Journal of Infrastructure, Policy and Development (2020) Volume 4 Issue 2.
DOI: 10.24294/jipd.v4i2.1236

ORIGINAL ARTICLE

Financing infrastructure using floating-interest-rate infrastructure bond†

Naoyuki Yoshino[1*], Dina Azhgaliyeva[2] and Ranjeeta Mishra[2]

[1] *Keio University, Tokyo, Japan*

[2] *Asian Development Bank Institute, Tokyo, Japan*

ABSTRACT

This paper proposes a floating-interest-rate infrastructure bond, where the interest of a government bond is paid to investors during the period of construction and the early period of operation. Unlike the usual government bond, which provides a fixed interest rate, the proposed floating-interest-rate infrastructure bond pays a floating interest, the rate of which depends on spillover tax revenues. Effective infrastructure projects have a positive effect on the economic growth of a region, known as the spillover effect. When user charges and the return from spillover tax revenues are below the fixed rate of the government bond, the interest rate will equal to the fixed rate of the government bond. In this case, investors in the infrastructure will receive interest on the government bond at the minimum rate. As the spillover effect of the infrastructure increases, the rate of return for infrastructure investment will become greater than the fixed rate of the government bond. The success of the floating-interest-rate infrastructure bond depends on the spillover effect and on transparency and accountability. Policy recommendations are provided in this paper on how to increase the spillover effect and improve transparency and accountability.

Keywords*: infrastructure bond; floating-rate bond; spillover effect; public private partnership; infrastructure finance; private finance*

1. Introduction

Government expenditures on healthcare and social security have increased substantially during the COVID-19 crisis. Financing infrastructure development using public funds has become more constrained due to the COVID-19 crisis. Yet, attracting funds for the development of infrastructure projects, such as water supply, roads, and railways, is particularly important for developing countries where infrastructure needs are very high. Public funds are not sufficient for meeting infrastructure needs especially during the COVID-19 crisis, and thus attracting private funds in infrastructure development is important. However, bankable infrastructure projects are scarce because revenue flow is generated mainly from infrastructure user charges, which are

ARTICLE INFO
Received: November 6, 2020
Accepted: December 13, 2020
Available online: December 25, 2020

*CORRESPONDING AUTHOR
Naoyuki Yoshino, Keio University (Economics), 2-15-45 Mita Minato-ku Tokyo Japan 108-8345;
yoshino@econ.keio.ac.jp

CITATION
Yoshino N, Azhgaliyeva D and Mishra R (2020). Financing infrastructure using floating-interest-rate infrastructure bond. *Journal of Infrastructure, Policy and Development,* 4(2): 306–315. doi: 10.24294/jipd.v4i2.1236

† The views expressed in this paper are the views of the authors and do not necessarily reflect the views or policies of the Asian Development Bank Institute (ADBI), the Asian Development Bank (ADB), its Board of Directors, or the governments they represent. ADBI does not guarantee the accuracy of the data included in this paper and accepts no responsibility for any consequences of their use. Terminologies used may not necessarily be consistent with the ADBI.

usually low in developing countries. This paper proposes a floating-interest-rate infrastructure bond, which can pay interest at the interest rate of the government bond during the construction period and the early operation period. The proposed floating-interest-rate infrastructure bond implies that part of spillover tax revenues generated by infrastructure should be shared with infrastructure investors by the government. As spillover tax revenues rise, infrastructure investors will be able to receive a higher return than the fixed-rate government bond. The proposed floating-interest-rate infrastructure bond will allow for more bankable projects in infrastructure and attract more private funds.

Evidence of spillover effect from past infrastructure projects is provided by the literature review of some countries. Yoshino and Pontines (2015); Yoshino and Abidhadjaev (2017a, 2017b); Yoshino, Helble and Abidhadjaev (2018); Hyun and Yoshino (2020); Yoshino *et al.* (2021); Azhgaliyeva and Kalyuzhnova (in press); and Yoshino, Hossain and Taghizadeh-Hesary (2020) estimated the spillover effect of infrastructure. Examples of spillover effect estimates are provided in the literature review section of this paper. Building on the existing literature, this paper contributes to the literature studying financing mechanisms of infrastructure. The main contribution of this paper is that it proposes an innovative floating-interest-rate infrastructure bond.

