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The economics of financing and funding public transport projects

Ben Ellis[1], Dr Neil Douglas[2]

[1]Director, NineSquared, Economic and Commercial Consultants, Brisbane, QLD

[2]Managing Director, Douglas Economics, Te Aro, Wellington, NZ

Email for correspondence: benellis@ninesquared.com.au

Abstract

The Fisher Separation Theorem postulates that the investment decision ('to build or not to build') can be made independently of the decision about how the project should be financed and funded. This postulate has usually been made in the context of private sector decisions but it has also been the 'default' position taken in public transport investments.

In this paper we assess how applicable Fisher's theorem is for public transport services that are usually provided by government. We show that there are often welfare costs associated with different financing and funding instruments and that these costs have implications for the investment decision. The paper discusses how these costs arise and how they should be treated in the economic cost-benefit analysis.

We begin with a discussion on the key terms used in the paper, namely the differences between investment, financing and funding. Next, we review the economic cost-benefit analysis approach used to assess projects. Typically, the decision to invest in a public transport project is underpinned by the results of a cost-benefit analysis. Cost-benefit analysis of public transport projects is well established in Australia and New Zealand, however the consideration of the financing and funding aspects in the cost-benefit analysis is less formalised. The next section identifies the financing and funding options available for public transport projects and we then draw on a case study from Wellington to demonstrate the linkages between the investment decision and the financing and funding aspects of the project. We then provide an illustrative example of how the financing and funding decisions will affect the investment decision and the benefit-cost ratio (BCR) hurdle rate. We conclude that the investment, financing and funding decisions should not be considered separately due to the welfare effects that the financing and funding decisions have on society.

1. Introduction

The Fisher Separation Theorem postulates that the investment decision ('to build or not to build') can be made independently of the decision about how the project should be financed. This postulate has usually been made in the context of private sector decisions but it has also been the 'default' position taken in public transport investments. This paper looks at how applicable Fisher's theorem is for public transport services that are usually provided by government.

Typically, the decision to invest in a public transport project is underpinned by an economic cost-benefit analysis. Cost-benefit analysis of public transport projects is well established in Australia and New Zealand.

Consideration of the financing and funding aspects has been less formalised. The 'default' position has been to admit, albeit covertly, that public funds invested into a public transport project has a shadow price but that it does not need including in the project costs. All that the shadow price affects is the required benefit-cost ratio (BCR). Thus, a BCR of 1 is too low to demark economic from uneconomic. Too often however projects requiring large taxpayer input are trumpeted despite BCRs struggling to exceed 1.

Moreover, lumping all options and projects together irrespective of their relative take on public funds can be misleading. An engineering project that emphasises greater cost efficiency that has a BCR of 1.1 and has no net call on public funds over its economic life should rank above a network expansion project that has the same BCR but a cost recovery of 30%. We argue that the shadow price should be included in the economic cost. Then an economic BCR of 1 demarks economic from uneconomic.

Thus the objective of this paper is to assess how separable the investment decision is from the financing and funding decision for public transport projects. To do this we look at the welfare costs of different financing and funding instruments and the implications of including such costs into the investment appraisal, the economic cost-benefit analysis.

2. Investment, Financing and Funding Decisions

It is necessary to begin with a definition of the key terms used in this paper, which are:

- Investment decision: the decision to invest in a project based on the net present value (NPV) or BCR estimated from an economic CBA (i.e. accept a project with a NPV > 0 and accept a project with a BCR > 1).
- Financing: the capital used to pay for the upfront construction of a project.
- Funding: the money used to pay for the upfront capital (e.g. to repay the debt/equity).

A study by Vander-Ploeg in 2006 distinguished between "financing" and "funding" and argued there were two ways to finance and two ways to fund[1]. In terms of financing, governments can either borrow or use pay-as-you-go (PAYGO). In terms of funding, governments can either use taxation or user pays (e.g. fares).

The Fisher Separation Theorem (Figure 1) postulates that the decision to invest in a project is separable from the financing decision which we have extended to also cover the funding decision. By extension, as long as a project provides a net economic benefit it should not matter how the project is financed (e.g. borrow or PAYGO) or funded (e.g. taxation or user pays). The purpose of the paper is to assess the validity of this view.

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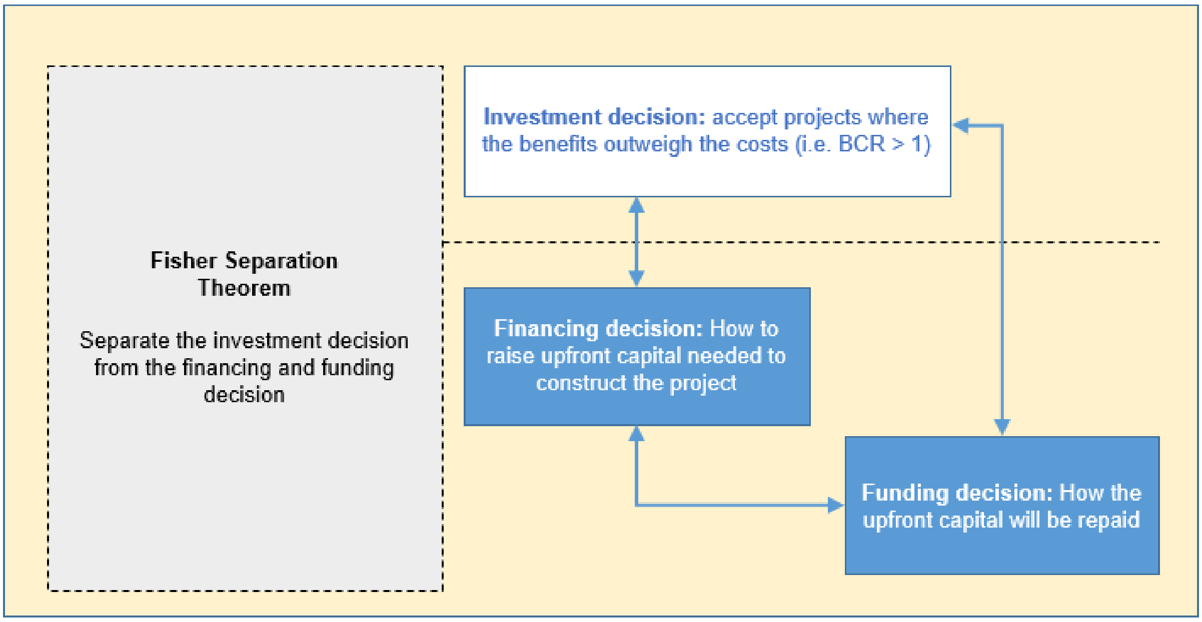
[1] Vander-Ploeg (2006) also talks about the "delivery" of transport projects and thus the 'triple-two rule' which is the rule stating that there are only two ways to finance (borrow or PAYGO), two ways to fund (taxation or user pays) and two ways to deliver (public or private sector) a transport project.

