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TREATMENT OF VAT AND CORPORATION TAX IN APPRAISAL



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ABSTRACT

This report examines the treatment of VAT and corporation tax in transport cost–benefit analysis (CBA), motivated by policy scenarios involving private operation of tolled road infrastructure and potential foreign investment. It clarifies how current TAG practice incorporates taxation and assesses whether tax revenues generated under private finance arrangements are economically additional.

The analysis demonstrates that VAT, and indirect taxation more broadly, creates a wedge between prices and resource costs and therefore generates a non-resource welfare effect. Changes in VAT revenues are thus additional components of social surplus to user benefits, captured through indirect tax revenue (ITR) terms. In contrast, corporation tax does not create a comparable price wedge in the goods market and is therefore treated as a transfer within the CBA framework. While it redistributes surplus between firms and government, it does not affect total welfare in a global CBA except where distortions in capital markets arise, which are addressed through the shadow price of capital (SPC) or discount rate assumptions.

Both indirect taxation and corporation tax can generate wider impacts. If output on final goods expands then a wider impact in the goods market will occur due to distortions caused by indirect taxation. If additional investment is triggered by the project a wider impact in the capital market will occur, due to capital market distortions caused by corporation tax and taxes on savings income.

The analysis also considers distributional and geographic dimensions, including Great Britain (GB)-centric appraisal and foreign direct investment. It highlights that when profits are repatriated abroad, which reduces GB citizen’s welfare, corporation tax becomes relevant to the appraisal. This is because it is the only component of the producer surplus that remains in Great Britain.

The treatment of taxation in private finance appraisal is clarified, emphasising that resource costs—not financial flows such as interest or tax payments—should form the basis of economic analysis.

Overall, the report concludes that existing TAG practice is broadly consistent with economic theory, but that refinements are required in specific cases, particularly where indirect tax regimes differ between scenarios or where distributional, geographic, wider impacts or capital market effects are material.

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1 INTRODUCTION

1.1 Policy background

The background to this study is the potential use of the private sector to manage existing tolled road infrastructure, and the potential use of private finance to increase road capacity. The private finance may potentially arise from overseas. This raises a number of technical matters in the cost benefit analysis (CBA) regarding the treatment of taxation: specifically the treatment of VAT and corporation tax. For example the transfer of management of existing government owned tolled road infrastructure to the private sector would lead to VAT being levied on tolls, that are currently VAT exempt. Profits by the private sector operating company would also be subject to corporation tax. There is also the possibility that the private sector finance initiative may lead to investment from overseas, a form of Foreign Direct Investment (FDI). The question then arises as to whether this foreign investment changes anything in the CBA.

It is important to recognise that in a mode-neutral sense this policy scenario is not new. Bus and train companies pay corporation tax on their profits, overseas companies have invested in the bus, train and rail networks in the UK, and VAT is paid on charges levied for use of private sector operated aspects of the road network (some roads, bridges, crossings and car parks). Thus TAG already has an approach to taxation. This can be briefly summarised as:

- i. A Market Price Adjustment (MPA) factor is used to convert prices faced by households and businesses into a common price base.¹
- ii. A non-resource term is used to capture the social surplus associated with the divergence between prices and resource costs in the transport market and the wider economy from a change in expenditure in the transport market. This relates to the treatment of VAT and excise duties.
- iii. Corporation tax within the transport sector (bus, air, train and private road infrastructure companies) is treated as a transfer. Importantly, compared to VAT, this transfer is not identified in the CBA as a distributional impact.
- iv. The discount rate is a Social Time Preference Rate (STPR). There is no explicit adjustment in the CBA through the discount rate or via the Shadow Price of Capital (SPC) for the distorting effects of corporation tax or taxes on savings.
- v. The marginal cost of public funds (MCPF) is ignored, or effectively treated as 1.
- vi. Wider impacts (WI):
 - a. The distorting effects of income tax in the labour market is included in the WI analysis. No other taxes are explicitly considered in the WI analysis.

¹ It's important here to distinguish between the prices faced by households and market prices. These are not necessarily the same. For example, the factor cost of fuel is the price of fuel minus fuel duty and VAT. The market price of fuel is factor cost adjusted by the MPA. In TAG the MPA is 1.19. Thus the market price of fuel differs from the price of fuel faced by households.

- b. No attempt is made to separate imperfect competition or agglomeration WI surpluses into government, firm and household surpluses. For example corporation tax will be paid on additional profits, but this is not identified.

It is important to recognise that CBA is primarily concerned with allocative efficiency. It is therefore essential that non-resource welfare impacts, where prices diverge from marginal social costs, are included in the CBA. These include the indirect tax revenue (ITR) terms and the wider impacts associated with changes in labour supply (income tax).

Transfers in contrast are only of interest where they affect distributional matters. As the identification of transfers places an increasing burden on the analyst, in CBA practical appraisal they are only really identified in certain situations – particularly when affecting households. Thus a transfer of a bus fare from a household to a bus company is identified in a TAG appraisal.

In contrast, in financial appraisals transfers are almost always of direct interest, as they impact on the financial viability of the project. For transport providing firms revenue forecasts and taxation liabilities are critical in determining operating viability. Changes in government taxation receipts are also relevant in understanding the impacts of private finance initiatives on the public exchequer.

Bringing this together the Net Present Value (NPV) and Benefit Cost Ratio (BCR) metrics in TAG can be thought of as in equations (1) and (2) below. Here the NPV is defined as changes in externalities, changes in user benefits, changes to transport providers and changes to government relative to some reference case and all suitably discounted and summed over project life.

$$NPV = \Delta E + \Delta B_{NB} + \Delta B_B + \Delta BTB + \Delta ITR + \Delta WI \quad (1)$$

Where:

E = externalities: the sum of changes in noise, local air quality, greenhouse gases, journey quality, physical activity and accidents

B_{NB} = Non-business user benefits

B_B = Business user benefits plus transport provider impacts less developer contributions

BTB = Broad Transport Budget (revenue directly received by government from the transport scheme, operating costs directly incurred, investment costs including capital grants to transport operators netted of developer contributions, and revenue support/concession payments received to/from transport operators)

ITR = Indirect Taxation Revenues

WI = Wider Impacts

The BCR is defined as follows.

$$BCR = \frac{\Delta E + \Delta B_{NB} + \Delta B_B + \Delta ITR + \Delta WI}{\Delta BTB} \quad (2)$$

These terms are all expressed in market prices. The MPA factor being used to convert the prices faced by government and businesses to market prices.² The MPA factor is defined as $(1 + t)$ where t is the average rate of indirect taxation in the economy. In TAG $t = 0.19$, therefore the MPA=1.19.

An important point is that guidance and practice in CBA has to be proportionate to the problem being analysed. Assumptions and simplifications are made, and it's important to recognise these for what they are. The simplifications broadly centre around boundaries of analysis within the transport sector, outside the transport sector but in the UK, and outside the UK. I set them out below.

- **Competition within the transport sector and outside the transport sector.** Transport providing firms are typically not required to equate price to marginal cost in a CBA. They are assumed to operate in some form of imperfectly competitive market. Thus a bus company that receives an increase in demand, for no change in operating cost, is permitted to keep the revenue surplus as a change in producer surplus. In a competitive environment the revenue surplus would be bid away to households, who would pay lower fares. There would be a small increase in household demand for transport as a consequence, a surplus that is not captured under this assumption. This simplifies the analysis significantly, but would be inappropriate for a policy test that was expected to bring competition to a particular transport providing sector leading to significant price adjustments (rail competition and airport expansion are potential policy examples).

Contrastingly, outside the transport sector markets are assumed competitive in that prices will adjust. In the main prices outside the transport sector are assumed to reflect marginal social costs. This also simplifies the analysis, though there are some exceptions. One exception is that indirect taxation occurs in the wider economy, so when expenditure on transport increases, and decreases in the wider economy, there is a social loss in the wider economy.³ This has to be netted off any changes in indirect taxation within the transport market. The other exceptions relate to the calculation of wider impacts in the labour market, an imperfectly competitive goods market and through agglomeration externalities.

Project costs are taken to reflect resource costs. The supply chain for project construction is taken to be competitive as is the labour market (for construction workers).

- **Expenditure and tax outside of the transport sector.** When calculating the ITR it is assumed that changes of expenditure within the transport sector are drawn from an 'average' good in the economy which is subject to the average rate of indirect taxation t . In reality different

² Businesses actually perceive in producer prices. These are net of VAT but include excise duties. Conversion to market prices involves removing excise duties to obtain factor prices, then uprating by the MPA.

³ The implicit assumption is that there are no net output effects at a national level from the switch in expenditure between the wider economy and the transport sector.

goods have different taxation rates, some goods have more elastic demand than others, and households with different incomes have different expenditure patterns. Thus it is a simplification to assume that increased expenditure on transport is drawn from across all goods in a pro rata manner. Discretionary goods, with elastic demand, will be more affected than others. Given the closeness of the MPA factor to the standard rate of VAT this assumption is likely tolerable in almost all circumstances, when identifying the ITR.

- **General equilibrium impacts.** If projects are large, even at the local regional level, then there will be structural changes in the wider economy (e.g. specialisation towards certain industries). Such changes will hold social value. In the main such impacts are not modelled, and the transport project is taken to have a 'small' impact in the context of the regional. This then allows the analysis to focus exclusively on the transport market.
- **UK benefits.** Typically it is taken that all benefits from transport projects accrue to UK citizens or businesses. To trace the final impact of all transport projects to the final beneficiaries (including shareholders in other countries) but be inordinately complicated and arguably unnecessary for almost all projects. Projects where such an assumption needs to be relaxed and additional analysis undertaken are those that affect international travel. Foreign direct investment may also lead to issues associated with the incidence of benefits between the UK and the rest of the world.

1.2 Objectives

Related to this policy background four questions have been posed, as set out in the specification.:

1. Does the transfer of an existing revenue stream (e.g. road tolls) from public hands (with no tax liable) to private hands (where tax is liable) lead to economic additionality? Note, both corporation tax and VAT are relevant here, as a private provider could both be required to charge VAT on tolls, and pay corporation tax on its profits.
2. Sticking with this example, but where the price (e.g. toll rate) is increased by the private operator compared to the public ownership case (i.e. the PSC), is the tax take on the additional revenue economically additional (again, considering both VAT and corporation tax)?
3. For corporation tax, does the source of private funds and the good being bought impact whether it is economically additional? For example, if foreign investors provide the private finance (e.g. FDI), is there greater additionality of corporation tax revenues? How should we consider displacement of consumer expenditure when assessing net tax receipts (e.g. if consumers spend on new tolls, are they spending less on other goods which would have associated VAT and corporation tax revenues)? Does this play out differently for business versus non-business travel?
4. How should tax be handled in the discount rate for PPP options? The literature on PPP discounting tends to suggest a downward adjustment to the PPP costs to reflect tax paid

(e.g. corporation tax). Is this consistent with ensuring additionality, related to the issue raised in the previous bullet?

1.3 Approach and report structure

The approach adopted in addressing the DfT's technical questions is to start from the underlying economic principles of CBA. Partly, this is because the economic foundations to CBA guide us to the answer to the questions posed, but also because whilst the policy context to road infrastructure is new the generic principle is not.