This remainder of the paper is structured as follows. Section 2 reviews the literature on financing infrastructure. Section 3 discusses the need for long-term private investments. Section 4 explains a theoretical model for an innovative floating-interest-rate infrastructure bond. Section 5 discusses how access to finance for small businesses further enhances the spillover effect of infrastructure investments. Section 6 discusses, concludes and provides policy recommendations.

2. Literature review

Infrastructure, such as water supply, electricity, roads, railways, etc., is an essential part of economic growth. Infrastructure can promote employment in a region. The COVID-19 crisis has forced governments to increase public expenditures on public healthcare and poverty alleviation. When revenues are not sufficient, governments borrow, which increases public debt. In many developing countries, infrastructure is financed from public funds. Attracting private sources of financing in infrastructure is challenged by high upfront costs, large-scale investments, low rates of return and high risks due to the longer term of investment. Due to COVID-19 crisis, financing infrastructure using public funds has become more difficult. Attracting private sources of financing in infrastructure projects is becoming an urgent issue.

Without private investors, some infrastructure projects will be canceled or frozen. At the same time, demand for some infrastructure, such as telecommunications, has increased due to the COVID-19 crisis. For example, more people have started to work from home. More schools have started to provide distance education via online platforms. Telecommunication infrastructure, such as internet services and broadband networks, has become even more crucial.

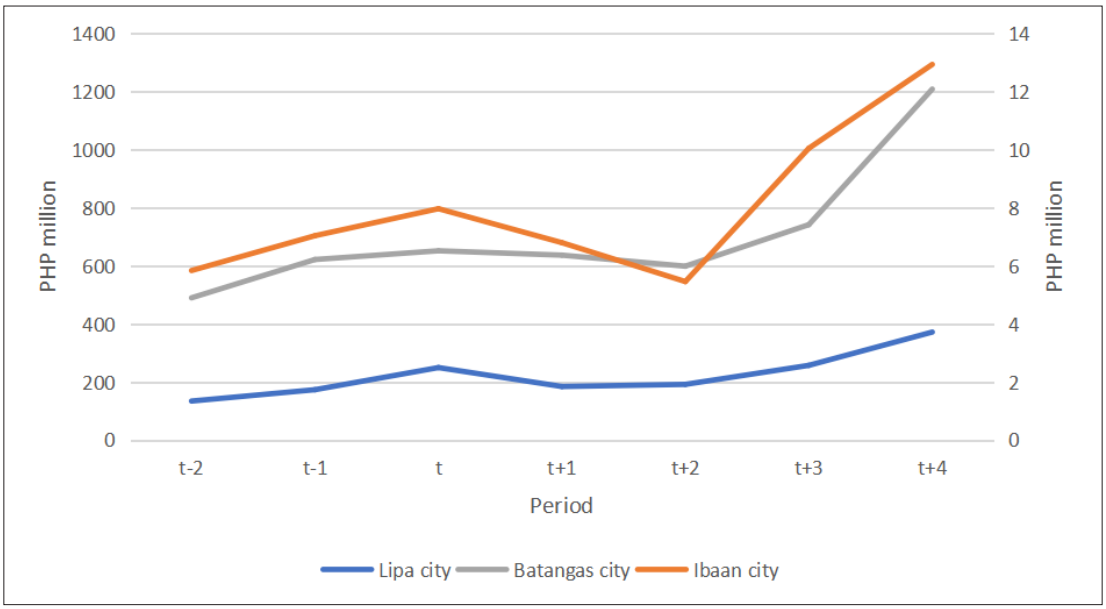
Innovative methods for attracting private investment in infrastructure, such public-private partnership (PPP), have been advocated in the literature for many years (Rillo and Ali, 2018; Rowley, 2020). However, one of the main difficulties that PPPs face is the scarcity of bankable projects due to the low rate of return from infrastructure projects that mainly depend on user charges. Susantono, Park and Tian (2020) stated that the barriers to attracting private investments in infrastructure include the complexity of PPP, corruption in developing countries and low rate of return (Eusepi, Wagner and Gu, 2019). User charges for infrastructure are usually low in developing countries, which causes a low rate of return for investors. There are internal conflicts of interest between private infrastructure investors and governments. For governments, there is a tradeoff between attracting private investment in infrastructure and affordability of user charges, i.e., tariffs for electricity, water, gas, telecommunications, etc. Such conflicts of interest are especially common in water supply infrastructure (OECD/ADBI/Mekong Institute, 2020).

