UNIVERSITY OF LEEDS

Valuing Consumers' Time in our Cost-Benefit Analysis

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Final report to the Financial Conduct Authority

ITS

Contents

Glossary of terms and abbreviations

Cost Benefit Analysis (CBA) – methodology to assess the costs and benefits a policy intervention is expected to generate

Department for Transport (DfT)

Financial Conduct Authority (FCA)

Financial Lives Survey (FLS) – nationally representative survey about UK consumers' attitudes towards managing their money, the financial products they have and their experiences of engaging with financial services firms

National Travel Survey (NTS) – a nationally representative household survey designed to monitor long-term trends in personal travel across England and to inform the development of policy

Other Non-Work (ONW) – non-work journeys for purposes other than commuting

Revealed Preference (RP) – methodology to elicit the value of non-market goods based on the actual/observed/reported choices of consumers

Size and Sign effects – variation in the value of travel time savings, depending on whether time is gained or lost, and the absolute magnitude of the gain/loss

Stated Preference (SP) – methodology to elicit the value of non-market goods, whereby an individual makes hypothetical choices between alternative goods embodying trade-offs between their attributes

Value of Travel Time Saving (VTTS) – unit value of saving a minute (or hour) of travel time and transferring this to another activity

Value of Leisure Time (VoL) – unit value of a minute (or hour) of leisure time

Value of Work Time (VoW) – unit value of a minute (or hour) of work time

Value of Time Assigned to Travel (VTAT) – unit value of a minute (or hour) of travel time

Wage rate (w) – average wage per hour

Willingness-to-Pay (WTP) – technique to elicit the value of a non-market good, which involves asking an individual how much money they would be willing-to-pay to consume the good

Willingness-to-Accept (WTA) – technique to elicit the value of a non-market good, which involves asking an individual how much money they would be willing-to-accept to forego consumption of the good

Executive summary

Background

The Financial Conduct Authority (FCA) routinely employs cost-benefit analysis (CBA) to determine the impacts of its interventions. Among the benefits/costs considered are time savings or losses accruing to both consumers and providers of financial products/services, for example due to changes in the levels of compliance required of providers.

The present study is concerned with valuing time savings/losses for consumers specifically. In principle, a minute less (more) time spent dealing with financial products/services implies a minute more (less) time for other leisure activities – thereby generating a benefit (cost) for consumers.

In practice however, there exists no definitive evidence on the value of time savings/losses in the finance context. Therefore, FCA's approach has been to transfer values from the transport context. More specifically, FCA transfers the standard appraisal value of travel time savings (VTTS) for 'other non-work' (often referred to as 'leisure') journeys, which is an average across all travel modes, from Unit A1.3 of the Department for Transport's 'Transport Analysis Guidance' (TAG).

The purpose of this study is to assess the defensibility of this approach to valuing consumers' time savings/losses and, where necessary and possible, explore options for strengthening the approach.

The rationale for transferring values of travel time savings to the finance context

The work began by rationalising the theoretical basis for FCA's practice of employing DfT's unit *value of travel time savings* (VTTS) for leisure journeys as a proxy for the unit value of time gained/lost by consumers as a result of FCA interventions. The following key definition was introduced:

> ***Value of travel time savings (VTTS) = Value of leisure (VoL) –***
>
> ***Value of time assigned to travel (VTAT)***
>
> *VoL is the value of time spent at leisure, whilst VTAT is the value of time spent travelling. VTTS is the value of reassigning time from travel to leisure, and DfT's official value of this is currently £6.60/hr, expressed in 2022 prices.*

In principle, the *value of leisure* (VoL) term is reasonably sector-generic and thus transferable from transport to finance. By contrast the *value of time assigned to travel* (VTAT) term is specific to the transport sector. Whilst intuition suggests that there will be an analogy to this in the finance sector – which might be referred to as the *value of*

time assigned to finance (*VTAF*) – there currently exists no empirical evidence on its value.

Of course, the ideal would be to conduct a bespoke valuation study in the finance context to estimate a sector-specific version of 'VTTS' – i.e. given by the difference between VoL and VTAF. However, this would require non-trivial investment by FCA, and it is debatable whether such a commitment would be proportionate when time gains/losses to consumers are typically a small portion of the estimated impact of an FCA intervention.

On this basis, the research conducted in this study has sought to build assurance around FCA's practice of transferring values from transport, under effectively two scenarios.

Scenario I

This scenario considers that the value of time assigned to travel represents a reasonable proxy for the value of time assigned to finance – such that DfT's VTTS for leisure journeys can be readily transferred to the financial products/services context.

However, even under this scenario, there is opportunity to strengthen the transferability of values from transport to finance:

- depending on the representativeness of the sample – mindful that a representative sample of travellers may not necessarily proxy for a representative sample of consumers of financial products/services;
- depending on whether time is gained or lost – mindful that DfT's VTTS is averaged over gains and losses (but focusses more on the former than the latter), whereas FCA interventions are usually associated with time losses;
- depending on the absolute size of the time gain/loss relative to the status quo (referred to as the 'deltaT' metric) – mindful that DfT's VTTS is based on a deltaT of 10 minutes, whereas FCA interventions may be associated with time losses substantially in excess of 10 minutes.

Scenario II

This scenario considers that DfT's VTTS for leisure journeys undervalues the corresponding value in the financial products/services context. In particular, this scenario considers the polar case where the value of time assigned to finance is zero (i.e. VTAF=0), such that VTTS reduces to the value of leisure (VoL).

Such a scenario could be rationalised as representing a 'pure' value of leisure unpolluted by travel-related factors, because the VoL is in principle directly transferable to other domains such as financial products/services. Under this scenario,

VTTS captures the full opportunity cost of reallocating time from leisure to financial products and services (and *vice versa*), but omits the direct (positive and negative) utilities of spending time on financial products/services (or assumes such utilities to net to zero[1]).

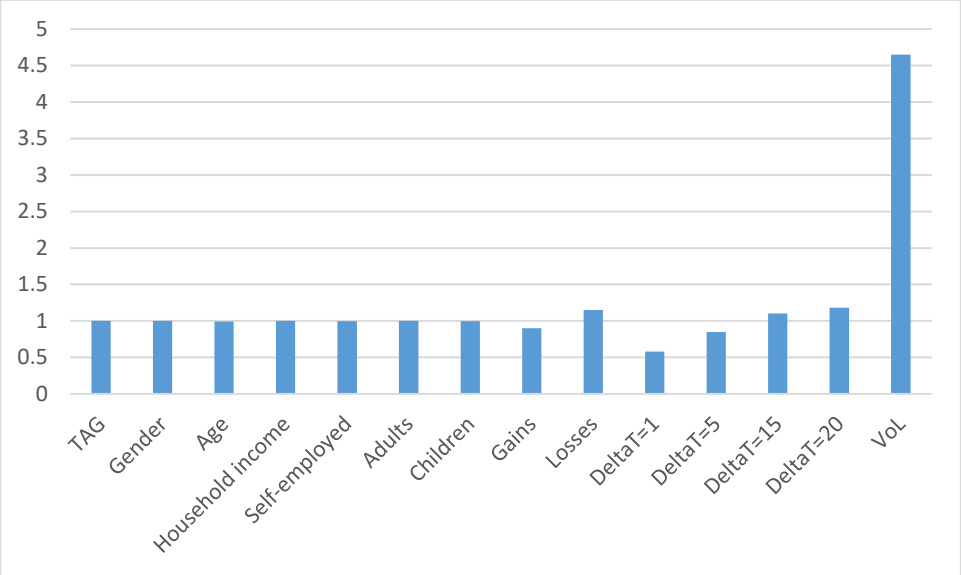
Research and analysis methods

The methods used in the course of this study have included a review of academic literature and evidence, re-analysis of the dataset from DfT's 2014-15 national VTTS study, and interpretation and deduction using economic theory.

Outputs from the study

The principal outputs from the study are a series of multipliers which can be applied to DfT's recommended VTTS, so as to build assurance around its transferability to the finance context. These multipliers are summarised in the figure below, where DfT's TAG value (i.e. £6.60/hr in 2022 prices/values) is assigned a multiplier of 1, and the remaining multipliers entail perturbations around 1.

Summary of VTTS multipliers



Summary of findings

Broadly speaking, the research conducted here supports FCA's practice of adopting DfT's VTTS for leisure journeys as a proxy for time gained/lost by consumers of financial products and services. This is for three reasons:

[1] For example, VTAF would net to zero where the disutility (utility) of time assigned to finance is exactly offset by a positive (negative) return on the investment.

- Time gains/losses are typically a minor contributor to the costs and benefits in FCA's CBAs, and it is questionable whether the commitment of funds to a sector-specific study would represent a proportionate response delivering good value-for-money.
- In the absence of any definitive evidence on the value of time assigned to finance (VTAF), it seems reasonable to conclude that VTAF is a number greater than zero and that the value of time assigned to travel (VTAT) represents the best available proxy. Indeed, such an interpretation is consistent with criteria given in HMT's Green Book for the transfer of DfT's values to other domains.
- When testing the sensitivity of the VTTS to a range of factors which could vary across transport and finance contexts, most of the resulting multipliers are close to unity.

Whilst recommending DfT's VTTS as the baseline, there is opportunity to strengthen assurance around this baseline through the following sensitivity tests. It is anticipated that in most CBAs undertaken by FCA, the focus would be on the sensitivity tests given under Scenario I. The alternative sensitivity test given under Scenario II would be applicable only with appropriate justification (as to why the direct utility of spending time on financial products/services should be omitted). ***Sensitivity tests under Scenario I***

Test 1: Representativeness of the sample

The first test, which should be implemented as a matter of course, is to adjust for the representativeness of the sample by applying a 'combined' multiplier of 0.9895 to DfT's VTTS. In effect, this multiplier adjusts DfT's to take account of slight differences between representative samples of travellers and consumers of financial products/services in respect of gender, age, household income, self-employed, adults and children.

In cases where FCA's interventions are targeted at specific consumer groups, there might also be an argument for the more disaggregated multipliers. However, any such practice would seem to depart from the notion of a representative consumer – and it would be sensible to consider the broader equity and efficiency implications of this before proceeding.

Test 2: Reference dependence

Since FCA's interventions tend to impose time losses on consumers rather than realise time gains, there is a case for applying the (indicative) multipliers of 0.90 for gains and 1.15 for losses.

If furthermore the anticipated time gain/loss resulting from a given FCA intervention is markedly different from the 10 minutes assumed by DfT, then there is a case for also applying the 'deltaT' multipliers which range from 0.58 to 1.40.

Sensitivity test under Scenario II

Test 3: Value of leisure

In effect, the baseline VTTS and sensitivity tests 1 and 2 assume that the values of time assigned to travel and finance are approximately equal, i.e. VTAT≈VTAF. In cases where the latter assumption is considered questionable, then an alternative sensitivity test would be to assume VTAF=0, such that VTTS reduces to the value of leisure (VoL). In practice, this entails applying a multiplier of 4.65 to the TAG value, giving a VTTS in the region of the UK average wage per hour. This multiplier should be seen as very much an upper bound, which is applicable only with justification as to why the direct utility of spending time on financial products/services should be omitted.

Conclusions

These are given in full in section 6 of this report, but the key conclusions are as follows:

C1 In the context of assessing the costs vs. benefits of time lost/gained by consumers of financial products and services due to the FCA's interventions, the practice of transferring DfT's unit values of travel time savings represents a reasonable approximation.

C3 Notwithstanding C1, it should not be overlooked that the transfer of values of time from transport to finance represents an approximation – which will likely be subject to some degree of error. It would therefore be prudent for FCA to review the basis of this practice at regular intervals, taking into account relevant considerations from both policy and analysis perspectives, including: a) the likely degree of error; b) the options for mitigating that error through further analysis; c) the cost of commissioning a valuation study bespoke to the finance context; d) the proportionality of action c), given the contribution of time gains/losses to the overall costs and benefits in the CBA.

C5 In order to give additional assurance around the practice of transferring values from transport to finance, this report has a proposed a series of sensitivity tests which could be conducted around the baseline of DfT's VTTS. As a next step towards implementation, it would be advisable for FCA to 'road test' these sensitivity tests, so as to determine their usefulness and the practical impact on the CBA.

0 Introduction

0.1 Background

The Financial Conduct Authority (FCA) routinely employs cost-benefit analysis (CBA) to determine the impacts of its interventions. Among the benefits/costs considered are time savings or losses accruing to both consumers and providers of financial products/services, for example due to changes in the levels of compliance required of providers.

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The purpose of this study is to assess the defensibility of this approach to valuing consumers' time savings/losses and, where necessary and possible, explore options for strengthening the approach.

0.2 Tasks

The research study involves four tasks, as follows.

