16 Role of Hometown Investment Trust Funds and Spillover Taxes in Unlocking Private-Sector Investment into Green Projects

Naoyuki Yoshino and Farhad Taghizadeh-Hesary

Contents

Abstract

In 2016, 88.90% of the Asia and the Pacific region's energy came from fossil fuel, the consumption of which accounted for almost 40% of global CO_2 emissions. To ensure the increasing energy needs of the region are in line with sustainable development goals, addressing the financing gaps of green-energy projects is critical. The major challenge for financing green energy is the lower rate of return on projects compared to fossil fuels. Electricity tariffs are often regulated by governments as prices need to be kept low to serve every household as a necessary good. Green energy's sources of revenue are only from user charges, making it is not so attractive to investors. This chapter proposes a model for using

N. Yoshino
Asian Development Bank Institute (ADBI), Keio University, Tokyo, Japan
e-mail: yoshino@econ.keio.ac.jp

F. Taghizadeh-Hesary (✉)
Faculty of Political Science and Economics, Waseda University, Tokyo, Japan
e-mail: farhad@aoni.waseda.jp; farhadth@gmail.com

J. D. Sachs et al. (eds.), *Handbook of Green Finance*, Sustainable Development,
https://doi.org/10.1007/978-981-13-0227-5_29

the tax spillover from green energy to returning a portion of the revenue to new projects. In addition, the chapter proposes a community-based funding scheme for smaller-scale green projects (e.g., solar and wind). The chapter shows that using this model for funding green-energy projects will increase the rate of return and make them feasible and attractive to private investors.

Keywords
Green energy · Green finance · Renewable energy · Hometown investment trust funds · Community-based fund · Spillover effect

JEL Classification
Q21 · E62 · G21

Introduction

Asia is the leading consumer of oil, coal, hydroelectricity, and, for the first time in 2016, the leading consumer of renewables in power generation, overtaking Europe and Eurasia. Europe and Eurasia remain the leading consumers of natural gas and nuclear power. Asia dominates global coal consumption, accounting for almost three-quarters of global consumption (73.80%). Fossil fuels are the main energy sources for the Asian economies, which has caused serious climate and global warming issues. Figure 1 compares the primary energy consumption in Asia and the Pacific with Africa, the Middle East, Europe and Eurasia, South and Central America, and North America. In 2016, 49.34% of energy consumption in Asia and

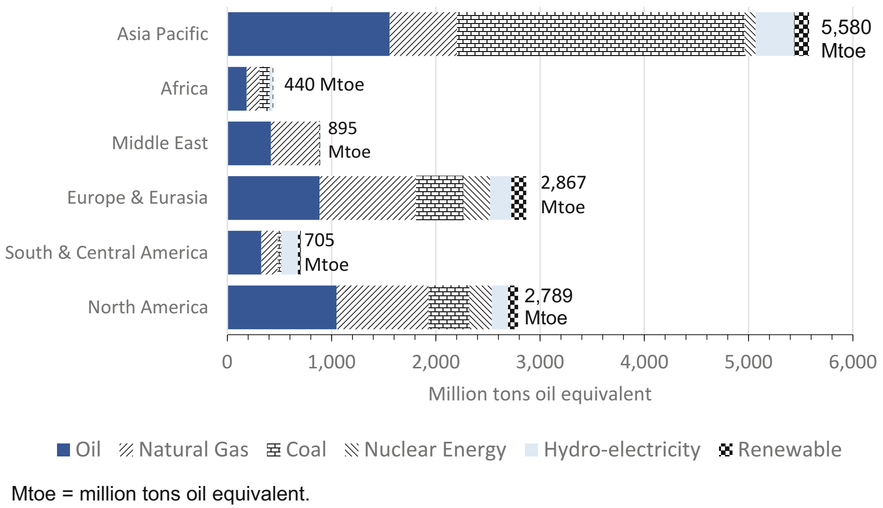

Figure 1: Regional Consumption of Energy by Fuel, 2016. *Mtoe* million tons oil equivalent. (Source: BP 2017)

the Pacific was from coal; their share of oil was 27.90%, and their share of natural gas and liquefied natural gas was 11.65%. This means a total of 88.90% of the energy consumption in Asia and the Pacific was from fossil fuel and less than 12% of energy consumption was from nuclear and renewable-energy resources (BP 2017).

Most climate scientists agree that the main cause of global warming is human aggravation of the "greenhouse effect" that is a consequence of the atmosphere trapping heat radiating from earth toward space. Hence, renewable-energy projects, by replacing fossil fuels, would be a sustainable solution for mitigating climate issues.

Another reason for the development of renewable projects is diversifying energy resources to promote energy self-sufficiency (Domestic production of primary energy (including nuclear)/domestic supply of primary energy × 100 [Yoshino et al. 2017]) and security. Too much reliance on finite resources (coal, oil, or gas) will reduce the resiliency of the economy and make it more prone to energy price fluctuations. Several studies (see, inter alia, Hamilton 1983; Barsky and Kilian 2004; Taghizadeh-Hesary et al. 2013, 2016; Taghizadeh-Hesary and Yoshino 2016) have evaluated the impacts of oil price fluctuations on various macroeconomic indicators and generally found that oil shocks are disruptive to economic growth and create inflation for most importing countries.

In a more recent study, Taghizadeh-Hesary et al. (2017) showed that after the Fukushima nuclear disaster in March 2011, which resulted in the shutting down of nuclear plants and the substitution of fossil fuels for nuclear power, energy security in Japan suffered. The authors applied a cointegration analysis and performed a vector error correction variance decomposition by using quarterly data from Q1 1981 to Q4 2010 and from Q1 2011 to Q4 2015. Their findings reveal that the absolute value of elasticities in oil consumption in some economic sectors decreased after the disaster because of an increased dependency, which endangered the country's energy security. They suggested that to raise energy self-dependency and security, Japan needs to diversify its supplies.

