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Infrastructure financing with project bond and credit default swap under public-private partnerships

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Abstract

This paper elaborates the use of project bonds and a credit default swap (CDS) in infrastructure financing under public-private partnerships (PPPs). First, a structural model is presented and calibrated using market data to estimate the default probability of a project company in a PPP project, which lays the foundation for determining the CDS premium. Second, the CDS is priced using the risk-neutral valuation method. Third, sensitivity analysis is conducted to evaluate the impacts of project parameters including capital structure, asset rate of return and volatility, bankruptcy loss rate, and tax rate on the default probability and CDS premium. This study concludes that it is beneficial to governments, project companies, and bond holders to implement bond financing in PPP projects with a fairly priced CDS.

Keywords: Public-private partnership (PPP); Project bond; Credit default swap; Government debt guarantee; Infrastructure financing

1. Introduction

The global infrastructure demand has outpaced historical levels, leaving a staggering funding gap of $ 1 to 1.5 trillion annually from 2013 to 2030 (Airoldi et al., 2013). Many governments around the world embrace public-private partnerships (PPPs) to close the infrastructure investment gap (Ke et al., 2010; Zhang et al., 2016; Liu et al., 2016). Loans provided by commercial banks have traditionally been the predominant instrument for PPP infrastructure financing. However, the onset of 2008 financial crisis limited the banks' appetite to finance long-term infrastructure projects (Ordonez et al., 2015). In addition, stiffer banking regulations have resulted in unfavorable lending terms that significantly affect the bankability and value for money of PPP projects (EPEC, 2012). Therefore, the need for an alternative financing instrument is pressing.

On the other hand, insurance companies, pension funds, and sovereign wealth funds have appealed for long-term investments in infrastructure projects to match their long-term liabilities and diversify their portfolios (Ordonez et al., 2015). Project bond, as an efficient debt financing instrument, has gained momentum in PPP projects. For instance, bond financing comprised 27% of project finance debt issuance in 2013 in Europe, which is substantially higher than the 3% bond financing in 2008 (Scott-Quinn and Cano, 2015).

Bond financing enables a project company to obtain debt directly from individuals and institutions with low interest rate and long maturity. Despite its merits, a primary concern for bond financing in PPP projects is the low credit rating that prevents a project company from raising funds with low capital costs. Institutional investors have the mandate to invest in bonds with a credit rating of at least "A" (Ordonez et al., 2015). However, the typical ratings for PPP infrastructure projects are BB+ or BBB− (EPEC, 2012), which hinder the widespread use of project bonds. Therefore, credit enhancement is needed to improve bond ratings to attract investors and ensure sustainable costs of finance (Chowdhury et al., 2015). With the demise of

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monoline insurers, public sectors have filled the role of providing credit assistance in PPP infrastructure projects (Ehlers, 2014). Under PPPs, governments can provide debt guarantees to reinforce the credit strength of project companies by assuming full or partial debt obligation in the event of default. With such a guarantee, the credit rating of a project can be upgraded to "A" to induce investments with low capital costs. This practice is prevalent. For example, the Transportation Infrastructure Finance and Innovation Act and Railroad Rehabilitation and Improvement Financing Program in the United States, and European 2020 Project Bond Initiative are sponsored by governments to provide credit assistance in the form of debt guarantee for infrastructure financing.

Nevertheless, governments are facing threats of significant fiscal risks, social inequity, and moral hazards from private sectors when providing debt guarantees. First, the magnitude of contingent liability of issuing a debt guarantee can be enormous. For example, the Mexican government assumed $7.7 billion in debt for 25 toll road concessionaires in 1997 (Ehrhardt and Irwin, 2004). The administration costs of implementing the guarantees further exacerbate governments' fiscal risks. Second, the fiscal burden incurred from the contingent liability creates significant intergenerational inequity because it enriches current citizens and governments at the expense of future citizens and governments by transferring potential fiscal risks to the future (EPEC, 2012). Moreover, the costs of guarantees are unfairly assumed by general taxpayer rather than the users, which violate the equality principle in infrastructure planning. Third, government debt guarantees unfortunately become a cost-free instrument to increase private sectors' profitability by providing access to low-cost capital, as well as an inevitable disincentive to promoting project success through endowing over-redundant risk hedging protection. Private sectors become habituated to guarantees and expect them regardless of individual project characteristics (EPEC, 2011), which significantly distort the fair risk allocation between private and public sectors.