Task 1 develops a commentary to rationalise the theoretical basis for the practice of transferring the value of travel time saving (VTTS) from the transport domain to the financial products and services domain. In particular, this commentary provides a constructive critique of the practice of adopting DfT's VTTS for leisure journeys, highlighting the attractions of this approach, as well as potential areas of challenge.

This commentary exposes the important point that, from a *theoretical* perspective, the VTTS for leisure journeys can be dissected into two components, namely the value of leisure (VoL) *per se* and the value of time assigned to travel (VTAT). More specifically, VTTS = VoL – VTAT. Since it represents the 'pure' value of leisure unpolluted by travel-related factors, VoL is arguably more transferable to other domains (such as financial products/services) than VTTS generally.

However, in *empirical* studies, including DfT's most recent UK national VTTS study in 2014-15 (Arup et al., 2015; DfT, 2015), the separate components of VTTS are not routinely identified and reported – and indeed identification of the separate

components is not a straightforward exercise. That said, there does exist a small academic literature of 11 studies conducted across a range of countries which have sought to extract distinct estimates of VoL. **Task 2** reviews these studies, with the objective of eliciting an indicative multiplier for VoL/VTTS, which can be applied to DfT's recommended VTTS in TAG and thereby derive an approximation to VoL for the UK.

Building upon Tasks 1 and 2, **Task 3** explores a number of specific theoretical and empirical issues that could affect the transferability of DfT's VTTS for leisure journeys to the financial products/services context, as follows:

- How VTTS varies depending on the sample population – mindful that a representative sample of travellers could offer a poor proxy to a representative sample of consumers of financial products/services.
- How VTTS varies between time gains and losses – mindful that DfT's interventions usually realise time savings, whereas FCA's interventions can sometimes impose time losses.
- How VTTS varies according to the absolute size of the time gain or loss – mindful that DfT's official value assumes an absolute change in travel time of 10 minutes, whereas the corresponding change(s) relevant to FCA could be somewhat greater or less than 10 minutes.

The above issues are developed using theoretical reasoning and re-working of the dataset underpinning DfT's VTTS.

Task 4 outlines the scale and scope of DfT's 2014-15 VTTS study and comments on how this might compare to an analogous study focussed on financial products and services.

0.3 Layout of this report

Sections 1-4 to follow report Tasks 1-4 respectively. Section 5 synthesises the outcomes from Tasks 1-4 in the form of implications for FCA's practice of using DfT's VTTS for leisure journeys. Section 6 reports the conclusions of the study.

1 Task 1: theoretical basis for the practice of transferring values of travel time savings from transport to financial products/services

1.1 Opening comments

Since interventions by FCA could result in consumers saving or losing time, it seems appropriate practice to include this impact within CBAs of those interventions. Ideally, unit valuations of such time gains/losses should be based on context-specific evidence – in this case from the finance sector. However, it would appear that little or no such evidence exists. In the absence of context-specific evidence from finance, the transfer of values of travel time savings from the transport context would seem a reasonable – if pragmatic – approximation. However, for reasons of assurance, there should be transparency around the strengths and weaknesses of this approximation.

Indeed, section A1.72 of the Green Book (HM Treasury, 2022) advises that: *'The DfT's published VTTS represent the typical values of time savings resulting from transport interventions. Therefore, the recommended standard VTTS may not be appropriate if the characteristics of the affected group are not similar transport users, or differ significantly from those of a typical transport scheme. In these circumstances the DfT values may still be used as an indication of the order of magnitude of impacts'* (p88).

In terms of the strengths of this practice, valuations from the transport context emanate from a substantial and authoritative evidence base. Savings in travel time typically account for the majority of the user benefits of transport infrastructure schemes, making it especially important that official unit values are robustly estimated and remain fit-for-purpose as socio-economic conditions and travel behaviours change over time. For this reason, the UK and a number of other developed countries commit significant resources to maintaining guidance on VTTS, especially through re-surveying values at regular intervals. The most recent national VTTS study in the UK was commissioned by DfT in 2014, with the £1.4M contract for the study being awarded to the Arup/ITS Leeds/Accent consortium – which included many of the leading VTTS researchers internationally. The study was conducted over an 11-month period and, as a matter of course, was subjected to a number of quality assurance and audit checks before the results were accepted by DfT and TAG updated accordingly. In short, the 2014-15 study was a very serious piece of work – and we can draw reasonable confidence as to its robustness.

In terms of the weaknesses of the practice of transferring values from transport to finance, valuations from the transport context will be confounded with influences associated with the disutility of travel *per se* and the socio-demographic characteristics of travellers. This means that TAG values cannot be interpreted as 'pure' values of time savings. The remainder of this chapter introduces some of the

key technical considerations around the transfer of values from transport to finance, and identifies opportunities for strengthening the basis of this transfer.

1.2 Theoretical background

If the principle of transferring values from transport to finance is accepted, then there is a choice to be made as to whether to adopt DfT's values pertaining to business, commute or other non-work. Intuition suggests that ONW is indeed the most appropriate variant to approximate the value of consumer time gains/losses, since dealings with financial products/services would generally be undertaken within one's own time and the ONW value is the closest approximation to this.

In theoretical terms (e.g. De Serpa, 1971; Jara-Díaz, 2002; 2003), the marginal (i.e. per minute or per hour) value of travel time savings for leisure journeys (VTTS) can be derived mathematically as the following expression:

$$VTTS = VoL - VTAT \quad (1)$$

Where VoL is the traveller's marginal valuation of leisure time, and VTAT is the traveller's marginal valuation of time assigned to travel specifically. If there is equilibrium in the traveller's allocation of work and leisure time, it can further be shown that the following equivalence holds:

$$VoL = w + VoW \quad (2)$$

Where w is the traveller's (after tax) wage rate, and VoW is the traveller's marginal valuation of working time (i.e. reflecting any satisfaction or dissatisfaction of working in 'utility' terms, as distinct from the monetary reward/compensation via the wage rate).

On this basis, substituting for VoL (2) in (1) gives:

$$VTTS = w + VoW - VTAT \quad (3)$$

Thus, to give (1) and (2) more intuition, the VTTS represents the unit value of reassigning time from travel (i.e. VTAT) to leisure (i.e. VoL) or work (i.e. VoW).

The central question considered here is whether and how VTTS can be transferred from the transport context to the finance context. Among the main considerations and observations in this regard are perhaps the following.

- Where there is equilibrium in the allocation of work and leisure time, VTTS can with reference to (3) be rationalised as some level of perturbation from the wage rate, where that perturbation is determined by the traveller's valuations of working time and travel. Despite the mention of work here, the analysis is still concerned with leisure journeys.

- In section 0, it was noted that, in principle, the VoL is more transferable to other domains (such as financial products/services) than VTTS generally. There is thus an interest in dissecting the VoL from the VTTS. On the face of it, the identities (1) and (2) provide two alternative routes for doing just that, but there are also some practicalities to consider.

- With reference to (1), the time assigned to travel may, depending on the context, bring pleasure (i.e. VTAT>0, which might apply to cycle ride on a sunny day) or displeasure (i.e. VTAT<0, which might apply to a car journey in heavy traffic). This makes it difficult to infer VoL from (1), since this will depend on the sign and magnitude of VTAT. Similarly, with reference to (2), the time assigned to work may or may not give satisfaction, making it difficult to infer VoL through that route. However, what can be said with confidence is that:

    a) if VTAT<0, then it must be the case that VTTS>VoL. In this case, if VTTS is being used by FCA in appraisals to proxy for VoL, then this will overstate the VoL;

    b) on the other hand, if VTAT>0, then VTTS<VoL, and using VTTS in appraisal will understate the VoL.

Moreover, in order to transfer the concept of VTTS to the finance context, one would ideally wish to:

- isolate the VoL term, since in principle this gives the 'resource' value of leisure time irrespective of context.

- formulate a context-specific equivalent of the VTAT term, to reflect the customers' marginal valuations of time spent dealing with financial products and services.

If FCA were to commission a bespoke valuation study in the finance context, then it would seek to capture both of the aforementioned effects. However, in the absence of such a study, the remainder of this report considers two alternative routes for strengthening the transferability of valuations from the transport context.

1.3 Strengthening the transferability of values

One route to strengthening transferability would be to seek to isolate the VoL term – thereby extracting any transport-specific influences on DfT's recommended VTTS in TAG. Unfortunately, a definitive analysis along these lines is not feasible, since it would require time use data which was not collected as part of DfT's 2014-15 national VTTS study. However, there exists a literature of 11 VTTS studies which have undertaken such an analysis – including one rather dated study from the UK. In section 2 of this report, a desktop review of these studies is undertaken, with the objective of:

- extracting an indicative multiplier for VoL/VTTS;
- using this multiplier as a basis for deriving an approximate estimate of VoL from DfT's recommended VTTS for leisure journeys.

A second route to strengthening transferability, would be to leave the VTTS term intact (remembering that VTTS = VoL – VTAT), but apply empirical adjustments to the valuations to account for any variations in the following technical features across the transport and finance contexts. This exercise is undertaken in section 3 of this report.

1.3.1 Representativeness

A key feature in this regard – which was applicable to DfT's 2014-15 study – is that behavioural values are typically estimated on unrepresentative samples of travellers. This is because field surveys of travellers intercepted in the course of travelling are inherently biased towards travellers who travel more often and make longer journeys – because these travellers carry a higher probability of being intercepted.

For this reason, appraisal values are derived from behavioural values by 'correcting' the sample for representativeness. The convention in DfT's national VTTS studies is to correct for representativeness by undertaking a sample enumeration process using the National Travel Survey (NTS), since the latter *does* constitute a representative sample of travellers. This provokes an important question in terms of the transferability of values from transport to finance; specifically, to what extent does a representative sample of travellers align with a representative sample of consumers of financial products and services?

There could however be opportunity to strengthen the transfer of values from transport to finance, by adjusting the sample enumeration process to better reflect the representativeness of consumers of financial services/products. In the course of DfT's 2014-15 study, an 'Implementation Tool' was developed which allows calculation of the representative VTTS for different segments of travellers and based on a variety of weighting options. In this way, it is possible to derive separate valuations for different geographical breakdowns or income bands, for example. If there were insight into the profile of the customer base for financial products and services, then the sample enumeration process could be adjusted accordingly.

1.3.2 Time gains vs. losses

From perusal of 11 CBAs which considered the impacts of FCA interventions on consumer time (FCA,2015a; 2015b; 2015c; 2018b; 2019a; 2019b; 2019c; 2020; 2021a; 2021b; 2022), an issue specific to the finance context is that, whereas some FCA interventions save consumers' time, most interventions cause consumers to incur more time. The VTTS literature has a long tradition of exploring the relative values of

time gains vs. losses, with the evidence tending to suggest that the latter have a greater unit value than the former.

That said, DfT (2015) concluded that: *'In transport appraisal, what we need are 'reference free' values of time. Transport appraisals are not really concerned with changes from the status quo, or some reference point, but with comparing two alternative versions of the future, one with and one without the intervention being appraised'*. On this basis, the 2014-15 national VTTS study employed a modelling procedure which in effect averaged valuations of time gains and losses. Depending on the significance of time losses vs. gains in the financial products/services context, there may however be a case for reviewing the practice of averaging over gains and losses. This issue will be considered further in section 3 of this report.

1.4 Alternative approaches to valuing consumer time

Finally, it should be acknowledged that DfT's VTTS are derived from Stated Preference (SP) experiments of the willingness of travellers to pay money to save time – where SP is one of a number of valuation approaches which could be deployed in this context.

Other approaches include the wage rate approach used in earlier FCA CBAs, as well as the wage rate/proxy wage approach used in HMRC appraisals. These approaches are unlikely to generate values that are readily applicable to most practical contexts of interest to FCA, but could remain useful as upper bound sensitivity tests. This point will be considered in section 5 of this report.

In addition to the willingness-to-pay (WTP) and wage rate approaches, another possible approach is the Travel Cost Method (TCM), which has been applied extensively in environmental economics, and especially in the context of valuing recreational sites. With reference to equation (2) above, the TCM in principle offers an alternative means of dissecting the value of leisure from the wage rate (Lloyd-Smith et al., 2019).

In short, SP is one of a number of approaches to non-market valuation, and if FCA were to commission a study bespoke to the finance context, then it would be prudent to consider the relative merits of the range of approaches.

2 Task 2: reviewing empirical evidence on the value of leisure

2.1 Opening comments

Following from the discussion of theory in section 1.2, this section reviews evidence on the ratio of the value of leisure to the value of travel time (i.e. VoL/VTTS) drawn from 11 studies reported in the literature, and then uses reasoning and intuition to deduce a multiplier that can be used to calculate an approximate VoL based on DfT's recommended VTTS.