As a result of eliminating nuclear power generation and substituting it with fossil fuels, energy self-sufficiency fell from 19.6% in fiscal year 2000 to 8.6% in fiscal year 2013 (MIAC 2015). Before the 2011 earthquake, Japan was the third-largest consumer of nuclear power in the world after the US and France. In 2010, nuclear power accounted for about 13% of Japan's total energy supply (Taghizadeh-Hesary et al. 2016). In 2012, the nuclear energy share fell to 1% of total energy supply (and contributed at a similar level to primary energy consumption in 2013 because only two reactors were operating for a little more than half of the year). In 2014–2015, Japan did not generate any nuclear power (Taghizadeh-Hesary and Yoshino 2015).

Hence, increasing the share of renewable-energy resources in the energy basket is required. One of the obstacles to development of renewable-energy projects is lack of private sector finance. Easing finance for investment in green-energy projects is a key challenge for climate change mitigation (Dangerman and Schellnhuber 2013; Grubb 2014; Stern 2015).

In recent years, several new methods for financing green-energy projects have been developed, including green bonds, green banks, and village funds. Green banks and green bonds have some potential to help clean-energy financing. The advantages of green banks include improved credit conditions for clean-energy projects, aggregation of small projects to reach a commercially attractive scale, creation of innovative financial products, and market expansion through dissemination of information about the benefits of clean energy. Supporters of green bonds believe that they can provide long-term and reasonably priced capital to refinance a project once it has passed through the construction phase and is operating successfully (NRDC 2016). However, it is necessary to secure a high rate of return to mitigate various risks associated with green energy.

Although the aforementioned methods were somewhat helpful for development of green projects, the data suggest they are inadequate. Fossil fuel investments continue to be much larger than those in renewable energy. In 2013, renewable energy received investments of about $260 billion, which is only 16% of the $1.6 trillion in total energy-sector investments (IEA 2014). Meanwhile, investment in fossil fuels in the power sector, where they compete directly with electricity from renewable energy, rose by 7% from 2013 to 2014 (UNEP and BNEF 2015). Clearly, fossil fuels still dominate energy investment. A major concern in the transition to low-carbon energy provision, therefore, is how to obtain sufficient financing to steer investments toward renewable energy (Mazzucato and Semieniuk 2017).

Due to the limitations of the Basel capital requirements on lending by financial institutions, and most renewable-energy projects' reputation for risk, banks are reluctant to finance them. Hence, relying only on bank financing is not a sustainable solution for green-energy projects, and new channels of financing to fill the gap are needed.

In line with nonbanking financing solutions, Gouldson et al. (2015) proposed revolving funds as an innovative mechanism that could reduce investment requirements and enhance impacts by recovering and reinvesting some of the savings generated by early investments. Such funds have been created in various contexts. Gouldson et al. (2015) proposed a generic revolving fund model and applied it by using data on the costs and benefits of domestic-sector retrofitting in the UK. They found that a revolving fund could reduce costs by 26%, or £9 billion. They concluded that revolving funds could enable countries with limited resources to invest more heavily and effectively in low-carbon developments, even in contexts of austerity. Ng and Tao (2016) explored the cause of the financing gap in Asia and proposed the use of bonds, specifically, three fixed-income instruments: local currency denominated corporate bonds, asset-backed project bonds, and financial green bonds. In the most recent research examining the potential of the capital market for filling the financing gap of green-energy projects, Monaca et al. (2018) examined whether publicly traded financial products offer investors competitive risk-adjusted returns, or whether renewable-energy investors face a penalty for choosing sustainable assets. They used a traditional portfolio approach to test whether adding renewable-energy exchange-traded funds (ETFs) to a standard portfolio provides diversification benefits over study periods of 2, 6, and 9 years. Their results show that the renewable-energy ETFs provide only minimal diversification benefits.

This chapter provides two types of innovative financing solutions which involve using spillover taxes originally generated by green-energy supply and returning them to green-energy projects in order to increase their rate of return and make them interesting to private investors. The first solution is more practical for larger green-energy projects (hydropower). The second uses hometown investment trust funds (HITs) for filling the financing gap of smaller-scale green-energy projects (solar and wind). This chapter's proposed method is the joint utilization of spillover tax payments and HITs to increase the supply of funds to green-energy projects (see Yoshino and Kaji 2013; Yoshino and Taghizadeh-Hesary 2014a).

The chapter is structured as follows. In section "Utilization of the Spillover Effects of Green-Energy Supply", we propose utilization of the spillover effect for the green-energy projects. Section "Modeling the Utilization of Spillover Effects of Green Energy and Application of Hometown Investment Trust Funds in Green Finance" focuses on modeling the utilization of the spillover effects of green-energy supply and application of hometown investment trust funds in green finance. The last section provides concluding remarks.

Utilization of the Spillover Effects of Green-Energy Supply

Asian economies are usually characterized as bank-oriented economies, as opposed to the capital market orientation typical of most Western economies. When looking at the financial assets of households in Asian countries, bank deposits and cash account for the largest share, with insurance companies and pension funds accounting for the second-largest share. In Japan in 2013, 55% of the total financial assets of households were in the form of cash and deposits at banks, 28% in the form of insurance and pensions, 12% in the form of securities and stock, and 5% in other forms. For American households, these ratios were 15% (cash and deposits), 28% (insurance and pension funds), 53% (securities and stock), and 4% (others), respectively (Yoshino and Taghizadeh-Hesary 2014b). Even in Japan, which has a developed capital market, the share of cash and deposits is much larger than that of securities and stock. In other Asian economies, the situation is similar to that in Japan, i.e., banks dominate the financial system, pension funds and insurance companies are second, and the share of the capital market is small. This means that banks, insurance companies, and pension funds will be the C for projects and businesses.

