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Using Bootstraph technique to support Value for money assessment for Public private Partnership projects in Vietnam

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Abstract: Vietnamese government is expectingPublic-private partnership (PPP) as an importantalternativeto conventional public procurement to develop road infrastructure projects next years. However, PPP may not usually be anappropirate selection.Value for money assessment allows public policy makers to determine whether PPP is more suitable than traditional delivery. This paper is proposing Bootstrap technique as a tool to support Value for money assessmentto examine the general applicability of the PPP model for the development of road sector in Vietnam.

Keywords: Bootstrap, Public- private partnership (PPP), road sector, Value for money (VFM), Vietnam.
JEL Classification: L32, L33

I. INTRODUCTION

During the past decades, Public-private partnership (PPP)has become an alternative to conventional procurement in developing public projects in many countries. This trend is proved by the utilization of the PPP model in the doingof 1,193 road infrastructure projects with the worth ofapproximately USD 353,169 billion from 1990 to 2020(World Bank, 2021). Like other countries,PPP projects in Vietnam have been increased significantly. To specify,there have been131 PPP projects which worths USD 24,143 billion between 1990 and 2020 (World Bank, 2021). In spite of its increased volume, there seems to be no consensus of practitionersonPPP model as anessentialfor the development of road projects in Vietnam.In particular, some have argued that using PPP model is a good orientation to develop road infrastructure sector in Vietnam. The others have stated that the Vietnamese government tends to have an overly optimistic viewpoint of using the PPP model over the traditional procurement methods. The use of VFM assessment could help address the competing views on the suitability of PPP projects in Vietnam.

Maralos and Amekudzi (2008) argue that VFM helps the public authority and agencies to determine whether PPP model is able to cut down costs when adopted instead of relying on traditional funding method, which is referred to the fully government funding. Many practical studieshave focused on the VFM assessment with the combination of Monte Carlo simulation (MCS) method in order to estimate the confidence level associated with a positive VFM for a project. However, since the MCS alone could not provide information of the confidence level that PPP is suitable to finance projects in general. This research is proposing the use of Bootstrap techique in VFM assessment to examine the general suitability of the PPP model for the development of road sector in Vietnam.

This paper begins with the literature review concerning quantitative VFM and Bootstraph. Then, it focuses on the VFM assessment procedure using Bootstraph. Next, the paper outlines an application of VFM assessment with the use of Bootstraph to justify whether PPP is more suitable than conventional procurement to develop projects in Vietnamese road sector. The shortcomings as well as suggestions for future work are closing this paper.

II. LITERATURE REVIEW

1.1. Quantitative Value for money assessment

Morallos and Amekudzi (2008) found that VFM is one of the most effective tools available to policy planners to evaluate the value of a given project via PPP delivery against conventional method. Deepark et al. (2015) argue that "VFM is a means to determine if project delivery via PPP rout would be better fit in comparision to project delivery via traditional options". In the same vein, Tsamboulas et al. (2013) note that VFM is used to compare the funds for implementation of project under PPP and by public sector. Basically,

quantitative VFM assessment consists of computing the value of a project under PPP and comparing with the value associated with the traditionally procured project.

For estimation of PSC (Public Sector Comparator)-the cost of the project done by public sector and SBP (Shadow Bid price)- the cost of the project via PPP , functions are defined by Tsukada (2015), as follows:

PSC = Transferable risks + retained risks + competitive neutrality + financing cost + raw project cost - future revenue

SBP = Capital expenditure + operating expense + financing cost + return on investment (profit) - future revenue

As the value of PSC and SBP are computed, it is possible to make a systematic comparison by caculation of quantitative Value for money as follows:

Quantitative value for money = PSC – SBP

Theoretically, VFM is achieved when the value of the PSC is larger than that of the PPP. In other words, if the quantitative VFM is positive, PPP delivery should be used to implement the project. On the contrary, if the quantitative VFM is negative, PPP scheme should not be used to implement the project.

