The Economic Efficiency of Value Capture and Road Pricing to Fund Major Transport Projects

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Abstract

Cost-Benefit Analysis is the most commonly used project evaluation tool to evaluate transport projects. However, Cost-Benefit Analysis generally disregards the economic cost of funding mechanism used to pay for the project. Public funds are typically used to pay for transport infrastructure projects, however, the use of the public funds has an economic cost to society through the raising of taxes. The marginal cost of using public funds accounts for both the tax burden and the welfare cost to society, through the distortion in resource allocation caused by the tax. This paper examines and compares the economic efficiencies of funding mechanisms, including a tax-based strategy consisting of various value capture strategies, and a user charges-based strategy of road pricing strategies. The economic efficiency of the two funding mechanisms is investigated through an adjusted Benefit-Cost Ratio, which is calculated by incorporating the economic cost of the proposed funding mechanism in the Cost-Benefit Analysis. A major Australian public transport project is investigated as a case study to observe the impact that the funding mechanism has on the economic viability of the project as measured by the adjusted Benefit-Cost Ratio. Incorporating the funding mechanism into the Cost-Benefit Analysis provides decision-makers with a better understanding of the impact that different funding strategies have on the viability of potential projects and also aids in the selection of the preferred funding mechanism. Different types of transport projects can be investigated to further study the effectiveness of various funding strategies.

KEY WORDS: value capture; road pricing; economic cost; tax burden; cost-benefit analysis; public transport

1. Introduction

The decision-making of a transport project on the basis of Cost-Benefit Analysis (CBA) generally disregards the economic consequences of the funding mechanisms used for the project. The Fisher Separation Theorem (Fisher, 1930) postulates that the investment decision, such as “to proceed” and “not to proceed”, can be made independently of the decision about project funding options. However, decision making about public investment should consider the government’s choice of funding mechanism as there are usually a number of economic costs to the community associated with how governments usually pay for transport projects, such as using tax revenue. Therefore, the economic costs, including deadweight loss of taxation and marginal costs of public funding that are associated with the funding mechanism, should be considered in the decision making of public transport investments.

A number of studies (Connolly & Wall, 2016; Walters, 2012) examined the effectiveness of potential funding mechanisms, in particular the value capture (VC) mechanism. Most studies however assess the effectiveness of different funding mechanisms in a qualitative manner. This paper extends this knowledge by conducting a CBA for an Australian project and examining

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the impacts different funding strategies can have on the overall economic viability of potential projects.

This paper examines and compares the economic efficiencies of two funding mechanisms, VC and road pricing (RP), which are currently the subject of significant debate in Australia by various Australian state governments (e.g. Victoria and New South Wales) and also the Federal Government. The opportunities of VC vary significantly across various contexts (Page, Bishop, & Wong, 2016). Australian governments are showing a strong interest in VC mechanism to fund transport infrastructure projects as demonstrated in recent governments reports (Infrastructure Australia, 2016; Infrastructure Victoria, 2016b). This suggests the need of studies on VC and its opportunities in the context of an Australian transport project. RP on the other hand has often been placed in the "too hard basket" by governments, however Infrastructure Australia[1] continues to advocate for RP as a way to manage congestion and create a new funding stream for transport projects.

The Cross River Rail (CRR) project, which is a proposed public railway development project in Brisbane, Australia, is examined as a case study, in order to observe the economic efficiencies of VC and RP in the context of an Australian major public transport project. The tax burdens and the welfare costs to society are accounted in the CBA in this study by incorporating the marginal costs of public funding in the Benefit-Cost Ratio (BCR) calculations. Marginal costs and adjusted BCR are estimated for the case study across the different funding mechanisms to highlight the impact of the funding mechanism on the BCR. This paper incorporates an assessment of the economic efficiencies in CBA, which ensures that the funding mechanism is considered in the decision-making on the basis of CBA. Incorporating marginal costs of funding sources in CBA has previously been considered on the basis of a transport project in New Zealand (Ellis & Douglas, 2015). This paper extends this knowledge through considering VC and RP in the Australian context.