Loans are suitable for financing short- to medium-term projects because the resources of banks are deposits, which typically are short-term or medium-term resources—usually 1 year, 2 years, and, at most, 5 years (deposits longer than 5 years are very rare). Hence, if banks allocate their resources to long-term infrastructural projects (bridges, highways, ports, airports, etc.) and mega energy projects (such as large hydropower projects), there would be a maturity mismatch. Therefore, because banks' liabilities (deposits) are short- to medium-term, their assets (loans) also need to be allocated to short- to medium-term projects rather than to long-term projects.

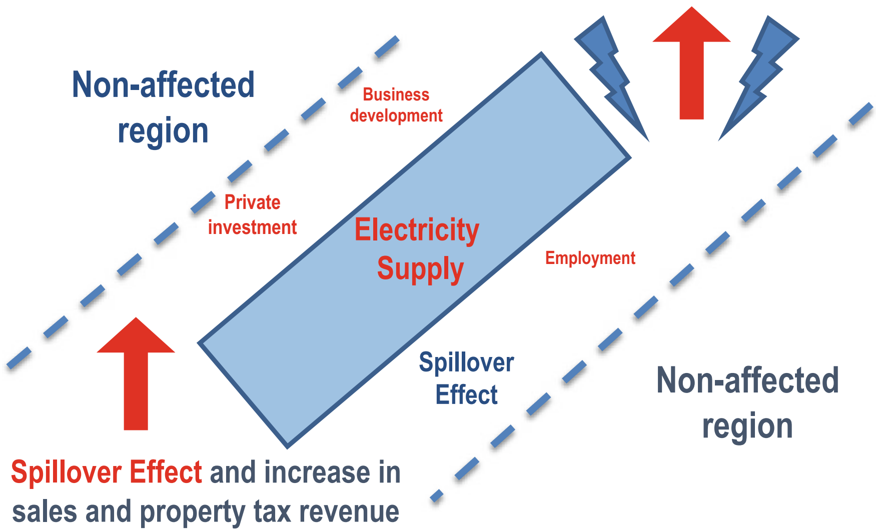

Figure 2: Spillover Effects of Green-Energy Projects. (Source: Yoshino and Taghizadeh-Hesary (2018))

Insurance and pensions are alternatives to long-term investments (10, 20, 30 years). Large projects, such as big hydropower, gas-, or coal-based power plants can be financed by insurance companies or pension funds because they are long-term (10–20-year) projects.

Having said that, electricity tariffs are often regulated by the government, and this makes it difficult for private institutions such as pension funds or insurance companies to finance energy projects. Hence, to increase the investment incentives, it is necessary to utilize the *spillover effects* originally created by energy supplies, and refund the tax revenues to investors in the energy projects (Figure 2). Energy supply will bring factories and businesses into the region. New residences will be constructed and property values will rise. Corporate income property, and sales taxes will rise in the area of new energy supply. All these spillover tax revenues were collected by either local or central governments, and they were not returned to investors in energy projects. They relied only on user charges accrued from electricity supply. If part of the spillover tax revenues had been returned to private investors, their rate of return would have increased not only for one period, but also for longer periods, and their maintenance costs could have been supported.

It is possible to measure the spillover effect of an energy project based on economic growth in a specific region. To create an incentive for the private sector to invest in a particular energy project, the government should refund all or part of the spillover taxes to the investor. Yoshino and Abidhadjaev (2017) measured the spillover effects of Uzbekistan's Tashguzar–Baysun–Kumkurgan railway connection (infrastructural project) and Japan's fast train on Kyushu island. They explained the impact of the project on growth rates of regional gross domestic product and sectoral value added by using a difference-in-difference methodology; the same method could be used to calculate the spillover effect of energy projects.

Modeling the Utilization of Spillover Effects of Green Energy and Application of Hometown Investment Trust Funds in Green Finance

In Japan, HITs are a newly created source of financing for supporting solar and wind power. The basic objective of HITs is to connect local investors with projects in their own locality where they have personal knowledge and interests. Individual investors choose their preferred projects and make investments via the internet (Yoshino and Kaji 2013). One of the major applications of HITs in Japan relates to wind- and solar-power projects, which have raised money from individuals (about $100 to $5,000 per investor) interested in promoting green energy. Internet marketing companies provide the platforms for investment in these projects and are able to promote them. Local banks have started to make use of the information provided by HITs. If these projects are done properly and are received well by individual investors, banks can then start to grant loans for those projects. In this way, renewable projects can be supported by HITs until they are able to borrow from banks. The use of alternative financing vehicles such as HITs has therefore assisted the growth of solar and wind projects in Japan, where the finance sector is still dominated by banks (Yoshino and Kaji 2013; Yoshino and Taghizadeh-Hesary 2014a).

HITs have expanded from Japan to Cambodia, Viet Nam, and Peru. They are also attracting attention from the government of Thailand, Malaysia's central bank, and Mongolia.

Asia's finance sectors are still dominated by banks, and the venture capital market is generally not well developed. However, internet sales are gradually expanding and the use of alternative financing vehicles such as HITs will help risky sectors in Asia to grow.

The Hokkaido Green Fund, established in 2000 to finance wind-power projects in northern Japan, was generated by donations. As banks financed only 20% of the total investments, the other 80% was obtained from individual investors and through donations. The community wind-power corporation sells electricity to the regional power company. In many cases, the price of the power produced by wind is 5% higher than that of other forms of electricity, but users are willing to pay extra to save the environment. More than 19 wind-power projects were constructed in northern Japan using a similar method. There are also examples of solar-power projects in Japan where local governments put money (seed money) into the community fund as an incentive for private investors.

