to measure the changes of the *WSSR* quantitatively. Quantitative data analysis is employed to determine the drivers of those changes. Numerical results show that Japan experienced a drastic decline in its food self-sufficiency ratio (*FSSR*) during the above period. The factorial component analysis shows that such a decline was caused by the changes in the *FSSR* of the food groups/items, not in the quantity of the food supply. A number of characteristics of those changes are presented and a list of major food groups that have major impacts on the changes is constructed. The findings in this paper reiterate the alarming food security problem in Japan and provide clear insight into the causes of this problem. The findings in this study pick up where previous studies have left off, aid the food-related policy-making process and identify new ideas for future food research.

Keywords

Food Self-Sufficiency Ratio, Food Security, Factorial Component Analysis

1. Introduction

"Food security" is an important issue in Japan. This is partly due to the surge in world food and agricultural commodity prices in 2007, but it also reflects the food supply insufficiency the country has experienced over the

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Statistical data analysis for investigating Japanese government subsidy policy for private universities

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Abstract This paper aims at investigating Japanese government's subsidy policy for private universities by applying statistical approaches to various types of quantitative data. Firstly, we briefly describe the history of the government subsidy policy to identify the dominant factors behind it and also explain the structure and mechanism of this subsidy. Secondly, by using 2005 data, we try to find influential factors in allocating both general subsidies and special subsidies for private universities. Thirdly, using the data in two periods given as 1975–1979 and 2000–2004, we try to elucidate the structural properties of the subsidy policy by applying correlative rank analyses approaches in order to measure the ''dominance power'' of the top-ranking subsidy-recipient schools. The results show that the number of faculty members is the most influential for general subsidies, while the number of students is the most dominant variable for special subsidies.

Keywords Correlative rank analysis · Dominance power · Government subsidy policy · Multivariate regression model · Private universities · Statistical data analysis

Introduction

Japanese private universities have undoubtedly played a long and vital role in providing academically high-level graduates for national developments. In fact, Japanese higher education has even been characterized as ''mass private higher education'' (Geiger 1986). Based on Geiger's typology, along with the US and the Philippines, Japanese private universities are characterized to be heavily dependent on student tuition and fees, demand absorbing, and market-oriented (Geiger 1986). Another typology proposed by Levy (1986) includes Japan as a distinct majority among private universities with more than 50% students enrolled in these institutions, and relies mostly on private finance. In 2005, based

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Risk Management Analyses on Measuring the Robustness of the Water Supply Network System in Tokyo

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1 Introduction

Water has always been an essentially inevitable resource for our daily lives. "Water problems" such as shortage caused by natural phenomena, disruption of water pipelines due to "natural disasters", such as earthquakes, floods; and also by some intentional attacks, and terrorism, need to be challenged at least, even though they might not be solved completely.

Given the concentration of population in large cities, water demand in urban areas has been growing rapidly. Thus, keeping the reliability and the robustness of the water supply system high has been becoming more and more important.

Tokyo, as the exceptionally biggest city in Japan, has its modern water supply network, which was established in 1898. Nowadays, 6,859,500 $m^3$of water per day is provided for Tokyo area, excluding Hinohara village, Okutama town, and Izu Islands. These areas have their own water supplies, which are not provided by the Tokyo water supply network [1].

The Tokyo water system has 11 purification plants, for example Kanamachi, Asaka, and Misato. From the historical data, we find that the share in supply for all purification plants during the period of 1999-2006 is rather stable, and Asaka, Higashi-Murayama, Kanamachi, and Misato are the four major plants occupying almost 80 percent of the total. These water resources and supply areas for Tokyo is shown in the Figure 1.

These purification plants obtain the water from four water resources: 1) Tone/Ara River, which covers 79.9% of the total water supply in Tokyo; 2) Tama River (17.0%); 3) Sagami River (2.9%); and 4) ground water (0.2%). From this coverage rate, we can say that the water supply in Tokyo heavily depends on the Tone/Ara River, and followed by the Tama River.