Therefore in the following section, Chapter 2, I set out the treatment of VAT and corporation tax within the transport market. This includes the use of the MPA to convert from factor to market prices. In Chapter 3 I widen the analysis to consider secondary markets and whether the distorting effects of VAT and corporation tax generate WIs in themselves. In Chapter 4 I look at the CBA of private finance projects and the choice of discount rate and treatment of tax in that choice, whilst in Chapter 5 I turn to foreign direct investment. Finally, in Chapter 6 I bring the key aspects of these economic foundations together to directly answer the four questions set by DfT.

2 TREATMENT OF TAX WITHIN THE TRANSPORT SECTOR IN A CBA

2.1 The Market Price Adjustment factor (MPA)

Within cost benefit analysis we also focus on maximising output with a given set of resources – that is allocative efficiency. As we are interested in allocative efficiency, it is therefore important that all prices used in the CBA reflect their resource costs. Observed (traded) prices may be distorted for a variety of reasons including taxation, subsidy and inefficient, poorly regulated markets. It is therefore important to remove these sources of distortion when undertaking a CBA. This typically includes removing the effects of tax and subsidies on unit prices and also shadow pricing where markets are distorted.

Once these distorting effects have been stripped away, the prices obtained are known as factor prices. Households however experience prices including indirect taxation.

The basic idea behind the [Market Price Adjustment factor] can be stated very simply. (This argument can be found in Department of Transport Highway Economics Note No. 3 [written by M.A. Schraer and dated December 1977] and in Sugden and Williams [1978, pp. 109-110].) Denote the average rate of indirect tax on final consumption by t . Thus, goods which are valued at 1 net of tax are valued at $1/(1+t)$ gross of tax; of each 1 of consumer spending, $1/(1+t)$ goes to producers in wages, rents and profits and $t/(1+t)$ goes to the government. Assume that the government balances its budget.

Now suppose the government increases its spending by 1, and wishes to finance this through direct taxation. To do this, it must raise direct taxes by *more than* 1, since the increase in direct taxation will imply a reduction in disposable income and hence a fall in indirect tax revenue. In fact, direct taxation must be increased by $1/(1+t)$. Disposable income will then fall by $1/(1+t)$. Since the proportion $t/(1+t)$ of all consumer spending goes to the government as indirect tax revenue, indirect tax revenue will fall by $1/(1+t) \cdot t/(1+t)$, i.e. by $t/(1+t)$. Thus the net effect on government tax revenue is $1/(1+t) - t/(1+t) = 1/(1+t)$. The implication of this example is that each extra 1 spent by the government is equivalent to a $1/(1+t)$ loss of disposable income by households.

This conclusion should not be interpreted as saying that resources have a different value when they are in the hands of the government than when they are in the hands of private consumers. The point is simply that we are using two different units of account. When we say the government spends 1, we mean that it spends 1 in terms of the factor-cost unit of account. The cost to households in terms of disposable income is $1/(1+t)$, but this is in terms of the market-price unit of account. Each factor-cost unit converts into $(1+t)$ market-price units: this conversion rate (or its reciprocal, depending on which unit we treat as basic) is the [Market Price Adjustment] factor.

Source: Sugden (2002 p6)

2.2 Indirect taxation and the non-resource welfare term

2.2.1 The basis to the TAG approach to indirect taxation

One way that transport can impact on government surpluses is by affecting the amount of revenue received from taxation. Taxes are income transfers. This is because the tax revenue received by government as part of its surplus corresponds to a reduction in surplus experienced by either consumers or producers. When taxes are levied on resources at different rates, then if the project is expected to change the quantities demanded then taxation revenue can alter. It can be shown that not all of these changes are transfers. There is therefore a need to include a non-resource term⁴ in the social surplus calculation. This reflects the change in taxation revenue.⁵ In the transport sector, a classic example arises if new projects affect traveller choices and thereby increase or decrease the quantum of fuel duty revenue accruing to Government. Similar issues arise with public transport, electric versus conventional fuel vehicles etc where differential indirect tax rates apply.

The change in indirect taxation is relevant to the CBA as indirect taxation creates a divergence between the resource costs of the trip (in terms of travel time and fuel resource costs) and the actual price paid. When quantities change this then creates an impact on net social surplus.

Sugden (2009) sets this impact out illustratively for a simple road improvement that reduces both the generalised cost of travel (g_0 to g_1), but also the amount of tax paid per trip (t_0 to t_1). His illustration is reproduced in Figure 2-1. This generates a change in consumer surplus of $a + b$ and a change in government surplus of $k - h - C$. The change in total surplus is therefore: $a + b + k - h - C$. $k - h$ is the change in indirect tax revenue (i.e. the ITR term in equations (1) and (2)).⁶

If total expenditure on transport services changes, not just whether the expenditure changes between modes, and the rest of the economy is subject to indirect taxation, then there is also a need to account for changes in indirect taxation in the rest of the economy.⁷

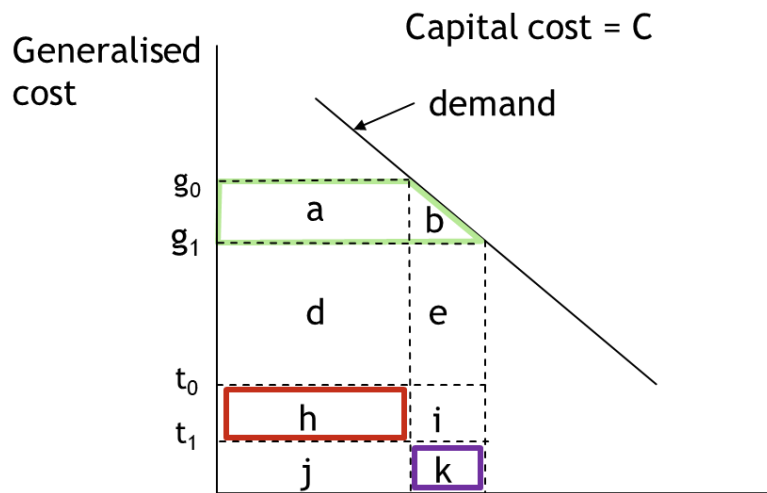
⁴ Consumers and producers surplus refer to changes in quantities of resources. The non-resource correction term relates to the divergence between perceived price and resource cost when quantities change.

⁵ de Rus (2010 pp31-32) gives a short exposition.

⁶ In this example Sugden is implicitly taken $t = 0$. That is the rate of indirect taxation in the wider economy is zero.

⁷ By assuming that there are no net output effects at a national level from the switch in expenditure between the wider economy and the transport sector, as in TAG, the CBA becomes more tractable.

FIGURE 2-1: SIMPLE ROAD IMPROVEMENT



Source: (Sugden, 2009)

2.2.2 A toll road example

I now extend the Sugden example to that of a toll road via three hypothetical projects that illustrate different facets of the questions posed.

Project 1. In line with the questions posed this project transfers operation of the asset and therefore the toll revenues from government to a private sector crossing provider. The private sector provider levies VAT, but only non-work trips pay the VAT and the toll including VAT is kept at the previous toll. This is Project 1, and is illustrated in Figure 2-2 with the relevant changes in surplus identified in Table 2-1. The final line in this table shows the net benefit to society. As can be seen VAT elements appear in the net benefits related to changes in indirect taxation in the economy outside the transport sector. Fuel tax changes also appear.

The formulas set out in TAG do not permit the rate of VAT to differ between the Do Minimum and Do Something. Thus they cannot be applied to this Project 1 example. TAG is a simplification of the general case. It is a simple matter to adjust the TAG formulae to the general case (see Appendix A). Drawing from Appendix A the general case is given by:

$$\Delta ITR_M(\text{market}) = (1+t) \left[\left(M^1 \frac{t_M^1}{1+t_M^1} - M^0 \frac{t_M^0}{1+t_M^0} \right) - (M^1 - M^0) \left(\frac{t}{1+t} \right) \right] \quad (3)$$

Where:

- M is monetary costs including fares, tolls and parking
- t is average rate of indirect taxation in the economy
- t_M is rate of indirect taxation on monetary costs as a final consumption good (non-work trips)
- 0 & 1 superscripts denote the Do Minimum and Do Something

Now for Project 1 $M^1 = M^0$ then Equation 3 becomes:

$$\Delta ITR_M(\text{market}) = (1+t) \left[\left(M^0 \frac{t_M^1}{1+t_M^1} - M^0 \frac{t_M^0}{1+t_M^0} \right) - (M^0 - M^0) \left(\frac{t}{1+t} \right) \right] \quad (4)$$

The right hand side term equals zero thus simplifying to:

$$\Delta ITR_M(\text{market}) = M^0(1+t) \left[\frac{t_M^1}{1+t_M^1} - \frac{t_M^0}{1+t_M^0} \right] \quad (5)$$

This sum given in equation 5 is the surplus a_{nw} in Figure 2-2. This is the increase in VAT that is transferred from the toll revenues (producer surplus) previously received by the government net of any changes in the wider economy. The latter, r_{nw} , is zero in this case, as the right hand side of equation 4 is zero.

The $\Delta ITR_M(\text{market})$ in Equation 5 is additional to user benefits, but there is a corresponding loss of government surplus (as government gives up the toll revenues it had received), thus in this case there is no net impact on total surplus.

Project 2. To this scenario we then introduce a capacity increase which reduces generalised cost. Toll levels remain the same. This is Project 2, and is illustrated in Figure 2-3, with the relevant changes in surplus identified in Table 2-2. Again it can be seen that VAT elements form part of the total net societal benefits. These include the additional VAT paid by new-non-work users of the tolled crossing, and changes in indirect taxation in the economy outside of the transport sector. Additional fuel tax revenues from the generated traffic are also relevant.

Project 3. To this second scenario we then identify the changes in surplus of the private sector crossing provider raises tolls. This is Project 3, and is illustrated in Figure 2-4 with the relevant changes in surplus identified in Table 2-3. Once again changes in VAT contribute to total net societal benefits and are not pure transfers. Relative to Project 2, the increase in tolls has reduced demand, so some of the surpluses for Project 3 are negative.

In conclusion we can see that changes in VAT are additional to changes in consumer and producer surplus in the CBA. Of course, TAG already treats changes in VAT as additional (see equations (1) and (2)). The issue for the appraisal of a project, like Project 1, is that the TAG formulae need adjusting before application.