Another example is the revitalization of an old hydropower plant in Japan's Nara prefecture. It was constructed in 1914, but decades later it was abandoned and abolished. The local community and individual investors raised money (one unit of investment was $300) and 274 individuals invested in the revitalization through HITs. The total cost amounted to $500,000, and 184 households received electricity from the revitalized dam and money from the surplus electricity sold to the power supply company in the region.

Although HITs are a form of crowdfunding, there are significant differences between them and conventional crowdfunds: i) there is a "warm feeling" behind the HITs because investors are sympathetic to the company/project owners, who are not solely in it for profit; ii) investors are ready to receive product or services generated by the project (e.g., the electricity generated by wind power) instead of a share of the profits; iii) the intermediator/assessor of HITs will monitor the project frequently so that the investors will not lose money and instead provide advice when the project faces some difficulty. This is unlike crowdfunding or venture capital where profit is the only purpose of investment.

Utilizing HITs for Green-Energy Projects

Investors' (households) utility function depends on the rate of return and risk. Equation (1) shows the utility function of investors, which is a function of rate of return and risk:

$$U = U(r_t, \sigma_t) = r_t - \beta \sigma_t^2 \tag{1}$$

where r_t denotes the rate of return, σ_t denotes the risk, and β is the weight for the risk. If an investor gives more weight to the risk, then β will be larger. A smaller β means that the investor is not so concerned about risk.

Equation (2) shows the total rate of return of households' investments. We are assuming that households are putting their money either in bank deposits or in HITs that will be invested into green-energy projects.

$$r_t = \alpha_t r_t^D + (1 - \alpha_t) r_t^E \tag{2}$$

In equation (2), we are assuming that α percent of the households' assets is going to bank deposits, and the rate of return on bank deposits or the deposit interest rate is r_t^D. On the other hand, $(1 - \alpha)$ percent of their assets are invested in HITs and r_t^E denotes the rate of return on HITs.

$$\sigma_t = \alpha_t \sigma_t^D + (1 - \alpha_t) \sigma_t^E \tag{3}$$

Equation (3) is the aggregated risk. There are two types of risk associated with households' investments. The first risk is for deposit $(\boldsymbol{\sigma_t^D})$ and the second risk is for HITs investment $(\boldsymbol{\sigma_t^E})$. If the deposit interest rate is fixed and not fluctuating, then $\boldsymbol{\sigma_t^D}$ is zerois zero.

Table 1 shows the risk-return trade-off for the households' investments. If a household invests in safer assets (here: deposit), the return is r_t^D and the risk is σ_t^D, which we assume to be zero. If the household invests in green-energy projects

Table 1: Return-Risk Trade-Off for Households' Investments

	Return	Risk
Safer Assets	r_t^D	σ_t^D
Green-Energy Projects	r_t^E	σ_t^E

Source: Authors.

that have a higher risk (σ_t^E) and expect to make a higher return (r_t^E), there is a trade-off between risk and return.

Next, in equation (4) we are looking at the dynamic welfare function and two constraints that are presented in equations (4.1) and (4.2):

$$W = \int_0^\infty e^{-\theta t}.U(r_t, \sigma_t) \tag{4}$$

$$s.t. \quad r_t = \alpha_t r_t^D + (1 - \alpha_t) r_t^E \tag{4.1}$$

$$\sigma_t = \alpha_t \sigma_t^D + (1 - \alpha_t)\sigma_t^E \tag{4.2}$$

In the next step, we develop the Hamiltonian and present it in equation (5) in which the utility function is shown in parentheses:

$$H = e^{-\theta t}\left(r_t - \beta \sigma_t^2\right) \tag{5}$$

$$= e^{-\theta t}\left[\left\{\alpha_t r_t^D + (1-\alpha_t) r_t^E\right\} - \beta\left\{\alpha_t \sigma_t^D + (1-\alpha_t)\sigma_t^E\right\}^2\right]$$

α is the ratio of allocation between deposits and HITs to green-energy projects. If $\alpha = 1$, that means households are putting all their money in bank deposits. If α becomes smaller, then the ratio of investment in HITs and green energy is increasing. In the next step, we maximize the Hamiltonian with respect to α, and the results are equations 6 and 6.1:

$$\frac{\partial H}{\partial \alpha_t} = e^{-\theta t}\left[\left(r_t^D - r_t^E\right) - 2\beta\left\{\alpha_t \sigma_t^D + (1-\alpha_t)\sigma_t^E\right\}\left(\sigma_t^D - \sigma_t^E\right)\right] \tag{6}$$

$$\left(r_t^D - r_t^E\right) - 2\beta\alpha_t\left(\sigma_t^D - \sigma_t^E\right)^2 - 2\beta\sigma_t^E\left(\sigma_t^D - \sigma_t^E\right) = 0 \tag{6.1}$$

Equation (7) shows the α that is obtained from Hamiltonian maximization:

$$\alpha_t = \frac{\left(r_t^D - r_t^E\right) - 2\beta\sigma_t^E\left(\sigma_t^D - \sigma_t^E\right)}{2\beta\left(\sigma_t^D - \sigma_t^E\right)^2} \tag{7}$$

We can rewrite equation (7) by dividing the numerator and denominator by 2β, and we write equation (8):