Asides from that, the Tokyo area is very vulnerable to natural disasters. From 1970-2002, the natural disasters which has mostly happened in this area are earthquakes, wind

Developing a Green Path Power Expansion Plan in Indonesia by Applying a Multiobjective Optimization Modeling Technique

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Abstract: This paper aims to apply a multiobjective optimization modeling technique to a power expansion problem evaluating two objectives functions: minimizing the power generating cost and minimizing CO_2 emissions, between which there is a tradeoff. A convex curve is obtained representing the relationship between the generating cost (Rp/kWh) and CO_2 emissions (ton). This represents a bad-luck curve where there is an increasing marginal cost to reduce 1 t of CO_2 emissions. This is because most of the less-carbon-intensive power plants consume oil, which has the highest fuel cost. Instead of simply minimizing CO_2 emissions, this paper argues that Indonesia needs to pursue technology to switch from steam coal subcritical technology to supercritical and ultra-supercritical technology to reduce CO_2 emissions. It is further found that the generating cost will increase by less than 1.6% and yearly CO_2 emissions can be reduced by about 6.9% by adopting supercritical technology. This implies that adopting ultra-supercritical technology can cut CO_2 emissions by more than half. A squeezing effect is also found by adopting more-advanced steam coal technology. Thus, promoting renewable energy and gas utilization also should be enhanced. The green path power system allows both CO_2 emissions and the generating cost to increase gradually, but with lower CO_2 emissions than by minimizing the generating cost alone. It is thereby proposed that the current feed-in tariff for renewable energy also needs to be supported with an emissions reduction target. **DOI: 10.1061/(ASCE)EY.1943-7897.0000392.**

Author keywords: Multiobjective optimization model; Electric power expansion; Technology switching; Renewable energy; Green path; Feed-in tariff.

Introduction

An electric power supply is one of the most important and fundamental elements for sustaining national economic growth and competitiveness. In 2009, electricity consumption per capita reached 590 kWh, but the Indonesian government has a target of increasing electricity consumption per capita to about 2,500 kWh in 2025 and 7,000 kWh in 2050 (Soerawidjaja 2011). The Indonesian government has attempted to increase the national installed capacity by implementing its first fast-track program. The program aims to promote energy diversity from oil to coal, gas, and renewable energy. The fast-track program also aims at reducing the burden of electricity subsidies as the power system will be designed to consume less oil.

Based on the work plan of the fast-track program in 2014, the share of steam power plants (coal based) in the total installed capacity would rise from about 48.8% in 2006 to about 63% in 2014 (Sambodo and Oyama 2010). This also indicates that coal will become the backbone of the primary energy supply for the national electricity system. Currently, electricity and heat contribute the most to CO_2 emissions from the energy sector and the share will increase in the future if planned systems depend on carbon-intensive sources (Sambodo and Oyama 2012). Thus, the power system will be trapped in a carbon lock-in situation if there is no well-designed green power system in the future.

Although Indonesia does not have a binding CO_2 emissions target, it has shown strong commitment to ease CO_2 emissions. Following the Copenhagen 15th Conference of the Parties (COP15) on January 30, 2010, Indonesia has planned to voluntarily reduce CO_2 emissions by 26% with domestic efforts and 41% with international support by 2020. According to the Ministry of Finance, this means reductions of around 6 and 24%, respectively, below the 2005 total national emissions levels (Ministry of Finance and Australia Indonesia Partnership 2009). This reduction covers seven major areas, namely peat-land, forestry, agriculture, energy, industry, transportation, and waste. Further, the government also followed up on the emissions target by issuing Presidential Regulation 61, Year 2011 on the National Action Plan for Greenhouse Gas Emissions Reduction (Republic of Indonesia 2011b). However, evidence from the energy sector indicates that although in the short-term, a 1% increase in the total primary energy supply (TPES) will increase CO_2 emissions by 0.82%, while in the long run, it will increase to around 1.0% (Sambodo and Oyama 2012). This implies that Indonesia needs more-robust strategies to ease the growth of CO_2 emissions in the future. However, it is still unclear what the consequences from pursuing a green power system are and what Indonesia needs to prepare in order to ease the transition to a low-carbon power system.