This paper first explains the study methodology and reviews literature, including recent academic literature, publications of Australian government agencies such as Infrastructure Australia and Infrastructure Victoria, and industry reports. Additionally, the review summarises the marginal costs of various funding sources. A brief background of the case study is then provided. Models are developed, in order to estimate revenues from various funding strategies. Calculations of the revenues and adjusted BCR are then demonstrated. Discussions and conclusion are drawn in the final section.

2. Methodology

Figure 1 illustrates the methodology of this study. A wide range of literature, including academic literature, government publications and industry reports, are reviewed. Through the literature review, characteristics of the study case and marginal costs of various funding sources are determined. Revenues are then estimated across various funding scenarios, which include VC, RP and fully public funded scenarios. Proportions of funding sources across the scenarios are then determined on the basis of the estimated revenues. Final marginal costs across the scenarios can be calculated on the basis of the proportions. Adjusted BCR is determined using the final marginal costs across the scenarios. The adjusted BCR can then be compared to the original BCR to determine differences in economic efficiencies across the scenarios.

[1] Infrastructure Australia is an independent statutory body with a mandate to prioritise and progress nationally significant infrastructure (see http://infrastructureaustralia.gov.au/)

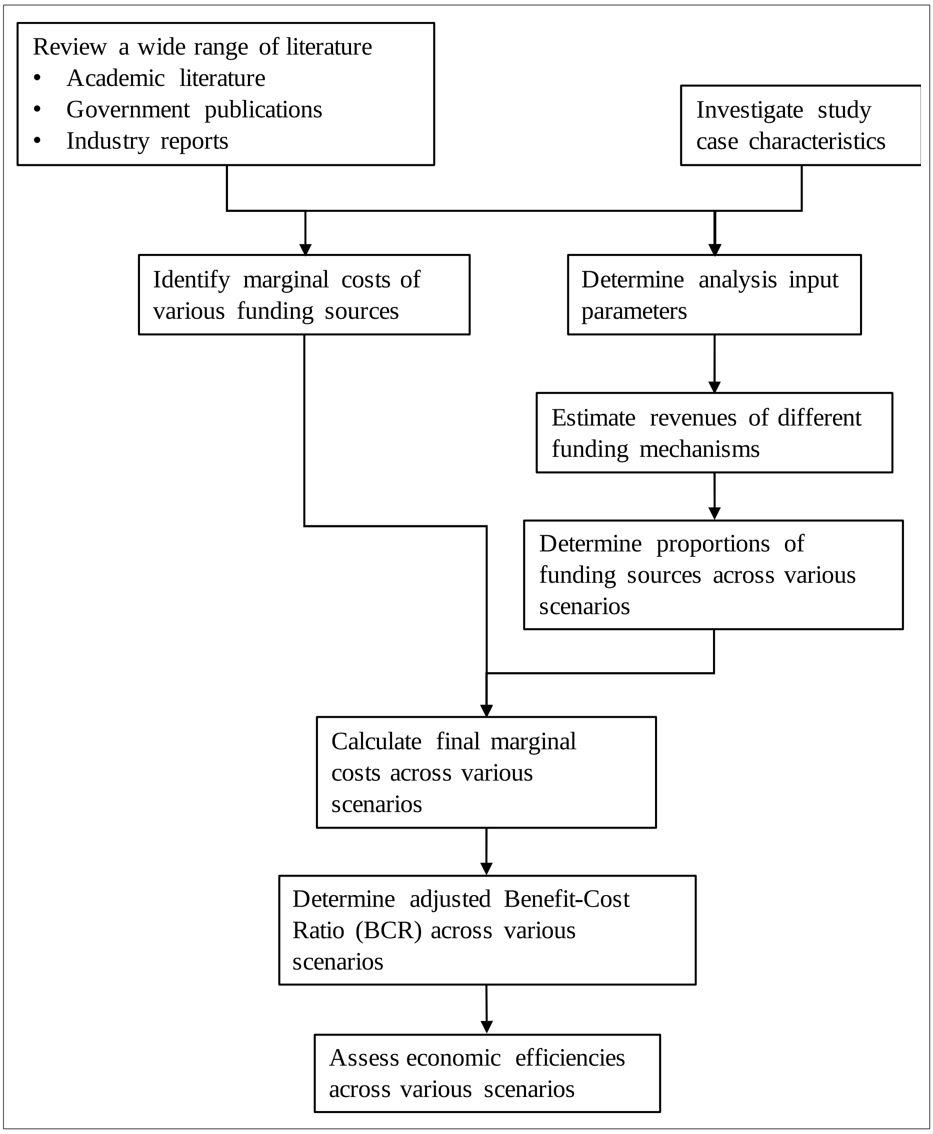

FIGURE 1 Study methodology

3. Literature Review

The costs that are accounted in transport CBA generally are financial costs of the project[2], whilst the benefits account for social cost savings, such as travel time savings and environmental cost savings. This indicates that economic costs, such as tax burdens, are not accounted in CBA. The Fisher Separation Theorem (Fisher, 1930) postulates that the investment decision, such as "to proceed" and "not to proceed", can be made independently of the decision