FIGURE 2-2: PROJECT 1- TRANSFER TOLL REVENUES FROM GOVERNMENT TO CROSSING PROVIDER AND LEVYING VAT

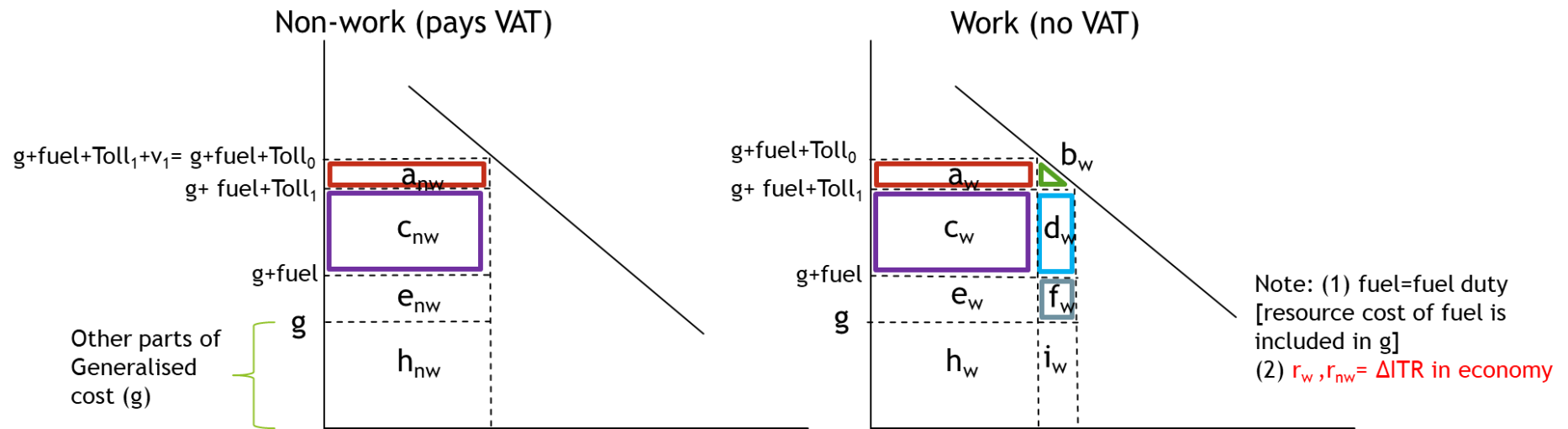


TABLE 2-1: PROJECT 1 - WILLINGNESS TO PAY ANALYSIS

	Non-work	Work	Notes (VAT terms in red in table)
Users (ΔCS)	Zero	$a_w + b_w$	
Taxpayers (ΔGS)	$+a_{nw} - (a_{nw} + c_{nw}) + r_{nw}$	$-a_w - c_w + f_w + r_w$	r =change in indirect tax revenue in rest of economy (+/-)
Crossing provider (ΔPS)	c_{nw}	$c_w + d_w$	Marginal cost (MC) of crossing provider is zero
Net Benefit	r_{nw}	$b_w + d_w + f_w + r_w$	NB $r_{nw} = 0$ in this case

FIGURE 2-3: PROJECT 2- PROJECT 1 AS DM THEN LOWERING GENERALISED COST OF CROSSING AS DS

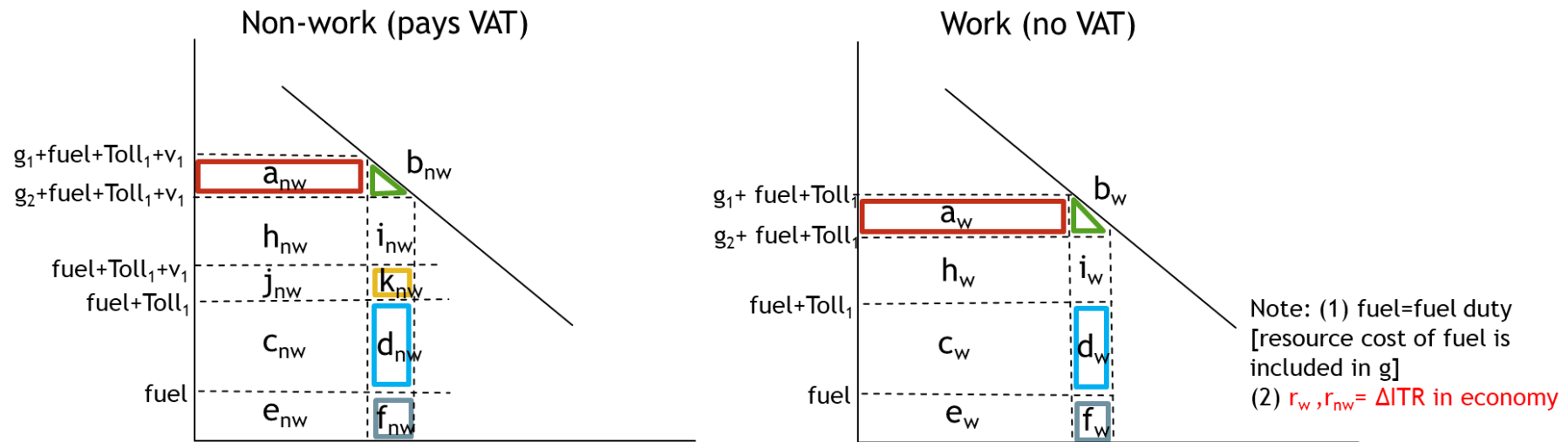


TABLE 2-2: PROJECT 2 - WILLINGNESS TO PAY ANALYSIS

	Non-work	Work	Notes (VAT terms in red in table)
Users (ΔCS)	$a_{nw} + b_{nw}$	$a_w + b_w$	Includes Δ time & Δ VOCs
Taxpayers (ΔGS)	$k_{nw} + f_{nw} + r_{nw}$	$f_w + r_w$	r =change in indirect tax revenue in rest of economy (+/-)
Crossing provider (ΔPS)	d_{nw}	d_w	Marginal cost (MC) of crossing provider is zero
Net Benefit	$a_{nw} + b_{nw} + d_{nw} + k_{nw} + f_{nw} + r_{nw}$	$a_w + b_w + d_w + f_w + r_w$	

FIGURE 2-4: PROJECT 3: PROJECT 2 AS DM AND THEN RAISING TOLL AS DS

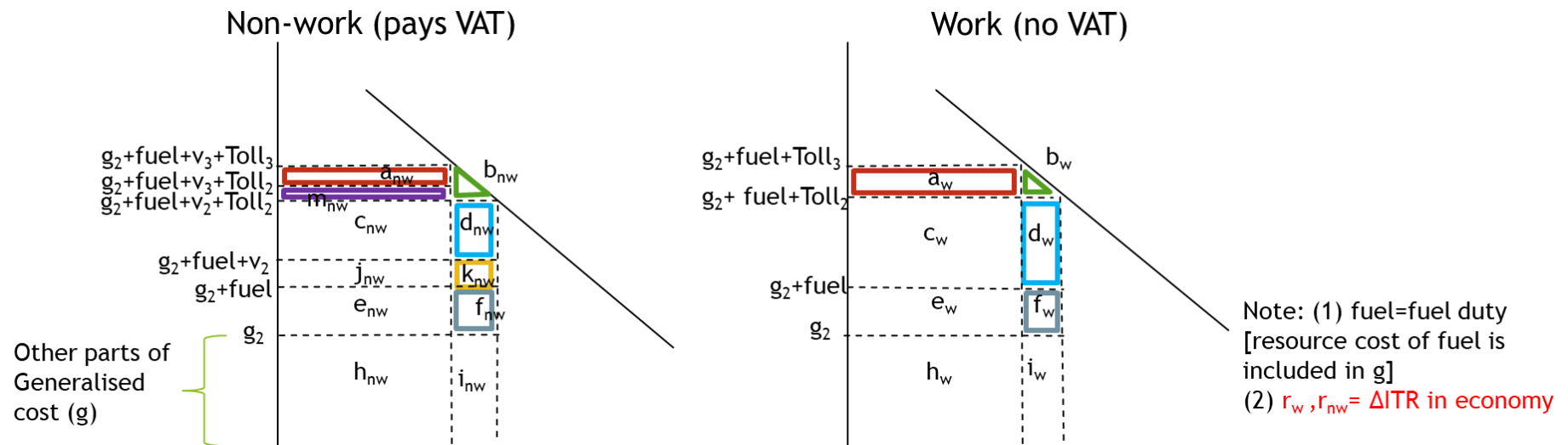


TABLE 2-3: PROJECT 3 - WILLINGNESS TO PAY ANALYSIS

	Non-work	Work	Notes (VAT terms in red in table)
Users (ΔCS)	$-a_{nw} - m_{nw} - b_{nw}$	$-a_w - b_w$	
Taxpayers (ΔGS)	$m_{nw} - k_{nw} - f_{nw} + r_{nw}$	$-f_w + r_w$	r =change in indirect tax revenue in rest of economy (+/-)
Crossing provider (ΔPS)	$a_{nw} - d_{nw}$	$a_w - d_w$	Marginal cost (MC) of crossing provider is zero
Net Benefit	$-b_{nw} - d_{nw} - k_{nw} - f_{nw} + r_{nw}$	$-b_w - d_w - f_w + r_w$	

2.3 Corporation Tax

2.3.1 TAG and corporation tax

TAG is silent on corporation tax. One interpretation of this is that it is treated as a transfer, but is not identified in the appraisal as it does not change net social surplus. Any distortions it creates through the shadow price of capital are handled elsewhere in the appraisal, e.g. via the discount rate. The analysis below demonstrates that this is an appropriate interpretation.

Corporation tax is levied on profits with rates of 19% and 25% in the UK depending on the level of profits. Investment allowances and other capital allowances are permitted, thus not all of profit is taxed.

2.3.2 Corporation tax and the Shadow Price of Capital

Corporation tax creates a deadweight loss in that it reduces the incentive to invest, leading to lower levels of productivity. It also distorts investment decisions, which are biased towards investments where investment allowances are permitted. It can also lead to other changes of behaviour by firms in terms of their structure and transferring profits overseas and decisions to fund investments through debt or equity. These distortions create a social cost.

A real example of this social cost is that the Office of Budget Responsibility (OBR) forecast that GDP would reduce by 0.2% to 0.3% in the long term when the main rate of corporation tax was raised from 19% to 25% in April 2023.⁸ Devereux et al. (2014) using discontinuities in the corporation tax regime at £10,000 and £300,000 as an identification strategy, find that the deadweight loss associated with corporation tax for very small businesses at the £10,000 profit mark to be large at 29% of revenues. For medium sized businesses with profits at the £300,000 mark the deadweight loss is much smaller at 6% of marginal tax revenues.

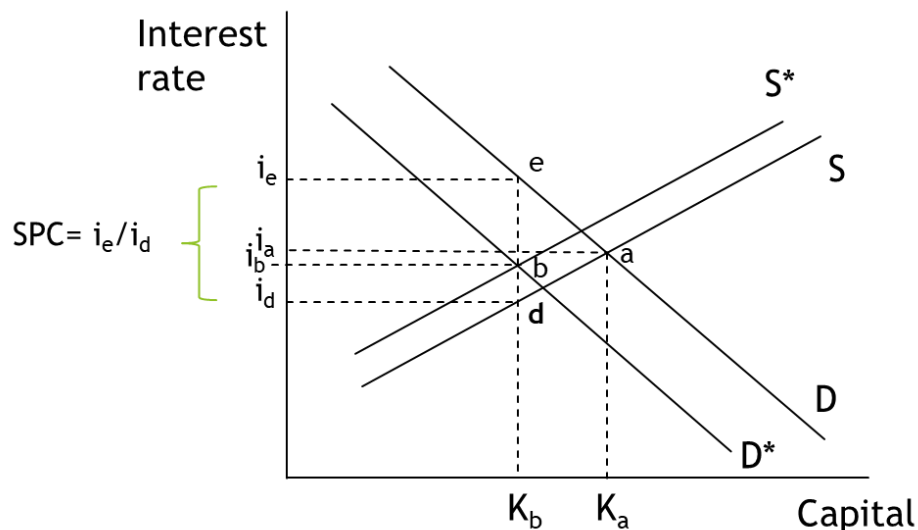
Corporation tax on company profits and income taxes on household savings drive a wedge between the rate of return on investment (ROI) and the consumption rate of interest (CRI) in capital markets. It is this wedge that creates the deadweight loss. This is illustrated in Figure 2-5. In an undistorted capital market the demand for capital is given by the demand curve D, and the supply of capital by the supply curve S. The demand curve gives the ROI,⁹ and the supply curve the CRI. In equilibrium at interest rate i_a , the ROI equals the CRI. In a capital market distorted by taxes, the demand curve is lowered to D^* by corporation tax and the supply curve raised to S^* by taxes on household savings income. At the new equilibrium point b, the interest rate is i_b and the amount of capital in the

⁸ <https://obr.uk/box/the-impact-of-corporation-tax-changes-on-business-investment/>

⁹ The ROI is viewed as a normal level of profit in economic terms. The firm is therefore just breaking even in economic terms when all opportunity costs have been included.

economy is K_b is lower than with an undistorted capital market. The ROI is i_e and the CRI is i_d . There is therefore a wedge between the two created by taxation.