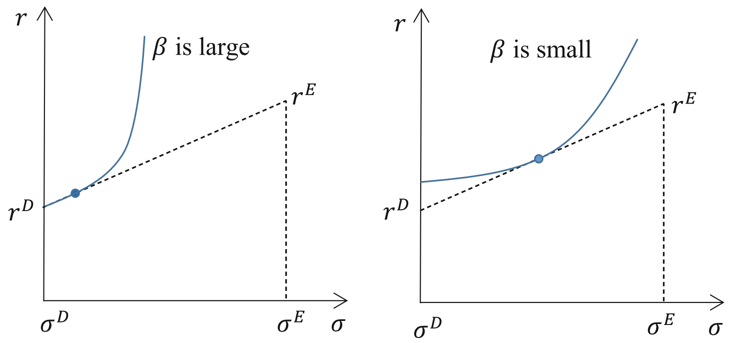

Figure 3: Utility Functions with Regard to Different Risk Preferences. (Source: Authors' compilation)

$$\alpha_t = \frac{\frac{1}{2\beta}\left(r_t^D - r_t^E\right) - \sigma_t^E\left(\sigma_t^D - \sigma_t^E\right)}{\left(\sigma_t^D - \sigma_t^E\right)^2} \tag{8}$$

Equation (9) shows changes of α_t with respect to β:

$$\frac{\partial \alpha_t}{\partial \beta} = -\frac{1}{2\beta^2} \cdot \frac{\left(r_t^D - r_t^E\right)}{\left(\sigma_t^D - \sigma_t^E\right)^2} > 0 \tag{9}$$

Equation (9) shows that if the weight of the risk (β) increases, or if the households become more risk-averse and seek safer types of assets, α_t, which is the share of bank deposits in total assets, will increase, and households will invest less in HITs for green-energy projects.

Figure 3 shows two cases of utility functions with regard to two different levels of risk preferences. On the left side, diagram β is large, which means households are risk-averse. Therefore, they deposit a major part of their assets in banks that have zero risk in this example and a smaller amount in HITs that have higher risk and higher return. On the right side, the diagram shows that β is small, which means these are risk-taking households. Households are ready to take risk, so the utility function becomes flatter compared to the first case. Hence, they are investing a significant portion of their assets in HITs that give them r^E return, but are associated with σ^E risk.

Equation (10) shows how α_t changes when the deposit interest rate $\left(r_t^D\right)$ goes up:

$$\frac{\partial \alpha_t}{\partial r_t^D} = \frac{\frac{1}{2\beta}}{\left(\sigma_t^D - \sigma_t^E\right)^2} > 0 \tag{10}$$

Equation (10) shows that if the deposit interest rate goes up α_t, the share of savings in bank deposits goes up.

$$\frac{\partial \alpha_t}{\partial r_t^E} = \frac{-\frac{1}{2\beta}}{\left(\sigma_t^D - \sigma_t^E\right)^2} < 0 \tag{11}$$

Equation (11) shows that if the rate of return on HITs for green energy $\left(r_t^E\right)$ increases, the share of investments in deposits, or α_t, will be reduced. That means households will be reluctant to put their money in bank deposits and instead will be more interested in investing in HITs for green-energy projects. If spillover tax revenues are returned to investors, the rate of return (r_t^E) increases and α_t will rise. Private investors will allocate much more money to green-energy projects.

$$\frac{\partial \alpha_t}{\partial \sigma_t^E} = \frac{\left[-\left(\sigma_t^D - \sigma_t^E\right) + \sigma_t^E\right]\left(\sigma_t^D - \sigma_t^E\right) - \left[\left(r_t^D - r_t^E\right) - 2\beta\sigma_t^E\left(\sigma_t^D - \sigma_t^E\right)\right]\left(-2\sigma_t^D + 2\sigma_t^E\right)}{\left(\sigma_t^D - \sigma_t^E\right)^2} > 0 \tag{12}$$

Equation (12) shows that if the risk of investment in HITs for green energy goes up, the share of investments in deposits or $\partial\alpha_t$ increases. Figure 4 shows that the higher the rate of return on green energy ($r^E > r^D$), the larger the portion of households' investments will be in green-energy projects.

Figure 4 graphically summarizes all the mathematical equations presented in this subsection by showing the households' investment preference functions. Households' utility function depends on the rate of return and risk that are shown by r *and* σ, which is very typical in finance theory. Figure 4 displays four different cases. The top two diagrams show cases in which $\alpha < 1$, meaning that households are investing their assets in two forms, bank deposits and HITs for green-energy projects. Case A depicts risk-averse households (β is large) that prefer deposits to green-energy projects. Case B depicts the risk-taker households (β is small) that invest more in HITs for green-energy projects and ultimately gain higher returns compared to Case A households. On the bottom are two cases (Case C and Case D) in which $\alpha = 1$, indicating that households keep only deposits without any investment in risky projects (green energy) when the rate of return from green energy is lower than the deposit rate of interest.

$$r = 1.r_D + 0.r_E \tag{13}$$

$$\sigma = 1.\sigma_D + 0.\sigma_E \tag{14}$$

Equations (13) and (14) show Case C and Case D households that invest their assets only in the form of risk-free assets (bank deposits), and their investment in HITs for green-energy projects is zero (shown in Figure 4, Case C, and Case D).