about project funding options. However, from the perspective of the host government, as the decision-maker, they are responsible in ensuring that the costs to society are considered in the decision making about public infrastructure investments. Calthrop, De Borger and Proost (2010) claim that ignoring the impact of the funding mechanism may lead to misleading CBA outcomes. Additionally, New Zealand Treasury (2015) advices to

[2] Albeit usually in resource prices as opposed to market prices that include taxes etc.

incorporate deadweight loss in the CBA calculation[3]. Marginal cost represents a difference between the change in cost and the change in quality due to economic activities (Bloomsbury Information, 2010), which can be used in various economic analysis applications, in order to incorporate economic costs in the analysis. Therefore, this study incorporates marginal costs to capture economic costs in the CBA. Figure 2 illustrates the deadweight loss due to taxes. Additionally, the application of marginal cost have been explored previously by Ellis and Douglas (2015).

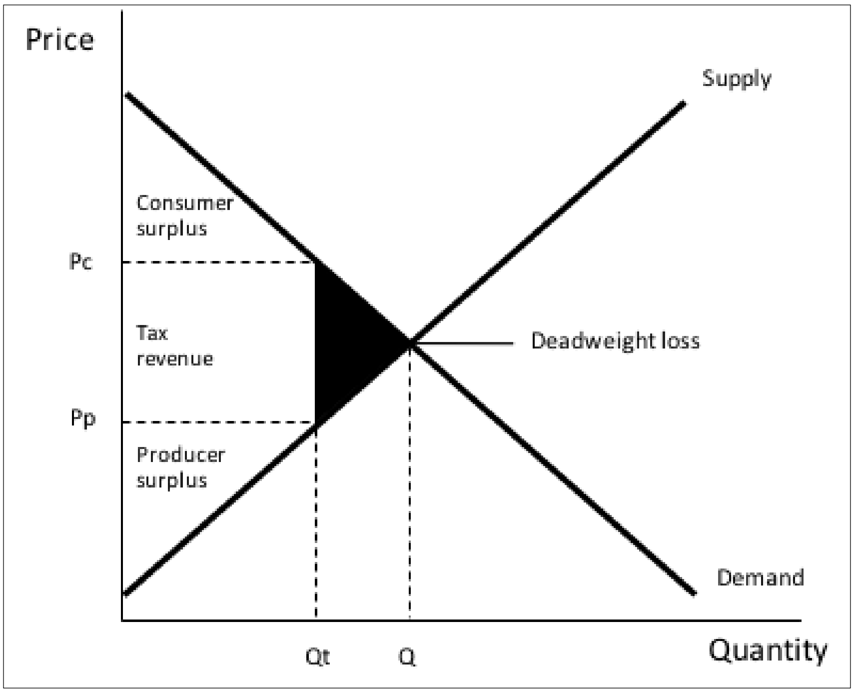

FIGURE 2 Price elasticity and deadweight loss

VC is a mechanism to fund public infrastructure projects by taxing or charging payments from those who benefit from the increased property values due to the proposed transport project. However, it can rarely fund the entire cost of a major transport project and is generally used as a contribution (Chapman, 2017; Infrastructure Victoria, 2016b). Five main value capture types that are considered by Australian governments include (Infrastructure Australia, 2016): betterment levies, developer charges, leveraging government land, taxes on property transactions, taxes on land value, and broad-based land tax. The key challenge of VC is the estimation of the increase of property values (Infrastructure Australia, 2016; Walters, 2012). Page et al. (2016) further discusses value capture in detail. Table 1 summarises a number of recent academic literature on VC as a funding mechanism to fund public projects. As shown, there are several studies examining VC in the context of trnaposrt projects.