FIGURE 2-5: DISTORTED CAPITAL MARKET (RISK FREE)



This gap between the ROI and CRI forms part of the debate regarding what the discount rate should be. These issues are discussed in CBA texts such as Boardman et al. (2018 pp245-256) and De Rus (2010 pp142-147).

The appropriate discount rate is determined by whether the government funded project displaces domestic consumption or private investment. If the government funded project displaces domestic consumption then the appropriate discount rate is the CRI (post-tax savings interest rate). This is i_d in Figure 2-5, and is lower than the pre-tax market return on investments i_b .¹⁰ If the government funded project entirely displaces investment then the appropriate discount rate is the ROI (so the pre-tax return on the investment). This is i_e in Figure 2-5, and is higher than the post-tax market return on investments i_b . This then leads to debates as to the source of government funds and the related discussion on the displacement of domestic consumption¹¹ and domestic private investment¹² or foreign investment.

¹⁰ These are risk free rates.

¹¹ Government raises taxes displacing consumption to fund the project

¹² Government raises debt (e.g. issues bonds) which are bought using household savings, which otherwise would have been used to fund private investment.

Using a Social Time Preference Rate (STPR) approach¹³, as in the UK to deriving the discount rate, the underlying presumption is that consumption is displaced by government spending on a project. If, however, some private investment is displaced by government expenditure the social cost of this displaced investment needs to be brought into the CBA by shadow pricing capital. The social cost of the displaced private investment is the value of the investment factored by the Shadow Price of Capital (SPC). As, the SPC is the ratio of ROI to CRI, then the SPC is greater than 1, with Boardman et al (*op cit*) estimating it at 2.2. Corporation tax and taxes on savings are the key driver to the SPC. Applying an SPC would imply, against the benchmark case of discounting capital costs at the CRI, the PVC of the project will increase and the NPV will decrease. The application of the SPC is however not straightforward, as it is necessary to identify the quantum of the return (on say government bonds) that is re-invested and the quantum that is consumed.¹⁴

The question then is whether applying an SPC to government funded capital costs is needed. The answer to this comes down to whether or not the government expenditure displaces private investment or not. Arguably this only occurs for deficit financed projects in a closed economy where the supply of savings and foreign funds is very unresponsive to the interest rate (Boardman et al., *op cit*). This is not typical of the majority of UK government funded transport projects, particular given the UK economy and capital markets are viewed as open. Spackman (2024 p232) also views that government spending displaces household consumption. Therefore discounting at the STPR, and ignoring the SPC, is appropriate in the UK.

2.3.3 Corporation tax in the transport sector

The previous section identified that the distorting effects of corporation tax on capital markets only need to be taken into account in public sector financed projects in certain circumstances, which are rather restrictive and generally not applicable to most transport project appraisals.

In this section I now consider whether corporation tax gives rise to surpluses in the transport market that are additional to the changes in consumer and producer surpluses. Such surpluses would be similar to those that are created by indirect taxation. Firstly, I consider a competitive transport sector, and secondly a transport sector with a degree of imperfect competition.

2.3.3.1 A competitive transport sector

Figure 2-6 illustrates a Do Minimum situation for a transport producing firm (e.g. an airport), facing a rising marginal cost (mc) curve. The producer surplus is the gap between the price received and the marginal cost curve. This is the area to the left of the supply curve but below the price paid. When there is a corporation tax this surplus is shared between the producer and the government. In

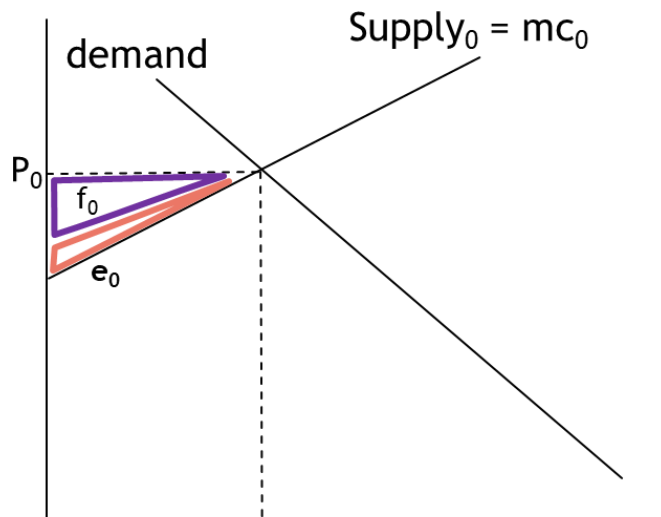
¹³ The STPR discount rate in the UK is estimated using the Ramsey formula. This combines risk components with preferences for consumption now or in the future (the CRI).

¹⁴ Boardman et al. (*op cit*) in their example assume that the interest received by savers from a government issued bond is spent on consumption, but that the repayment of the capital is re-invested.

Figure 2-6 it is assumed that there are no allowances that can be offset against corporation tax and the whole of the gap between price and marginal cost is subject to a 25% tax.

Relating Figure 2-6 back to the discussion in section 2.3.2, under competitive conditions with no scarcity rents and long run equilibrium the producer surplus is normal profits. Economic profits after all opportunity costs are accounted for are therefore zero. Corporation tax is a cost to the firm.

FIGURE 2-6: CORPORATION TAX IN A TRANSPORT PRODUCING FIRM



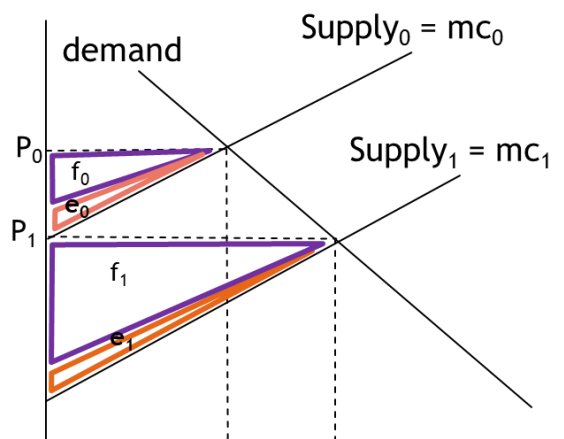
Note:

$f = \text{profit net of tax } (=75\% \cdot (P - mc))$

$e = \text{corporation tax } (=25\% \cdot (P - mc))$

As discussed, corporation tax creates a disincentive to invest leading to too little capital in the economy and productivity being too low. A policy that increases productivity at all levels of output would lower the marginal cost curve. Thus, in the absence of a corporation tax the marginal cost curve of the transport producing firm would be expected to be lower. With prices lowering and output expanding the benefits of this policy would be captured through the associated changes in consumer and producer surplus (and government surplus), other than an impact via the SPC discussed in the previous section. This is illustrated in Figure 2-7 for a hypothetical project that lowered the rate of corporation tax from 25% to 10%.

FIGURE 2-7: A LOWERING OF CORPORATION TAX



Note:

f =profit net of tax ($f_0=75\%$; $f_1=90\%*(P-mc)$)

e =corporation tax ($e_0=25\%$; $e_1=10%*(P-mc)$)

As can be seen by comparing Figure 2-6 and Figure 2-1, unlike VAT, corporation tax does not create a gap between the price faced by transport users and marginal cost. There is therefore no non-resource term as there is with VAT. Corporation tax is a transfer. It changes the beneficiaries – with some of the change in producer surplus being transferred to government – but does not change the net total surplus of the policy.

2.3.3.2 Imperfect competition in the transport sector

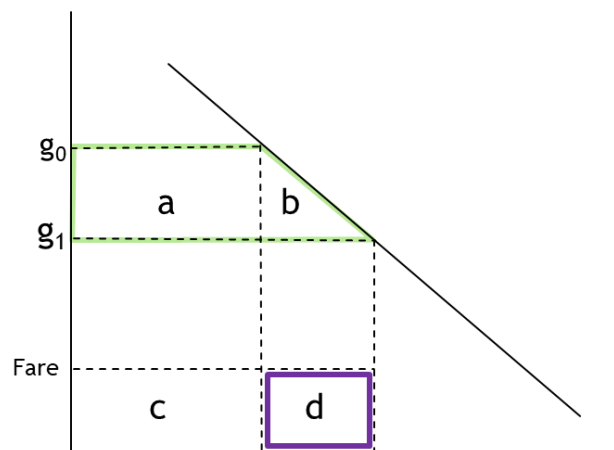
As mentioned in the introduction it is common in transport appraisals to assume that the transport market has a degree of imperfect competition. Thus for example public transport prices would be held fixed following a reduction in public transport journey times. Excess profits might then be made in the transport sector. Thus is viewed as a tolerable simplification in most instances.

This is illustrated in Figure 2-8, where surplus d is the additional revenue received, but is treated as the increase in producer surplus in the appraisal (marginal cost is zero). In reality any increase in producer surplus by the bus company would be subject to corporation tax and shared with the government. This is illustrated in Figure 2-9 where surplus d has been split between a surplus e which is transferred to government as corporation tax, and surplus f which is retained as profit by the bus company.

In this instance corporation tax is acting as wedge between the marginal cost of operating the bus service at resource cost and the price faced by the user. This is the same situation as with VAT. However, corporation tax receipts are transferred from the transport producing firm (the bus company) out of their gross surplus. That is they are not additional to the change in producer surplus gross of corporation tax, instead they are part of it (surplus d in Figure 2-8).

Thus including corporation tax in the appraisal would more clearly identify the beneficiaries, but would not change the net social benefit of the project.