Figure 1: Study scope



3. Financing and funding in economic CBA

3.1 Overview

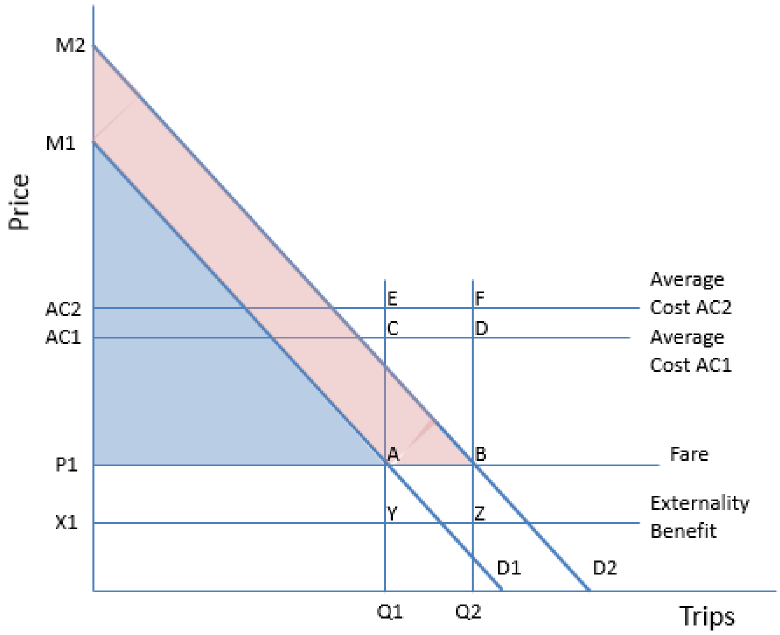
The decision to invest in a public transport project is typically underpinned by an economic cost-benefit analysis (CBA) rather than a financial appraisal. According to the Australian National Audit Office (ANAO, 2010), *"a key aspect of the Infrastructure Australia analytical framework for the Infrastructure Priority List was the development of a staged assessment process to prioritise between investment proposals, drawing from international and nationally based practices and research. Of note was that the published methodology outlined that objective cost-benefit analysis (through benefit cost ratios or BCRs) would be used as the 'primary driver' of decision making but they were not the only consideration."*

An economic CBA can be thought of as extending the perspective of a financial appraisal. Both involve the estimation of a project's costs and benefits over the life of the project which are then discounted to determine the project's net present value and benefit-cost ratio. A broader perspective of benefits is taken in an economic appraisal to cover consumer surplus benefits (time savings or improved amenity / facilities) to users that are not paid for in higher fares and net externality benefits such as benefits to road users from reduced road congestion as a result of an improved rail service.

In contrast, financial appraisals only consider the costs and benefits affecting the 'bottom line' of the organisation undertaking the project. For a public transport project, the appraisal would normally focus on fare revenue, capital and operating costs[2]. Figure 2 presents a stylised example of a rail improvement.

[2] More complicated financial appraisals may depart from economic appraisals in the treatment of tax, equity, debt and inflation (required rates of return, costs of debt finance etc).

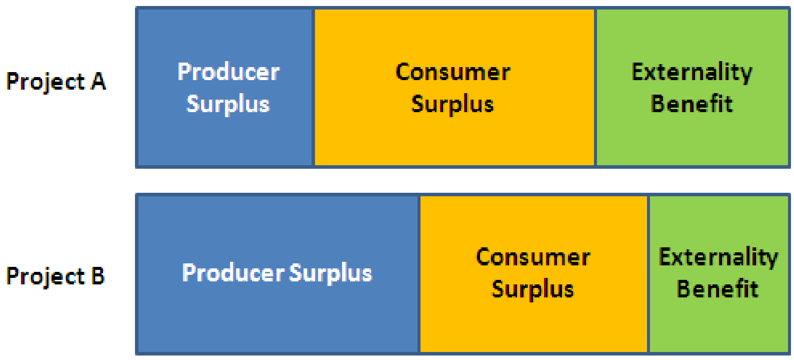
Figure 2: Economic and Financial Effects of a Rail Improvement



The improvement shifts the demand curve out from D1 to D2 raising demand from Q1 to Q2. Fares are left unchanged at P1 thus revenue increases by rectangle P1(Q2-Q1). The project increases costs from AC1 to AC2 with total costs equalling (AC2.Q2) minus (AC1.Q1). Neither before nor after the improvement does the rail service return a profit with average costs higher than revenue[3]. Moreover in this example, the change in producer surplus is negative since the average cost increases. Users benefit since they get a better service at the same price. Their benefit can be measured by the difference in what they are willing to pay minus what they actually pay. The difference in consumer surplus is triangle Q1(M1-P1)/2 minus Q2(M2-P1)/2. Finally, by attracting users from car, some externality benefits from reduced road congestion, accidents and pollution are achieved at the rate of X1 per trip. Thus externality benefits increase by X1(Q2-Q1).

In economic CBA, benefits and costs are added without weighting. Thus in Figure 3, projects A and B despite the difference in composition are treated the same irrespective of any difference in the demands on public funds as a result of subsidy requirements.