2.2 Theoretical approach

The theoretical approach followed in these 11 studies broadly follows that outlined in Jara-Diaz et al. (2008), which can be summarised as follows.

Let A^u be the non-empty set of 'uncommitted' activities, A^c the set of 'committed' activities assigned the minimum required time (T^{min}), G^u the non-empty set of uncommitted goods, and G^c the set of committed goods assigned the minimum required expenditure (E^{min}).

To explain the distinction between 'uncommitted' and 'committed':

- In the case of committed activities/goods, individuals would wish to reduce the time/money spent on them but cannot beyond some 'technical constraint'. One example would be work, for which minimum hours are usually determined by a work contract. Another example is travel, which, given a maximum speed, cannot be undertaken at less than a minimum travel time/cost.
- In the case of uncommitted activities, time/money spent on them can be freely chosen and are not subject to any technical constraint. A good example would be leisure activities.

In what follows, leisure will be adopted as an indicative uncommitted activity/good, whereas travel will be adopted as an indicative committed activity/good.

It is assumed that the individual/traveller seeks to maximise his/her utility, as a function of the time assigned to work T_w, the time assigned to 'uncommitted' activity $T_i \in A^u$, the time assigned to 'committed' activity $T_i \in A^c$, the expenditure assigned to consumption of 'uncommitted' good $E_j \in G^u$, and the expenditure assigned to consumption of 'committed' good $E_j \in G^c$.

In particular, a Cobb–Douglas functional form is adopted here (Zellner et al., 1966), since this implies the desirable property of diminishing marginal utility to both time and expenditure (i.e. satiation) as time/expenditure increases (Bhat, 2005; 2008).

$$maxU = \theta_w log(T_w) + \sum_{i=1}^{n} \theta_i log(T_i) + \sum_{j=1}^{m} \psi_j log(E_j) \quad (4)$$

s. t.

$\tau - T_w - \sum_{i=1}^{n} T_i = 0 \quad (\mu)$

$wT_w + I - \sum_{j=1}^{m} E_j \geq 0 \quad (\lambda)$

$T_i - T_i^{min} \geq 0 \; \forall i \in A^c \quad (\kappa_i)$

$E_j - E_j^{min} \geq 0 \; \forall j \in G^c \quad (\eta_j)$

Where:

θ_w is the baseline utility parameter of T_w;

θ_i is the baseline utility parameter of activity i;

ψ_j is the baseline utility parameter of expenditures assigned to good j;

τ is the total time available;

w is the wage rate;

I is the fixed income from sources other than paid work;

μ and λ are the Lagrangian multipliers representing the marginal utility of increasing available time for freely chosen activities and increasing available money for freely consumed goods, respectively;

κ_i is the Lagrangian multiplier representing the marginal utility of reducing the minimum time constraint of committed activity $T_i \in A^c$;

η_j is the Lagrangian multiplier representing the marginal utility of reducing the minimum expenditure constraint of committed good $E_j \in G^c$.

The problem is solved by deriving the First Order Conditions (FOCs) to maximise the objective function, firstly optimising for the time assigned to work (T_w^*), and then for the time assigned to each of the other activities, and for the expenditure assigned to consumption of each of the goods. Work time is optimised first, since this in turn determines wage-related income (and thus the money budget for consumption) and the residual time available for leisure (and thus the time budget for consumption and other activities).

Having solved the problem in this manner, it is possible to then derive marginal valuations of time in different activities, through taking the ratio of the marginal utilities of time and expenditure (i.e. marginal rates of substitution between money and time). With regards to the current study for FCA, there is particular interest in three such valuations, namely:

The value of leisure: $VoL = \frac{\partial U/\partial T_i}{\partial U/\partial E_j} = \frac{\mu}{\lambda} = \frac{\boldsymbol{\theta}(wT_w{}^* - E_c)}{\boldsymbol{\psi}(\tau - T_w{}^* - T_c)}$ (5)

The value of work: $VoW = \frac{\partial U/\partial T_w}{\partial U/\partial E_j} = \frac{\mu}{\lambda} - w = VoL - w$ (6)

The value of travel time savings: $VTTS = \kappa_k = \frac{\mu - \partial U/\partial T_k}{\lambda} = VoL - VTAT$ (7)

Where:

T_w^* is the optimal amount of time assigned to work;

E_c is expenditure on committed goods, where $E_c = \sum_{j \in G^c} E_j^{min}$;

T_c is time spent on committed activities, where $T_c = \sum_{i \in A^c} T_i^{min}$;

$\boldsymbol{\theta}$ is the baseline utility parameter of time, where $\boldsymbol{\theta} = \sum_{i=1}^{n} \theta_i$;

$\boldsymbol{\psi}$ is the baseline utility parameter of expenditure, where $\boldsymbol{\psi} = \sum_{j=1}^{m} \psi_j$

An important distinction is that, whereas work and leisure are freely variable subject to the time resource constraint (μ), travel is a committed activity, and subject to minimum time (κ_j) and expenditure (κ_k) constraints. In a similar vein, time spent dealing with financial products/services would represent a committed activity.

So in essence:

VoL = the value of residual time (after work and other committed activities) / the value of residual money (after committed activities)

2.3 Empirical approach

2.3.1 Scope of the data

From a review of the academic literature, 11 studies have been identified which provide empirical evidence on VoL. All were published or co-published by the originator of the methodology – namely Sergio Jara-Diaz. Five of these studies were conducted in Chile, reflecting Jara-Diaz's nationality. The remaining six studies were conducted in northern European countries and the USA – countries which are arguably more transferable to the UK in terms of typical activity and expenditure patterns. One study was conducted in the UK, albeit on rather dated data (two separate waves collected in 1975 and 1985), and the results from this study would seem rather mixed in terms of their robustness. Some of the papers are to a greater or lesser extent duplicative, in that they conduct slightly different analyses on essentially common data (e.g. some of the Chilean studies and the two Austrian studies).

2.3.2 Approaches followed

Implementing the theoretical approach summarised above, the 11 studies pursue a common interest of estimating the value of leisure (VoL). The vast majority of studies also estimate the value of time assigned to work (VoW) – two exceptions would seem to be Jara-Díaz & Guevara (2003) and Hossinger et al. (2020), since they appear not to estimate VoW explicitly, and instead infer VoW via an estimate of VoL and data on the wage rate (i.e. via equation (2)).

In order to populate the modelling framework, data collection generally involves some form of activity or time use survey (conducted over one day, a few days or one week), combined with some form of expenditure data. Some papers conduct a fully integrated activity and expenditure survey, whilst others combine an activity survey with expenditure data from another source. In addition to VoL and VoW, four of the 11 studies also estimate the value of travel time savings (VTTS). In order to populate this extension to the modelling framework, specific travel/mobility data is captured within the activity survey (which might be regarded as Revealed Preference (RP) data), whilst one study (Schmid et al., 2021) also combines this with Stated Preference (SP) data on mode and route choices.

The features of these studies are summarised in Table 2.1, in particular documenting:

- **Location and year of survey:** where and when the survey was conducted which underpins the analysis.
- **Scope:** all studies estimate the value of leisure, but some studies also estimate the value of travel time savings via a mode choice exercise.
- **Survey:** whether the data collection encompasses travel, activity/time use, expenditure and/or other surveys.
- **Sample:** number of and type of individuals surveyed.
- **Modes modelled:** for the subset of studies estimating VTTS, the different travel modes considered.
- **Activities modelled:** for all studies estimating the VoL, the different activities considered.

2.3.3 Synthesis of the data

Since the majority of the studies focus on the estimation of VoL, and only a minority estimate VTTS, the synthesis undertaken here will proceed by first eliciting estimates of the ratio of VoL to the wage rate (i.e. VoL/w). Evidence from the UK will then be used to calculate the ratio of the wage rate to DfT's VTTS (i.e. w/VTTS), thereby allowing the ratio (VoL/VTTS) to be derived[2]:

$$\frac{VoL}{VTTS} = \frac{VoL}{w} \times \frac{w}{VTTS} \quad (8)$$

In the context considered here, an important attraction of working with valuations in ratio form is that, in principle, these ratios are comparable across countries (i.e.

[2] It should be qualified that, for (8) to hold strictly, the proportionality of wage to VoL in the first term of the product should be consistent with the proportionality of wage to VTTS in the second term – but this may not apply when (as is the case here) the two terms are estimated on different datasets.

independent of exchange rates) and years (i.e. independent of changes in prices and incomes over time within any given country).

In what follows, estimates of VoL/w from the 11 studies are collated, screened to arrive at a final subset of estimated ratios, and measures of central tendency (namely mean and median) and dispersion (namely minimum, maximum and standard deviation) are then calculated and reported.

Table 2.1: Summary of VoL studies from the literature

Study	Reference	Location and year of survey	Scope	Survey	Sample	Modes modelled	Activities modelled
1	Jara-Díaz, S.R. & Guevara, C.A. (2003)	Santiago, Chile (1991)	VoL & VTTS	1-day activity diary; unsure of source of expenditure data	366 workers; average work 7.25 hrs/day medium income, 7.18 hrs/day; average workers income 40.5-110 CH$/yr medium income, 110+ CH$/yr high income	Car driver, car driver-metro, car companion, car companion-metro, bus, bus-metro, shared taxi, shared taxi-metro, metro	Work, personal care, sleep, entertainment, shopping & errands, travel
2	Munizaga et al. (2008)	Santiago, Chile (2001)	VoL & VTTS	3-day activity diary; unsure of source of expenditure data	290 workers (174 retained), average work 45.2 hrs/wk, average workers income 867 USD/mth	Car driver, car driver-metro, car companion, car companion-metro, bus, bus-metro, shared taxi, shared taxi-metro, metro	Work, personal care, sleep, entertainment, shopping & errands, travel
3	Jara-Díaz et al. (2008)	Santiago, Chile (2001); Karlsruhe, Germany (1999); Canton Thurgau, Switzerland (2003)	VoL	Santiago, Chile (3-day activity diary); Karlsruhe, Germany (6-week travel diary); Canton Thurgau, Switzerland (6-week travel diary); plus interview surveys	Santiago, Chile (290 workers; average work 45.2 hrs/wk; average workers income 867 USD/mth) Karlsruhe, Germany (159, including 90 workers; average work 32.5 hrs/wk; average household income 2546 USD/mth) Canton Thurgau, Switzerland (230, including 126 workers; average work 36.5 hrs/wk; average household income 6922 USD/mth)	n/a	Santiago, Chile (work, personal care, entertainment); Karlsruhe, Germany (work, entertainment); Canton Thurgau, Switzerland (work, entertainment)
4	Konduri et al. (2011)	USA (2008)	VoL	1-day activity diary combined with 1-week expenditure survey administered twice; plus interview survey	332 single persons aged 25-64; average work 38.5 hrs/wk	n/a	In-home leisure, out-of-home leisure, out-of-home work
5	Jara-Díaz & Astroza (2013)	Santiago, Chile (2001)	VoL	1-week travel diary; expenditure obtained from other sources	9464 workers; average work 51.27 hrs/wk	n/a	Work, home, out-of-home recreation
6	Jara-Díaz et al. (2011)	Santiago, Chile (2001)	VoL	1-week travel diary; expenditure obtained from other sources	9464 workers; average workers income 488.3 USD/mth	n/a	Work, home
7	Jara-Díaz & Rosales-Salas (2015)	UK (1975 & 1985)	VoL	Activity diaries of various durations; expenditure obtained from other sources	1941 in 1975, including 1304 workers; 1350 in 1985, including 579 workers	n/a	Leisure, work, committed, sleep, childcare

8	Jara-Díaz et al. (2016)	The Netherlands (2012)	VoL	1-week activity and expenditure diary	5463 workers from single-person households; average work 33.4 hrs/wk	n/a	Work, activities with children, entertainment, and sleeping & relaxing
9	Jokubauskaitet al. (2019)	Austria (2015)	VoL & VTTS	1-week travel, activity and expenditure survey	748 workers	Walk, bike, car, PT	Work, leisure, travel time by mode
10	Hossinger et al. (2020)	Austria (2015)	VoL	1-week travel, activity and expenditure survey	737	n/a	Work, leisure, eating & shopping, committed activities
11	Schmid et al. (2021)	Zurich (2015-16)	VoL & VTTS	1-week travel, activity and expenditure survey, plus SP mode/route choice data	367; average work 36.2 hrs/wk; average workers income 2000.2 CHF/wk	Walk, bike, motorized individual vehicles, PT, car share, car pool	Work and out-of-home leisure