An effective remedy for the above problems is to charge the project company for a debt guarantee, which is referred to as a credit default swap (CDS). CDS can compensate the government for its future liability and administration cost, shift a portion of the cost of guarantees to users rather than general taxpayers, and redistribute the risk and award in a project to achieve fair allocation. However, there are three questions that need to be answered before the implementation of CDS in PPP bond financing. The first question is how to determine the fair premium for CDS? Second, how do the project characteristics affect the premium for CDS? Third, will the project company be willing to pay the insurance premium? The answers to these questions are ambiguous, eliciting this study that aims to address the above puzzles and shed light on policy and investment decision-making in bond financing in PPP infrastructure projects.

2. Literature review

Many studies have focused on the valuation of minimum traffic and/or revenue guarantees in PPP projects. Cheah and Liu (2006) attempted to evaluate government subsidies and guarantees through Monte Carlo simulation of a discounted cash flow model. Wibowo (2006) adopted a capital asset pricing model to assess the impacts of government financial supports on the cost of debt, cost of equity, expected return on equity, and project net present value of infeasible and risky private infrastructure projects. Huang and Chou (2006) utilized a real option approach to value the minimum revenue guarantee and the option to abandon in a build-operate-transfer (BOT) infrastructure project. Vassallo and Soliño (2006) illustrated the results of implementing a minimum income guarantee mechanism in transportation projects in Chile. Chiara et al. (2007) modeled minimum revenue guarantee as a simple multiple-exercise real option and used multi-least-squares Monte Carlo technique to determine the option value. Brandao and Saraiva (2008) utilized market data to determine stochastic project parameters for the valuation of a minimum traffic guarantee.

Galera and Soliño (2010) obtained an estimate of the value of a minimum traffic guarantee by applying the theory of real options. Jun (2010) and Ashuri et al. (2011) elaborated the valuation of a minimum revenue guarantee combined with a revenue cap option. The probability distributions of when and the number of times the concessionaire may request minimum revenue guarantee, as well as when and the number of times the government may share the additional revenue were characterized. Almassi et al. (2012) proposed the use of a finite-difference method based on a continuous stochastic process to value government guarantees. Brandão et al. (2012) analyzed the effects of the minimum traffic guarantee and subsidy payments on the value and the risk of a concession project, as well as their cost and risk to the government.

Kokkaew and Chiara (2013) proposed to adjust the threshold level of the minimum revenue guarantee over time. In their study, the revenue shortfalls and revenue excess were modeled as multi-early exercise options and were valued using multi-least squares Monte Carlo method. Carbonara et al. (2014) used the concept of fairness to structure the minimum revenue guarantee to balance the private sector's profitability needs and the public sector's fiscal management interests. Mirzadeh and Birgisson (2015) proposed an option-pricing framework to enable financial assessment of toll road in the presence of different government support mechanism. They focused on the evaluation of highway projects under a price adjustment guarantee. Power et al. (2016) modeled revenue-sharing and minimum revenue guarantee options and used least squares Monte Carlo simulation to value the options.

Most of the above studies focused on valuing minimum traffic and/or traffic guarantees, with very few exceptions on valuing debt guarantees. Mody and Patro (1996) and Irwin (2007) discussed the valuation of loan guarantee and accounting issues in a much simplified context. However, none of the previous studies explored the role of government debt guarantee to enhance project bond rating under PPPs. The aforementioned three questions have not been explored by the previous studies. The limitation is partially due to the complexity in using government guarantee to enhance project bond rating, and the need to consider a number of project parameters