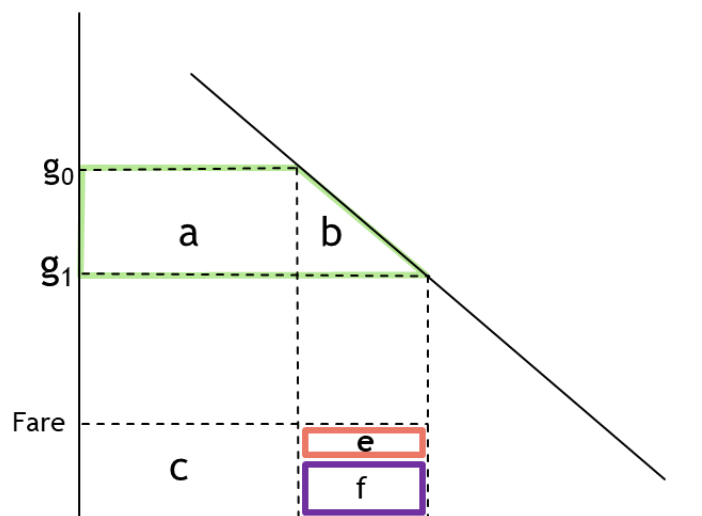
FIGURE 2-8: A BUS IMPROVEMENT



For simplicity assume:

- zero indirect taxation in economy (i.e. $t = 0$)
- Zero marginal cost of new bus users (i.e. $mc = 0$)

FIGURE 2-9: A BUS IMPROVEMENT WITH CORPORATION TAX



For simplicity assume:

- zero indirect taxation in economy (i.e. $t = 0$)
- Zero marginal cost of new bus users (i.e. $mc = 0$)

2.3.3.3 Corporation tax and distributional impacts in the cost benefit analysis

The previous discussion has argued that corporation tax impacts in the transport market are not additional in the way that VAT and other indirect tax revenues are. However, an argument for their inclusion may exist if there is a need to more closely examine who the beneficiaries are –

government versus the private sector. This might be particularly relevant if the denominator in the benefit cost ratio (equation 2) was adjusted to include all changes in government surplus. Two remarks on this are necessary.

The first is that such a course of action would require detailed financial modelling taking into account the ability of companies to offset investment against corporation tax.¹⁵ The Green Book affirms this as it asks that tax estimates reflect the “effective tax rate based on tax actually paid rather than a theoretical maximum” (HM Treasury, 2026 p78).

The second, as outlined in the introduction, is that this analysis pushes up against the manner that in most appraisals the focus is on the transport sector. Outside the transport sector prices are taken to adjust with prices equalling marginal cost, other than for indirect taxation and certain wider impacts.¹⁶ The consequences of reduced expenditure in the wider economy (due to more expenditure in the transport market) is taken to have no net social value (see for example Boardman et al. (2018 Chapter 5) for an exposition). This is viewed as a proportionate simplification.

However, this reduction in expenditure in the wider economy whilst having no net social value in the CBA, does impact on government revenue (i.e. corporation tax receipts). This would point towards its inclusion in a distributional analysis for the CBA and in a financial analysis.¹⁷ That said given corporation tax rates are comparable between the transport sector and the wider economy then it might be expected that there will be equal offsetting changes in corporation tax between the transport sector and the wider economy from changes in expenditure in the transport sector. Having said that, given there appear to be systematic differences between firms in their abilities to minimise tax liabilities,¹⁵ accurately modelling changes in corporation tax from changes in transport expenditure may prove challenging. This differs from indirect taxation.

2.3.3.4 Application to a tolled road crossing

In Figure 2-10 and Table 2-4 this analysis is extended to the Project 1 example where operation of a tolled road crossing is transferred to the private sector who has to levy VAT on the toll.

As can be seen corporation tax on the gross of tax producers surplus enters the calculation of the net of tax change in producers surplus and the change in government surplus. However, as these are

¹⁵ Bilicka (2019) in her paper in *American Economic Review* finds that foreign multinationals pay less tax than comparable domestic firms.

¹⁶ The specific wider impacts are: agglomeration, imperfect competition when expanding output, labour supply and move to more or less productive jobs.

¹⁷ Corporation tax should not affect the NPV of a social CBA. If corporation tax receipts are included, the corresponding reduction in producer surplus must also be included, whether the tax effect arises within or outside the transport market. Corporation tax is a transfer, so its inclusion should not change net social benefit.

transfers there is no net change in benefit (see second last row in Table 2-4 which refers to a British owned road crossing company).

2.4 GB centric cost benefit analysis

A CBA that is GB focused would zero benefits to non-British entities. Thus if the company that operated or owned the tolled crossing then any profits that are repatriated would be given a value of zero in the CBA table.

This is illustrated in Figure 2-10 and the last row of Table 2-4. Here we can see that the net benefit compared to a British firm is reduced by the net of tax profits repatriated by the foreign owned firm. These are surpluses $c_{nw(\text{net of tax})}$, $c_{w(\text{net of tax})}$ and $d_{w(\text{net of tax})}$.

What is left in the net social benefit calculation of the original change in producer surplus (vis a vis the no corporation tax case in Figure 2-2) is the component of the change in gross of tax producer surplus that remains in GB (which is the corporation tax paid). Corporation tax would therefore feature in a transport appraisal where the transport producing firm is foreign owned and repatriates its profits. However, it features not because it is additional to a 'standard' TAG analysis, but because the corporation tax receipts are all that is left of the change in producer surplus.

2.5 The marginal cost of public funds

Indirect taxation and corporation taxes along with many other taxes levied by government create deadweight losses. Thus the social cost of government expenditure exceeds the nominal value of that expenditure. The ratio between the two is known as the marginal cost of public funds. A transport project that creates additional taxation revenue, can therefore reduce the level of government expenditure. This has a social benefit greater than the nominal reduction in expenditure. This is well recognised in the cost benefit analysis literature, but the Green Book does not permit the use of an MCPF at sector appraisal level (HM Treasury, 2026 p38).

FIGURE 2-10: PROJECT 1- TRANSFER TOLL REVENUES FROM GOVERNMENT TO CROSSING PROVIDER AND LEVYING VAT AND CORPORATION TAX

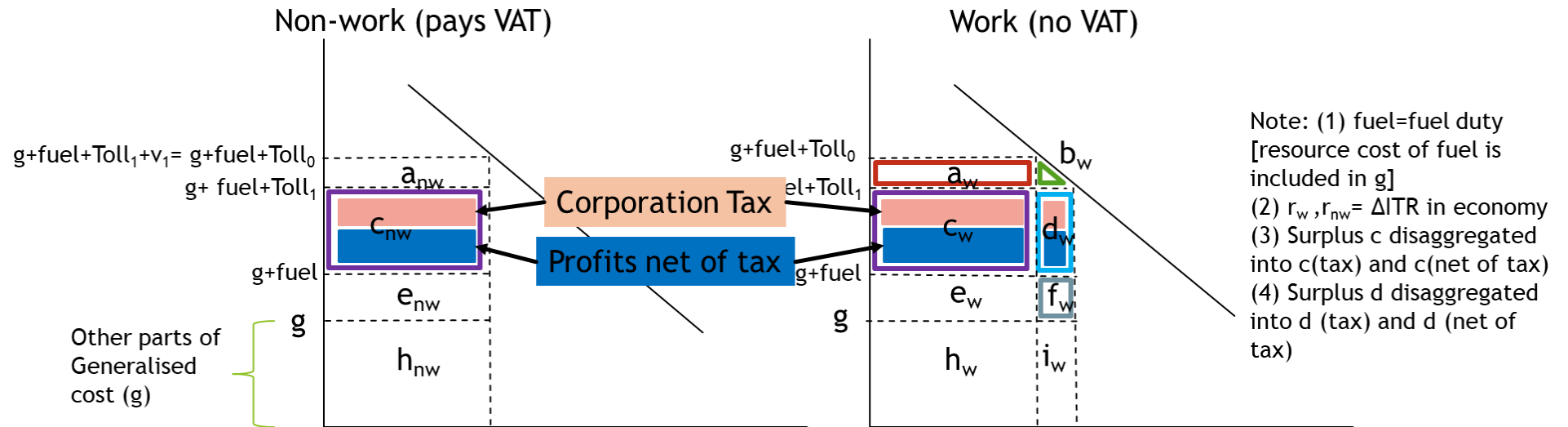


TABLE 2-4: PROJECT 1 - WILLINGNESS TO PAY ANALYSIS ALSO IDENTIFYING CORPORATION TAX

	Non-work	Work	Notes
Users (ΔCS)	Zero	$a_w + b_w$	
Taxpayers (ΔGS)	$-(a_{nw} + c_{nw}) + a_{nw} + c_{nw}(\text{tax}) + r_{nw}$	$-(a_w + c_w) + c_w(\text{tax}) + d_{nw}(\text{net of tax}) + f_w + r_w$	
Crossing provider (ΔPS)	$c_{nw}(\text{net of tax})$	$c_w(\text{net of tax}) + d_w(\text{net of tax})$	Marginal cost (MC) of crossing provider is zero
Net Benefit to GB citizens (if crossing provider is British)	r_{nw}	$b_w + d_w + f_w + r_w$	
Net Benefit to GB citizens (if crossing provider is foreign)	$r_{nw} - c_{nw}(\text{net of tax})$	$b_w + d_w + f_w + r_w - c_{nw}(\text{net of tax}) - d_w(\text{net of tax})$	Terms in red are surpluses lost to GB citizens vis a vis the all British case

3 Wider impacts

3.1 Introduction

In this chapter we broaden the sphere of interest from just the transport market to include impacts in some secondary markets that are distorted. TAG refers to market failures associated with monopolistic competition, agglomeration externalities, income tax, and distortions in the land market. For the first three of those four TAG offers methods and parameters for the calculation of wider impacts that will result. For the land market a land value uplift approach is adopted for certain types of development.

TAG does not discuss VAT or corporation tax in the context of wider impacts. There is a mention in TAG Unit A2-1 of foreign direct investment (FDI). The potential of VAT and corporation tax for generating wider impacts is now considered. FDI is addressed in Chapter 5 on Foreign Direct Investment.

3.2 VAT

VAT drives a wedge between the resource cost of producing a final good for household consumption and the price. This has been discussed earlier in the context of impacts within the transport market. It also leads to the MPA. What is of interest in this section is the impact on net social benefits outside the transport sector, in secondary markets, if final goods are subject to VAT.

In the first instance if we consider a scenario in which a transport project affects a single final good (e.g. whisky). Haulage costs along a route only used by the whisky industry are reduced by a public investment in a road for example. This good is subject to an indirect tax (IT). This is the scenario illustrated in Figure 3-1. The indirect tax creates a wedge between the price faced by consumers of whisky and the marginal cost of producing and distributing it. The market is distorted.

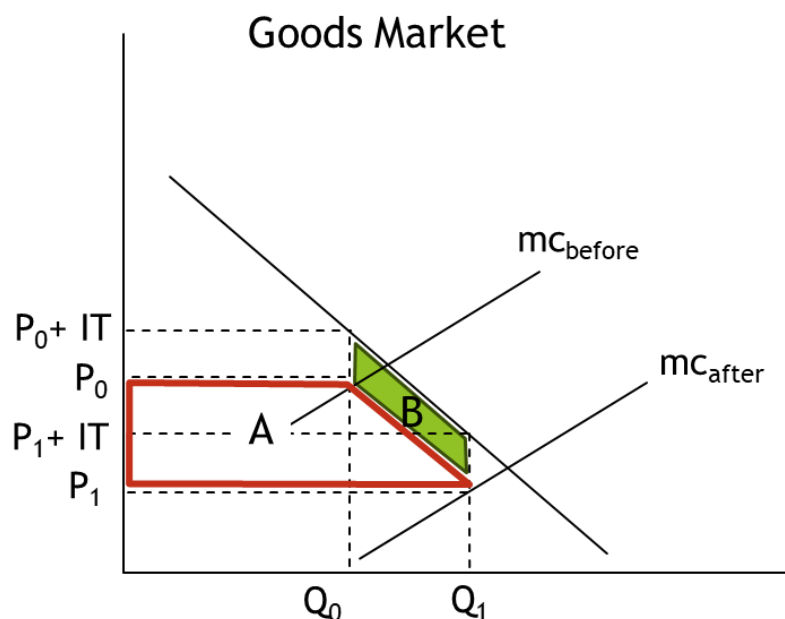
The transport project creates a change in consumer surplus in the transport market for the whisky haulage industry. This double counts Area A in Figure 3-1. There is however an additional surplus Area B which the primary market analysis has not included. This is the additional indirect tax revenue from a marginal expansion in output in the distorted final goods market. It is analogous to both wider impacts associated with imperfect competition and labour supply. For inclusion in the CBA, as with other tax related aspects that feature in the CBA, the tax revenue received by the government needs to be uprated by the MPA.