1.2. Introduction to Bootstraph

The method of Bootstrap was originally introduced in 1979 by Bradley Efron (Hardi et al., 2015). The method is a resampling technique for evaluating uncertainties (Davison & Kuonen, 2013). Additionally, Efron and Robert (1998)found that Bootstrap is a "computer-based method" for quantification the quantification of statistical estimates. Since then, the bootstrap method has become a common statistical tool for analyzing the quantitative estimates of uncertainties in cases where analytical methods are not insufficient, or modeling supposition are worthless (Neto, 2015).

One of the Bootstrap method's characteristic is that, based on a given sample, it is possible to derive and simulate new samples are through a non-parametric or parametric process. The non-parametric approach is done through a resampling process that involves replacements, while the parametric approach is implemented through a pre-defined parametric distribution of the original sample, which is then stochastically calibrated to derive new sample distributions (Thomas & Rossukon, 2015).

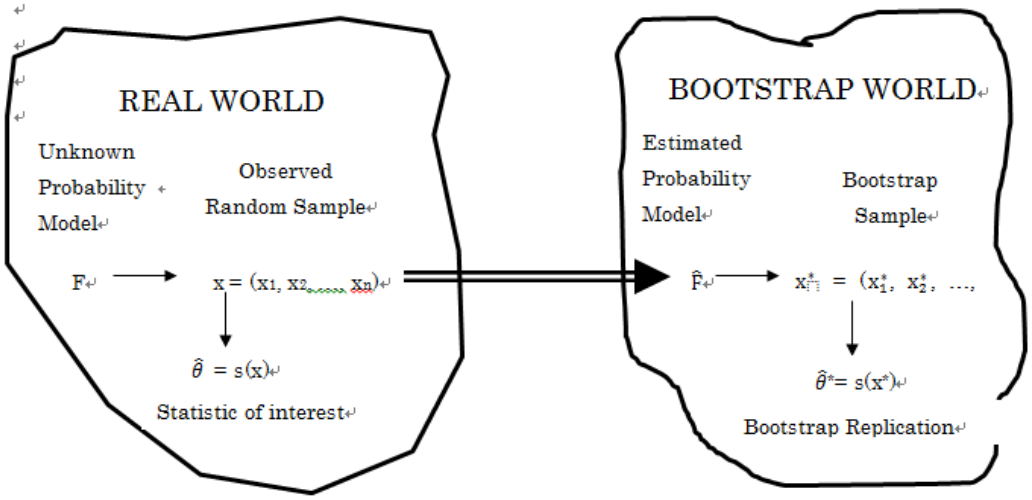

Figure 1: A schematic process of the bootstrap applied to one sample problems
(Source: Efron & Robert, 1998)

Figure 1 provides the schematics of the bootstrap process. $x^* = (x^*_1, x^*_2, \ldots\ldots x^*_n)$ is a bootstrap sample, which is generated through a sampling and resampling process that involves n times replacementfrom the existing data range, $x(x_1, x_2, \ldots\ldots x_n)$. Along with the bootstrap samples, Bootstrap statistics $s(x^{*1})$, $s(x^{*2})$…. $s(x^{*B})$ isfoundby computing and solving for the value of s(x).

III. VALUE FOR MONEY ASSESSMENT PRODEDURE USING BOOTSTRAPH TECHNIQUE

There are four main steps involved in the generalization of the quantification of VFM in the context of the Bootstrap method. These include: (1) estimating PSC and SBP (2) resampling the original data on the

values of the PSC from the projects, (3) resampling the initial data of the SBP from the projects, and (4) computing the mean values of the quantitative VFM and the confidence interval based on the new samples of the PSC and SBP.

The procedure guiding the application of the Bootstrap method in the resampling process is illustrated in the Figures 2, 3, and 4.