This paper aims to evaluate the tradeoff between minimizing both generating costs and CO_2 emissions. Furthermore, the possibility of implementing a constraint on CO_2 emissions into the

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RESEARCH ARTICLE

Investigating economic growth, energy consumption and their impact on CO_2 emissions targets in China

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This article aims to analyse economic growth, energy consumption and carbon dioxide (CO_2) emissions data in China comparing with the US and Japanese data. Then, we try to evaluate the Chinese government's targets in reducing energy use and carbon intensity. Economic growth is a key factor that determines the Chinese's ability to meet these targets. If we suppose that China's economic growth is maintained at 9.54% per year, and total primary energy supply (TPES) growth is stabilized at 3.82% on average, the country would be able to cut energy consumption per unit amount of gross domestic product (GDP) by 23.5% in 2010: if carbon-GDP intensity could decrease by 4.5% on average, China would be able to achieve a reduction in carbon-GDP emissions target by 49.87% or above the target in 2020. We suggest that China needs to stabilize CO_2 per total primary energy supply intensity. This target can also push government to implement clean coal technology and promote renewable energy target more seriously. Finally, we argue that binding target on CO_2 emissions has worked effectively in the case of Japan, but we have to be careful when analysing economic-energy-CO_2 emissions in Japan due to 'the lost decade' of Japan's economy. Finally, we expect that developed countries such as Japan and the United States can help China not only in transferring technology but also in strengthening the institutional capacity such as in harmonizing regulations, in energy planning and in developing human capability.

Keywords: economic growth; energy consumption; primary energy supply; carbon dioxide emission; China; Japan; the United States

1. Introduction

As the country with the largest population in the world, China has shown impressive and consistent economic growth since the last three decades. In terms of purchasing power parity (PPP), China was the second largest economy in the world, sharing 15% of the world gross domestic product (GDP) in 2006 (International Energy Agency (IEA) 2007a). China has now become important as an essential engine of world economic growth. However, there is an ongoing debate on growth sustainability and sustainable development. Bergsten *et al.* (2009) argued that China has experienced an unbalanced economic growth. The authors contend that promoting energy-intensive heavy industry and investment-led growth has aggravated income inequality, undermined employment gains, heightened trade tension and contributed to serious energy and environmental problems for both China and the rest of the world. The rebalancing of China's economic growth was formally announced in

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RESEARCH ARTICLE

Evaluating the emission reduction targets in UNFCCC Kyoto Protocol by applying primary energy data analyses

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Emission reduction targets set for Annex I countries to the Kyoto Protocol have been raising questions about its rationality though it has been agreed upon by member countries. This paper focuses on evaluation of emission reduction targets in the Kyoto Protocol based on energy supply structure and consumption analysis for major developed and developing countries. Energy supply and consumption, per capita energy consumption, per capita emission and share of clean energy in energy supply structure for 13 Organization for Economic Co-operation and Development (OECD) and non-OECD Annex I and non-Annex I countries to the Kyoto Protocol have been analyzed. It is argued that emission reduction targets set in the Kyoto Protocol for various Annex I countries are neither rational nor consistent from the viewpoint of energy data analysis. Furthermore, it is recommended that a common per capita emission norm is a more rational and simple approach to set an emission reduction target.

Keywords: emission reduction targets; Kyoto Protocol; energy data analysis

1. Introduction

Global warming and in turn climate change has posed a major threat to this planet and consequently it has drawn greater attention of policy makers as well as the general public in many countries. Several studies in the past few years have suggested that global temperature has been rising in the recent past and this trend would continue if emission of greenhouse gases (GHGs) is not arrested and brought under permissible limits. One of the major reasons attributed by scientists for global warming and in turn climate change is anthropogenic emission of carbon dioxide (CO_2), which is a major constituent of GHG. According to the Intergovernmental Panel on Climate Change (IPCC), global warming is likely to cause extreme weather conditions, variability in precipitation causing severe and frequent floods and droughts in varying degrees, depending on different geographical regions, thus adversely affecting agriculture, living conditions for human life, sea-level rise, increase in tropical cyclone and so on (Meehl *et al.* 2007).[1]

Energy is one of the most essential inputs required for socio-economic development. However, the use of fossil fuel-based energy is the main contributor to emission of GHG causing global warming and climate change. Fierce competition for expanding the market backed with high technology and process of globalization, especially by developed and some of the developing countries, and the quest to achieve a reasonable level of economic and social development by developing and least developing countries has continuously increased

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