Figure 3: Comparison of Economic Benefit Composition



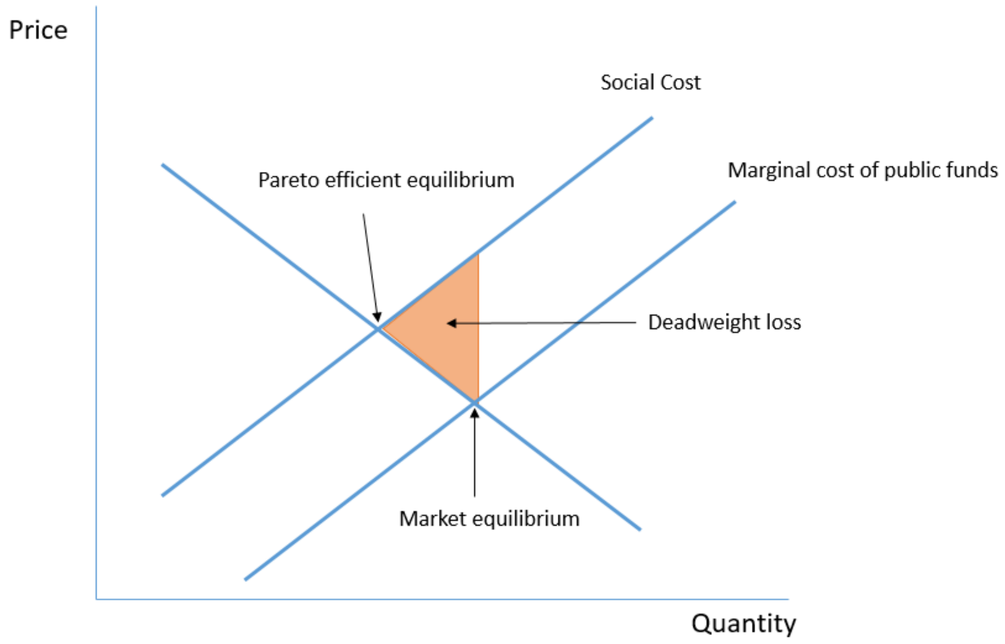
[3] Economic CBAs sometimes omit revenue by arguing that it is a ‘transfer payment’ from user to producer thereby leaving net welfare unaffected. However when so omitted, a comparable financial appraisal is not possible nor include the deadweight loss associated with taxation required to cover any revenue - cost shortfall over the life of the project.

3.2 Economics of public finance

Transport projects can be financed by government through borrowing or PAYGO. In either case, taxes will be higher than they would otherwise need to be, or alternatively some other 'competing' projects will need to be cancelled or deferred.

In the case of increased taxes, the marginal cost of the public transport project is the cost imposed by increased taxes. By raising additional tax revenue, the government places an additional cost on the economy, known as the deadweight loss of taxation. The deadweight loss reflects the changes in economic behaviour caused by the change in the tax structure. The orange "Harberger" triangle in Figure 4 illustrates the deadweight loss occurring when prices, costs and output is non Pareto optimal due to the existence of taxes[4].

Figure 4: Deadweight loss of public financing



The welfare cost to the economy from a tax expressed as a ratio of the tax revenue it generates is known as the marginal cost of public funds. When a public transport projects involves a subsidy, it therefore follows that it should be included in the economic CBA as part of the opportunity cost of the project. According to Browning (1976), *"an expenditure program will be efficient only if its benefits exceed the direct tax cost by an amount at least as large as the additional welfare cost of the funds."* Therefore the project would need to provide a return that is sufficient to cover the normal rate of return plus the marginal deadweight loss. Put simply, the economic BCR would need to exceed 1 for the project to be worth doing.

In Australia, Findlay, and Jones (1982) estimated the marginal cost of public funds to range from 1.23 to 1.65 per dollar of additional tax revenue. Campbell and Bond (1997) estimated a narrower range of 1.19 to 1.24[5]. More recently KPMG (2010) estimated marginal costs for

[4] The Harberger triangle is generally attributed to economist Arnold Harberger.
[5] Excludes other costs such as administration, enforcement, evasion and compliance. Also, the study was pre-GST.

different types of taxation that ranged from 1.02 for municipal rates to 1.41 for payroll tax[6], see Table 1.

Table 1: Marginal cost of Australian taxes

Tax	Marginal cost of public funds
Municipal rates	1.02
GST	1.08
Land taxes	1.08
Fuel taxes	1.15
Motor vehicle registration	1.37
Corporate income tax	1.40
Payroll tax	1.41

Source: KMPG (2010)

Inclusion of the financing 'deadweight loss' into the economic CBA could be made through the interpretation of the accept/reject decision rule for projects which would be to accept a project when the:

- Project BCR > Shadow BCR (marginal cost of public funds).

Using Campbell and Bond (1997) as an example, the shadow BCR would be 1.24 and any additional public transport project seeking financing from the government should have a BCR greater than 1.24.

An alternative approach would be to inflate the project capital costs by the marginal cost of public funds and leave the BCR hurdle rate at 1. In NZ, the Treasury (2005) *recommended "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."* According to Robson (2005) the US government modified its cost-benefit procedures in 1991 to assign a cost of $1.25 to every dollar of expenditures raised out of tax revenues based on a study on the marginal cost of public funds.

Figure 5 shows how costing a subsidy using a deadweight loss value can affect project ranking. Projects can be classified into viable (+NPV) or unviable (-NPV) both economically and financially. Two projects A and B are shown. Project A is economically viable but financially unviable and therefore requires a subsidy. Project B has the same economic BCR (1.2) as option A but is financially viable. Judged solely on the basis of economic BCR, A and B would rank the same. However if a shadow price is attached to the subsidy, the BCR over A falls below option B. Moreover, if the shadow price also worked in reverse, the economic BCR of option B would increase, further widening the gap.

[6] KPMG reported marginal excess burden figures which are the marginal cost of public funds minus 1.