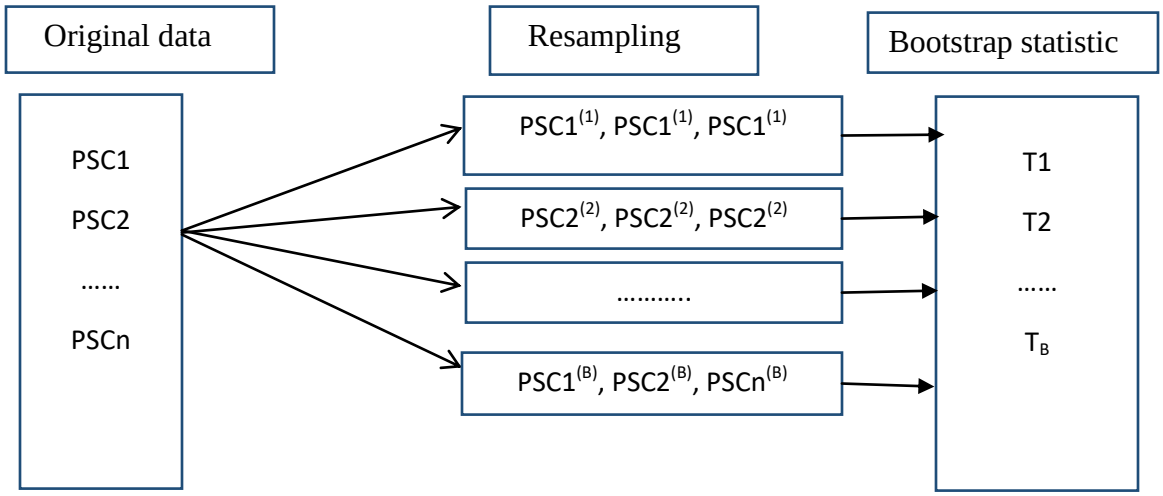

Figure 2. Graphical application of Bootstrap for the value of PSC
*Source:*Proposed by Authors

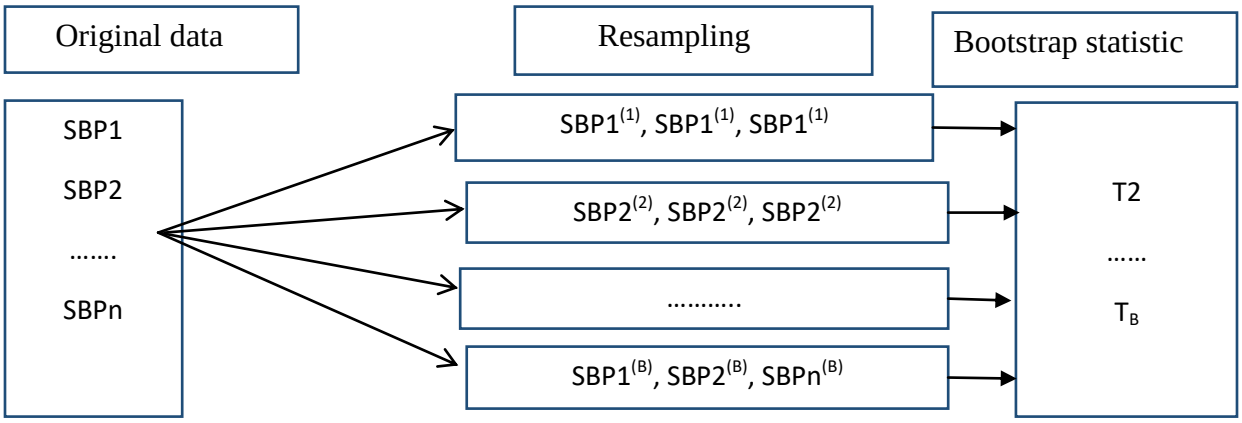

Figure 3. Graphical application of Bootstrap for the value of SBP
*Source:*Proposed by Authors

The quantitative VFM is the difference between the Public Sector Comparator (PSC) and SBP. Thus, in order to estimate the value of VFM in general, the data on the new samples of PSC and SBP will be used.