[3] NZ Treasury advise a rate of 20% as a default deadweight loss value in the absence of an alternative evidence based value. Thus public expenditures should be multiplied by a factor of 1.2 prior to discounting to incorporate the effects of deadweight loss.

TABLE 1 Recent academic literature on value capture (VC) as a funding mechanism to fund public projects

Author	Study purpose	Context	Key finding
Chapman (2017)	The study identifies key issues of VC as an infrastructure funding mechanism	General public infrastructure projects	VC is unlikely to fund full cost of the project
Connolly and Wall (2016)	The study examines challenges of different VC strategies through case studies	Heavy and light railway projects in the UK and the US	Successful applications of various VC strategies, either individually or in combination, depends on factors such as the enabling environment, stakeholder support and institutional capacity
Jillella, Matan and Newman (2015)	The study proposes a participatory sustainability approach to enable a more deliberated stakeholder engagement intervention across the VC life cycle	A railway project in India	VC funded projects using the approach to incorporate a more deliberated stakeholder engagement intervention can ensure that the development is in compliance with sustainable development goals, including community aspirations with well-defined value creation and value redistribution strategies upfront
McIntosh, Trubka and Newman (2014)	The study investigates the impact of transit on urban land markets in the highly car dependent corridors of Perth, Australia with a focus on where new fast rail transit services have recently been built	Railway projects in Perth, Australia	The increased willingness to pay for transit accessibility demonstrated that land and property value capture mechanisms to capture induced increases in existing land and property taxes resulting from this uplift to substantially defray the cost of building new transit in highly car dependent cities
Xu and Zhang (2016)	The study examines transit access premiums for planning applications	Railway corridors in Wuhan, Chine	Substantial revenues from VC mechanism that can potentially relieve or eliminate transit operation cost deficits
Walters (2012)	The study identifies which policy goals are being pursued in practice and to assess the practical potential of VC	General public infrastructure projects	The local authorities should clearly define the VC policy objective, whether that objective is cost recovery for specific investments

Table 2 summarises marginal costs of the funding sources that are particularly relevant to VC mechanism. For example, this shows that for every $1 dollar raised in broad-based land taxes the "economic cost" is 8 cents.

TABLE 2 Marginal costs of various funding sources

Funding source	Marginal cost	Source
Broad-based land tax	$0.08	KPMG (2010)
Municipal rates	$0.02	KPMG (2010)
Land taxes	$0.08	KPMG (2010)
Stamp duty	$0.72	Cao et al. (2015)
Public funds (general consolidated revenue)	*$0.20*	*New Zealand Treasury (2015)*

Australian governments are showing a great interest in VC mechanisms. Infrastructure Victoria (2016b) encourages greater use of VC and recommends developing a process to assess VC within the existing project appraisal framework. While, Infrastructure Australia (2016) claims that the opportunities for VC need to be assessed early in the planning phase.

RP is another funding mechanism, whereby road users pay some form of payment, such as tolls, to use the road, and can also be used as a road congestion management strategy. As Infrastructure Victoria (2016a) highlighted, RP is commonly used for roads in a metropolitan region, where road congestion is a constant problem. The effect of RP depends on the level of congestion, instead of the features of the existing network (Börjesson, Brundell-Freij, & Eliasson, 2014).

4. Study Case

CRR is a proposed project of a 18 kilometres north-south rail line between Salisbury and Bowen Hills in Brisbane, Australia (SKM & Aurecon, 2011). CRR project includes development of a 10-kilometre tunnel, six new railway stations and two railway station upgrades (SKM & Aurecon, 2011). This study incorporates publicly available data from the economic analysis (and from the environmental impact statement) that was previously conducted for the CRR by Deloitte (2011)[4]. Table 3 summarises key economic impacts and parameters used for the CRR. All prices were converted to dollar values in 2016 using the methodology of the Reserve Bank of Australia (Reserve Bank of Australia, 2017).