Utilizing Spillover Taxes in Development of Green-Energy Projects

As shown in section "Utilizing HITs for Green-Energy Projects", if the rate of return on green-energy projects increases, households are more interested in investing in

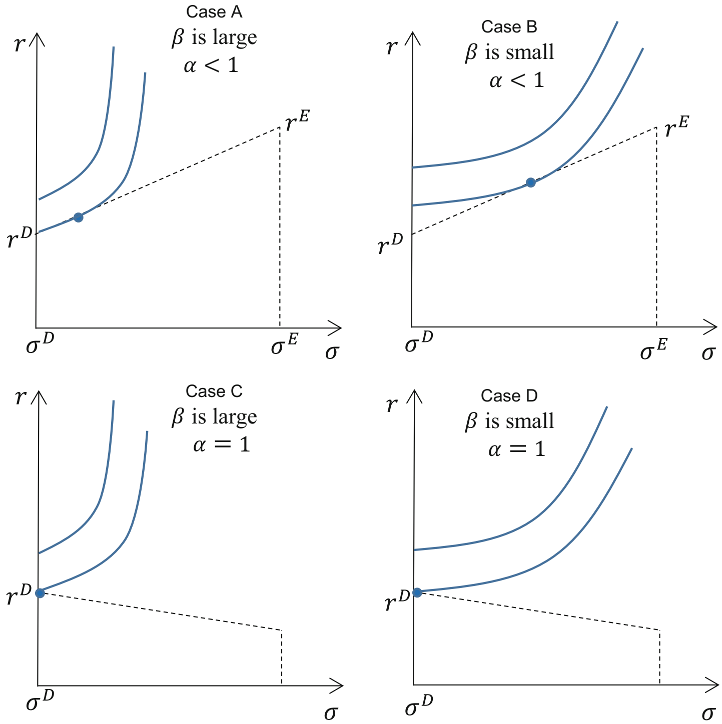

Figure 4: Households' Investment Preferences. (Source: Authors' compilation)

HITs and reluctant to keep their assets in bank deposits. Hence, it is very important to increase the rate of return on green-energy projects. In order to increase the rate of return on HITs for green energy, we are proposing using spillover tax revenue originally generated by energy supply.

Electricity tariffs/user charges collected by a power company are often regulated by governments because electricity, water, and other utilities are necessary goods for everyone. Therefore, if investors in green energy rely only on user charges, the rate of return will be very low. However, green energy supply creates spillover effects in the region such as the building of new apartments and new industries, as well as the entry of small and medium-sized enterprises. Property, income, sales, and corporate tax revenue from this region will subsequently increase.

$$dt = t.dY \tag{15}$$

Equation (15) shows dt, which is the total increase in tax revenue from the spillover impact of regional development created by green-energy supply. t is the tax rate and dY is the increase in regional production created by green-energy supply.

$$Y = F(K,N,E) \tag{16}$$

Equation (16) shows the production function consists of private capital (K), labor (N), and green energy (E).

$$\frac{\partial Y}{\partial E} = \frac{\partial F}{\partial K} \cdot \frac{\partial K}{\partial E} + \frac{\partial F}{\partial N} \cdot \frac{\partial N}{\partial E} + \frac{\partial F}{\partial E} \tag{17}$$

Changes in Y with respect to green-energy supply are shown in equation (17). The right side of equation (17) consists of three components. The first component $\left(\frac{\partial F}{\partial K} \cdot \frac{\partial K}{\partial E}\right)$ shows spillover effects from private capital. Green-energy supply in a region will bring restaurants, hotels and other services, small and medium-sized enterprises, and manufacturing that will increase private capital (K), which will contribute to the gross domestic product. The second component on the right side, $\left(\frac{\partial F}{\partial N} \cdot \frac{\partial N}{\partial E}\right)$, is the spillover effect through labor employment. Green-energy supply in the region will create new jobs, and this will increase the output. The last or third component is $\left(\frac{\partial F}{\partial E}\right)$, which is energy by itself that has a direct effect in the region.

By using the trans-log production function, Japanese data, and Thai data, Nakahigashi and Yoshino (2016) estimated the spillover effect of private capital and employment on the output level.

$$r_E = \begin{pmatrix} \text{Electricity price} \\ or \\ \text{User charges} \end{pmatrix} + \gamma(tdY) \tag{18}$$

Originally, the electricity tariff was the only source of return on revenue for green-energy investors. In this case, r_E is very low when the rate of return comes only from electricity tariff/user charges. However, the spillover tax revenues can be returned to energy investors, in this case γ percent, for example, 60%. Then 60% of the increased tax revenue (tdY) will be returned to the private investors, and the rate of return (r_E) goes up, with the remaining 40% of the increase in tax revenue going to local government.

Equation (18) and Figure 5 show that if government returns spillover taxes to HITs that are designed for green-energy projects, the rate of return increases. This makes the projects feasible and interesting for hometown investors, and hence, the supply of investment money to these funds will increase (Figure 6).

On the other hand, if HITs invest in very risky green-energy projects, this makes hometown investors reluctant, which shrinks the supply of lending/investment to these sectors. Hence, it is crucial for fund managers to check the feasibility and creditworthiness of projects and select only those with a high probability of success.

Stable Supply of Risk Capital to Renewable-Energy Sector

Due to environmental issues, and to increase energy self-sufficiency with a view to improving energy security, greater reliance on renewable-energy resources is crucial

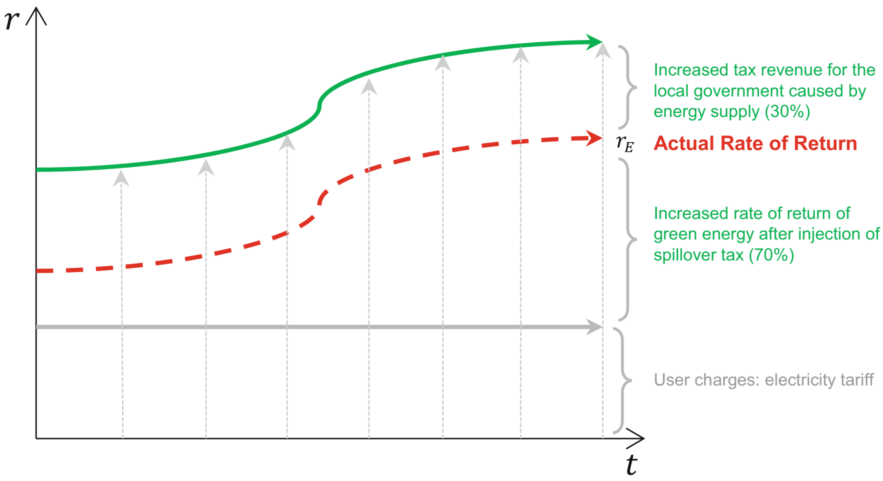

Figure 5: Spillover Effect of Green-Energy Supply and Rate of Return. (Source: Authors' compilation)