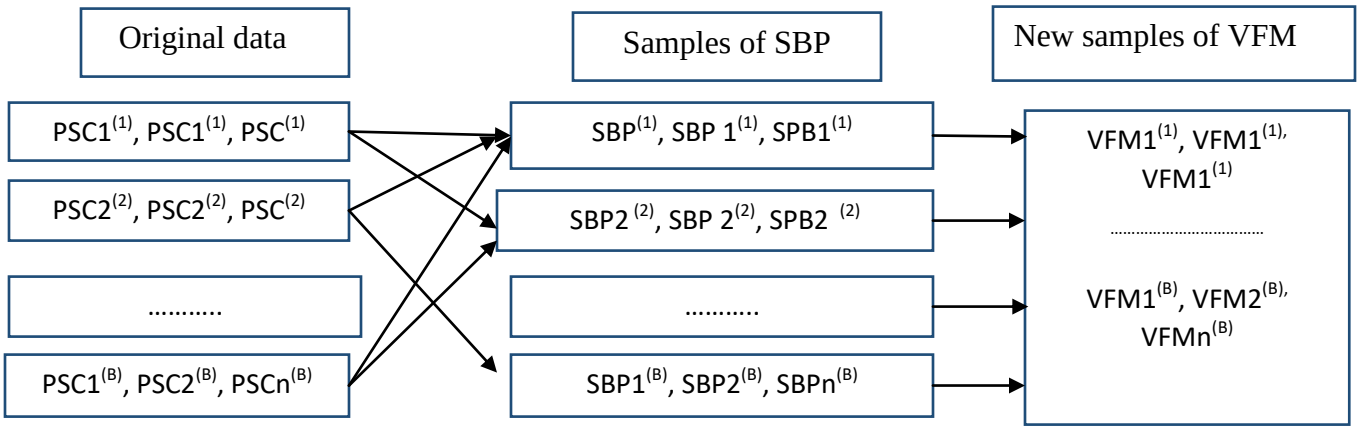

Figure 4. Graphical application of Bootstrap for value of the VFM
*Source:*Proposed by Authors

Based on the Bootstrap sample, statistics (for example mean or standard deviation) and confidence intervalare then calculated.

IV. An application of value for money assessment using bootstraph technique

4.1. Description of case studies

This research covers three projects (Phu My Bridge, Trung Luong-My Thuan Expressway and My Loi Bridge) in road sector, which were strongly argued on determining what the best procurement is. Particularly,Phu My Bridge and the Trung Luong-My Thuan Expressway were argued on whether the Vietnamese government s decisions to revert themback to the public sector are correct. Likewise, the My Loi Bridge was argued that decision-making to opt for PPP approach, instead the on-going conventional delivery to finance is wrong.

** Phu My Bridge projects*

Phu My project is located in Ho Chi Minh City. It spans across the Sai Gon River. Its length and width are 2.4 kilometers and 27.5 meters respectively. The goal of the project was to eliminate traffic congestion and shorten the travel time on the roads of corridor 2.

** Trung Luong – My Thuan Expressway project*

Trung Luong – My Thuan Expressway project is located between Ho Chi Minh City and Tien Giang province. The primary aim of the project is to reduce the travel time from Ho Chi Minh City to the Mekong Delta provinces. The starting point of the project is at the Than Cuu Nghia (Km49 - 620) intersection, which is under the Ho Chi Minh City -Trung Luong Expressway, while the endpoint is at the intersection with the National Highway 30 (Km100 - 750).

** My Loi Bridge project*

The My Loi project is located between the Long An province and the Tien Giang province. The primary aim of the project is to improve the road capacity and the flow of traffic, and to eliminate high congestions of Highway 50. More specifically, it is expected to provide a better connection from Ho Chi Minh City to Long An and Tien Giang provinces.