TABLE 3 Economic impacts and parameters from Cost-Benefit Analysis (CBA) of Cross River Rail (CRR) (Deloitte, 2011)

Impacts	Value
Discount rate	7 %
Evaluation period	30 years
Project costs	$ 6,374 millions
Project benefits	$ 9,035 millions
Increase of public transport fares due to CRR	$ 390 millions
Benefit-Cost Ratio (BCR)	1.42
Net present value	$ 2,661 millions

[4] Note: an updated business case for CRR was prepared by Building Queensland in 2016. The updated BCR for the project is 1.21 using a 7% discount rate. However, as there is limited publicly available information on the updated project, the 2011 project information was used in this paper (see http://buildingqueensland.qld.gov.au/).

The outcome of the economic analysis of the CRR resulted in a positive BCR. The main sources of project benefits were public transport benefits and decongestion benefits due to modal shifts (Deloitte, 2011).

The overarching characteristics of the CRR represents characteristics of a major Australian public transport project that would require significant government funding. Through examinations of project's CBA, this study explores the impact that VC or RP would have on the project if these mechanisms were used to pay for the project.

5. Model Development

5.1 Funding Strategies

Funding strategies that are explored in this study include the following. Definitions of these strategies have been given by the Infrastructure Australia (2016).

1. Betterment levies: Captures a portion of the estimated value uplift on land (residential, commercial or both) around an infrastructure investment
2. Leveraging government land: A government sells or leases land or air rights around an infrastructure investment to fund its construction and capture the corresponding value uplift
3. Taxes on property transactions: Taxes levied at the point of property transaction as a portion of the sale price, charged to the seller or the buyer
4. Taxes on land value: Existing state, territory and local government taxes levy a recurrent charge on land or property owners to pay for service delivery. The method of calculation varies by jurisdiction, and a number of exemptions are applied – most commonly for the primary place of residence
5. Broad-based land tax: A broad-based land tax would involve removing many exemptions to existing taxes on land value, streamlining charging processes and phasing out other charges such as stamp duties.

It is beyond the scope of this study to examine the developer charges payments, whereby a property developer is charged payments to contribute to the shared infrastructure and services in the area surrounding their development. This is because the charges will be used to fund the shared infrastructure and services and do not provide additional funds for new infrastructure developments.

Table 4 summarises funding sources of the funding strategies and their marginal costs.

TABLE 4 Marginal costs of funding sources across value capture strategies

Funding strategy	Funding source	Marginal cost
Betterment levies	Municipal rates	\$0.02
Leveraging government land	Sources other than tax	\$0.00
Taxes on property transactions	Stamp duty	\$0.72
Taxes on land value	Land taxes	\$0.08
Broad-based land tax	Land taxes	\$0.08

Betterment levies, taxes on property transactions and taxes on land value are considered for the purpose of comparisons in this study. Marginal costs of these funding strategies vary and will highlight the outcome of each scenario.

The following sections summarise the models used in this study. These models do not account for price elasticity impacts that the funding strategies may have on individuals' decision making. This paper presumes rather simplified assumptions for the purpose of comparing different funding mechanisms.

5.2 Betterment Levies

This study presumes that the property values in the suburbs where new railway stations are going to be built will increase due to the CRR development. Levies will be collected from the property owners in the impacted suburbs. The annual revenue from the betterment levies for year y is given as follows:

$$R_{y,BL} = LV \times PO_i \tag{1}$$

Where:

LV= amount of levy payment ($)

PO_i = number of property owners in the suburb or region i

5.3 Taxes on Property Transactions

This study presumes that the stamp duty will be increased for all property sales in the whole of Brisbane. The annual revenue from increasing the stamp duty payment for year y is given as follows:

$$R_{y,SD} = SD \times PS_i \tag{2}$$

Where:

SD= amount increased in stamp duty payment ($)

PS_i = number of property sales volume in the suburb or region i

5.4 Taxes on Land Value

This study presumes that the land taxes will be collected from the property owners in the whole of Brisbane. The annual revenue from the betterment levies for year y is given as follows:

$$R_{y,LT} = LT \times PO_i \tag{3}$$

Where:

LV= amount of land tax ($)