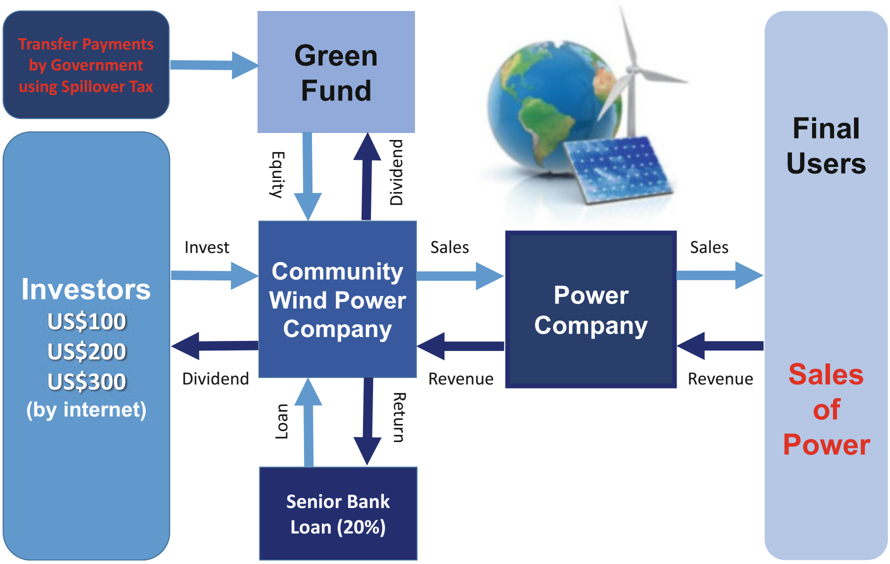

Figure 6: Financing Scheme for Green-Energy Projects Using HITs and Spillover Tax Transfer Payments. *HITs* hometown investment trust funds. (Source: Authors)

in Asia. But as mentioned above, lack of finance is an obstacle to renewable-energy projects.

Asia has bank-centered financial systems, and though they offer micro credit, they loan money at high interest rates so that risky borrowers, such as renewable-energy projects, struggle. It is essential that the HITs discussed here develop in Asia as investment alternatives to microcredit and venture capital.

For infrastructure investment or larger energy projects, in the future it will also be possible to put together infra funds (infrastructure investment trusts) and to implement project finance. When considering HITs in Asia for investments such as energy projects that demand long-term funding, the question will be whether they can put together financing that will be stable for 5 or 10 years, or even longer periods.

In the US and Europe, venture capital and other funds tend to operate in the short term. Money from life insurance companies and pension funds is best suited for stable long-term funding. If private pension funds also begin to participate, demand will emerge in tandem with long-term HITs as places for them to invest. To engage in long-term fund management, it will be necessary for Asia to provide for an increase in pension funds and life insurance companies that seek long-term investments.

Fostering Sound Hometown Investment Trust Funds

HITs, forest investment funds for environmental protection, infrastructure funds, and other such investments are also expected to appear in areas removed from the main urban centers. When they do, it will be necessary to prevent the rise of unscrupulous fund companies that offer inferior projects and have no commitment to the projects they are invested in.

When HITs are on a small scale, it is to be expected that many individual investors will consider the investment as support for the local region. They can be expected to consider the investment trust will operate as a combination of contribution and investment. A variety of different regional assistance funds have come into being, including HITs for the purpose of development of solar power and wind power in Japan, after the Great East Japan Earthquake that resulted in a nuclear disaster. HITs are expanding in Thailand, the Philippines, and Mongolia, as well as in many other countries outside the region, for example, in Peru.

The fund operators will have to set up a self-regulating organization that checks the activity of each fund and cultivates excellent operators who will not betray the confidence of investors; otherwise, the HITs that have finally managed to grow will lose credibility. It will be necessary to monitor the self-regulating organization as it supports excellent operators and eliminates unscrupulous operators. It will also be desirable to create a system whereby the Financial Services Agency or other government authority monitors investment funds.

Concluding Remarks

Fossil fuels, especially coal, are the main sources of fuel for Asian economies. Excessive reliance on fossil fuels, especially coal, is a major cause of GHG emissions in Asia. Renewable-energy projects are solutions for mitigating climate warming that raise self-sufficiency and security through resource diversification.

Too much reliance on coal, oil, or gas will reduce economies' resiliency and make them more prone to energy price fluctuations.

Banks are the major sources of financing projects, but they do not have long-term assets because most of their liabilities are short-term and medium-term (deposits of up to 5 years). After banks, in most Asian economies, insurance companies and pensions have the second-largest share of the financial market. Savings at insurance companies are predominantly long-term (10 years, 20 years, or 40 years), which means they can allocate their resources to long-term infrastructural or mega energy projects. On the other hand, electricity tariffs are regulated by the government and kept at low rates. Hence, to increase the investment incentives, *spillover effects* originally created by energy supplies need to be utilized and tax revenues refunded to investors in energy projects. This will increase the rate of return on energy projects, making these projects more attractive, especially for the institutional investors including pension funds and insurance companies.