Key features of three projects are summarized as following:

Table 1**.** Key features of the three projects

	Phu My	Trung Luong – My Thuan	My Loi
Location	Ho Chi Minh City	Ho Chi Minh City – Tien Giang province	Long An province -Tien Giang province
Length	2.4km	54.3km	2.691 km
Construction cost	VND1,806,523million (USD90million)	VND12,616.95billion (USD 630 million)	VND1,337billion (USD 66.55 million)

Construction duration	4 years (2005-2009)	4 years (2015-2019)	2 years (2014-2015)
Operation period	26 years (2009-2034)	29 years (2019-2048)	30 years (2016-2045)

Source: Authors' compilationfrom related projects' feasibility study reports

4.2. Value for money assessment using bootstraph technique

The estimation of VFM in general is based on the available data on the PPP and PSC of the three projects (Phu My, Trung Luong-My Thuan and My Loi) in Vietnam, which is summarised in Table 2.

Table 2.Comparative costs of PSC and SBP among three projectsUnit: billion VND*

No	Projects	PSC	SBP	VFM
1	Phu My	1,581	2,913	-1,332
2	Trung Luong-My Thuan	19,508	13,055	6,453
3	My Loi	2,030	2,410	-380

Note: *VND (Vietnamese Dong) = 0.00005 USD

Source: Calculated byauthors

Given the Table 2, if the Phu My Bridge project is implemented under conventional govement model, the total cost of project is VND1,581billion, while under PPP model, the cost of project is VN2,913billion. It results in negative VFM, precisely-VND1,332billion. For the Trung Luong-My Thuan, the whole cost of theproject implemented under PPP is VND13,055billion. In contrast, under the traditional government procurement, the total life cost of the project is forecasted at VND19,508 billion. As a result, one can conclude that the PPP model provides VFM, precisely VND6,453billion, compared to traditional procurement.For My Loi project, the whole life cycle cost of the project under PPP scheme is VND2,410 billion. On other hand, the spending under the conventional model is VND2,030 billion. This leads to a negative VFM-VND380billion.

*** Resampling the original data on the values of the PSC**

Based on the Bootstrap sample, statistics (for example mean or standard deviation) are then calculated. In particular, based on the results of the PSC associated with the three case studies (Phu My project, Trung Luong-My Thuan project, and My Loi project), we have the following values of PSC as PSC1 = VND1,581 billion; PSC2 = VND19,508 billion; and PSC3 = VND2,030 billion. These values are taken to be the original sample. By resampling with a replacement 10,000 times from the initial sample, we have a mean value of the PSC that equals VND7,694.13billion, with a standard deviation of VND4,816.37billion (see Figure 5)

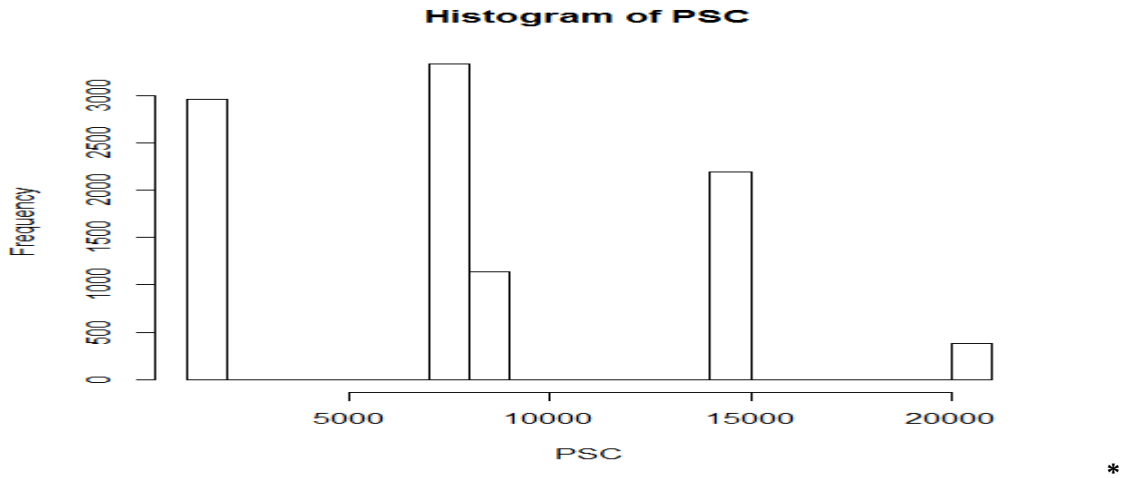

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Figure 5. Histogram of a 10,000 bootstrap replication of PSC