Table 2.2: Notes on screening of VoL/w estimates

Obs	Study	Source	Country	Survey year	Segment	VoL/w	VoL/w after screening	VoL/VTTS	Quality comments
1	1	Jara-Diaz & Guevara (2003)	Chile	1991	Medium income	0.04		0.05	
2					High income	0.05		0.05	
3	2	Munizaga et al. (2008)	Chile	2001	Total sample	0.62		0.79	VTTS borderline sig; VTAT not sig
4	3	Jara-Diaz et al. (2008)	Chile	2001	Total sample	0.66			Same data as study 2
5			Germany	1999	Total sample	1.2	1.2		VoW not sig from zero
6			Switzerland	2003	Total sample	0.88	0.88		VoW not sig from zero
7	4	Konduri et al. (2011)	USA	2008	Low income	1.21	1.21		VoW not sig from zero
8					Medium income	0.82	0.82		VoW not sig from zero
9					High income	2.48			VoL & VoW not sig from zero
10					Women	1.14			Used income segmented values instead
11					Men	2.2			Used income segmented values instead
12	5	Jara-Diaz & Astroza (2013)	Chile	2001	Women	0.92			
13					Men	0.57			
14	6	Jara-Diaz et al. (2011)	Chile	2001	Men, E	0.71			Same data as study 5
15					Men, SE	0.83			Same data as study 5
16					Men, W	0.74			Same data as study 5
17					Men, N	0.88			Same data as study 5; VoW not sig
18					Men, S	0.76			Same data as study 5
19					Women, E	1.09			Same data as study 5; VoW not sig
20					Women, SE	1.21			Same data as study 5
21					Women, W	1.19			Same data as study 5; VoW not sig
22					Women, N	1.33			Same data as study 5; VoW borderline sig
23					Women, S	1.27			Same data as study 5
24	7	Jara-Diaz & Rosales-Salas (2015)	UK	1975	Week	1.3	1.3		
25					1 day	1.66			Used 1 week diary values instead; VoL borderline sig, VoW not sig
26					2 days + w/e	3.08			Used 1 week diary values instead; VoW not sig
27					2 days + w/e weighted	2.55			Used 1 week diary values instead; VoL & VTAT not sig

28					3 days + 2 w/e	2.08			Used 1 week diary values instead; VoW not sig
29					3 days weighted + 2 w/e	2.13			Used 1 week diary values instead; VoW not sig
30				1985	Week	8.2			VoL & VoW not sig from zero
31					1 day	4.21			VoL & VoW not sig from zero
32					2 days + w/e	3.9			VoL & VoW not sig from zero
33					2 days + w/e weighted	7.19			VoL & VoW not sig from zero
34					3 days + 2 w/e	5.6			VoL & VoW not sig from zero
35					3 days weighted + 2 w/e	12.49			VoL & VoW not sig from zero
36	8	Jara-Diaz et al. (2016)	The Netherlands	2012	Exog min time, endog min consumption	3.31			VoL not sig from zero
37					Endog min time, exog min consumption	3.31			VoL not sig from zero
38					No children	3.6			VoL not sig from zero
39					Children	0.16			VoL not sig from zero
40					Up to 50 yrs age	0.39			VoL not sig from zero
41					Over 50 years age	4.06			VoL not sig from zero
42					Urban area	4.13			VoL not sig from zero
43					Non-urban area	3.41			VoL not sig from zero
44					Low income	1.08			VoL not sig from zero
45					High income	6.48			VoL not sig from zero
46	9	Jokubauskaite et al. (2019)	Austria		Walk	0.77		0.53	Used all modes values instead
47					Bike	0.77		1	Used all modes values instead; VTAT not sig
48					Car	0.77		0.93	Used all modes values instead; VTAT not sig
49					PT	0.77		2.38	Used all modes values instead; VTAT not sig
50					All modes	0.77	0.77		VoW not sig; VTAT not sig
51	10	Hossinger et al. (2020)	Austria		Proportional expenses	0.67			Same data as study 9; doesn't actually estimate VoW
52					Equal expenses	0.8			Same data as study 9; doesn't actually estimate VoW
53	11	Schmid et al. (2021)	Switzerland		Walk	0.46		0.94	Used all modes values instead; fails consistency check
54					Bike	0.46		1.38	Used all modes values instead; fails consistency check

55					MIV	0.46		0.82	Used all modes values instead; fails consistency check
56					PT	0.46		1.7	Used all modes values instead; fails consistency check
57					Car share	0.46		0.94	Used all modes values instead; fails consistency check
58					Car pool	0.46		0.91	Used all modes values instead; fails consistency check
59					All modes	0.47	0.47		Passes consistency check; VoW not sig

2.3.4 Screening the data

On the face of it, Table 2.2 reports 59 estimates of this ratio, but it is appropriate to make a number of qualifications, as follows.

- As noted above, some papers use essentially the same data – such that estimates of VoL from these papers are duplicative. In these cases, estimates from only one of these related papers are retained.
- Whilst some papers report an average VoL, other papers segment VoL by various dimensions (e.g. income, gender). Where possible, the average VoL has been used in the synthesis conducted here. However, in papers where no average is reported, VoLs for mutually exclusive segments (e.g. women vs. men) are retained[3].
- Some papers report estimates of VoL that are not significantly different from zero; these have been screened out.
- Finally, another aspect of data quality, is whether estimates of VoL and VoW are internally consistent, in the sense that the mathematical derivation of section 2.2 implies that the following condition should hold:

  $$VoL/w - VoW/w = 1 \qquad (9)$$

  In other words, where VoL and VoW are independently estimated, the former should exceed the latter by the wage rate. Any estimates not complying with this condition have been screened out.

2.3.5 Measures of location and dispersion

With reference to Table 2.3, it can be seen that, based on the above screening criteria, the original 59 estimates have been reduced to 12, yielding estimated VoL/w ratios ranging from 0.04 to 1.3, with a mean and median of 0.74 and 0.8 respectively. Obviously, a sub-sample of 12 observations is inadequate to conduct any formal statistical tests, but based on the full sample of 59 observations together with the sub-sample after screening, the following tentative inferences can be drawn:

- Based on the 12 observations in the sub-sample, the suggestion is that both VoL/w and VoW/w are positive, implying that individuals place a positive value not only on leisure time (which is to be expected *a priori*), but also on work time. It should be stressed that, in this context, VoW reflects any 'utility'

[3] That is to say, in this instance, two estimates of VoL/w are extracted from the relevant paper, one for each gender.

to the individual above and beyond wages received as compensation/reward for working.

- Having said the above, the 12 observations in the sub-sample comprise five observations from Chile and seven from northern European countries and the USA. There is a suggestion – which cannot be tested statistically given the small sample size – that the Chilean values bias the average downwards. Indeed, averaging the seven non-Chilean values gives a mean and median VoL/w of 0.96 and 0.88 respectively.

Table 2.3: Descriptive statistics of VoL/w estimates

	Full sample	**Sub-sample after screening**	**Sub-sample after screening & restricting to USA and Europe**	**Sub-sample after screening, restricting to USA and Europe & re-weighting**
Min	0.04	0.04	0.47	0.09
Max	12.49	1.30	1.30	4.18
Median	1.08	0.80	0.88	1.13
Mean	1.96	0.74	0.95	1.23
St Dev	2.27	0.41	0.30	0.30
Count	59	12	7	7

2.3.6 Adjusting for data quality

To some extent, the screening procedure described in section 2.3.4 makes appropriate adjustments to the dataset to account for data quality, and the screened dataset has, for reasons of consistency and transferability, been further restricted to studies from the USA and Europe.

That said, a further procedure which can be deployed, is to account for data quality within the averaging process. This can be achieved by taking a weighted rather than arithmetic average, where the weights are given by the inverse of the standard errors of the estimates – such that estimates with lower (higher) standard errors are accorded relatively more (less) weight in the averaging process. More formally:

$$\bar{X}_{weighted} = \frac{\sum_{s=1}^{S}\left(\frac{1}{s.e.(X_S)}.X_S\right)}{\sum_{s=1}^{S}\frac{1}{s.e.(X_S)}} = \sum_{s=1}^{S} s.e.(X_s) \cdot \sum_{s=1}^{S} t(X_s) \qquad (10)$$

Where in the case considered here, X=VoL/w and S=7.

Thus, in effect, the weighted average (10) is given by the sum of the t-statistics of the seven remaining estimates of X, multiplied by the sum of the corresponding standard errors.

In applying this formula, there are however some practical details which need to be borne in mind. First, in the studies considered here, the wage rate is a constant and not an estimate. Therefore, the standard error of the estimated VoL will be representative of the standard error of the ratio as a whole. Second, two of the studies do not report the standard error of the estimated VoLs, with Jokubauskaite et al. (2019) instead reporting the standard deviation, and Schmid et al. (2021) instead reporting the inter-quartile range.

In the former case, the standard deviation was converted to the standard error via the following relationship:

$$s.e. = \frac{s.d.}{\sqrt{sample\ \ size}} \tag{11}$$

where sample size refers to the dataset used to estimate the VoL. In the latter case, the inter-quartile range (IQR) was similarly converted, albeit via an approximate relationship which strictly holds only where the dataset exhibits normality (which was not possible to confirm from the information given in the relevant paper):

$$s.e. \approx \frac{I.Q.R.}{1.35} \tag{12}$$

Moreover, following re-weighting, Table 2.3 reports that the mean and median VoL/w of the seven non-Chilean values are revised upwards to 1.23 and 1.13 respectively.

2.3.7 Combining with the wage rate to elicit an approximate VoL/VTTS multiplier

Having undertaken the above analysis to estimate VoL/w, it remains to multiply this by w/VTTS, such that VoL/VTTS can be derived via (8).

The w/VTTS ratio was calculated by a sample enumeration process based on the 2014-15 UK national VTTS study, as follows:

- For each trip recorded in the 2010-12 NTS sample, VTTS for the ONW (i.e. leisure) journey purpose was calculated using the behavioural model from the 2014-15 study.
- The person wage corresponding to each trip was also extracted from NTS.
- Both the VTTS and wage for each trip were adjusted using the NTS weights, thereby deriving representative values of each.
- Finally, w/VTTS was calculated for each trip and averaged over the NTS sample of trips.

Following this approach, the ratios given in Table 2.4 were calculated. With respect to the primary surface modes, it is notable that the ordering of the wage rate is rail > car > bus, which follows the *a priori* expectation. However, the w/VTTS ratio shows the

ordering car > bus > rail, across the range 4.9 to 2.1, with an average of 4.7. Therefore, whilst rail has the highest wage rate, it also has the lowest w/VTTS ratio, indicating that the VTTS for rail is disproportionately high, when comparing the same ratio across modes.

Table 2.4: w/VTTS estimates based on the 2014-15 behavioural model and 2010-12 NTS sample (2014 prices and values)

Mode	Average w/VTTS	Standard deviation w/VTTS	Wage rate (£/hr)
Bus	3.6411	4.3660	9.2782
Rail	2.0913	1.6105	15.4834
Other PT	2.8905	1.5984	14.8782
Car	4.9426	6.5370	14.7113
All modes	4.6542	6.2425	14.5152

Coupled with the conclusion from section 2.3.6 that VoL/w=1.23, this gives rise to a VoL/VTTS ratio:

$$\frac{VoL}{VTTS} = \frac{VoL}{w} \times \frac{w}{VTTS} = 1.23 \times 4.65 = 5.72 \quad (13)$$

Relating this result to Arup et al.'s (2015) recommended VTTS of £5.12 per hour (2014 perceived prices) for ONW journeys from the 2014-15 study, application of the 5.72 multiplier would imply a VoL of £29.28/hr. Such an estimate of VoL is not only considerably in excess of the recommended VTTS for ONW, but also at the upper limit of the VTTS for business journeys (commensurate with long distance business journeys by rail).

Intuition tells us that this ratio is rather high. Bearing in mind the paltry size of the dataset for estimating VoL, it is not possible to conduct a formal statistical test, but it would not seem unreasonable to conclude that the VoL is not demonstrably different from the wage rate, i.e. implying VoL/w ≈ 1. Such a multiplier is intermediate between the mean values given in the third and fourth columns of Table 2.3, and falls within two standard deviations of the upper bound of 1.23. On this basis, VoL/VTTS is downrated somewhat to:

$$\frac{VoL}{VTTS} \approx 1 \times 4.65 = 4.65 \quad (14)$$

Given a VTTS for ONW of £5.12/hr, equation (14) would imply a VoL of £23.81 – a value somewhat greater than the all-distance and all-mode VTTS for business journeys estimated in 2014-15 of £18.23/hr, but not as extreme as that implied by (13).