The main contribution of this paper to the existing literature is that this paper proposes an innovative method to attract private finance in infrastructure projects with an increased rate of return by reducing the risks associated with infrastructure investments. Floating-interest-rate infrastructure bonds, which will capture part of spillover tax revenues created by the infrastructure, can reduce the tradeoff between attracting private investors and affordable user charges.

2.1. Spillover effect

The ultimate goal of infrastructure investment is not just developing infrastructure by constructing new roads, railways, electricity, etc. An effective infrastructure project not only constructs the infrastructure but also leads to the growth of the region along that infrastructure, such as roads, railways, water supply, electricity, etc. For example, transportation infrastructure attracts businesses by providing faster access to the region. New restaurants could open at new railway stations. Big opportunities for employment could be created by the new infrastructure construction. This could lead to the development of residential areas due to employment growth. New apartments could be constructed along the new infrastructure. Small businesses could start to open new shops. An effective infrastructure investment means not only the physical quality of the infrastructure but also how infrastructure helps to develop the region and the impact on employment and poverty alleviation in the region. An effective infrastructure investment could have a significant impact on income inequality mitigation. Transportation infrastructure allows local products, for example, agricultural products, such as rice, vegetables and meat, to be transported to consumers faster. Farmers could sell their crops to cities, where demand is located, that are connected by road and railways, which will bring income to rural farmers. Fishermen could sell their fish to cities by use of infrastructure much faster than before. This could lead to the growth of local production and exports. These are some examples of the spillover effect of infrastructure.

A number of empirical studies have demonstrated the spillover effect of infrastructure. Yoshino and Pontines (2015); Yoshino and Abidhadjaev (2017a, 2017b); Yoshino, Helble and Abidhadjaev



Source: Own elaboration, using data from Yoshino and Pontines [1]

Figure 1. Impact of highway in Manila on tax revenues.

(2018); Hyun and Yoshino (2020); Yoshino *et al.* (2021); Azhgaliyeva and Kalyuzhnova (in press); and Yoshino, Hossain and Taghizadeh-Hesary (2020) estimated the spillover effect of infrastructure. For example, Yoshino and Pontines (2015) demonstrated the spillover effect of Manila's highway on tax revenues. By comparing the regions which were affected by the highway in Manila, Philippines, before and after the construction of the highway, they demonstrated the positive impact of the highway on tax revenues in Manila. Period $t-2$ is the period before construction started, and $t-1$ and t are the periods of construction (**Figure 1**). At $t+1$, the operation of the highway started. After four years of operation, at $t+4$, increments of taxes went up about three times as much as in $t-2$, before construction started. The spillover effect of the highway in Manila on tax revenues is remarkable, which demonstrates the positive impact on the economy along this highway.

Another example of spillover effect demonstrates the impact of railways in Uzbekistan on economic growth using the difference-in-difference method (Yoshino and Abidhadjaev, 2017a). After the connectivity between the agricultural region and cities was completed, the growth rate of the economy increased by 2.2 percentage points compared with the region where no railway had been constructed (0.2 percentage points). The difference between the two regions is 2.0 percentage points of the growth rate of the economy.

The next example of spillover effect demonstrates the positive impact of high-speed railways in the Kyushu region in Japan on tax revenues (Yoshino and Abidhadjaev, 2017b). Corporate tax, income tax and other tax revenues increased significantly after the completion of the high-speed railways. The results show that tax revenues increased to JPY194,790 million, after the construction period, from JPY94,896 million. High-speed railways improved the connectivity of the Kyushu region with two large cities, Osaka and Tokyo, and, as a result, attracted more businesses into the region. Both personal income tax and corporate tax increased 7 times and 26 times, respectively, compared with the pre-construction period. Revenues from other taxes, including property tax, increased even during the construction period, i.e., before the connectivity of the Kyushu region

with the two large cities (Osaka and Tokyo) were completed, due to property speculations.