Source: Authors' result

Resampling the original data on the values of the SBP

As can be seen in Figure 6, the original PPP associated with the three case studies (SBP 1, SBP 2, SBP 3) are taken to be the original samples. In particular, given the results of PPP values from the three case

studies of three projects, the values of PPP are comprised of PPP 1 = VND 2,913 billion; PPP 2 = VND13,055 billion; and PPP 3 = VND2,410 billion. Through a resampling process that involved 1000 replacements from the original sample, the resulting mean and standard deviation of PPP value are VND6,115.38 billion (USD30.4 million) and VND2,832.92 billion (USD141 million), respectively.

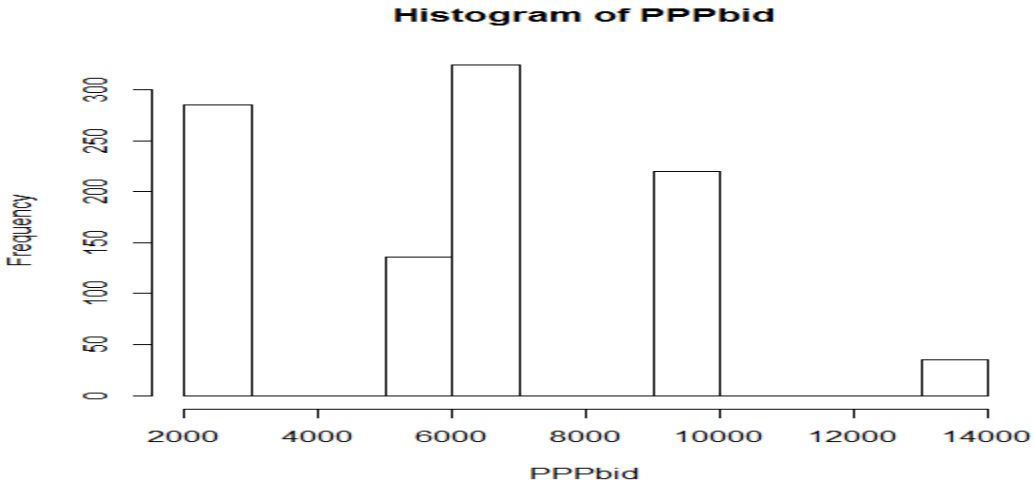

Figure 6. Histogram of a 10,000 bootstrap replication of SBP
Source: Authors' result