This is potentially challenging to parameterise as whilst we know that on average the gap between P_0 and P_0+IT is 19% (from the MPA factor in TAG), and DfT already uses an estimate for the elasticity of demand for goods (in the imperfect competition wider impact calculation), we do not know what the average price of final goods are. This of course could be derived from ONS data. Further research is therefore needed to parameterise this wider impact.

The WI associated with indirect taxation does not double count either the MPA or the indirect tax non-resource welfare term. This is for reasons as follows.

- **The MPA.** In Sugden's model in which he formally derives the MPA, he takes the supply of factors to be fixed (Sugden, 2002 p8). In this model indirect taxation is non-distortionary. Thus Sugden did not consider the distortionary effects of taxation, and such effects are additional to his analysis.
- **Indirect tax non-resource welfare term.** As discussed in section 2.2 the indirect tax non-resource welfare term captures the welfare effects of switching expenditure between the transport sector and the rest of the economy, but with no change in net national output. This wider impact analysis concerns an increase in output in secondary markets at the national level arising from a transport related productivity shock. The source of the additional surpluses are the same, the distortionary effect of indirect taxation, but they are different impacts.

FIGURE 3-1: INDIRECT TAX AND THE GOODS MARKET



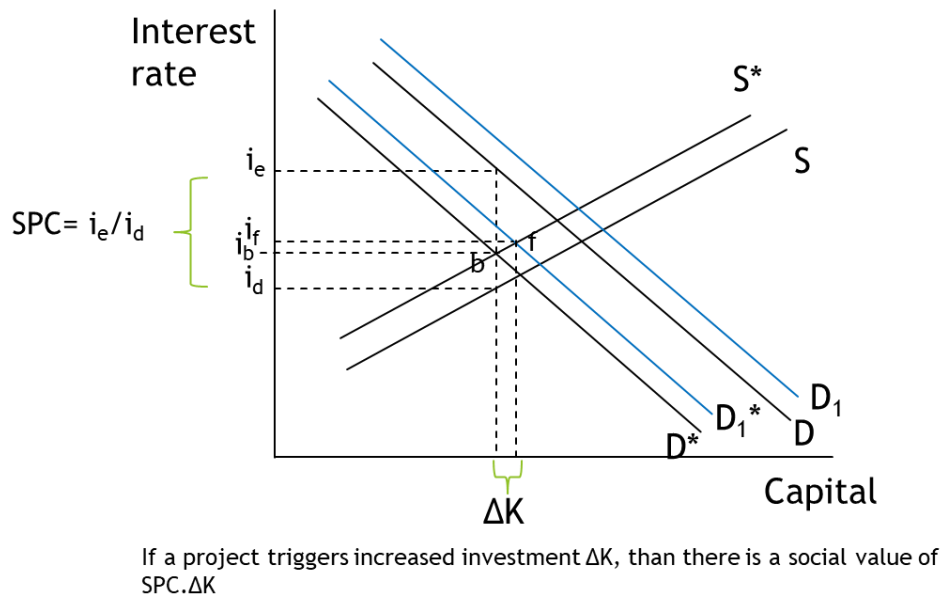
3.3 Corporation Tax

3.3.1 Wider Impact of corporation tax in the capital market

If a transport project triggers net additional investment at the national level then a wider impact will occur. This is illustrated in Figure 3-2, where the project raises the ROI for given levels of capital in the economy, shifting the pre- and post-tax demand curves outwards to D_1 and D_1^* . At the new equilibrium position, f , the interest rate is higher at i_f , and the amount of capital in the economy has increased by ΔK . In addition to user benefits, there is therefore an additional surplus equal to the

SPC. ΔK . To bring this into an appraisal there would be the need to both model the quantum of additional investment, but also the identify the SPC.

FIGURE 3-2: WIDER IMPACT IN THE CAPITAL MARKET, WHEN A TRANSPORT PROJECT TRIGGERS INCREASED CAPITAL INVESTMENT



3.3.2 Wider Impacts of corporation tax in the goods market

As discussed in Section 2.3 in the context of a transport producing firm, there is no distortion of transport prices arising from corporation tax. Thus there is no additional benefit to user benefits in the transport market. This is in contrast to indirect taxation. The same analysis and logic can be applied to the wider economy. Figure 2-6 would apply equally to a firm in the wider economy as it does to a transport producing firm.

In contrast to indirect taxation there is no wider impact due to corporation tax arising in the goods market. Any wider impact associated with corporation tax will arise in the capital market, where the distortion occurs.

4 Private Finance, social cost benefit analysis and value for money assessment

4.1 Social cost benefit analysis

When considering finance options typically the choice is between some form of private finance (PF) option and a government funded option – referred to as the public sector comparator (PSC). Under both options finance charges, interest and debt repayments are incurred. The government issues gilts, pays interest on those gilts and repays the debt. With a PF option, the concessionaire will borrow money and commercial interest rates and repay the debt.

However, these financing arrangements – unless they themselves incur resource costs¹⁸ – are not relevant to a social CBA. A CBA is focused on allocative efficiency. The focus is on the use of resources, the cost of doing so and the benefits that arise from that. Thus what is of primary relevance is what resources (e.g. labour and materials) are used to create the project and when those occur. Interest payments and when debt repayments are made are not relevant to the social CBA. They are transfers. They are of course relevant to a value for money assessment that the government may undertake and/or the financial appraisal – if the latter differs from the value for money assessment for some reason.

When comparing a PF option with a PSC therefore construction costs and operating costs from both financing options should be converted to market prices by removing indirect taxes (including VAT and excise duties) and uprating by the MPA (Sugden, 2005, Laird and Mackie, 2017). They then enter the CBA and the discounting process at the point in time that resources (labour/capital) are utilised, not when government (or the firm) experiences a financial cost (pays for them).

Private finance affects the CBA, not via the financing arrangements, but in how it can impact on resource costs. The involvement of the private sector can drive down capital and operating costs (i.e. whole life costs) via transferring risk to parties better able to manage it, and through delivery efficiencies which can make the project come available earlier.

As we are concerned with the use of resources and the benefits that arise from them, and we are appraising from the perspective of society then the social discount rate should be used (which in the

¹⁸ Resource costs might include undertaking due diligence, accounting and reporting. Usually differences in resource costs between finance options are not estimated when comparing the private finance option with the public sector comparator.

UK is the STPR) for both finance options. Thus, differences in corporation tax receipts between finance options do not affect the discount rate.

4.2 Value for money assessment

A key difference between a social CBA and a value for money assessment from the perspective of government (or the taxpayer) is that in the value for money assessment the cost is government expenditure, rather than pure resource costs. In such an assessment the unitary charges paid by government in the PF option would be used as and when they occur. This is instead of using the resource costs of labour, materials, etc. at the point in time when those resources are used.

Related to this is that in the PF option the project cost charged by the private sector firm is a certainty equivalent plus interest. Therefore, risk and the cost of borrowing is built into the unitary charges. The sum of these costs are therefore higher than expected resource costs that would be used in a social CBA.¹⁹

Several different approaches have been proposed in the literature, each with their own justification. The debate centres around the treatment of project specific risk, firm level risk, the ROI as well as the societal perspective.

In what has become known as the 'Spackman Approach' all costs (including financing costs as calculated based on a weighted average cost of capital (WACC) and benefits are discounted at the STPR (Joint Regulators Group (JRG), 2011, Spackman, 2024 p234). This is benchmark position advocated in the 2026 Green Book Annex A.

In contrast Boardman and Hellowell (2017 p3) consider that given this is a value for money assessment to government, standard capital budgeting theory would point towards the risk free rate in the capital markets for discounting for both the PF and PSC options.²⁰ In the UK context this would be the real gilt rate. This is the sensitivity test advocated in the 2026 Green Book Annex A.

In their recent Green Book discount rate review Freeman and Groom (2026) (F&G) argue for an alternative approach. They consider that the PF contract is risky for the government. This is because it constitutes a fixed outlay (the unitary charge), for an uncertain return. The return being

¹⁹ Certainty equivalent project costs are not used in the social CBA as it is presumed that the government investment portfolio is diverse, the project is small relative to the whole portfolio and risk is diversified across many taxpayers and even generations.

²⁰ Boardman and Hellowell (2017) argue that if a risk adjusted discount rate were to be used in a CBA, then the risk free rate should be adjusted upwards if net social returns of the financing option are correlated with growth in aggregate consumption, and downwards if they are correlated with a reduction in aggregate consumption. They consider that financing options are unlikely to change the relationship between the project and aggregate consumption and therefore the same risk adjusted discount rate should be used for all financing options.

the benefits being derived by society (e.g. time savings). In principle they consider that a higher risk adjusted discount rate should therefore be applied. The implication is that it is higher than the gilt rate, which is based on debt rather than equity. However, they leave it to HMT to determine whether determining such a rate can be done in a “practical, proportionate and evidence based manner” (p12 of F&G Summary).

F&G go on to suggest that “under current market conditions, if the social discount rate and the WACC are set appropriately for the risk each party bears, that the distinction between the STPR and the gilt rate will largely disappear” (p167 F&G Technical Annexes). That is the distinction between the ‘Spackman Approach’ or the ‘Boardman and Hellowell approach’ will diminish. It is then questionable in their view as to whether the sensitivity test proposed in the Green Book will have any material value. The choice set proposed by F&G for PF option discounting is therefore to continue with the Spackman approach, or if proportionate to determine higher project specific risky discount rates.

In none of the positions advocated in the literature do corporation tax receipts affect the discount rate. However, corporation tax receipts are relevant to the value for money assessment of the PSC against the PF options. This is to ensure that the options are compared like-for-like. The 2026 Green Book advocates adjusting the PSC option for such tax distortions (Annex A p78), rather than netting off tax receipts from the unitary charges in the PF option. Either approach is appropriate, but as the Green Book states it is important to use estimates of the actual taxes to be paid and not theoretical maximums. This is relevant as there is an empirical literature,²¹ as well as anecdotal evidence,²² that large multinational corporations and PF shell companies pay less tax than like-for-like domestic firms.

4.3 Financial appraisal

A financial appraisal differs again, as it would only consider financial transactions. These would include the unitary charges paid to PF operator, taxes received, etc. Non-market benefits such as travel time savings, etc. would be excluded from the analysis.

²¹ See Bilicka (2019) paper in *American Economic Review* comparing tax returns from foreign multinationals with comparable domestic firms.