PO_i = number of property owners in the suburb or region i

5.5 Road Pricing

This study presumes that tolls will be collected from the traffic going through the Brisbane central business district (CBD). The annual revenue from tolling for year y is given as follows:

$$R_{y,RP} = AADT \times 365 \times TP \quad (4)$$

Where:

$AADT$= annual average daily traffic of the movement that will be tolled (veh)

TP= toll price ($)

5.6 Marginal Cost of Funding Source

Marginal cost varies depending on the proportions of the total project cost paid for by the funding mechanism. Marginal cost of scenario j is given as follows:

$$M_j = \sum \left(P_{f,j} \times M_f\right) \quad (5)$$

Where:

$P_{f,j}$= proportion of funding source f under scenario j, $f \in (BL, SD, LT, RP)$ (%)

M_f= marginal cost of funding source f ($)

5.7 Adjusted Benefit-Cost Ratio

The adjusted BCR for scenario j is given as follows:

$$BCR_{adj,j} = \frac{\sum B_y (1+d)^{(1-y)}}{\left(M_j + 1\right) \sum C_y (1+d)^{(1-y)}} \quad (6)$$

Where:

B_y = total benefits at year y ($)

d = discount rate (%)

C_y = total costs at year y ($)

6. Revenue Estimations Across Funding Strategies

For a comparison, three VC strategies and one RP strategy are considered in this study as stated as follows:

- Taxing the property owners that own properties in the suburbs where new railway stations will be built annually (betterment levies)

- Taxing the property owners that own properties in the whole of Brisbane annually (land taxes)
- Increasing stamp duty for all property sales in the whole of Brisbane (taxes on property transactions)
- Tolling the traffic going through Brisbane CBD (RP)

RP mechanism that is considered in this paper does not account for shadow tolls, whereby the host government is responsible for paying the concessionaire according to traffic volume or travel distance (Brocklebank, 2014). This indicates that the marginal cost of the RP mechanism is zero. The following discussed revenue calculations of these strategies.

6.1 Input Parameters

Table 5 summarises data used in the revenue calculations of the VC and RP scenarios considered in this study. The suburbs considered in the first scenario include Dutton Park, Woolloongabba, Brisbane City, Spring Hill and Bowen Hills, where new railway stations are going to be built as part of the CRR. The number of dwellings in 2011 (Australian Bureau of Statistics, 2013) was referred to estimate the number of dwelling in 2016 on the basis of the dwelling growth rate shown below. The rate of growth of dwellings in Brisbane was estimated on the basis of 2011 Census data (Australian Bureau of Statistics, 2013) and the number of dwelling approvals in Brisbane (Queensland Treasury and Trade, 2012). Annual average daily traffic (AADT) along Captain Cook Bridge in Brisbane was used in this study to demonstrate the traffic volume travelling through the Brisbane CBD. AADT in 2015 (Queensland Department of Transport and Main Roads, 2015) and the traffic growth rate shown below were used to estimate the AADT in 2016.

TABLE 5 Input parameters used in revenue calculations of VC and RP scenarios

Item	Value
Number of dwellings in Greater Brisbane in 2016	859,292
Number of dwellings in Dutton Park, Woolloongabba, Brisbane City, Spring Hill and Bowen Hills combined in 2016	11,372
Dwelling growth rate in Brisbane	0.91 %
Traffic growth rate	2.80% (Australian Bureau of Infrastructure Transport and Regional Economics, 2012)
Number of property sales in 2016	30,126 (Queensland Treasury, 2015)
Annual average daily traffic (AADT) along the Captain Cook Bridge in Brisbane in 2016	132,316

6.2 Estimated Revenues

Table 6 summarises estimated revenues from the first strategy, whereby taxes are charged annually from the property owners that own properties in the suburbs where new railway stations are going to be built, on the basis of the growth rate of dwellings in Brisbane. Total revenues over the planning horizon and proportions to the project cost are also summarised.