Figure 5: Including Deadweight Loss of Subsidy into the Economic Appraisal

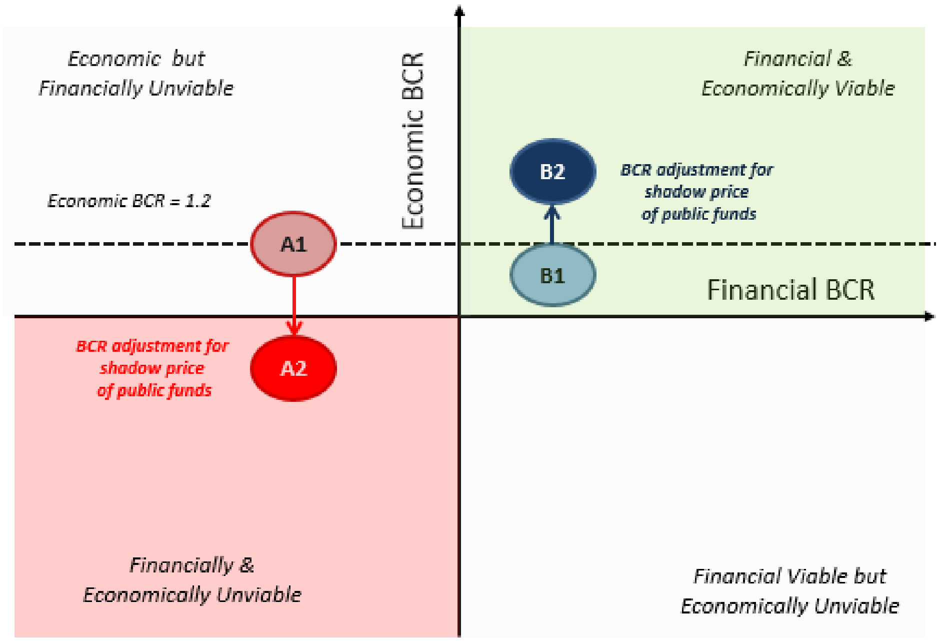


Table 2 shows the effect of including a shadow price for public funds of 20% using the 2006 Sydney 'North West Transport Link' as an example. This study considered Heavy Rail, Light Rail and Bus Transitway options to link the Castlehill area of Sydney to the rail system at Epping. The Heavy Rail link was evaluated as the best option. Evaluated at a discount rate of 7%, economic benefits totalled $2.1 billion compared to costs of $1.54 billion which gave an economic BCR of 1.39. Financially, the heavy rail link would require a large 'subsidy' amounting to $1.3 billion over the life of the project (evaluated at 7%). If a deadweight loss of 1.2 was applied, the shadow price of the public funds would be $268 which when added to the costs would reduce the economic NPV to $336 million and the BCR to 1.19.

Including the deadweight loss also reduced the economics of the Light Rail and Transitway options. Economic NPV turned from positive to negative for the Transitway. The ranking of the three options did not change however with Heavy Rail remaining the best option.

Table 2: Including the Shadow Price of Funds - Example of the North West Transport Link (2006 Evaluation)

#	Cost/Benefit	Heavy Rail	Light Rail	Transityway
1	User benefits	1,504	560	234
2	Net revenue	156	25	64
3	Externality benefit	487	336	122
4	Total benefit	2,147	921	420
5	Land, capital and op costs	1,494	1,044	364
6	Fuel tax & RUCs	49	36	22
7	Total economic cost	1,543	1,080	386
8	Economic NPV (4-7)	604	-159	34
9	Economic BCR (4/7)	1.39	0.85	1.09
10	Financial NPV (2-5)	-1,338	-1,019	-300
11	Financial BCR (2/5)	0.10	0.02	0.18
12	Shadow price of public funds (20% of 10)	268	204	60
13	Adjusted NPV (4-(7+12))	336	-363	-26
14	Adjusted economic BCR (4/(7+12))	1.19	0.72	0.94

3.2 Economics of public funding

As noted earlier, there are two ways to fund a transport project, user pays or taxation. Most public transport projects are evaluated on the basis of no ‘fare increase’. There have been exceptions and these projects have usually involved the private sector. The Sydney Airport Rail is one example which levied substantial ‘station access charges’ (SACs) on passengers boarding or alighting at the airport stations and lesser SACs at Green Square and Mascot (removed since 2013).

In Australia and New Zealand, urban bus and rail fares recover only a proportion of the total cost of providing the services. In NZ, the rule of thumb is that users pay 50% of the cost, regional authorities pay 25% (mainly through rates) and central government pays 25% via the Land Transport Fund. For rail, crown funding provides an additional source for specific investments (Matangi trains in Wellington) or bail-outs.

In Australia, there is no Commonwealth Government operating subsidy support for public transport. State contributions vary from state to state. In NSW, between 2011 and 2014, around three-quarters of public transport ‘revenue’ was paid by the NSW Government with one quarter paid by bus, rail and ferry fares. The operating subsidy was lower for rail (around 22%). In 2009/10, the public subsidy for rail totalled $2.1 billion which equated to $780 for every household in NSW. The operating cost ratio for bus at around 25% has been lower than in other Australian states (25% to 45%) and internationally (60% to 80%) based on figures in the TfNSW Long Term Transport Master Plan.

There are two main reasons for subsidising public transport: ‘social’ (providing a means of transport for people without access to cars) and ‘economic’ (providing a ‘second best’ solution in the presence of road congestion and in the absence of road pricing).

Economic CBAs typically only address the ‘economic’ reason by including the ‘externality’ benefits from diverted car users: reduced road congestion (time savings to remaining road users); accident savings; pollution savings and reduced Green House Gas emissions.

Given that rail and bus fares are rarely increased as a result of a project, the main beneficiaries are the existing users who get a better service but do not pay higher fares as a result. Typically, user benefits account for 50-60% of total project benefits. Revenue gain is limited to the fares paid by additional users (diverted from car plus induced) net of any GST which is offset by the investment and additional operating costs. Financially therefore, public transport 'investments' that expand the market (as distinct from 'engineering' projects that seek only to make the operation more efficient) nearly always have negative financial NPVs (i.e. they require more subsidy) and financial BCRs well below 1. Rarely however are these financial measures included in Business Case reports alongside the economic measures.

Where a public transport project will result in additional users, given the role of government in subsidising public transport, the project will have a negative impact on government finances. Therefore the economic CBA should include the net subsidy requirement (i.e. increased subsidy required minus additional fare revenue collected). In addition, like the discussion on financing, efficiency losses created by the need to support increased public transport subsidies with higher taxation should be taken into account. State taxes which fund public transport subsidies in Australia include payroll tax which has a higher marginal excess burden than other federal taxes.