²² See the 2017 BBC News article identifying that the five largest foreign PF shell firms involved in the UK pay little or zero tax. <https://www.bbc.co.uk/news/business-41778609>

5 Foreign Direct Investment and Cost Benefit Analysis

5.1 Introduction

Foreign direct investment (FDI) is viewed positively as it leads to additional capital in the UK economy. These investments are often associated with jobs, may create exports, knowledge spillovers to domestic firms and agglomeration. However, in a resource constrained economy FDI may increase demand leading to wage and price inflation which can crowd out some of the growth. The inflow of foreign capital may also increase the exchange rate crowding out some exports. Thus some of the growth linked to the FDI may be tempered. Another aspect of FDI is that the foreign investors will be expecting a return, and some profits will be repatriated.

These different facets of FDI impact on the CBA in different ways. We consider them from two perspectives: (i) as an injection of capital into the economy and how the benefits of that are captured; and (ii) as a source of a wider economic impact.

5.2 Increased capital in an economy and the CBA

An increase in capital in an economy is not classically thought of as a benefit per se. An investment would be expected to be matched by outflows of rents. Thus, there is no net gain from the capital per se. The benefit of FDI is what it does for the economy and society. In the CBA this is captured through the usual manner of changes in consumer surplus, producer surplus and government surplus. Three remarks are necessary.

Firstly, where the increased activity related to the FDI interacts with market failures (e.g. labour taxes and agglomeration) then as with other transport projects there would be wider impacts.

Secondly, if the project is large vis a vis the regional economy and leads to wage and price inflation and for FDI in particular a crowding out of exports and a crowding in of imports, then a general equilibrium modelling approach might need to be adopted to ensure the crowding out effects are captured in the CBA. This could for example use an S-CGE model. Such crowding out/in effects would not only include the impact on exports and imports, but also in the manner that an economy under full employment would re-structure towards the FDI industry, crowding out existing UK businesses. Such an approach could also capture any second-round impacts on the level of capital formation in the economy that the project may trigger.

Thirdly, the use of foreign capital, rather than domestic capital may affect the SPC for a government funded project.²³ As discussed in Section 2.3 the SPC is not likely relevant to the UK context.

²³ If a country borrows money from overseas investors it would borrow at the world interest rate. This is the equilibrium opportunity cost of capital and the SPC = 1.

Finally, in a GB centric appraisal any profits made by the foreign owned firm that are repatriated, would need to be netted off the change in producers surplus. The concept of this was discussed in Section 2.3, as the corporation tax element of the change in producer surplus would remain in a GB centric CBA.

5.3 Wider impacts

FDI is often associated with knowledge spillovers. These knowledge spillovers would be associated with technology transfer or transfer of new management or organisational approaches. The productivity gains from these transfers would be additional to the user benefits in a transport CBA.

This was first discussed in context of transport CBA by SACTRA (Standing Advisory Committee on Trunk Road Assessment (SACTRA), 1999). Follow on work by NERA failed to identify anything tangible that could be used in transport CBAs linking transport projects with FDI and then to knowledge spillovers (NERA, 2010). Arguably this finding arises due to difficulties in identifying the impact of FDI. To a limited extent some of these difficulties are being overcome in recent empirical research, certainly in terms of linking FDI flows to changes in air accessibility (albeit not UK specific).²⁴ The lack of empirical data in this regard, means that to date FDI features in the transport project appraisal in a qualitative manner.

Typically, any knowledge spillover discussions related to transport projects, are associated with how a transport project triggers FDI in manufacturing or service industries. These industries then create spillovers to domestic manufacturing or service industries. In the context of our tolled crossing project (Project 2), it is hard to see the relevance of these knowledge spillover arguments. If there are knowledge spillovers they will be in the design and construction of road crossing infrastructure.

²⁴ For example, Fageda (2017) the availability and frequency of nonstop flights between Barcelona and a destination country significantly increases bilateral FDI flows with a 1% increase in air frequencies leads to between a 0.15–0.46% increase in FDI flows. Campante and Yanagizawa-Drott (2018) find that a 10% increase in network centrality, i.e. the position of the airport in the network, leads to a 10% increase in FDI flows, whilst Tanaka (2019) finds that an increase of one flight a day raises the likelihood of new FDI in high face to face contact sectors by 0.032 percentage points.

6 The Department's Questions

6.1 Summary of key findings

This thinkpiece has considered the role of indirect taxation and corporation tax in a transport CBA. These taxes simultaneously influence several facets of the CBA, including the unit of account, welfare impacts within the transport sector, welfare impacts outside the transport sector, capital markets and the discount rate, and they also raise issues regarding the treatment of foreign-owned firms in a GB-centric appraisal. The welfare impacts of these taxes are brought together and summarised in Table 6-1. This table then acts as a basis for answering the Department's four questions.

TABLE 6-1: SUMMARY OF KEY FINDINGS FOR DOMESTIC AND FOREIGN-OWNED PRODUCERS OF TRANSPORT SERVICES

	Domestic Producer of Transport Services	Foreign-owned producer of transport services
Indirect Tax impacts in the transport CBA	The different rates of taxation between different parts of the transport sector and the rest of the economy result in welfare impacts that do not net out as transfers.	As per the domestic producer.
	The TAG/TUBA formulae for indirect taxation cannot evaluate changes in indirect taxation rates (e.g. zero VAT on tolls to VAT @ 20% on tolls). The formulae need to be amended for the appraisal.	As per the domestic producer.
Corporation Tax in the transport CBA	Corporation Tax is a transfer of part of the producer surplus from the firm to the UK government.	As per the domestic producer.
	Corporation tax has no net impact on welfare. This follows from the tax being a transfer.	In the absence of corporation tax the change in producer surplus would be excluded from a GB-centric appraisal, as this would be repatriated by the foreign firm. With corporation tax a part of the change in producer surplus stays in the UK, and would feature in a GB-centric appraisal.
	Corporation tax has a distributional effect, as it shares the producers gain between government and the firm.	As per the domestic producer.

		Domestic Producer of Transport Services	Foreign-owned producer of transport services
Increased capital in economy		The project benefits from the increased capital in the economy arise from ΔCS and ΔPS plus interactions with market failures (e.g. agglomeration).	As per the domestic producer.
		If the project is large vis a vis the regional or national economy crowding out effects due to resource constraints, including full employment, may occur.	As per the domestic producer, but additionally an inflow of foreign capital may lead to an appreciation of the exchange rate and a crowding out of exports and crowding in of imports.
Wider impacts in a transport CBA	Mkt failure: Indirect tax	An increase in output in final goods will generate a wider impact, due to the distortion in the final goods market created by indirect taxation.	As per the domestic producer.
	Mkt failure: Corporation tax	An increase in private investment leading to a change in capital stock (ΔK) in the UK would lead to a wider impact arising from a distortion in the capital market due to corporation tax (and savings taxes). The capital associated with the project would not form part of the wider impact (see increased capital in economy above). These are induced investment impacts.	As per the domestic producer.
	Mkt failures associated with FDI	n/a	FDI can give rise to knowledge spillovers associated with technology transfer, or new management or organisational approaches. These are usually associated with advanced manufacturing or service industries, rather than for transport service providers.
Discount rates		A social CBA should use the STPR discount rate, if government taxation displaces consumption. Several approaches exist for determining the discount rate to be used in comparing value for money assessments between financing options. These are the STPR rate or higher. Corporation and indirect taxes feature in the financing option value for money assessment insofar as tax receipts are used as adjustments to costs or benefits to ensure a like-for-like comparison between options. Corporation tax and indirect tax do not affect the discount rate.	As per the domestic producer.

6.2 The benchmark case

The Department's questions are posed around the 'additionality' of taxation revenues within the CBA. When discussing 'additionality', there is a need to be mindful of the base against which one claims additionality. In this sense the base taken is the TAG position with respect to taxation. This was summarised in the introduction and is reproduced here:

- i. A Market Price Adjustment (MPA) factor is used to convert prices faced by households and businesses into a common price base.
- ii. A non-resource term is used to capture the social surplus associated with the divergence between prices and resource costs in the transport market and the wider economy from a change in expenditure in the transport market. This relates to the treatment of VAT and excise duties.
- iii. Corporation tax within the transport sector (bus, air, train and private road infrastructure companies) is treated as a transfer. Importantly, compared to VAT, this transfer is not identified in the CBA as a distributional impact.
- iv. The discount rate is a Social Time Preference Rate (STPR). There is no explicit adjustment in the CBA through the discount rate or via the Shadow Price of Capital (SPC) for the distorting effects of corporation tax or taxes on savings.
- v. The marginal cost of public funds (MCPF) is ignored, or effectively treated as 1.
- vi. Wider impacts (WI):
 - a. The distorting effects of income tax in the labour market is included in the WI analysis. No other taxes are explicitly considered in the WI analysis.
 - b. No attempt is made to separate imperfect competition or agglomeration WI surpluses into government, firm and household surpluses. For example corporation tax will be paid on additional profits, but this is not identified.

I now turn to answering the Department's questions against this benchmark position.

6.3 Answering the Department's questions

1. **Does the transfer of an existing revenue stream (e.g. road tolls) from public hands (with no tax liable) to private hands (where tax is liable) lead to economic additionality? Note, both corporation tax and VAT are relevant here, as a private provider could both be required to charge VAT on tolls, and pay corporation tax on its profits.**

This question relates to a project comparable to the example Project 1 road tolling project. Taking the different impacts in turn:

Firstly, the **changes in indirect taxation** should be calculated and included in the CBA. These are not additional to a standard TAG CBA, as TAG already includes them. The TAG formulae for changes in

indirect taxation, however, need to be generalised to allow the rate of indirect taxation to vary between the Do Minimum and Do Something. The general formulae are set out in Appendix A.

Secondly, the **changes in corporation tax** within the transport sector and outside the transport sector represent a transfer.²⁵ They are not additional to a standard TAG CBA. They may be of interest in a distributional analysis, or an analysis where the impact on government finances were relevant (e.g. if the denominator of the BCR was widened to include corporation tax).²⁶ The distributional aspects also vary by whether the

- **Domestic transport producing firm.** If a toll revenue stream is handed over from government to the private sector with the toll held fixed but now including VAT (the Project 1 example), then for:
 - **Non-work traffic** there will be an increase in corporation tax receipts associated with the toll payment, but with the toll held fixed there is no change in household expenditure in the wider economy. There is therefore no offsetting loss of corporation tax in the wider economy. However, as corporation tax is a transfer, there is no change in welfare from this gain in corporation tax receipts.
 - **Business traffic** experiences a toll reduction and there will be an expansion in demand. Corporation tax will be paid on the toll revenues, and there will also be an impact on corporation tax receipts in the wider economy due to these changes in demand. As corporation tax is a transfer, there is no change in welfare from these changes in corporation tax receipts. They are only relevant in a distributional sense.
- **Foreign-owned transport producing firm.** This is as with a domestic firm with respect to the changes in corporation tax receipts and welfare, with the addition that If the private firm is foreign owned, then in a GB-centric CBA the component of the change in producer surplus that is repatriated is excluded from the CBA. Corporation tax would therefore feature in the CBA as the residual of the change in producer surplus. However, it features not because it is additional to a 'standard' TAG analysis, but because the corporation tax receipts are all that is left of the change in producer surplus. A GB-centric appraisal should also exclude benefits that accrue to foreign businesses and citizens (e.g. if the infrastructure catered for a significant volume of international destined traffic).