TABLE 6 Estimated revenues from various betterment levies and proportions to the project cost

Levy payment	Annual revenue	Total revenue over the planning horizon	Proportion to project cost
$10	$0.11 millions	$2 millions	0.02%
$50	$0.57 millions	$8 millions	0.12%
$100	$1.14 millions	$16 millions	0.24%
$200	$2.27 millions	$31 millions	0.49%

Table 7 summarises estimated revenues from the second strategy, whereby taxes are charged annually from the property owners that own properties in the whole of Brisbane, on the basis of the growth rate of dwellings in Brisbane. Total revenues over the planning horizon and proportions to the project cost are also summarised.

TABLE 7 Estimated revenues from various land tax payments and proportions to the project cost

Levy payment	Annual revenue	Total revenue over the planning horizon	Proportion to project cost
$10	$8.59 millions	$117 millions	1.84%
$50	$42.96 millions	$586 millions	9.19%
$100	$85.93 millions	$1,172 millions	18.39%
$200	$171.86 millions	$2,344 millions	36.78%

Table 8 summarises estimated revenues from the third strategy, whereby stamp duty is increased for all property sales in the whole of Brisbane. Total revenues over the planning horizon and proportions to the project cost are also summarised.

TABLE 8 Estimated revenues from the increase of stamp duty and proportions to the project cost

Increase of stamp duty	Annual revenue	Over the planning horizon	Proportion to project cost
$10	$0.30 millions	$4 millions	0.06%
$100	$3.01 millions	$37 millions	0.59%
$500	$15.06 millions	$187 millions	2.93%
$1,000	$30.13 millions	$374 millions	5.86%

Table 9 summarises estimated revenues from the fourth strategy, whereby the traffic going through the Brisbane CBD is tolled. Total revenues over the planning horizon and proportions to the project cost are also summarised.

TABLE 9 Estimated revenues from tolling and proportions to the project cost

Toll price	Annual revenue	Over the planning horizon	Proportion to project cost
$2	$99.30 millions	$1,676 millions	26.30%
$3	$148.94 millions	$2,514 millions	39.44%
$4	$198.59 millions	$3,352 millions	52.59%
$5	$248.24 millions	$4,190 millions	65.74%

7. Adjusted Benefit-Cost Ratio

For the purpose of comparing VC and RP mechanisms, six funding scenarios were considered in this study as follows:

A. Betterment levies (VC)
B. Land taxes (VC)
C. Stamp duty (VC)
D. RP
E. Fully publicly funded
F. Land taxes (VC) and RP

Previously estimated proportions of the revenues across funding strategies to the project cost were used in the marginal cost calculations. Table 10 summarises marginal cost calculations. This study presumes that under RP scenario, public transport fare revenues will be increased due to modal shifts. According to Deloitte (Deloitte, 2011), the estimated increase of public transport fare revenue is $355 millions. This was then converted to dollar values in 2016 using the methodology of the Reserve Bank of Australia (Reserve Bank of Australia, 2017), in order to determine the proportion to the project cost. This study also presumes that the rest of funds will be raised using the public funds (i.e. consolidated government revenue), when the funding strategy does not raise enough revenues to fund the whole project cost. For instance, $200 betterment levy will raise 0.49 percent of the project cost under the scenario A. This indicates that almost all funds need to be raised from the public funds. Additionally, this study presumes that $200 land taxes will be charged under the scenario B, the stamp duty will be increased by $1,000 under the scenario C, and $5 tolls will be charged under the scenario D. As total proportions of land taxes, RP and the increase of public transport fares exceeds 100 percent, this study presumes that the proportions of RP and the increase of public transport fares stays consistent, while the proportion of land taxes decrease under the scenario F.

TABLE 10 Marginal cost calculations across scenarios

Funding source	Marginal cost	A	B	C	D	E	F
Betterment levies	$0.02	0%	0%	0%	0%	0%	0%
Taxes on property transactions	$0.72	0%	0%	6%	0%	0%	0%
Land taxes	$0.08	0%	37%	0%	0%	0%	28%
Road pricing	$0.00	0%	0%	0%	66%	0%	66%
Increase of public transport fares due to RP	$0.00	0%	0%	0%	6%	0%	6%
Public fund	$0.20	100%	63%	94%	28%	100%	0%
Final marginal cost	-	$0.20	$0.16	$0.23	$0.06	$0.20	$0.02

Table 11 summarises the calculated adjusted BCR for CRR. Adjusted BCR resulted in lower values across scenarios than the original BCR. Scenario F has the highest adjusted BCR and scenario C has the lowest adjusted BCR across scenarios.