4. Financing and funding alternatives

The financing and funding decision on public transport projects will have an influence on the economic viability of the project due to the deadweight loss of taxation. To reduce this effect, a greater proportion of private finance and user charges will be required. This section investigates the range of alternatives to finance and fund public transport projects.

4.1 Financing options

The most common forms of financing for public transport projects are:

- Budget appropriations (including hypothecated taxes)
- Specific purpose borrowing
- Public-private partnership (PPP)
- Privatisation, asset sales or leases.

According to PC (2013) budget appropriations, financed on a PAYGO basis or from public debt, remain the major form of financing for government investment in infrastructure (63% in 2006-07). As noted in Chan et al (2009) funds that are appropriated to finance investment in public infrastructure, as well as other public goods and services, can be sourced from general taxation, hypothecated taxes or intergovernmental transfer from tax revenue. The sources of funds for budget appropriations raises issues for the treatment in the economic CBA, in particular intergenerational issues. For example, PAYGO funding through budget appropriations from current revenue brings the burden of the project forward onto current taxpayers. While budget appropriations funded by general public debt defer this funding burden to taxpayers in future years, but at a cost of interest payments (on public debt). How should the economic CBA treat government financing if it is raised from PAYGO or through borrowing? For example, should different discount rates be used to capture the intergenerational affects?

Hypothecation (tax earmarking) typically means that all, or part of, the revenue raised from a particular tax is used for a specific use that either fully or partially funds a particular program. In the United States, fuel taxes are hypothecated into the Highways Trust Fund which finances investment in road infrastructure[7]. There have been calls for a similar approach in Australia with the ARA (2014) suggesting the hypothecation of Australia's fuel tax for public transport and road investment would both increase the funding pool available and provide a

[7] National Surface Transportation Infrastructure Financing Commission (2009)

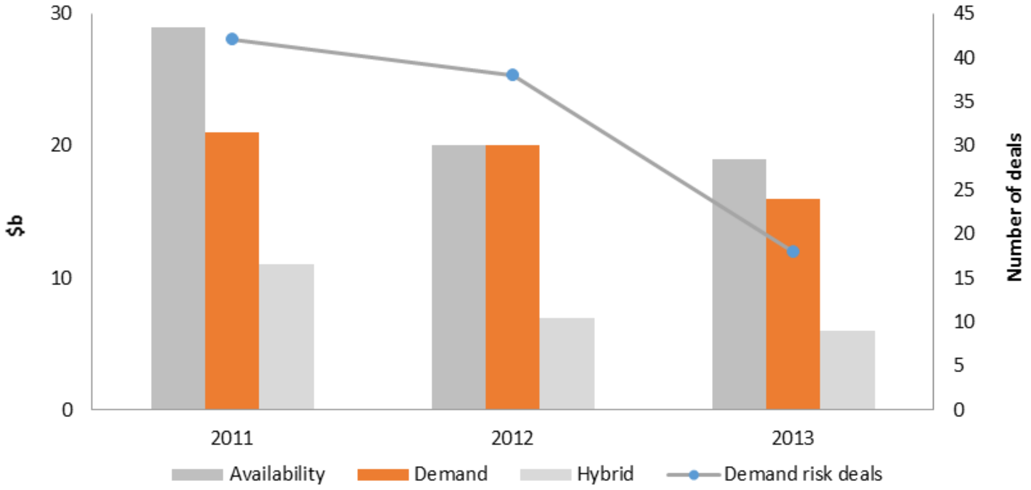
reliable source of revenue for transport investment[8]. According to Carling (2007), *“there is a good case for earmarking on allocative efficiency grounds where the tax acts like a user charge, provided: the tax fully funds the service being delivered, or does so in conjunction with another price mechanism (that is, the service is only part tax-funded), and does not over-fund it (that is, generate a contribution to general revenue as well); and the tax is paid by the beneficiaries of the service”.* On the other hand if the earmarked tax only partly funds a programme, it deludes taxpayers as to the true cost of what they are paying for. An example in Australia is the Medicare levy. The levy covers only around one-quarter of the cost of Medicare, thereby giving misleading cost information to taxpayers, Carling (2007). From a welfare point of view, hypothecation may be beneficial if the marginal excess burden of the hypothecated tax is lower than over broad based taxes which are normal used to finance a project.

Specific purpose borrowing can entail the issue of bonds to finance a particular project. Debts incurred through these bonds are usually repaid from income generated from the project or via government funding. Australia does not currently have a government bond market linked to specific projects. However in the United States and Canada ‘revenue bonds’ (better known as infrastructure bonds) are a major source of finance for infrastructure projects.

The only option to reduce government financing of public transport projects is to increase the share of projects financed from private sources such as a PPP. Under a PPP the private sector is typically contracted to deliver one of, or a combination of, the design, build, operation, maintenance and finance aspects of a new project. While tapping into private sector expertise to deliver projects is important, it is the access to private finance, as an alternative to public finance that is attractive to governments. In an ideal world PPPs used for economic infrastructure projects would generate sufficient revenues from user charges to cover costs and generate the appropriate returns. However as the private sector is becoming more averse to taking demand risk, public funding is usually required to meet revenue shortfalls. PPPs are often mentioned as crucial for future delivery of projects[9]. However, in general the use of PPPs to finance infrastructure has declined. According to data from IJGlobal (2014), PPP investment globally has declined since 2010. In terms of deal activity globally, a total of 108 transactions reached financial close in 2013. Of the 92 construction projects that closed in 2013, projects that benefited from availability payments accounted for 78%, demand risk projects 18%, and hybrid (share of demand risk and other payment type) structures accounted for the rest. As shown in Figure 6, the risk appetite of investors for demand risk PPPs has fallen significantly. According to IJGlobal (2014), the number of global demand risk PPPs was over 40 in 2011 but has fallen to less than 20 in 2013.

[8] Subject to increases in tax with CPI.
[9] See PwC (2010) “Public-private partnerships: The US perspective”, PricewaterhouseCoopers LLP.