For smaller-sized green-energy projects, including solar power and wind power generators, this chapter introduced a combined model of spillover tax return and HITs, which are a form of community-based funding. HITs began in Japan and became a national strategy; most recently, this scheme of financing has spread to other Asian and non-Asian countries including Viet Nam, Cambodia, Thailand, and Peru. This type of fund is a suitable solution for small and medium-sized projects and start-up businesses that have financing gaps.

Most green-energy projects are considered to be risky from the point of view of financers. Hence, owners developing green energy usually need to borrow from the market at very high interest rates. The chapter theoretically shows that by returning the spillover tax revenue that was originally generated by green-energy supply to HITs, projects will become more feasible and more interesting to hometown investors. Hence, the supply of investment money to these funds will increase. Having said that, if HITs support very risky green-energy projects, hometown investors will hesitate to invest, which will reduce the supply of lending/investments to these sectors. It is crucial, therefore, that fund managers carefully assess the feasibility and creditworthiness of projects and only select those with a high probability of success.

References

Barsky RB, Kilian L (2004) Oil and the macroeconomy since the 1970s. J Econ Perspect 18 (4):115–134

British Petroleum (2017) BP statistical review of world energy, 66th edn. British Petroleum, London

Dangerman ATCJ, Schellnhuber HJ (2013) Energy systems transformation. Proc Natl Acad Sci 110 (7):E549–E558. https://doi.org/10.1073/pnas.1219791110

Gouldson A, Kerr N, Millward-Hopkins J, Freeman MC, Topi C, Sullivan R (2015) Innovative financing models for low carbon transitions: exploring the case for revolving funds for domestic energy efficiency programmes. Energy Policy 86:739–748

Grubb M (2014) Planetary economics. Routledge, Oxford, UK/New York

Hamilton JD (1983) Oil and the macroeconomy since World War II. J Polit Econ 91(2):228–248
International Energy Agency (2014) World energy investment outlook 2014 special report. International Energy Agency, Paris
Mazzucato M, Semieniuk G (2017) Financing renewable energy: who is financing what and why it matters technological forecasting & social change. Technol Forecast Soc Change 127:8. https://doi.org/10.1016/j.techfore.2017.05.021
Ministry of Internal Affairs and Communication (2015) Statistical handbook of Japan 2015. Statistics Bureau, Ministry of Internal Affairs and Communication, Tokyo
Monaca SL, Assereto M, Byrne J (2018) Clean energy investing in public capital markets: portfolio benefits of yieldcos. Energy Policy 121:383–393
Nakahigashi M, Yoshino N (2016) Changes in economic effect of infrastructure and financing methods. Public Policy Rev 12(1):47–68. Japan, Policy Research Institute, Ministry of Finance
Natural Resources Defence Council (2016) Clean energy finance outlook: opportunities for green banks and green bonds in Chile. Natural Resources Defence Council, New York
Ng TH, Tao JY (2016) Bond financing for renewable energy in Asia. Energy Policy 95:509–517
Stern N (2015) Why are we waiting? The logic, urgency, and promise of tackling climate change. MIT Press, Cambridge, MA
Taghizadeh-Hesary F, Yoshino N (2015) Macroeconomic effects of oil price fluctuations on emerging and developed economies in a model incorporating monetary variables. Econ Pol Energy Environ 2:51–75
Taghizadeh-Hesary F, Yoshino N (2016) Monetary policy, oil prices and the real macroeconomic variables: an empirical survey on China, Japan and the United States. China Int J 14(4):46–69
Taghizadeh-Hesary F, Yoshino N, Abdoli G, Farzinvash A (2013) An estimation of the impact of oil shocks on crude oil exporting economies and their trade partners. Front Econ China 8:571–591
Taghizadeh-Hesary F, Yoshino N, Mohammadi Hossein Abadi M, Farboudmanesh R (2016) Response of macro variables of emerging and developed oil importers to oil price movements. J Asia Pac Econ 21(1):91–102. https://doi.org/10.1080/13547860.2015.1057955
Taghizadeh-Hesary F, Yoshino N, Rasoulinezhad E (2017) Impact of the Fukushima nuclear disaster on the oil-consuming sectors of Japan. J Comp Asian Dev 16(2):113–134. https://doi.org/10.1080/15339114.2017.1298457
UNEP, BNEF (2015) Global trends in renewable energy investment. Frankfurt School of Finance & Management, Frankfurt, p 2015
Yoshino N, Abidhadjaev U (2017) An impact evaluation of investment in infrastructure: the case of a railway connection in Uzbekistan. J Asian Econ 49:1–11
Yoshino N, Kaji S (eds) (2013) Hometown investment trust funds. Springer, Tokyo
Yoshino N, Taghizadeh-Hesary F (2014a) Hometown investment trust funds: an analysis of credit risk. Asian Development Bank Institute (ADBI) working paper 505. ADBI, Tokyo
Yoshino N, Taghizadeh-Hesary F (2014b) An analysis of challenges faced by Japan's economy and Abenomics. Jpn Pol Econ 40(3–4):37–62
Yoshino N, Taghizadeh-Hesary F (2018) Alternatives to private finance: role of fiscal policy reforms and energy taxation in development of renewable energy projects. In: Anbumozhi V, Kalirajan K, Kimura F (eds) Financing for low-carbon energy transition: unlocking the potential of private capital. Springer, Singapore, pp 335–357
Yoshino N, Taghizadeh-Hesary F, Tawk N (2017) Decline of oil prices and the negative interest rate policy in Japan. Econ Pol Stud 5(2):233–250. https://doi.org/10.1080/20954816.2017.1310798