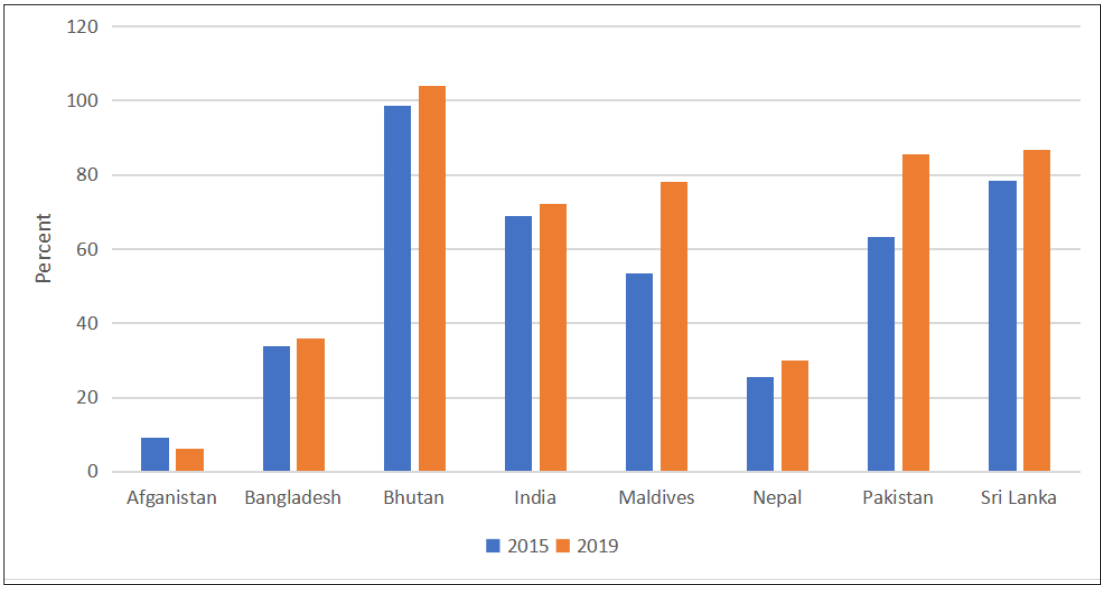
The above examples of infrastructure spillover effect reveal that regional impacts of highways, railways and high-speed railways positively affect GDP growth and tax revenues in the region compared with regions with no such infrastructure and compared with pre-construction periods.

3. Need for long-term private investments

Figure 2 shows the percentage of public debt to GDP in selected South Asian countries. The proportion of public debt to GDP has increased for all countries in South Asia in 2019 as compared with 2015. It is expected to rise further post-COVID-19 crisis. As the COVID-19 crisis forces governments to increase public expenditures on healthcare and social security, fewer funds become available for financing infrastructure. This increases the importance of private sector participation in financing infrastructure projects.

Insurance and pension funds choose to invest in local infrastructure if the rate of return is sufficiently high and the risks are sufficiently low. However, currently, there is only a small proportion of insurance and pension funds in Asia (Yoshino *et al.*, 2020). Foreign long-term investors could be invited to invest in infrastructure in Asia. Insurance and pension funds are long-term investors and they do not change their portfolio based on short-term rate of return. Such patient investors are suitable for infrastructure investments (Yoshino *et al.*, 2020).

Infrastructure projects are usually funded by long-term fixed interest rate loans. In most developing countries, the fixed rate of interest, $\bar{r}$, is high. However, as spillover tax revenues, as shown in **Figure 3**, increase after Point T^*, the spillover tax revenues created by infrastructure projects are subtracted from the fixed interest loans. The real burden of infrastructure loans would decline over time once the spillover effect of the infrastructure starts increasing. Therefore, after Point T^*, the interest burden of loans would decline, as shown in Figure 3.



Source: World Economic Outlook, October 2020

Figure 2. Percentage of public debt to GDP in South Asia.