TABLE 11 Adjusted BCR across VC and RP strategies for CRR

Scenario	Adjusted BCR
Original BCR	1.42
A (VC)	1.18
B (VC)	1.23
C (VC)	1.15
D (RP)	1.34
E (fully publicly funded)	1.18
F (VC and RP)	1.39

8. Discussion

Revenue calculations highlighted that RP mechanism effectively raises substantial revenues. Applying tolls along the nearby non-tolled motorways will further increase the fare revenues and raise substantial toll revenues at the same time. The total traffic volume moving in and out of the Brisbane CBD is higher than the traffic volume that was considered in this study. This indicates that the revenues from RP can potentially be higher.

In comparison, VC mechanism failed to raise sufficient revenues. This is consistent with the literature review. The estimated revenues from land taxes were relatively higher than other VC strategies. However, under this strategy, the property owners in a large region between the west of Noosa Heads, Queensland and the west of Tweed Heads, New South Wales will need to pay the taxes, therefore the number of property owners that would be affected can be enormous. This indicates potentially significant oppositions against the policy.

The adjusted BCR across scenarios were lower than the original BCR, which indicates that the adjusted BCR has effectively represented the economic efficiencies of different funding mechanisms. The adjusted BCR varied between 1.39 and 1.15, which indicates that the impacts of the various funding mechanisms can be significant in the decision making process.

Scenario F, whereby both VC and RP mechanisms are used, the adjusted BCR resulted in the highest BCR across the scenarios. This indicates that using both funding mechanisms to fund the project is most economically efficient. Comparing to scenario D, scenarios A, B and C resulted lower adjusted BCR. This indicates that RP mechanism is more economically efficient than VC mechanism. In comparison to the original BCR, scenario E and all VC scenarios resulted in significantly lower adjusted BCR.

9. Conclusion

This paper examined and compared value capture (VC) and road pricing (RP) funding mechanisms, using the adjusted Benefit-Cost Ratio (BCR) as a measure to observe their economic efficiencies. Marginal costs of various funding strategies were estimated on the basis of the marginal costs of various funding sources, which represent the tax burdens and the welfare costs to the society. The adjusted BCR were calculated using the marginal costs across funding strategies.

The adjusted BCR effectively represented economic efficiencies of various funding mechanisms within CBA. The adjusted BCR quantified economic efficiencies of various funding mechanisms, which then can be extremely useful in the decision making. Additionally, the adjusted BCR takes considerations of the economic efficiency within the CBA calculation and does not require a separate analysis.

Examinations of the adjusted BCR showed that the RP mechanism is more economically efficient than the VC mechanism. They also showed that fully publicly funding the project is economically inefficient compared to RP.

As has been highlighted, the opportunities of VC vary significantly across various contexts (Page et al., 2016). This study extended the knowledge of VC and RP funding mechanisms by examining them in the context of a major public transport project in Australia. The previous study (Calthrop et al., 2010) indicated that ignoring economic efficiencies may lead to misleading CBA outcomes. This study incorporated economic efficiency considerations, using the marginal costs of various funding sources in CBA. The findings of this study are particularly useful for Australian government agencies, because there has been a growing interest in VC funding mechanism in Australia, as demonstrated in literature (Infrastructure Australia, 2016; Infrastructure Victoria, 2016b), and CBA practitioners. Additionally, this paper presented the methodology of the adjusted BCR in great detail, which can readily be used in practice. The adjusted BCR provides decision makers with an effective measure to examine the economic efficiency of a project.

Examinations of the adjusted BCR of various transport projects further extend the knowledge of VC and RP. The marginal costs of public transport projects, particularly for those that provide stations closer to each other, such as light rails and busways, may result differently from the findings of this study. The number of properties that are directly impacts by the development of major roads, such as motorways, can also differ from those of public transport projects. Future studies will examine the economic efficiencies of RP and VC funding mechanisms, when used for these various transport projects. As highlighted, recent studies on VC is conducted in the context of railway projects. Studying VC in the contexts of other types of public transport, such as bus rapid transit, will extend the knowledge of VC.

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