2.4 Findings

An academic literature of 11 studies conducted across a range of countries has been reviewed and analysed, with the objective of eliciting an indicative multiplier for VoL

/VTTS, which can be applied to DfT's recommended VTTS in TAG and thereby derive an approximation to VoL for the UK. **Whilst repeating caveats around the quantity and quality of the available evidence, this analysis has estimated a value of leisure (VoL) of around 4.65 times the value of travel time savings.**

In empirical terms this might seem to yield a rather large multiplier, but reference back to the theory in section 1, together with some deduction, will help to put this result into context. Recall the key definition:

Value of travel time savings (VTTS) = Value of leisure (*VoL*) *– Value of time assigned to travel* (*VTAT*)

Which can be re-stated equivalently as follows, given equilibrium in the allocation of time to work and leisure:

Value of travel time savings (VTTS) = Wage rate (w) + Value of work (*VoW*) *– Value of time assigned to travel* (*VTAT*)

If $VoL/VTTS \approx 1 \times 4.65 = 4.65$, then it must be the case that:

$$VTTS = (4.65 \times VTTS) - VTAT \quad (15)$$

Implying that:

$$VTAT = 3.65 \times VTTS \quad (16)$$

That is to say, the unit value of time assigned to travel *per se* is more than three times that of VTTS as a whole, equating to £18.69/hr in monetary terms (i.e. based on a VTTS of £5.12/hr in 2014 perceived prices).

Furthermore, it must be the case that:

$$VTTS = w + VoW - (3.65 \times VTTS) \quad (17)$$

Implying that:

$$w + VoW = 4.65 \times VTTS \quad (18)$$

Based on the average wage (of £14.52/hr) and VTTS (of £5.12/hr) from the 2014-15 study (Table 2.4), this implies that VoW, i.e. the unit value of work above and beyond wage reward/compensation, is worth £9.29/hr (or around two-thirds of the wage rate). More generally, given the above definitions, it must be the case that, if VoL>w then VoW>0, whereas if VoL<w then VoW<0.

Thus, based on the empirical evidence for VoL, combined with the VTTS and wage rate from the 2014-15 UK national VTTS study, the unit values given in Table 2.5 can be estimated or deduced.

Table 2.5: Summary of unit values estimated or deduced (2014 prices and values)

	£/hr
Value of travel time savings (VTTS)	5.12
Wage rate (w)	14.52
Value of leisure (VoL)	23.81
Value of work (VoW)	9.29
Value of time assigned to travel (VTAT)	18.69

3 Task 3: theoretical and practical considerations which could give rise to further adjustments to the VTTS

3.1 Opening comments

This section considers a number of technical issues highlighted in section 1.3, which are potentially relevant to the transferability of DfT's VTTS for leisure journeys from the transport context to the finance context. In particular, two broad sets of issues are explored – concerning the treatment of representativeness and reference dependence – through re-analysis of the dataset from the 2014-15 UK national VTTS study.

3.2 Background to the estimates of VTTS from the 2014-15 study

As noted in section 2.3.7 above, Arup et al. (2015) recommended that a VTTS of £5.12 per hour (expressed in 2014 perceived prices) for other non-work (ONW) journeys should be implemented in TAG. This recommendation was subsequently accepted by DfT[4], and is applicable to leisure journeys across all modes of transport, and has over time been uprated to current day values using standard practices accounting for economic growth amongst other things. **This is the unit value presently used by the FCA, when assessing the time impacts of its interventions on consumers.**

To arrive at a figure of £5.12 per hour, various steps were undertaken which are briefly summarised here. The data collection for the 2014-15 UK national VTTS study targeted users of four different modes (car, bus, rail and other public transport users) across three journey purposes (commute, business and other non-work). Since the FCA has adopted the ONW value for its appraisals, only this journey purpose is considered here. Each traveller surveyed was invited to make trade-offs between travel cost and travel time in the context of what is known as a Stated Preference (SP) (or more specifically a Stated Choice (SC)) survey (see Figure 4.1). This technique involves presenting a sample of travellers with a series of hypothetical choices between faster/more expensive vs. slower/cheaper journey alternatives. By examining the choices made, it is possible to infer the travellers' willingness-to-pay (WTP) for a reduction in travel time.

For each of the four travel modes, a separate statistical choice model was estimated to explain the responses to the aforementioned trade-offs. The four choice models directly estimated the VTTS for a given mode of transport, and allowed this to vary by socio-economic characteristics (e.g. gender, age, income), trip characteristics (e.g.

[4] Although, for reasons unknown, DfT slightly adjusted the figure eventually implemented in TAG – to £5.14/hr. The present report retains the £5.12/hr figure, in order to maintain consistency with the dataset which was collected in 2014-15 and is re-analysed here.

time, cost, distance) and reference dependence. The latter phenomenon accounts for the fact that consumers are more sensitive to losses than gains – a concept first introduced by Tversky & Kahneman (1991). Relating this to the transport context, travellers are generally found to be more sensitive to travel time when additional time is added to a reference trip, as opposed to when time is saved. Similarly, travellers are assumed to be more sensitive to travel cost when having to paying more relative to a reference trip, as opposed to when paying less.

Given four different functional forms (i.e. for each mode) and numerous factors influencing the VTTS, it was something of a challenge to derive a representative national average value suitable for implementation in TAG. To overcome this challenge, a process of sample enumeration was employed, which comprised the following three steps:

1. National Travel Survey data from 2010 to 2012 was used (which was the latest NTS data available at the time of undertaking the study). For each ONW trip recorded in the NTS, the mode of transport was identified alongside the relevant trip characteristics and the socio-economic characteristics of the traveller. Using the relevant mode-specific functional form, the VTTS for each such trip was calculated.

2. To translate the trips recorded in the NTS data to a representative sample of trips for England, expansion weights were applied. This is a standard variable included in the NTS, which takes a value more (less) than one if, for example, trips of a given distance occur relatively more (less) frequently than recorded in the NTS. The 2014-15 study added two further options for adjusting the expansion weights. First, it allowed for distance weighting, by multiplying the standard expansion weight by the distance of the trip. Second, it allowed for income weighting. For full details of these weighting procedures see Chapter 7 of the 2014-15 study report (Arup et al., 2015). Note that the VTTS of £5.12 per hour (2014 perceived prices) was based on the standard NTS expansion weight in combination with distance weighting – and income weightings were not in this case applied.

3. A weighted average was taken across all ONW trips and all four modes of transport, where the weights were based on step 2 above.

One of the key reasons for averaging the VTTS for ONW across all modes was that differences in the VTTS observed for different modes could not be solely attributed to comfort effects (i.e. as would manifest in the VTAT term introduced in equation (1) of this report), but were also due to differences in the travellers using these modes (as would manifest in the VoL term). Since these different effects could not be straightforwardly disentangled, it was decided that the VTTS for ONW should be an

all-modes value – which indeed had been the existing practice in TAG prior to the 2014-15 study.

In what follows, the 2014-15 analysis has been revisited in order to explore two sets of phenomena which potentially affect the transferability of the VTTS for ONW trips from the transport context to the finance context, namely:

1. Differences between the travelling population included in the NTS and the population relevant to the FCA.
2. The treatment of reference dependence effects (comprising both gains and losses, and size and sign effects).

3.3 Adjustment I: Differences in the population of interest

The Financial Lives Survey (FLS) provides an excellent opportunity to compare the population relevant to the FCA with the population sampled by the NTS.[5] Contrasting the 2010-2012 NTS data with the headline demographic characteristics of the 2022 FLS[6], the following set of socio-economic characteristics have all been shown to influence the VTTS and were also included in the FLS survey:

a) Gender
b) Age
c) Household income
d) Number of adults in the household
e) Number of children in the household
f) Self-employment status

Table 3.1 summarises the characteristics of the NTS and FLS populations sampled on the selected socio-economic characteristics. The first observation to make is that the differences between the two datasets are relatively minor. Relative to the FLS, the NTS slightly under-represents the age cohorts below 40 years old and has some under-representation of the higher household income categories. Moreover, the NTS data has slightly more females, households with two adults, households with children, and self-employed.

[5] Since the NTS survey is representative for England and the FLS is representative for the UK, the adjustments are accordingly representative for the UK under the implicit assumption that the VTTS is the same across the different nations comprising the UK.

[6] Note that an inconsistency here is that the FLS 2022 is compared to the NTS 2010-2012 without accounting for changes in the general population and income bands over time – but such changes are generally minor and would not be expected to have a material impact on the resulting multipliers.

Table 3.1: Comparing the NTS 2010-2012 and the FLS 2022 sample on selected socio-economic variables

Variable	Description	NTS 2010-2012[+]	FLS 2022[#]	FLS variable
Gender	% females	52.24%	50.60	D1
Age	18-21*	5.34%	6.00%	PD2D3_1
	22-29*	12.62%	13.49%	
	30-39	16.66%	17.26%	
	40-49	20.66%	16.22%	
	50-59	16.74%	17.10%	
	60-69	16.49%	13.12%	
	70+	11.49%	16.81%	
Household income (per year or per annum)	Less than £5,000	2.24%	3.31%	D38DV
	£5,000 to £9,999	5.02%	6.04%	
	£10,000 to £14,999	8.26%	7.46%	
	£15,000 to £19,999	7.30%	8.27%	
	£20,000 to £29,999	14.73%	14.21%	
	£30,000 to £39,999	12.16%	12.45%	
	£40,000 to £49,999	16.07%	10.22%	
	£50,000 to £59,999	6.60%	7.89%	
	£60,000 to £69,999	5.69%	5.65%	
	£70,000 to £99,999	7.44%	8.91%	
	More than £100,000**	14.51%	15.58%	
Number of adults in the household	1	14.69%	19.09%	D4a
	2	57.76%	52.02%	
	3	16.11%	19.31%	
	4	8.58%	6.71%	
	5+	2.86%	2.87%	
Number of children in the household	0	70.17%	72.85%	D7b
	1	14.72%	13.03%	
	2	11.71%	10.44%	
	3	2.68%	2.80%	
	4	0.57%	0.64%	
	5+	0.16%	0.24%	
Self employed	% of self-employed	9.13%	6.17%	D10

[#] The FLS figures are rebased figures excluding prefer not to say for gender, number of adults in the household, and number of children in the household

[+] NTS 2010-2012 statistics are based on the implicit weights after applying the expansion weights.

* In the NTS data these two age categories are 17-20 and 21-29, instead of 18-21 and 22-29.

The sample enumeration process described above can however be adjusted to account for these minor discrepancies between the two populations of interest. The original trips included in the NTS and their corresponding VTTS as calculated in Step 1 are maintained, but Step 2 'corrects' for over- or under-representation of specific socio-economic groups by any given variable a) to f). That is to say, the expansion weights for each trip are adjusted such that the total weight does not change, but for example trips made by females now receive a smaller weight whereas trips made by men receive a slightly higher weight. Following this procedure, the implicit representation of each category after correction then matches with the FLS 2022 characteristics as presented in Table 3.1. Step 3 then proceeds as before, thereby yielding a weighted average VTTS based on the FLS 2022 population. Steps 1 to 3 are repeated for each of the variables a) to f).

Note that any differences in the resulting VTTS (i.e. based on FLS as opposed to NTS) may arise because i) the relevant variable a) to f) has a positive or negative impact on

the VTTS in the choice model, and ii) people with these characteristics make a given type of journey associated with a higher or lower VTTS. An example of the former is that higher income households have a higher VTTS. An example of the latter is that such households may also make longer trips which are also associated with a higher VTTS.

The results in Table 3.2 highlight that the minor differences between the NTS and FLS populations have a very limited impact on the VTTS for other non-work journeys. Age has the most notable impact on the VTTS; through now giving greater weight to the age cohorts below 40 and above 70, the VTTS drops by 0.64%, giving a value of £5.08 per hour. The impacts of the remaining five variables on the VTTS are negligible.

Table 3.2: VTTS measures based on the adjusted expansion weights to match the FLS 2022 population

	VTTS (£/hr)	Ratio
Original recommended VTTS of the 2014/15 study	5.12	
Adjustment for: Gender	5.12	1.0015
Adjustment for: Age	5.08	0.9936
Adjustment for: Household Income	5.12	1.00004
Adjustment for: Number of adults in the household	5.10	0.99628
Adjustment for: Number of children in the household	5.12	1.0007
Adjustment for: Self employed	5.10	0.9975

3.4 Adjustment II: Treatment of reference dependence

As mentioned above, the formulation of the choice models assumes that when travellers make trade-offs between travel time and travel cost, they display traits of reference dependence in relation to both variables. The respondents have all been intercepted on a given trip – which is taken to be the 'reference trip' with corresponding reference travel time and cost. The travel times and costs in the trade-off scenarios are varied positively and negatively around the reference trip. In this context, we can identify two particular scenarios. First, a willingness-to-pay (WTP) scenario where a respondent is paying more (i.e. monetary loss) for a quicker journey (time gain) than the reference trip. Second, a willingness-to-accept (WTA) scenario where a respondent is being compensated (i.e. monetary gain) for a slower journey (time loss). From economic theory, the presence of income effects would generally imply that WTA>WTP. However, reference dependence affects these WTP and WTA values through so-called 'size' and 'sign' effects.