Figure 6: Global PPP deals by risk structure ($b value and number of deals)



Source: IJGlobal (2014)

It is also important to consider the size and scale of proposed public transport projects and its impact on the attractiveness to investors. For example, the majority of global deals in the last three years required capital investment of between $100 million and $500 million. In 2013, only 12 PPP deals were larger than $1 billion each, and their combined value made up more than half of the total market volume that year. These large scale projects are provided in Table 3. These projects are dwarfed by the currently proposed public transport projects in Australian such as the Brisbane Bus and Train (BaT) project $5 billion, Sydney Rapid Transit $10 billion and Melbourne Metro $9 billion. Therefore the ability of PPPs to finance mega public transport projects is questionable.

Table 3: Largest global PPP deals in 2013

Country	Type	Project	Capital cost ($b)
Italy	Road	BreBeMi toll road	$2.9b
Turkey	Road	Northern Marmara motorway/Bosphorus bridge	$2.8b
UK	Rollingstock	Thameslink rolling stock	$2.8b
Turkey	Road	Gebze-Orhangazi-Izmir toll road	$2.8b
Italy	Road	Milan outer east orbital road	$2.5b
Brazil	Airport	Guarulhos airport	$1.5b
US	Road	North Tarrant Express	$1.4b
US	Road	Ohio River bridges east end crossing	$1.3b
Australia	Rollingstock	Next generation rolling stock	$1.2b
Australia	Entertainment	Sydney international convention centre	$1.2b
Netherlands	Road	A1/A6 Schiphol-Amsterdam-Almere motorway	$1.1b
US	Road	Goethals bridge replacement	$1.0b

Source: IJGlobal (2014)

Privatisation, asset sale or lease (full or partial) involves the government selling its stake in a government owned entity such as a port or electricity network. The proceeds of the sale (or lease) can then be used to finance an infrastructure project. This is known as capital recycling hypothecation – the hypothecation of the proceeds of an asset sale to the development of new infrastructure. This is exactly what has occurred recently in NSW. The government has leased its electricity network business (poles and wires) to develop and finance $20 billion worth of infrastructure projects[10]. In particular, the government has reserved $8.9 billion for urban public transport projects including $7 billion for Sydney Rapid Transit[11].

4.2 Funding options

Numerous studies internationally have investigated the different options available to fund public transport projects, including TCRP (2009), Irwin and Bevan (2010), Tomalty (2007), TransLink (2012), Ploeg (2006) and Litman (2012). A summary is shown below. The literature review shows that the majority of funding options are 'tax related', and therefore will cause some deadweight loss to society.

Table 4: Public transport funding options

User charges	Taxes		
	Traditional user taxes	**Beneficiaries**	**Broad based***
Fares	Fuel taxes (1.15)	Tax incremental financing (TIF)	Property taxes (1.08)
Tolling	Luxury car tax (1.20)	Transit-oriented developments (TODs)	GST (1.08)
Congestion charging	Motor vehicle registration (1.37)	Development or transport impact fees	Utility levy
Car parking levy	Driver license registration	Local improvement levies	Income tax (1.24)
	Motor vehicle stamp duties (1.38)	Land value capture	Corporate income tax (1.40)
		Station rents	Payroll tax (1.41)
		Advertising	Gambling (1.92)
		Station air rights	Intergovernmental transfers

Note: brackets - marginal cost of public funds according to KPMG (2010) where possible. *Examples of general revenue raising taxes.

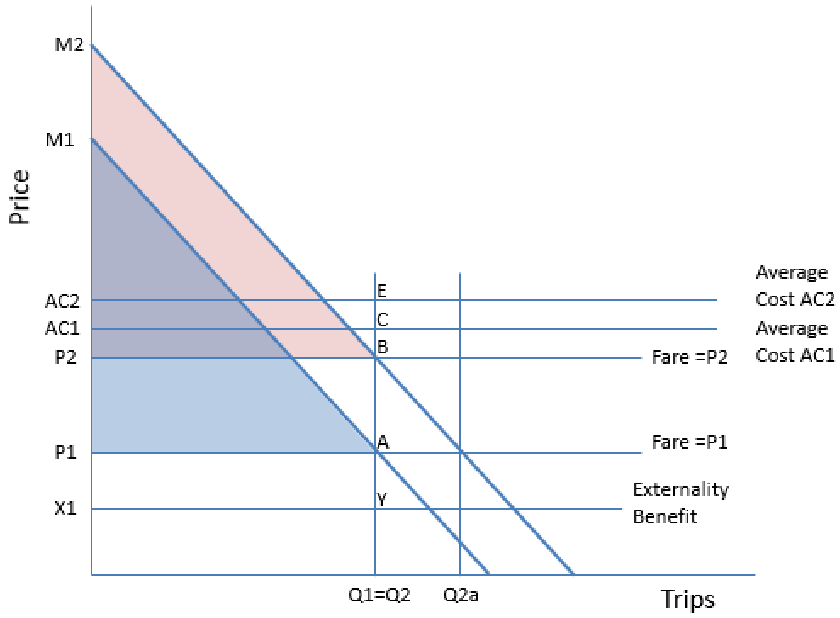
In Australia, government subsidies through fares and budget appropriation are the major funding sources for public transport.

Firstly fares, the elasticity of public transport with respect to fare is considered to lie between -0.2 and -0.5 in the short run, and between -0.6 and -0.9 in the long run. Thus, raising fares by 10% would increase revenue by 5% to 8% in the short run and by 1% to 4% in the long run. However by raising fares, user benefit (consumer surplus) will reduce and by diverting bus and rail users to car, externality benefits from public transport will also reduce.

As commented earlier, the Sydney Airport Rail Link is an example where fares were increased. Figure 7 repeats Figure 2 but shows the effect of raising fare such that demand is kept at the pre-investment level. Net consumer surplus is zero with triangle Q2(M2-P2)/2 exactly equalling Q1(M1-P1)/2. Externality benefits are zero since there is no change in demand. What changes is producer surplus with revenue increasing by Q2(P2-P1) offset by an increase in costs of Q2(AC2-AC1) to give a net gain in producer surplus. In this example, the economic CBA gives the same result as the financial CBA. There is no adjustment for the reduction in public funds as outlined in Figure 7.

[10] The proceeds from the electricity networks will be added to by at least $2 billion from the Commonwealth asset recycling incentive scheme.
[11] See NSW Government (2014).