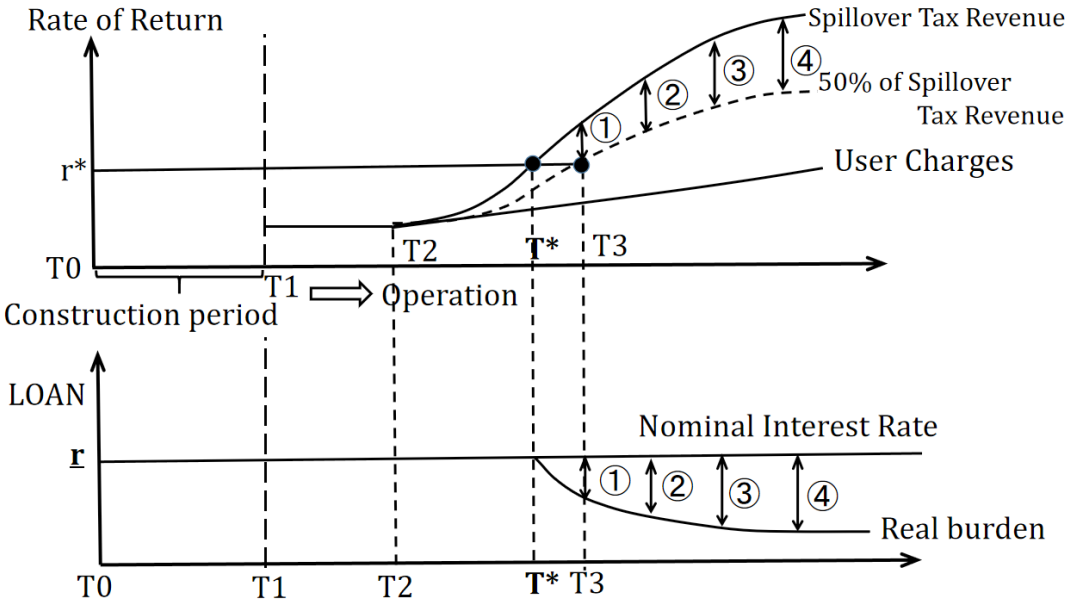


Figure 3. Spillover tax revenues created by infrastructure investments.

4. Floating-interest-rate infrastructure bond: The proposed model for financing infrastructure

The period from T_0 to T_1 is the construction period of the infrastructure, where no return from the use of infrastructure is observed. The operation of the infrastructure starts at time T_1. User charges and spillover effect from infrastructure are not so large until Point T_3, after which user charges and 50% of spillover tax return become higher than the government bond's interest rate. Between T_0 and T_3, where not enough revenues are created by the infrastructure, the interest rate of the infrastructure bond is the same as the government bond.

From Point T_3, 50% of spillover tax revenues, in addition to user charges, become larger than the interest rate of the government bond. After this point, the floating-rate bond will start paying a higher rate of interest than the government bond. Due to the infrastructure, when the economic effects in the region become larger and larger, the spillover tax revenues will rise and pay a higher rate of return to investors with the floating-rate infrastructure bond.

Investors in infrastructure will purchase floating-rate infrastructure bonds, where government bond interest is paid during T_0–T_3 and the floating interest rate becomes higher than the government bond rate after T_3. The rate of return on the floating-rate bond is the upward-moving red line in **Figure 4**.

Revenue for the issuer of floating-interest-rate infrastructure bond is generated from two sources: infrastructure user charges and a part of spillover tax revenues. At Point T_3, these two revenues become greater than the interest rate of the government bond. The floating-rate infrastructure bond can pay higher interest than the government bond rate.

During the construction period (T_0 and T_1) and the low-return period (T_1 to T_3), the infrastructure bond can pay at the same interest rate of the government bond. However, when user charges