3.4.1 Size effects

Size effects are associated with non-linearity in the time and cost sensitivities. It is assumed that as the size of the difference in time (or cost) relative to the reference trip increases, the time (or cost) sensitivity either increases or decreases. For example, if the alternative journey is already thirty minutes longer than the reference trip ($\Delta t =$

30 mins), then adding an additional minute of travel time to that journey may be either more negative (i.e. where the traveller is increasingly intolerant to further travel time) or less negative (i.e. where the traveller is increasingly ambivalent to further travel time). In a similar vein, adding a pound to an already much more expensive journey may be hardly noticeable to travellers.

3.4.2 Sign effects

Sign effects are associated with the direction of change in time and cost. Under sign effects, travellers are assumed to be more sensitive to travel time and cost losses and less sensitive to travel time and cost gains. In terms of the sensitivities discussed in relation to size effects, this means that losses increase these sensitivities and gains reduce these sensitivities for any given size effect. If we assume, in its simplest form, that VTTS is given by the ratio of the travel time sensitivity over the travel cost sensitivity, then lower time sensitivities due to quicker journeys divided by higher cost sensitivities due to more expensive journeys will result in lower WTP estimates relative to WTA estimates. Contrariwise, WTA estimates are associated with higher time sensitivities due to slower journeys which are divided by lower cost sensitivities due to cheaper journeys, thereby amplifying the VTTS. The larger the sign effect, the more significant the discrepancy between WTP and WTA estimates.

The choice models estimated in the 2014-15 study embody this property, but to limit the impact of reference dependence on the VTTS, an averaging procedure was implemented to arrive at a 'reference free' VTTS (Hess et al., 2017). It should however be noted that this averaging procedure controls only for sign effects – whereas size effects persist. As such, to arrive at the VTTS of £5.12 per hour for ONW journeys (i.e. the value recommended by Arup et al. (2015) in 2014 perceived values), it was necessary to make an assumption concerning 'deltaT' (Δt), i.e. the absolute change in travel time from the reference trip. Based on examination of the data and consultation with DfT, it was decided to settle on an assumption of $\Delta t = 10$ minutes.

Mindful that the practical contexts of interest to DfT and FCA may embody different features in terms of size and sign effects, the analysis that follows explores the sensitivity of the VTTS for ONW journeys to alternative assumptions in this regard. The analysis proceeds by first separating out the WTP and WTA components from the original averaging procedure (Adjustment 2a), before then testing the sensitivity of the VTTS to deltaT (Adjustment 2b).

3.4.3 Adjustment 2a: separating out WTP and WTA values

Some policies introduced by the FCA may realise time savings for consumers of financial products and services, whereas other policies may impose time losses. Therefore, it may be of interest to FCA to develop specific WTP- or WTA-based VTTS. Obtaining these WTP and WTA estimates requires adjustments to Step 1 of the sample enumeration process. Instead of using the geometric mean across the WTP and WTA

values, which is the current practice, the analysis conducted here elicits separate WTP and WTA values for each trip in the NTS sample. In effect, this serves to 'reintroduce' sign effects[7] alongside size effects, where intuition suggests that WTA for time losses > WTP for time gains. The formulae for retrieving the WTP and WTA values are presented in De Borger & Fosgerau (2008, section 2.3) and these have been adjusted here for the functional form adopted by Hess et al. (2017).

The implementation of these adjusted formulae produces surprising results. For certain trips in the NTS data, the geometric mean falls outside of the WTP-WTA range, whereas for other trips the WTA value is smaller than its corresponding WTP value. By transferring the relevant VTTS formulae from the SP data (on which they have been estimated) to the NTS data (the application sample), it is not guaranteed that for all possible values of the input variables, the resulting behaviour is consistent with loss aversion.[8] More precisely, in the calculation of the WTP, WTA and averaged VTTS measures, the size effect Δt is scaled by a parameter θ. The latter term captures various forms of heterogeneity in the VTTS (i.e. the impact of socio-economic and trip characteristics on an individual's VTTS). Although θ is always positive in the application sample, it covers a very wide range. When taking the power of that parameter, especially when it becomes very small, the relationship between WTP, WTA and their geometric average is not always consistent with the underlying theory of reference dependence as estimated (on average) on the SP sample.[9]

The aforementioned anomaly has not been previously reported in the VTTS literature, because that generally only works with the geometric mean and does not derive all three welfare measures simultaneously. Addressing this issue therefore falls outside the scope of the present study. Moreover, it precludes estimation of WTP and WTA relative to the original VTTS measure at the level of the population average. Nevertheless, there is sufficient evidence to draw inferences on the relationship between the WTP, WTA and geometric mean VTTS for values of θ which are consistent with theory.

For the three travel modes (car, rail and other public transport) for which loss aversion was identified in the choice models, relevant statistics for the VTTS, WTP and WTA at specific levels of theta θ are given in Table 3.3. For simplicity, it can be assumed that higher values for θ represent longer trips (which are associated with higher VTTS),

[7] Recall that DfT's VTTS seeks to neutralise size effects by adopting an averaging procedure across gains and losses.

[8] Neither has this been verified in the estimation sample, i.e. the SP data.

[9] De Borger & Fosgerau (2008) take the geometric average before deriving the VTTS and hence the mean can fall outside of the WTP-WTA range.

made by travellers who are willing to pay more for travel time savings (e.g. higher income households, self-employed etc.).

Table 3.3: Contrasting WTP and WTA estimates across different modes and distances

Car								
ϑ		VTTS (£/hr)	WTP (£/hr)	WTA (£/hr)	Consistent	$\frac{WTP}{VTTS}$	$\frac{WTA}{VTTS}$	$\frac{WTA}{WTP}$
min	0.02	0.00	0.01	0.00	No			
Q1 (25%)	1.29	0.86	0.80	0.91	Yes	0.94	1.07	1.14
Mean	2.75	2.23	1.91	2.61	Yes	0.86	1.17	1.37
Median	2.09	1.58	1.39	1.78	Yes	0.88	1.13	1.28
Q3 (75%)	3.41	2.93	2.44	3.52	Yes	0.83	1.20	1.44
max	95.05	198.99	111.35	355.62	Yes	0.56	1.79	3.19
Rail								
ϑ		VTTS (£/hr)	WTP (£/hr)	WTA (£/hr)	Consistent	$\frac{WTP}{VTTS}$	$\frac{WTA}{VTTS}$	$\frac{WTA}{WTP}$
min	0.33	0.15	0.17	0.14	No			
Q1 (25%)	3.84	3.41	2.80	4.15	Yes	0.82	1.22	1.48
Mean	6.56	6.72	5.18	8.71	Yes	0.77	1.30	1.68
Median	5.61	5.51	4.33	7.01	Yes	0.79	1.27	1.62
Q3 (75%)	8.2	8.91	6.69	11.88	Yes	0.75	1.33	1.78
max	67.72	129.49	75.46	222.19	Yes	0.58	1.72	2.94
Other Public Transport								
ϑ		VTTS (£/hr)	WTP (£/hr)	WTA (£/hr)	Consistent	$\frac{WTP}{VTTS}$	$\frac{WTA}{VTTS}$	$\frac{WTA}{WTP}$
min	0.97	0.78	0.71	0.87	Yes	0.90	1.11	1.24
Q1 (25%)	3.08	2.85	2.56	3.17	Yes	0.90	1.11	1.24
Mean	5.02	4.92	4.42	5.46	Yes	0.90	1.11	1.24
Median	4.37	4.21	3.79	4.68	Yes	0.90	1.11	1.24
Q3 (75%)	6.83	6.93	6.24	7.71	Yes	0.90	1.11	1.24
max	14.24	15.76	14.18	17.51	Yes	0.90	1.11	1.24

Table 3.3 reveals that the VTTS, WTP and WTA measures are indeed increasing with θ. It is only for the shortest journeys with lowest VTTS in the car and rail samples that reversal occurs in the ordering of the three values of interest. Furthermore, for the car and rail samples, the range of, and ratio between, WTA and WTP increases with θ. This is a direct result of the differences in size effects between the gain and loss domains estimated for these samples. These non-linearities were not present in the other public transport sample, and here the relative ratios between WTA, WTP and VTTS are constant across θ. Note that due to distance weighting in the sample enumeration, greater weight is given to longer trips; hence the discrepancy between WTA and WTP may be greater at the sample level than at the mean and median. Nevertheless, based on the observed ratios and noting that bus journeys are not associated with WTA-WTP discrepancies, the indication is that:

- WTP estimates are around 10-15% lower than the VTTS and;

- WTA measures are around 15-20% greater than the VTTS.

In order to arrive at more definitive results, it would be necessary to resolve the problem of inconsistent values detected for part of the sample.

3.4.4 Adjustment 2b: sensitivity to the value of deltaT

This part of the analysis only considers the VTTS estimates at their geometric average and studies the impact of changing the absolute values for Δt (i.e. not distinguishing between gains and losses). Table 3.4 presents a range for Δt between 1 and 60 minutes. Note again that $\Delta t = 10$ is assumed as the reference point in TAG, and this gives rise to the VTTS for ONW journeys of £5.12 per hour across all modes.

Table 3.4: Impact of deltaT on the VTTS

Δt (min)	**All mode VTTS (£/hr)**	**Ratio vs. Δt =10**	**Step size**
1	2.97	0.580	-
2	3.49	0.682	0.519
3	3.84	0.750	0.349
5	4.33	0.847	0.495
10 (default)	5.12	1.000	0.784
15	5.64	1.103	0.528
20	6.05	1.183	0.409
25	6.39	1.249	0.339
30	6.68	1.306	0.292
35	6.94	1.357	0.258
40	7.17	1.402	0.232
45	7.38	1.443	0.211
50	7.58	1.482	0.194
55	7.76	1.517	0.181
60	7.93	1.550	0.169

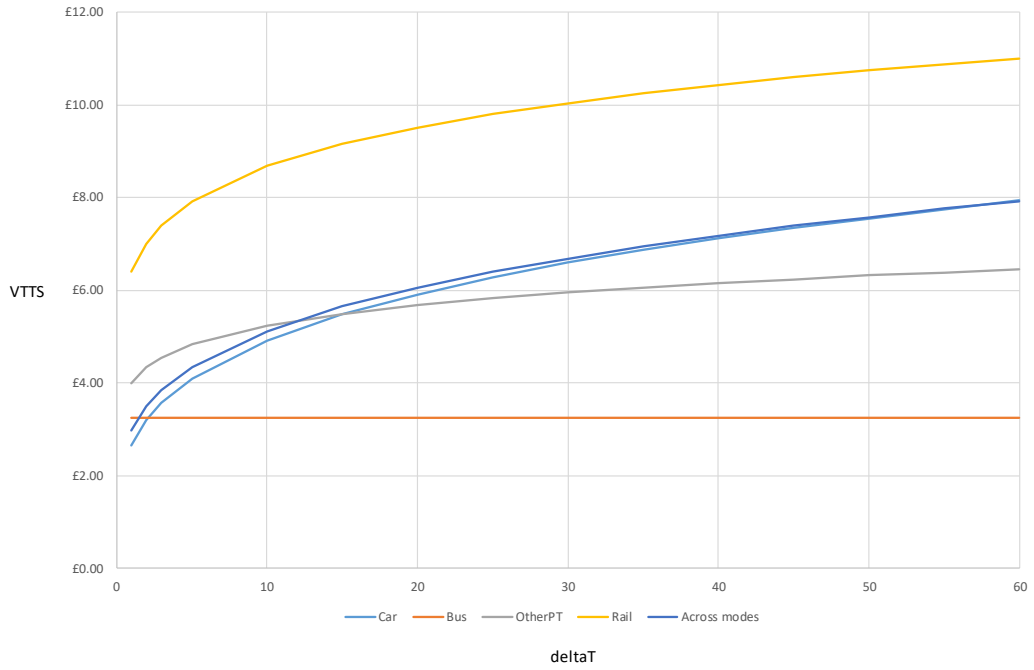


Figure 3.1: Plot of VTTS by deltaT

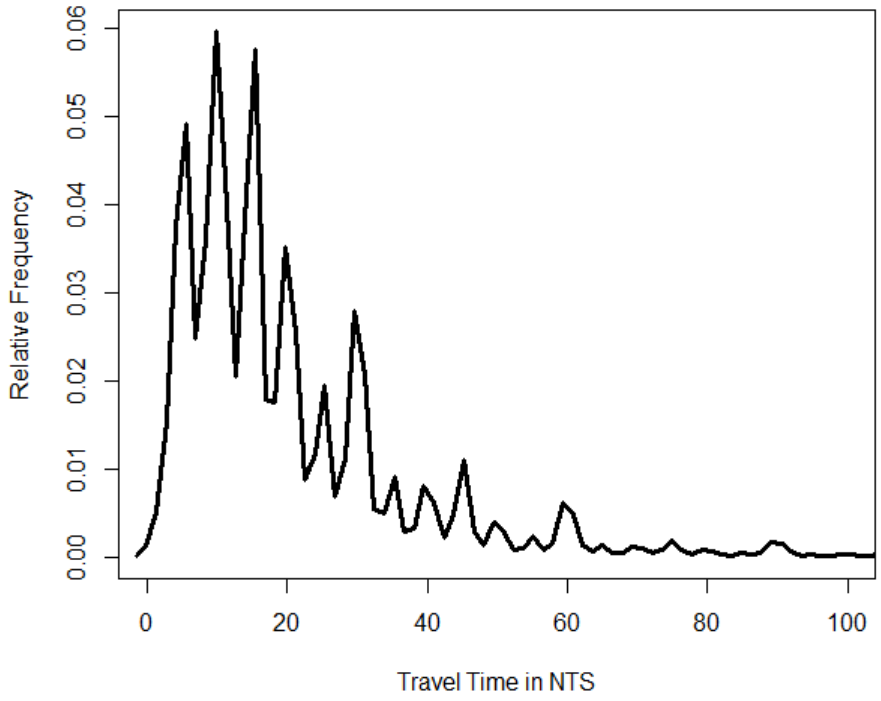


Figure 3.2: Distribution of travel times in the NTS

In common with the impact of θ, VTTS is increasing in Δt – which can be seen more clearly when plotting this relationship in Figure 3.1. The final two columns of Table 3.4 indicate that the speed at which the ratio (relative to $\Delta t = 10$) increases and accordingly the step size (relative to the preceding value of Δt) is decreasing as Δt gets