Figure 7: Economic & Financial Effects of a Rail Improvement with a Fare Increase



The implementation of congestion and car parking levies can also be used to raise revenue from car users to help fund public transport[12]. In London, the congestion charge raised £222 million in 2012/13. The congestion charge is hypothecated for transport improvements across London[13]. In Sydney, the Parking Space Levy (PSL) has been in operation since 1992. The PSL is hypothecated to fund infrastructure projects that make it easier to access public transport such as ‘kiss and ride’ facilities. In 2013/14 the PSL raised $101 million. In theory, both schemes would have a demand side effect resulting in a mode shift away from car. For example, in Singapore the introduction of the Electronic Road Pricing (ERP) program increased public transport mode share from 45% to 65%. If the mode shift is towards public transport then a proportion of the revenue raised from congestion or parking levies would need to be used towards paying for the increased public transport subsidy.

Transit-oriented development (TODs) potentially offer a funding source that may reduce ‘deadweight economic losses’. Chatswood (Sydney) and Melbourne Central railway stations provide examples where air rights have been sold to build major retail and residential complexes in exchange for building station precincts. Under this approach, the infrastructure provider jointly develops the real estate in and around the infrastructure to generate a revenue stream to offset the cost of its provision[14]. This approach will reduce some of the deadweight loss associated with the project. However the ability of TODs to fund the cost of a large public transport project is limited. Successful funding of public transport projects occurs in places like Hong Kong and Tokyo where the property development opportunities are large enough and commercially profitable for the developer to pay a large sum for the rights to the development.

There are some examples where taxes or proportions of taxes have been used to fund public transport projects. The Gold Coast City Council used a proportion of a property transport levy

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[12] According to Clarke and Prentice (2009), *“economics is generally lukewarm on the issue of hypothecating such revenues to particular purposes such as transport infrastructure. But given the very substantial public opposition to pricing there could be ‘political economy’ benefits in making it clear that such revenues will be directed towards reducing other costs associated with transport such as statutory registration charges or public transport.”*

[13] https://www.tfl.gov.uk/cdn/static/cms/documents/congestion-charge-factsheet.pdf

[14] Infrastructure Australia (2012).

($111 per property) to part fund (13%) the cost of the Gold Coast Light Rail while the Sunshine Coast Regional Council has proposed a similar approach to fund its proposed light rail project. As noted in the KPMG study mentioned earlier, property related taxes have a lower marginal excess burden than other taxes.

5. Case study - Wellington

There are few examples of studies that assess the funding options of a public transport project. The Public Transport Spine Study in Wellington (New Zealand) offers an example of how funding can be considered in scheme appraisal. The assessment, undertaken by Douglas Economics for the Greater Wellington Regional Council (GWRC), assessed a range of funding methods including increases in Wellington City rates; fare rises; a regional fuel tax (RFT); a cordon charge on vehicles entering Wellington city and a car parking levy[15].

The three public transport options were Bus Priority (BP) with a capital cost of $50 million; Bus Rapid Transit (BRT) costing $207 million and Light Rail Transit (LRT) costing $938 million.

The economic appraisal, undertaken by John Bolland Consulting for the GWRC found that none of the options were economic. The LRT option produced only 5 cents of economic benefit for each dollar of cost. The benefit/cost ratio increased to 0.57 for the BP option and to 0.87 for BRT.

In terms of funding, BP was forecast to require $2.7 million in funding per year over a 20 year period, BRT $5 million and LRT $47 million over a 40 year period.

Four alternative funding methods were individually modelled and the results are summarised in Table 5.

A 4% fare rise applied to all bus and rail trips in Wellington could raise sufficient revenue to fund the BP option. For BRT, the required increase would be 7%. For LRT, the maximum revenue that could be achieved from raising fares, which would be with a 74% increase, would still be $247 million short of the required funding. For BP and BRT, the fare increase would be much larger if restricted to the PT spine corridor which simply reflects the small market.

A RFT of 1.4 cents per litre levied on petrol and diesel sold in the Wellington Region would completely fund the BP option. A 2.9 cent RFT was forecast to fund BRT with a much larger tax of 30.4 cents required to fund LRT.

A cordon charge of $1 levied on vehicles entering Wellington CBD in the AM Peak would fund the BP investment. A $1.22 charge would be required for BRT. For LRT, a much higher charge of $8.04 would be required.

Given the estimated administration/collection cost of 70 cents per vehicle, widening the cordon charge to cover the inter-peak (set at half the AM peak rate) would somewhat perversely increase the charge for BP and BRT. For LRT, a cordon charge of $3.32 in the AM peak and $1.66 in the inter-peak would produce the required level of funding.

A 4% car park levy imposed on public and private car park could fund BP with a 7% increase funding BRT. For LRT, a levy that more than doubled (117%) car park charges would be required.

[15] Note: the funding forecasts were indicative estimates covering only first-round effects and excluding any inter-relationships between funding methods (for example a regional fuel tax or cordon charge may encourage a switch from car to public transport increasing net revenue). Economic 'multiplier' impacts of the funding methods on the regional economy were also not modelled.

Table 5: Forecast funding revenue for Wellington Spine Options

	BP	BRT	LRT
Funding gap PV $2013 $m	35.1	51.5	685.6
Start year	2014	2019	2018
Funding years	20	20	40
Funding amount per year $m ($2013)	2.7	5.0	47.0
1a Regional PT fare increase %	4%	7%	74%
Residual funding gap $m	0.0	0.0	247.0
1b PT Spine fare increase %	59%	74%	74%
Residual funding gap $m	0.0	11.5	630.0
2 RFT tax increase c/L	1.4	2.9	30.4
Residual funding gap $m	0.0	0.0	0.0
3a S1: AM Pk cordon charge $/veh	1.00	1.22	8.04
Residual funding gap $m	0.0	0.0	0.0
3b S2: AM & IP cordon charge $/veh	1.19	1.25	3.32
Residual funding gap $m	0.0	0.0	0.0
4 Car park charge increase %	4%	7%	117%
Residual funding gap $m	0.0	0.0	0.0

A package approach was developed for BRT and LRT that combined funding methods with residential/business rates picking up any residual (see Table 6). For BRT, a car park charge of 5% was charged. For LRT, a package based on a 10% increase in regional PT fares, a 5c per litre regional fuel tax, a $1.50 cordon charge on vehicles entering Wellington City in the AM peak and a 10% car park charge was assessed.