Thirdly, the increase in output associated with the generated business and freight traffic will create a **wider impact** associated with distortions in the product market created by indirect taxation. This is additional to the WIs already included in a standard TAG CBA. Additionally, if the transport project

²⁵ A transfer is a transaction that changes who receives resources, but does not change the total amount of resources available to society.

²⁶ As corporation tax is a transfer, including it in the CBA – for example, to identify distributional effects – requires an equal and offsetting reduction in producer surplus. There should be no change in the net social benefit when including corporation tax receipts in a social CBA.

triggers an increase in capital investment then a wider impact associated with corporation tax (and taxes on savings income) will occur. This is also additional to a standard TAG CBA.

2. Sticking with this example, but where the price (e.g. toll rate) is increased by the private operator compared to the public ownership case (i.e. the PSC), is the tax take on the additional revenue economically additional (again, considering both VAT and corporation tax)?

This question relates to a project comparable to the example Project 3 road tolling project – where tolls are raised. The answers are the same as for Question 1, namely:

- **Indirect tax revenues** need to be calculated but are not additional to a standard TAG appraisal.
- **Corporation tax** changes are not additional to a standard TAG appraisal, but might be of interest in a distributional sense.
- **Foreign-owned transport producing firm.** The point made regarding a foreign owned firm is the same. In a GB-centric CBA, corporation tax receipts would remain in the CBA, with the ‘repatriated’ part of the change in producer surplus excluded. A GB-centric appraisal should also consider the incidence of benefit between GB and foreign households and businesses.
- There could be **wider impacts** associated with indirect taxation and distorted capital markets. This is additional to a standard TAG appraisal, but will be negative. They are negative due to the contraction in output in product markets resulting from this ‘productivity loss’ in the transport sector, and a likely related reduction in investment in the wider economy.

3. For corporation tax, does the source of private funds and the good being bought impact whether it is economically additional? For example, if foreign investors provide the private finance (e.g. FDI), is there greater additionality of corporation tax revenues? How should we consider displacement of consumer expenditure when assessing net tax receipts (e.g. if consumers spend on new tolls, are they spending less on other goods which would have associated VAT and corporation tax revenues)? Does this play out differently for business versus non-business travel?

The answers to questions 1 and 2 have identified that **corporation tax revenues** are:

- Not additional to the CBA.
- They may be of interest from a distributional perspective or from a financial analysis.

- The same principles apply to both business and non-business travel, but the scale of the impacts may differ and will depend on the relevant elasticities.
- Changes in expenditure in the transport sector will lead to changes in corporation tax revenues from the sector, but also some offsetting consumption changes and therefore corporation tax changes in the wider economy. These changes in corporation tax in the wider economy are also transfers. Whether the changes in corporation tax revenues in the transport sector fully offset those in the wider economy will be an empirical matter. Unlike indirect taxation effective corporation tax rates vary systematically with type of firm (e.g. sector, scale, ownership type). This is due to firms' abilities to minimise tax liabilities vary with firm type, with foreign owned firms particularly noted for paying lower effective rates of tax (Bilicka, 2019). This variation may make it harder to create a general rule as in the case of indirect taxation.
- With foreign investors, when profits are repatriated the residual of the change in producers surplus that is left in GB is the corporation tax. The repatriated profits are loss to GB, and are 'additional' to a standard TAG appraisal (albeit negative).
- More broadly, a standard TAG appraisal is, in practice, a 'world' CBA method. It does not distinguish benefits to foreign traffic from domestic, nor identify the ultimate recipients of producer surpluses. When extending the analysis to be GB-centric, then there is a need to be mindful to extend it in all relevant directions. Thus, consideration of who the beneficiaries are (foreign based hauliers and businesses), as well as whether the transport infrastructure or service is owned by British or foreign firm.

Turning to the source of the finance. **In a social CBA** the benefits of the increased capital in the economy arise through changes in consumer surplus, changes in producer surplus and any interactions with market failures (e.g. agglomeration, reductions in unemployment, etc.). If the investment is large relative to the regional or national economy and then some crowding out of the benefits will occur, particularly if the economy is at full employment. This does not differ whether the finance is sourced domestically or from overseas. Some form of general equilibrium modelling, e.g. an S-CGE model, might be required to model these crowding out effects.

For **overseas finance, i.e. FDI**, two additional impacts might be expected:

- FDI is often associated with **knowledge spillovers** impacting on regional and national productivity. This is a wider impact and would be seen as additional. It has been difficult to parameterise to date. Arguably, there will be limited spillover benefits from a road operation FDI, certainly compared to FDI in advanced manufacturing or business services. Any spillovers would be seen as welfare enhancing.
- The **FDI inflows to the UK will lead to an appreciation in the exchange rate** and a crowding out of exports, and a crowding in of imports. In this case a general equilibrium modelling approach, for example using an S-CGE model, might need to be adopted to ensure the crowding out/in effects are captured in the CBA. This would be an enhanced form of a standard TAG CBA with some of the classic simplifications on general equilibrium effects relaxed.

4. How should tax be handled in the discount rate for PPP options? The literature on PPP discounting tends to suggest a downward adjustment to the PPP costs to reflect tax paid (e.g. corporation tax). Is this consistent with ensuring additionality, related to the issue raised in the previous bullet?

In answering this question, I firstly need to distinguish between a social CBA of the project and a government's value for money assessment of different financing options for that project, before turning to the matter of corporation tax.

In a **social CBA of the project**, we are interested in the allocation of resources. In that sense in the UK the STPR rate would be used for discounting.

For a **value for money assessment of different financing options** there is no clear consensus on the discount rate to be used. The Spackman Approach uses the STPR (Joint Regulators Group (JRG), 2011), Boardman and Hellowell (2017) argue that the risk free rate in the capital markets should be used (e.g. the real gilt rate in the UK), whilst Freeman and Groom (2026) argue that a higher discount rate could be justified subject to project specific risks.

Corporation tax receipts do not feature in the discount rate discussion. The rate of corporation tax forms part of the gap between the CRI and ROI. This gap creates the SPC and influences how costs are treated when undertaking using a STPR discount rate, but where some of the project financing displaces private investment. This is in the context of a social CBA. However, corporation tax receipts are not a determinant of the discount rate in a social CBA, and nor do they feature in the discourse surrounding the appropriate discount rate for a value for money assessment of financing options.

In contrast, corporation tax receipts (and other tax receipts) do have relevance to how the costs and benefits are adjusted in a **value for money assessment of different financing options**. In such an assessment there is a need to ensure a like-for-like comparison between the private finance option and the public sector comparator. This is because the cost to the exchequer of the private finance option is net of tax receipts, which are not paid in by the public sector option. To ensure a like-for-like comparison either the cost of the public sector comparator needs to be adjusted upwards for taxes the public sector does not have to pay, or the costs of the private finance option need to be adjusted downwards for the tax it pays.

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Appendix A: Including variable VAT rates on tolls in the TAG formulae

This appendix reproduces the TAG formulae for changes in indirect taxation. It shows that the TAG formulae is a simplification of the general case where tax rates between the Do Minimum and Do Something vary. It also confirms as correct similar working, provided by email, by Iven Stead as part of this project.

The formula in TAG associated with non-work ITR in market prices is:

$$\Delta ITR(\text{market}) = (F^1 - F^0) \frac{(t_f - t)}{(1 + t_f)} + (M^1 - M^0) \frac{(t_M - t)}{(1 + t_M)} + (N^1 - N^0) \frac{(t_N - t)}{(1 + t_N)} \quad (A.1)$$

Where:

- F is fuel cost including indirect taxes (fuel duty and VAT if applicable)
- N is non-fuel vehicle operating costs
- M is monetary costs including fares, tolls and parking
- t is average rate of indirect taxation in the economy
- t_f is rate of indirect taxation on fuel as a final consumption good (non-work trips)
- t_N is rate of indirect taxation on non-fuel vehicle operating costs as a final consumption good (non-work trips)
- t_M is rate of indirect taxation on monetary costs as a final consumption good (non-work trips)

The policy context of interest is that of VAT on tolls in the Do Something but not in the Do Minimum. This relates to the second term in the right hand side of Equation A.1. It is reproduced below.

$$\Delta ITR_M(\text{market}) = (M^1 - M^0) \frac{(t_M - t)}{(1 + t_M)} \quad (A.2)$$

Looking at the general case now and setting tax rates in the Do Minimum and Do Something to t_M^0 and t_M^1 then:

$$\text{Indirect tax take from the transport sector in the Do Minimum} = M^0 \frac{t_M^0}{1 + t_M^0}$$

$$\text{Indirect tax lost from the wider economy in the Do Minimum} = M^0 \frac{t}{1 + t}$$

These formulae give levels of indirect taxation in nominal terms, which from the perspective of government is in factor prices. Therefore the change in indirect tax in factor prices is:

$$\Delta ITR_M(\text{factor}) = \left[M^1 \frac{t_M^1}{1 + t_M^1} - M^1 \frac{t}{1 + t} \right] - \left[M^0 \frac{t_M^0}{1 + t_M^0} - M^0 \frac{t}{1 + t} \right] \quad (A.3)$$

$$\Delta ITR_M(factor) = \left[M^1 \frac{t_M^1}{1 + t_M^1} - M^0 \frac{t_M^0}{1 + t_M^0} \right] - (M^1 - M^0) \left(\frac{t}{1 + t} \right) \quad (A.4)$$

Converting to market prices by multiplying by the MPA (=1+t) gives.

$$\Delta ITR_M(market) = (1 + t) \left[\left(M^1 \frac{t_M^1}{1 + t_M^1} - M^0 \frac{t_M^0}{1 + t_M^0} \right) - (M^1 - M^0) \left(\frac{t}{1 + t} \right) \right] \quad (A.5)$$

For the TAG case the tax rate in the Do Something equals that in the Do Minimum. Therefore $t_M^1 = t_M^0$, and A.5 becomes:

$$\Delta ITR_M(market) = (1 + t) \left[\left(M^1 \frac{t_M^0}{1 + t_M^0} - M^0 \frac{t_M^0}{1 + t_M^0} \right) - (M^1 - M^0) \left(\frac{t}{1 + t} \right) \right] \quad (A.6)$$

$$\Delta ITR_M(market) = (1 + t)(M^1 - M^0) \left[\left(\frac{t_M^0}{1 + t_M^0} \right) - \left(\frac{t}{1 + t} \right) \right] \quad (A.7)$$

$$\Delta ITR_M(market) = (1 + t)(M^1 - M^0) \left[\frac{t_M^0(1 + t) - t(1 + t_M^0)}{(1 + t_M^0)(1 + t)} \right] \quad (A.8)$$

$$\Delta ITR_M(market) = (M^1 - M^0) \left[\frac{t_M^0 + t_M^0 t - t - t_M^0 t}{(1 + t_M^0)} \right] \quad (A.9)$$

$$\Delta ITR_M(market) = (M^1 - M^0) \left[\frac{t_M^0 - t}{(1 + t_M^0)} \right] \quad (A.10)$$

Equation A.10 is the same as Equation A.2. Thus demonstrating that the TAG equation is a simplification of the general case (Equation A.5).