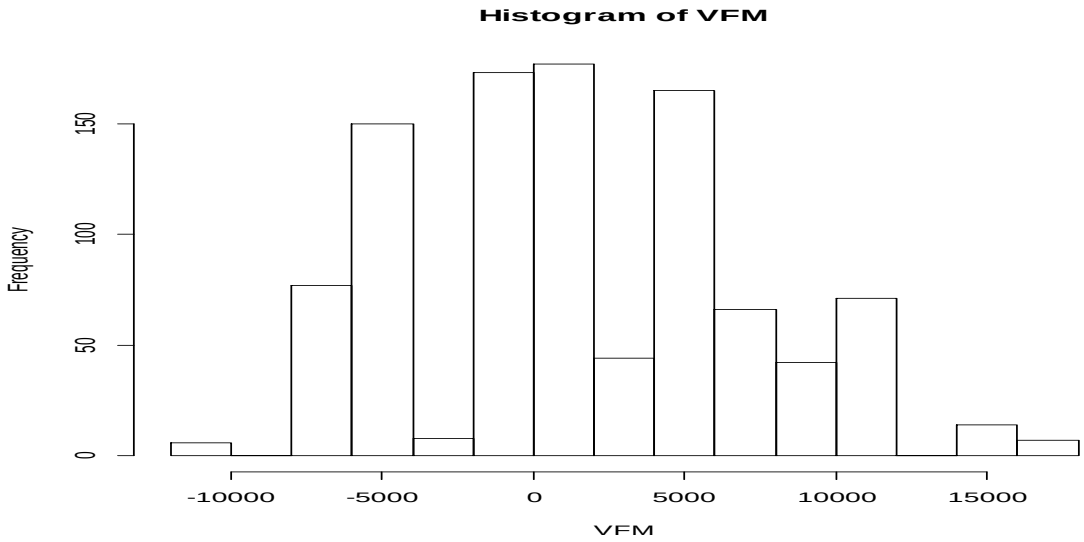

Figure 7. Histogram of 1,000 bootstrap replications of VFM
Source: Authors' result

Figure7presents a histogram of the general quantitative VFM that resulted from the difference between the resampled values of the PSC and the PPP after 10,000 bootstrap replications. The x-axis represents the value of the quantitative VFM, while the y-axis represents the corresponding frequency of the value-for-money. The mean VFM in general is VND1,578.74 billion (USD 90.35 million), with a standard deviation of VND5,562.19 billion (USD 289.5 million).

Table 3.Bootstrap confidence interval

Confidence interval	**Range of the VFM** ***(billion VND*)***
95%	-7,776.0 to 10,945.67

90%	-4,563 to 9,833.67
85%	-4,395.33 to 7,406.33
80%	-4,096 to 5,446
75%	-1,968.0 to 5,128.67
70%	-1,800.33 to 4,961.0
65%	-865.0 to 4,025.67
60%	-547.67 to 1748.0
59%	4,77.33 to 1,748.0
55%	1,412.67 to 1,598.33

Note: * 1 VND= 0.00005 US$
Source: Authors' result

The information in Table 3 shows that the bootstrap confidence interval indicates that, at 95 percent confidence interval, the values of VFM is between -VND 7,776billion and VND 10,945.67 billion. Also, at 85 percent confidence interval, the value of the quantitative VFM is between –VND 4,563 billion and VND 9,833.67 billion. Furthermore, the confidence level at which the quantitative VFM takes a positive value, at the minimum, is 59 percent. According to the theory of quantitative value-for-money assessment, this reflects that there is a 59 percent chance that PPP model may be a better option than direct government financing, in relation to road projects in general in Vietnam. Consequently, the Vietnamese government's decision to use the PPP approach for the development of the road sector seems to be a relatively well warranted.

IV. CONCLUSION AND DISCUSSION

This paper has applied Bootraph technique to determine the probability distribution for quantitative VFM in PPP in general. In particular, it estimates the confidence intervals within which PPP delivery becomes thebetter-off and viableoption. The result of this research reveals that there is 59% confident level that PPP model could do better than government direct investment in Vietnamese road projects.The result is expected to become a significant reference for public policy makers in the anlaysis of importance of PPP as well as confimation of pursing PPP model in the development of road sector in Vietnam.

It should be acknowledged that the application of the bootstrap method to estimate the probability of PPP being suitable in road projects, in general, is not always the best approach on an individual basis. This is because every project has own characteristic, size and cash flow. In the future, when the amassed data is sufficient, a more accurate estimation of the probability of VFM may give rise to new revelations.

Furthermore, the three projects examined in this study have faced a lot of oppositions and criticisms. In any case, there seems to be no consensus on what the best option is. Without looking at the subjective opinions of the stakeholders, this study has focused on a quantitative assessment, which has in turn allowed us to estimate the values associated with each option. Nevertheless, it may be necessary to conduct a new study on the qualitative issues that have helped make the cases unpopular among some groups. In this regard, in future studies, a Multi-Criteria Decision Analysis (MCDA) may help reveal some of the contentions and issues.

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