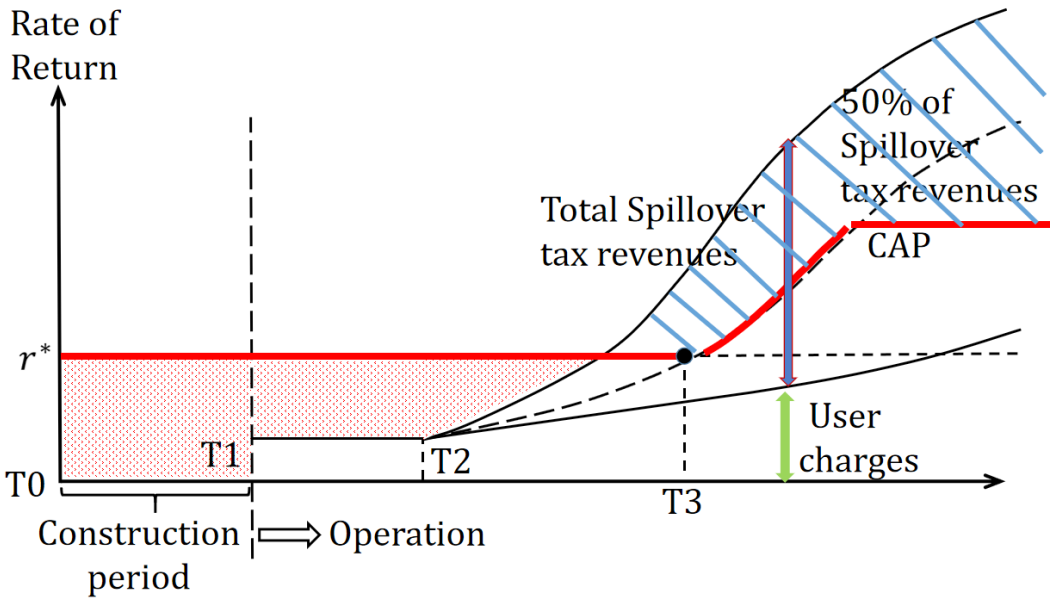


Figure 4. The proposed floating-rate infrastructure bonds to make spillover tax return in practice.

and part of spillover tax return become greater than the interest rate of the government bond, the floating-rate infrastructure bond will pay at a greater interest rate than the government bond.

Figure 4 shows that, over the time of infrastructure operation, new businesses come to the region by utilizing infrastructure. New residential areas could be constructed and new businesses and new restaurants, etc., could be established, which could increase revenues from income tax, sales tax and corporate business tax. Spillover tax revenues could rise due to the big spillover effect created by infrastructure development. New businesses that come to the region along the infrastructure can create job opportunities. Access to finance for new businesses is necessary for the spillover effect. When bank loans are not accessible or not affordable, hometown crowdfunding is one of the ways to finance small businesses and startups, which will increase economic activities in the region along the new infrastructure (Yoshino, 2013).

The issuer of the floating-interest-rate infrastructure bond could set a cap to the rate of return. If the spillover effect is very large, the floating interest rate will grow. The issuer could set a cap for the interest rate to be paid to infrastructure investors. However, the cap has to be set up by the issuer in advance, prior to bond issuances. Otherwise, private investors would be very skeptical of the cap level of the floating-rate bond.

Extra revenues above the cap can be kept by the issuer as reserves to fund infrastructure maintenance and repairs due to future natural disaster damages of the infrastructure. Maintenance and repairs are needed for infrastructure especially after natural disasters, and such costs are usually covered by public funds.

A floating-rate infrastructure bond can be explained mathematically as follows:

(1) Construction period (period between T_0 and T_1)

$$\sum_{t=T_0}^{T_1} r_t^* \times t$$

There is no revenue, and the cost is the interest payment to infrastructure bondholders, which is at the same interest rate of the government bond (=r_t^*).

(2) Net cost of the first operation period (period between T_1 and T_2)

$$\sum_{t=T_1}^{T_2} r_t^* \times t - \sum_{t=T_1}^{T_2} (\text{User Charges})_t$$

Since the operation has started, user revenues (User Charges), which is smaller than the government bond's interest rate, are commencing to infrastructure operators. The cost is the interest payment to bondholders, which is r_t^* multiplied by the time period from T_1 to T_2.

(3) Positive spillover tax revenues (period after T_2)

The net cost of infrastructure equals to the interest rate payment without user charges and without spillover tax return:

$$\sum_{t=T_2}^{T_3} r_t^* \times t - \sum_{t=T_2}^{T_3} (\text{User Charges})_t - \sum_{t=T_2}^{T_3} (t \times \triangle Yt) \times 0.5$$

where, $Y_t = F(L_t K_t^P K_t^G)$ is the production function of the region along the new infrastructure, Y_t is output, L_t is labor employment, K_t^P is private capital, K_t^G is infrastructure (=public capital), $\triangle Y_t = \frac{\partial \triangle Y_t}{\partial \triangle K_t^G}$ and $t \times \triangle Y_t$ is total spillover tax revenue. It is assumed that 50% of total spillover tax revenues are returned to infrastructure bondholders.