For BP, rates would need to be increased by $2.7 million a year. For BRT, the car park charge levy would raise $36 million leaving $15 million to be rates funded. For LRT, the four funding methods raised $481 million requiring $204 million to be rates funded.

Table 6: Mixed funding revenue

	BP	BRT	LRT
Funding gap PV $2013 $m	35.1	51.5	685.6
Start year	2014	2019	2018
Funding years	20	20	40
Funding amount per year $m ($2013)	2.7	5.0	47.0
PV Regional PT fare increase $m	0	0	110
PV PT Spine fare increase $m	0	0	0
PV RFT tax increase c/L $m	0	0	116
PV S1: AM Pk cordon charge $/veh $m	0	0	155
PV Car park charge increase $m	0	36	101
PV Funding total $m	0	36	481
Residual funding gap $m	35	15	204
Residual funding amount p.a. $2013 $m	2.7	1.5	14.0

In terms of rates, Wellington City residents were forecast at $100 per average commercial property and $12 per average residential property (see Table 7). For LRT the rates increases were nine times higher at $930 and $109 respectively.

Table 7: Residual Rates Funding

	Average rate increase p.a.			Percentage increase (+%)		
	BP	BRT	LRT	BP	BRT	LRT
Commercial	189	100	930	1%	1%	5%
Residential	21	12	109	1%	1%	6%

Clearly, the emphasis in this study was funding options. There was no linkage back to the economic appraisal and neither were wider economic impacts made of the funding options. Thus the impact of fares on the economic performance of the options was not considered in the way that Figure 7 outlined. Neither were the consumer surplus and externality impacts of the fuel tax, car parking and cordon pricing methods assessed.

6. Impact of financing and funding decisions on the investment decision

The previous sections of the paper have shown that unless users pay more, or the cost of public transport provision reduces, government financing and funding will continue to be the major source of money to pay for public transport projects.

What is therefore important concerns the decision on what taxes may be used to fund certain projects as it will impact the economic viability of the project. As discussed earlier TransLink (2013), Vander-Ploeg (2006) Litman (2013), Stanley (2014) and LGNZ (2015) suggest a raft of different measures. But as noted in the KPMG (2010) study, each tax has a different excess burden on society. For example, one of Stanley's (2014) six ways to boost funding for better public transport is to increase payroll taxes levied on businesses located within 800 metres of high frequency tram, train or bus services. In Paris and Portland (Oregon) governments recognise the benefits employers get from access to high quality public transport services and levy them through payroll tax to help fund these services. However, payroll tax has one of the highest marginal excess burdens with modelling from KPMG (2010) suggesting that the marginal cost of public funds raised from payroll tax is 1.41. On the other hand Stanley also recommends fuel excise indexation as a funding source. Fuel excise has a much lower marginal cost compared to payroll tax, 1.15.

To see how the financing and funding decision may impact the economic CBA and therefore the investment decision consider a project that can be financed and funded under a variety of different options. The illustrative example is shown in Table 8 and is based on the Wellington case study. It shows that the project can be funded via two approaches, using direct user charges in the form of fares, congestion charge and a car park levy, and hypothecated taxes in the form of fuel tax, property rates (with an allowance for an increase in the public transport subsidy which is funded from budget appropriations). The alternative approach is to fund the project using fares and budget appropriations only. The different funding mixes of user charges and taxes would result in different shadow BCRs. The results show that when using taxes that are hypothecated specifically for the project, which have a lower excess burdens (in weighted average terms), the shadow BCR is reduced. This example is an illustration of how the financing and funding decisions impact the investment decision and economic CBA. This provides a useful starting point for the debate on whether the investment decision, financing and funding decisions should be separated.

Table 8: Illustrative example of financing and funding shadow BCR

(a) Shadow BCR with hypothecation

Hypothecated taxes	%	Marginal cost of public funds
Financing sources		
Private	0%	0.00
Public via budget appropriations	100%	1.24
	Score	**1.24**
Funding sources		
Fares	20%	0.00
- Offset by increased PT subsidy	10%	1.24
Regional fuel tax	15%	1.15
Congestion charge	15%	0.00
Car park levy	5%	0.00
Property rates	35%	1.08
Budget appropriations	0%	1.24
	Score	**0.67**
	Shadow BCR	**1.91**

(b) Shadow BCR with broad based taxes

Broad based general taxation	%	Marginal cost of public funds
Financing sources		
Private	0%	0.00
Public via budget appropriations	100%	1.24
	Score	**1.24**
Funding sources		
Fares	20%	0.00
- Offset by increased PT subsidy	10%	1.24
Regional fuel tax	0%	1.15
Congestion charge	0%	0.00
Car park levy	0%	0.00
Property rates	0%	1.08
Budget appropriations	70%	1.24
	Score	**0.99**
	Shadow BCR	**2.23**

7. Conclusion

In this paper we highlighted that the decision to invest in a public transport project ('to build or not to build') is typically underpinned by an economic CBA which is made independently of the decision about how the project should be financed and funded. We discussed that this approach to decision making is best known as Fisher's Separation Theorem.

However, we showed that when a government is required to finance and fund an additional public transport project, using money sourced from taxes, the government places an additional cost on the economy, known as the deadweight loss of taxation. The deadweight loss reflects the changes in economic behaviour caused by the change in the tax structure. We showed show that these costs have implications for the investment decision using a theoretical framework and an example in Wellington.

The objective of this paper was to generate discussion on how these factors should be considered in future economic CBAs. An approach developed in this paper was to include the financing and funding aspects of the project via the estimation of a shadow BCR. Therefore, the project would need to provide a return that is sufficient to cover the normal rate of return plus the marginal deadweight loss. In other words, the accept rule would be:

- Accept a project when the Project BCR > Shadow BCR (marginal cost of public funds).

In summary, the paper showed that the investment, financing and funding decisions should not be considered separately due to the welfare effects that the financing and funding decisions have on society. The development of an approach to combine these factors, including the estimation of a shadow BCR, will be the subject of future research.

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