larger. At the upper extreme of $\Delta t = 60$, the VTTS across modes is 55% higher than at $\Delta t = 10$. It should however be noted that the evidence base for such large changes in travel time is limited. As shown by Figure 3.2, most journeys included within the NTS are shorter than 40 minutes and therefore such large time differences should be extrapolated with caution.

3.5 Findings

The 2014-15 UK national VTTS dataset has been revisited, in order to analyse two phenomena which potentially affect the transferability of the VTTS for ONW trips from the transport domain to the finance domain, namely:

- Differences between the travelling population included in the NTS and the population relevant to the FCA.
- The treatment of reference dependence effects (comprising both gains and losses, and size and sign effects).

The analysis has found only very slight disparities between the NTS and FLS populations, such that the NTS offers a defensible representation of the population of interest to FCA. That said, multipliers have been estimated which could be used to adjust the VTTS for these slight disparities (Table 3.2).

The analysis has also highlighted the features of reference dependence within DfT's values, finding that there is a potential case to adjust VTTS if: a) there is interest in specific WTP (i.e. for time savings) or WTA (i.e. for time losses) values, rather than the 'average' value adopted by DfT; or b) there is an interest in a deltaT value (i.e. the absolute time saving/loss) that varies from the 10 minutes assumed by DfT. Again, multipliers have been estimated which could be applied to VTTS to adjust for these effects (Tables 3.3 and 3.4).

It should however be noted that the vast majority of the adjustments implied by these multipliers are minor. The multipliers imparting most influence on VTTS are those associated with size effects, which will serve to reduce VTTS for deltaT<10 mins, and increase VTTS for deltaT>10 mins.

4 Task 4: brief commentary outlining the scale and scope of DfT's 2014-15 VTTS study

4.1 Opening comments

The purpose of this section is to present a brief commentary outlining the scale and scope of DfT's 2014-15 VTTS study and how this might compare to an analogous study focussed on financial products and services.

4.2 Background to the 2014-15 study

In 2009, DfT took steps to review the theoretical, methodological and evidential basis of its VTTS guidance. Apart from annual updates to reflect changes in incomes, the guidance had not been materially updated since the previous study, which was conducted in 1994 study by Accent and Hague Consulting Group (published some years later as AHCG (1999)), and re-analysed by ITS Leeds (Mackie et al, 2003) before being committed to guidance.

Among the key actions taken by DfT were the commissioning of scoping studies concerning the valuation of travel time for both non-work and business. Informed by these scoping studies, the Department commissioned new market research to deliver updated evidence on values of travel time and reliability, and the resulting £1.4M tender was awarded to the Arup/ITS Leeds/Accent consortium.

The study was conducted in two phases, across a challenging timeframe of 11 months. Phase 1 of the study involved the development and testing of methods for undertaking the requisite market research. Phase 2 involved a substantial field survey and detailed modelling to complete estimation of the values of travel time using the collected data.

4.3 Scope

The Department specified the following aims for the research:

- To provide recommended, up-to-date national average values of in-vehicle travel time savings, covering business and non-work travel, and based on primary research using *'modern, innovative methods'*.
- To investigate the factors which cause variation in the values (e.g. by mode, purpose, income, trip distance or duration, productive use of travel time etc.) and use this to inform recommended segmentation of the values.
- To improve understanding of the uncertainties around the values, including estimating confidence intervals around the recommended values.
- To consistently estimate values for other trip characteristics for which values are derived from the values of in-vehicle time savings.

In pursuit of these aims, the study employed an analysis framework based upon the primary dimensions of trip purpose and mode of travel (see Table 4.1). Within this framework, it is appropriate to make a few 'high-level' comments:

- With reference to mode of travel, the walk & cycle research encountered significant methodological challenges, and the eventual focus was narrowed to the mechanised modes of car, bus, rail and 'other public transport (PT)'[10].
- With reference to trip purpose, business travel was analysed from the perspectives of both the employee and employer.
- The principal methodology for eliciting measures of willingness-to-pay (WTP) to save travel time was Stated Preference (SP), but some analysis (limited to rail) was undertaken using Revealed Preference (RP) for purposes of validation.
- For each mode/purpose combination, three SP games were developed, considering trade-offs of time vs. money (SP1), time vs. money vs. reliability (SP2) and time vs. money vs. quality (SP3).
- The surveys collected comprehensive background data concerning the traveller and trip, which were used to analyse variations in VTTS.

Table 4.1: Summary of the survey design

		Trip Purpose				SP Experiments	Covariates
		Commute	Other Non-Work	Employees' Business	Employers' Business	SP1: Time SP2: Time & Reliability SP3: Time & Quality (e.g. crowding, congestion and other types of time)	Income Distance/Duration Productive Time Trip Type etc.
Mode of travel	Car	SP	SP	SP	SP		
	Bus	SP	SP	N/A	N/A		
	Rail	SP & RP	SP & RP	SP & RP	SP		
	Other PT	SP	SP	SP	SP		
	Walk & Cycle	SP	SP	N/A	N/A		

Notes: N/A = Deemed not to be applicable on the grounds that trip rates are relatively low; SP = Stated Preference; RP = Revealed Preference.

[10] Comprising tram, light rail and London Underground.

4.4 Design and implementation of the market research

The study involved a substantial market research exercise, beginning with qualitative research, then questionnaire/experimental design, two rounds of pilot surveys, and then a full field survey.

4.4.1 Qualitative research

Qualitative research was first conducted in certain areas of the brief that were considered to involve particular challenges; these areas included the valuation of business travel time savings, the presentation of reliability, and the presentation of car use costs. This qualitative research informed the design of the SP and RP experiments, as well as the development of the questionnaires more generally. Cognitive depth interviews tested the flow, comprehensibility and wording of the questionnaires.

4.4.2 Stated Preference (SP) design

Table 4.2 summarises the context and content of the SP experiments.

Table 4.2: Summary of principal SP formats by game and mode

Game and mode	Description of SP format
SP1	SP1 used a generic format across all modes, presenting respondents with an 'abstract' choice between two options described only on the basis of travel time and travel cost, where one option was cheaper, but the other option was faster.
SP2	SP2 also presented respondents with an abstract binary choice, still focussing on travel cost and travel time but where, for travel time, five different typical trip outcomes were presented for each alternative as a representation of travel time variability.
SP3	SP3 used somewhat different presentations across modes, whilst nevertheless retaining an abstract binary choice context, as described for each mode below.
SP3 car	For car, the two options were described in terms of travel cost for each trip and the amount of time that each trip spends in three types of driving conditions (free-flow, light traffic, heavy traffic).
SP3 rail	For rail, two different experiments were used: For the first group, we presented a choice similar to SP1, with the difference that for each alternative we additionally defined the level of crowding applying to the trip. For the second group, we presented a choice between up to three operators, described in terms of travel time, fare and headway.
SP3 bus	For bus, two different experiments were also used. For the first group, we presented a crowding game analogous to the rail game, albeit with different crowding definitions. For the second group, we presented a choice between two bus routes described in terms of free-flow time, slowed down time, dwell time, headway and fare.
SP3 other PT	For other PT, two different experiments were again used. For the first group, we presented a crowding game analogous to the bus game. For the second group, we presented a mode choice game (other PT against either bus or rail) using time, headway and cost as attributes.

Examples of SP1 and SP2 for car are presented in Figures 4.1 and 4.2 respectively.

Figure 4.1: Time vs. cost experiment (SP1) for car

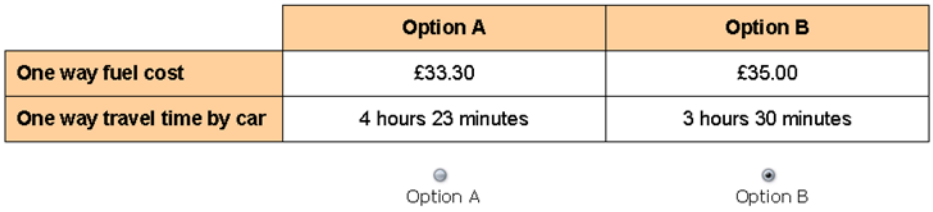
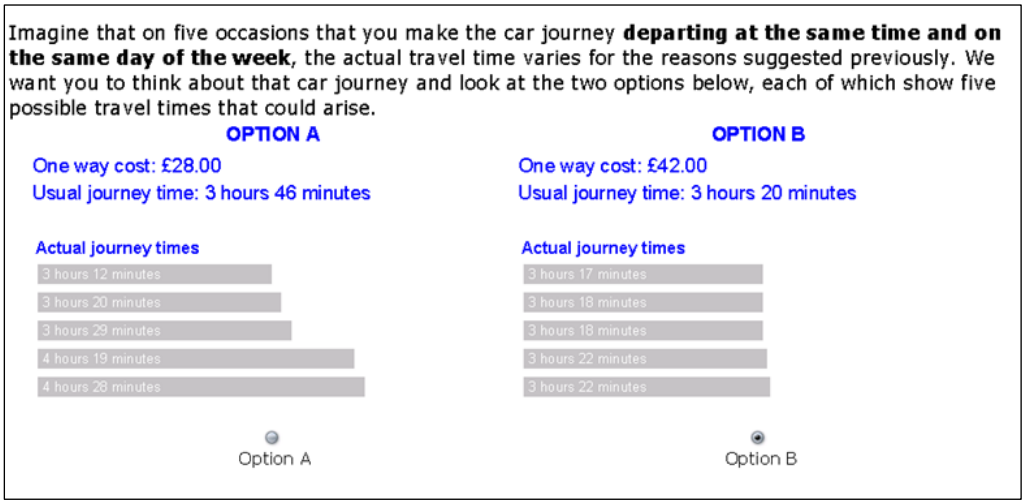


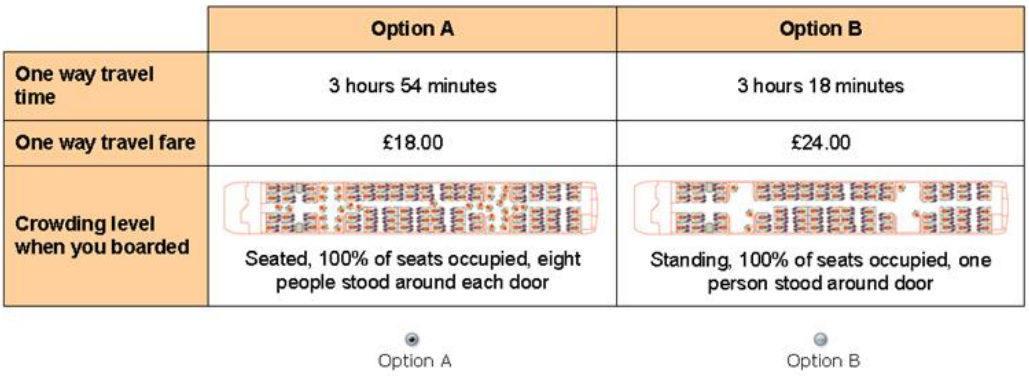
Figure 4.2: Time vs. cost vs. reliability experiment (SP2) for car



Figures 4.3 and 4.4 present examples of SP3 for car and rail, respectively, where the car game considers congestion and the rail game considers crowding.