5. Policy recommendations

The success of floating-interest-rate infrastructure bonds depends on the spillover effect and on transparency and accountability. Policy recommendations are provided below regarding the evidence of the spillover effect and of transparency and accountability.

The magnitude of the spillover effect can be increased in order to ensure the success of floating-interest-rate bonds. Spillover effect depends on a number of factors, such as quality of infrastructure, interconnectivity with other infrastructure with neighboring regions or countries, population density, type of infrastructure (i.e., water supply, roads, railways, etc.), income, access to finance, education, etc. Knowing this, governments can increase the spillover effect, for example, by improving access to finance or infrastructure interconnectivity with other regions or countries.

For example, access to finance is necessary for the infrastructure spillover effect. Better access to finance can increase the spillover effect. In order to create new jobs and new businesses, financing for small- and medium-sized enterprises (SMEs) are quite important in developing countries. However, as banks are reluctant to lend funds to SMEs (Yoshino and Taghizadeh-Hesary, 2020; Yoshino *et al.*, 2020), hometown crowdfunding (Yoshino, 2013) will be one of the ways to provide finance for startups and small businesses to start their restaurants, etc., along the newly constructed infrastructure. They will create big opportunities for the people in the region, hence enhancing the economic growth in the region.

Connectivity of infrastructure with other neighboring regions or neighboring countries could also increase the spillover effect. For example, in the Central Asian region, where infrastructure financing is challenged by low population density and large distances, the spillover effect can be increased by the interconnectivity of the infrastructure with other countries. Interconnectivity across borders

can increase the spillover effect of infrastructure, particularly transportation infrastructure. Such infrastructure could have a positive impact on cross-border trade and services. Such infrastructure could also increase economic development and could increase spillover tax revenues further.

Transparency and accountability on tax revenue are necessary for attracting private investors. The involvement of multilateral banks, such as the World Bank, the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), etc., could play an important role in avoiding corruption in infrastructure investment. Even a small share of involvement of multi-lateral institutions could reduce corruption and increase transparency and accountability in infrastructure investment Tax evasion is evident in many regions in Asia. Especially, it is difficult to check the sales and profits of SMEs. One way to collect adequate tax revenues in Asian countries is by the use of satellite photos. Satellite photo can assist the accuracy of tax collection by estimating how much an agricultural track is bringing in crops each day or how many people go to a particular restaurant every day. This may allow tax authorities to estimate the sales by farmers, shops, manufacturing factories, etc.

6. Conclusion

This paper proposes an innovative bond, the floating-interest infrastructure bond, which could attract private finance in infrastructure projects. This paper explains how private finance can be channelized into infrastructure investment by the sharing of spillover tax revenues between the government and the investors using a floating-interest-rate infrastructure bond. The private sector, such as banks and postal banks, will develop long-term deposits to provide loans for infrastructure development.

Unlike the usual government bond, which provides a fixed interest rate, the proposed floating-interest-rate infrastructure bond pays a floating interest, the rate of which depends on spillover tax revenues. When user charges and the return from spillover tax revenues are below the interest rate of the fixed-rate government bond, the interest rate will equal to the fixed rate of the government bond. In this case, investors in infrastructure will receive interest on the government bond at the minimum rate. As the spillover effect of infrastructure investment increases, the rate of return from infrastructure investment will become greater than the fixed rate of the government bond. The government compensates for the losses by paying interest at the rate of government bond during the infrastructure's early stage, when no user charges are collected. The spillover tax revenues in the latter stage can serve as a source for compensation for losses in the first period.

Spillover effect depends on a number of factors, such as quality of infrastructure, inter-connectivity with other infrastructure with neighboring regions or countries, population density, type of infrastructure (i.e., water supply, roads, railways, etc.), income, access to finance, education, etc. Thus, governments can increase the spillover effect of infrastructure.

Transparency and accountability of infrastructure project and tax revenue are necessary for attracting private investors. In order to improve transparency and accountability, governments could work on infrastructure projects with multilateral institutions. Such institutions could play an important role in avoiding corruption and improving transparency and accountability.

References

Abiad A, Rana Hasan R, Jiang Y and Patalinghug E (2020). "The past and future role of infrastructure in Asia's development". In: Susantono B, Park D and Tian S (Eds.), *Infrastructure Finance in Asia*. pp. 1–25. https://doi.org/10.1142/9789811215124_0001.

Azhgaliyeva D and Kalyuzhnova Y (in press). *Trans-Caspian Transport Corridor: Infrastructure and Trade*.

Eusepi G, Wagner RE and Gu Q (2019). "Introduction to the JIPD Special Issue on Infrastructure". *Journal of Infrastructure, Policy and Development*, 3(2): 176. http://dx.doi.org/10.24294/jipd.v3i2.1158.

Hyun S and Yoshino N (2020). "Spillover capture financing for infrastructure projects: Implications for Asia". In: Susantono B, Park D and Tian S (Eds.), *Infrastructure Financing in Asia*, pp. 83–111. https://doi.org/10.1142/9789811215124_0004.

OECD/ADBI/Mekong Institute (2020). I*nnovation for Water Infrastructure Development in the Mekong Region, The Development Dimension*. Paris, France: OECD Publishing. https://doi.org/10.1787/167498ea-en.

Rillo AD and Ali Z (2018). "Toward an innovative approach of financing infrastructure in Asia". *Journal of Infrastructure, Policy and Development*, 2(1): 87–96. https://doi.org/10.24294/jipd.v2i1.141.

Rowley AH (2020). *Foundations of The Future: The Global Battle for Infrastructur*e. Singapore: World Scientific. https://doi.org/10.1142/11765.

Susantono B, Park D and Tian S (2020). "Introduction". In: Susantono B, Park D and Tian S (Eds.), *Infrastructure Financing in Asia*. pp. i– xlviii. Singapore: World Scientific. https://doi.org/10.1142/11688.

Yoshino N (2013). "The background of hometown investment trust funds". In: Yoshino N and Kaji S (Eds.), *Hometown Investment Trust Funds: A Stable Way to Supply Risk Capital.* pp. 1–13. Tokyo, Japan: Springer. https://doi.org/10.1007/978-4-431-54309-1.

Yoshino N and Abidhadjaev U (2017a). "An impact evaluation of investment in infrastructure: The case of a railway connection in Uzbekistan". *Journal of Asian Economic*s, 49: 1–11. https://doi.org/10.1016/j.asieco.2017.02.001.

_____ (2017b). "Impact of infrastructure on tax revenue: Case study of high-speed train in Japan". *Journal of Infrastructure, Policy and Development*, 1(2): 129–148. https://doi.org/10.24294/jipd.v1i2.69.

Yoshino N, Helble M and Abidhadjaev U (2018). *Financing Infrastructure in Asia and the Pacific: Capturing Impacts and New Sources*. Tokyo, Japan: Asian Development Bank Institute.

Yoshino N, Hossain M and Taghizadeh-Hesary F (2020). "Enhancing financial connectivity between Asia and Europe: Implications for infrastructure convergence between the two regions". *Asian Economic Papers* 19: 2. https://doi.org/10.1162/asep_a_00773.

Yoshino N, Huang B, Azhgaliyeva D and Abbas Q (2021). *Developing Infrastructure in Central Asia: Impacts and Financing Mechanisms*. Tokyo, Japan: ADBI Press. https://www.adb.org/adbi/publications/books.

Yoshino N and Pontines V (2015). "The 'highway effect' on public finance: Case of the STAR highway in the Philippines". *ADBI Working Paper No. 549*. Tokyo, Japan: Asian Development Bank Institute (ADBI). https://doi.org/10.2139/ssrn.2697322.

Yoshino N and Taghizadeh-Hesary F (2020). "Role of SMEs in Asia and the financing challenges they face". In: Yoshino N and Taghizadeh-Hesary F (Eds.), *Unlocking SME Finance in Asia: Role of Credit Rating and Credit Guarantee Schemes*. pp. 3–22. New York, NY, USA: Routledge.