Figure 4.3: Time vs. cost vs. quality experiment (SP3) for car

Figure 4.4: Time vs. cost vs. quality experiment (SP3) for rail



The SP designs for this study were based upon the concept of Bayesian D-efficiency, which can give more precise parameter estimates when used appropriately (Rose and Bliemer, 2014). As well as developing different designs different games (e.g. SP1-3), designs were optimised for the specific values of attributes and priors of interest, in two respects. First, separate designs were developed for business and non-business, allowing the former to be geared towards their likely higher willingness-to-pay. Second, surveys presented respondents with trips 'pivoted' around the travel time and cost of the 'reference trip' they were making when intercepted or had recently made.

4.4.3 General public SP market research method

The core research method for the SP survey was 'intercept' recruitment (80% of recruits) followed by on-line or telephone interviews; this was supplemented by telephone recruitment (20%) again with on-line or telephone completion. The 'intercept' survey recruited travellers during a break in their journey, at the likes of bus stops, rail stations and motorway service stations. By collecting information about the journey being made, it was possible to design a customised SP survey for each traveller based around this 'reference' journey. The telephone survey followed a similar approach, but instead asked the respondent to recount a recent journey they had made. The rationale for this 80/20 mixed approach was that intercept recruitment is more likely to survey travellers who travel more frequently and/or make longer distance trips, whereas telephone recruitment allows correction for any self-selection in the intercept survey by capturing travellers who travel less frequently/shorter distance. On a more practical level, another attraction of the intercept approach is that interviewers can be located where the target respondents are – thereby permitting some efficiencies in the data collection effort.

The intercept survey was administered face-to-face using Android tablets. Interviewers approached a random sample of adults (typically 1 in 3) and asked scoping questions to check whether each respondent was in-scope and matched required quotas. If in-scope, the respondent was invited to undertake a follow-up survey either on-line or by phone. Figure 4.5 shows the intercept locations, which

were designed to cover car, rail, bus and other PT users across England (with some cross-border flows into Scotland and Wales). For the general public telephone sample, Random Digit Dialling (RDD) sample of landline numbers was purchased that geographically represented the population of England as shown in the 2011 Census by region.

Figure 4.5: Maps of the intercept survey locations for rail, car, bus and other PT

Rail SP locations

Car locations

Bus locations

Other PT locations

4.4.4 Employers' business SP market research method

This survey focussed on so-called 'briefcase' travellers and deliberately omitted operational functions undertaken by the likes of service engineers, travelling sales forces, delivery agents etc. The surveys were administered by telephone, and the target respondent was '*the person within the company who was responsible for making decisions about how employees travel for business purposes, for example when travelling to meet clients, customers or suppliers or when travelling between different offices within their organisation'*.

The telephone sample was supplied by Sample Answers and used LBM Direct Marketing and Experian Business Files, which in turn were based on data from Thomson Directories and Companies House. Telephone numbers were randomly drawn from this sample.

4.4.5 Incentives

All participants were offered a £10 incentive (an Amazon or Boots voucher or a donation to a charity) on completion of the main questionnaire. Towards the end of the fieldwork period, some participants were offered a £20 incentive to help meet certain quotas. In total, 3% of the general public sample and 25% of the employers sample received £20. For employers, these participants were more likely to be rail users and from larger companies, as these were the quota groups that were being targeted at this stage of the survey.

4.4.6 Implementation of field surveys

Fieldwork took place between 24th October and 15th December 2014. The latter date was a 'hard' deadline agreed with DfT, so as to avoid conducting survey work during the Christmas and New Year period when travel behaviour might be atypical.

With regards to the general public SP survey, 8,623 interviews were undertaken against an overall target of 8,500. The number of interviews exceeded both the overall target, and most of the mode/purpose segment targets. The shortfall for some targets, particularly other PT employees' business and bus commuting, were due to a shortage of business/commute travellers at the survey locations identified for those modes (Table 4.3).

Table 4.3: Total completed SP interviews (on-line and CATI) by mode and purpose (targets in parentheses)

Mode		Commute		Other non-work		Employees' business		Total
Car	(1,000)	1,032	(1,000)	1,037	(1,000)	956	(3,000)	3,025
Bus	(500)	371	(500)	672	(0)	N/A	(1,000)	1,043
Rail	(1,000)	998	(1,000)	1,128	(1,000)	1,010	(3,000)	3,136
Other PT	(500)	614	(500)	540	(500)	265*	(1,500)	1,419
Total	(3,000)	3,015	(3,000)	3,377	(2,500)	2,231	(8,500)	8,623

*Includes 22 bus

With regards to the employers' business SP survey, the target of 400 employers' business interviews was achieved, although there was a shortfall on the largest businesses.

Table 4.4: Total SP interviews (CATI completion) by mode and number of employees (targets in parentheses)

Mode	Target	Actual
Car	(194-257)*	244
Train	(130-194)*	143
Other PT	N/A	13
Number of employees	**Target**	**Actual**
1-19	(67)	74
20-49	(67)	73
50-249	(133)	149
250+	(133)	104
Total	(400)	400

* Other PT dropped, remaining interviews split between rail and car (agreed revised minimum for rail of 130).

To give an indication of the success of the recruitment approach, Tables 4.5 and 4.6 show the total number of 'contacts' for the general public SP survey, with breakdown by those contacts recruited and those 'lost' for one reason or another. As might be expected, the intercept-based approach – which targeted existing users of specified modes – was considerably more successful in recruiting respondents (71% on average) as compared with the telephone-based approach (6%) – which simply entailed random sampling of residential landlines.

Table 4.5: General public SP survey intercept recruitment

	Total %	Bus %	Rail %	Car %	Other PT %
Recruited	71	72	79	62	76
Refusals	11	19	6	16	14
Drop-outs	2	3	2	3	2
Out-of-scope	15	6	13	19	7
Sample size	39,475	3,757	9,993	10,403	5,462

Table 4.6: General public SP survey telephone recruitment

Recruitment outcome	Total %
Recruited	6
No reply/answerphone	50
Refusal	31
Number not recognised/fax/business etc.	8
Out-of-scope	4
Sample size	31,960

For the intercept-recruited respondents as a whole (i.e. across all surveys), the overall response rate was 37%. Of those recruited, 93% supplied an e-mail address for the on-line survey, whilst 7% supplied a phone number for the follow-up telephone survey; the response rate was the same for both approaches. For the CATI-recruited respondents as a whole, the response rate was 61% for those who were in-scope and recruited.

4.5 Estimation of behavioural values of travel time

The SP data was subjected to extensive analysis using the methodology of choice modelling – the primary objective being one of eliciting estimates of 'behavioural' values of travel time savings (VTTS) and value of travel time reliability (VoR), as well as insight into key sources of variation in those values, especially by mode and trip purpose. This analysis involved various stages:

- Preliminary work was undertaken to ensure that the data met appropriate quality standards.
- Initial models were developed for each mode and SP game (i.e. SP1-3) separately.
- Having identified the set of covariates applicable to each mode and game, SP1-3 were jointly modelled for each mode, and there was extensive testing of covariates of VTTS.
- Developing the models further, additional elements of functionality were introduced, for example incorporating sign and size effects, the productive use of travel time, and different formulations of random error.
- Finalised model specifications for each mode/purpose combination were identified.

4.6 Estimation of appraisal values of travel time

The final stage of analysis involved 'converting' the behavioural VTTS estimated by choice models from the SP data into appraisal VTTS suitable for implementation in DfT's TAG guidance.

As explained in section 3 of this report, the primary consideration in this regard is one of 'representativeness'. Whilst the intercept/telephone survey approach sought to capture a wide range of travellers and trips, it could not be considered fully representative of the UK travelling population. Therefore, in order to 'correct' for representativeness, a 'sample enumeration' approach was employed. This involved the calculation of VTTS for each observation in the NTS sample of trips during the years 2010-12, followed by the calculation of weighted averages over the sample. While NTS is also a sample, it contains a set of weights aimed at achieving a representative picture of national travel. In order to provide maximum flexibility for the Department, an 'Implementation Tool' was developed in 'R', which allowed the calculation of appraisal values for different segments and based on a variety of weighting options.

As well as correcting for representativeness, there was extensive analysis of key sources of variation in the values – reconciling various considerations in terms of theory, empirics and policy. Resulting from this analysis, the final appraisal values adopted by DfT were formulated on the following basis:

- Business values were based on the employee rather than employer survey, and segmented by mode.
- In the case of car and rail, business values were also segmented by distance.
- Non-business (i.e. commute and other non-work) values were averaged across modes and distances.

4.7 Postscript

Although commissioned across a challenging timeframe of 11 months, the study was delivered on time and to specification. Following a period of assimilation, DfT released the final report (Arup et al., 2015), along with their own interpretation of the findings and proposals for updating national values of VTTS in TAG (DfT, 2015). DfT then consulted industry stakeholders (DfT, 2016), before finalising their proposals on VTTS and in 2017 issued new TAG guidance. The current version of that guidance (expressed in 2022 prices) is reproduced below (Table 4.7).

4.8 Findings

A brief commentary has been presented, outlining the scale and scope of DfT's 2014-15 VTTS study. In principle, broadly the same set of methods could be deployed in the context of financial products and services to produce a sector-specific estimate of the unit value of time gained or lost by consumers (and indeed businesses) due to the FCA's interventions. However, reflecting on the transferability of the methods from transport to finance, a number of comments can be made.

- A key consideration would be to formulate a clear and meaningful experimental game couched in the finance context, such that consumers can conceptualise the trade-off between time and money, all else equal. The relevant 'payment vehicle' in the finance context is not immediately obvious. In the case of time savings, an appropriate vehicle could perhaps be the professional fee, since a financial adviser can make product applications on behalf of a client, thereby saving the client's time. In the case of time losses, an appropriate vehicle is perhaps the return-on-investment, since a consumer invests time (and money) in making product applications, with the objective of generating a return. However, both approaches could well have their complications.

- In broad terms, FCA would need to decide *a priori* the key dimensions of variability in VTTS that would be relevant to their appraisals, for example whether values should be segmented by consumers vs. business, and whether there should be further segmentations, for example by gains vs. losses, and by different categories of financial products and services. These considerations are analogous to Table 4.1 above pertaining to the transport context – since they dictate the overall scope of the study.

- Unlike the transport context, the survey of consumers of financial products and services could be conducted on-line. With the assistance of organisations operating in this sector, and provided relevant data protection protocols are observed, such a survey could also exploit existing customer databases. Perhaps an SP experiment could even be linked to the Financial Lives Survey. Any of the above could achieve considerable efficiencies in the data collection effort relative to the transport context.

- The detailed analytical procedures of designing SP experiments and estimating discrete choice models on the responses to those experiments embody no transport-specific features and are readily transferable to finance.

- As has been demonstrated in section 3 of this report, the FLS provides a ready analogy to the NTS – in terms of establishing a representative sample of the relevant travellers/consumers of interest – which can be exploited to translate estimates of VTTS from behavioural models into nationally representative averages suitable for use in appraisal.

Notwithstanding the above points, a more fundamental question is whether there is a strong case for FCA to undertake an analogous study in the finance context. Whilst acknowledging that the practice of transferring values from transport to finance represents an approximation, this should be offset against the fact that time gains/losses are typically a minor contributor to the costs and benefits estimated in FCA's CBAs. It is questionable whether the commitment of funds to a study of similar

scale as DfT's (£1.4M for the main study, plus a number of prior scoping studies) would be proportionate.

If however FCA were interested in further exploring the possibility of undertaking a bespoke study, then a sensible next step would be to undertake a scoping study to explore the candidate valuation methods (not limited to SP), the possible format of the experimental games including payment vehicle, the relevant data collection and analysis methods, as well as the implied resource requirements and delivery risks.

Table 4.7: Current version of DfT's TAG guidance on VTTS, as at February 2023

Table A 1.3.1: Values of Working (Employers' Business) Time by Mode (£ per hour, 2022 prices, 2022 values)			
Mode	**Factor Cost**	**Perceived Cost**	**Market Price**
Car driver	21.60	21.60	25.70
Car passenger	21.60	21.60	25.70
LGV (driver or passenger)	15.29	15.29	18.19
OGV (driver or passenger)	17.62	17.62	20.97
PSV driver	17.35	17.35	20.64
PSV passenger	12.24	12.24	14.56
Taxi driver	16.70	16.70	19.88
Taxi / Minicab passenger	21.60	21.60	25.70
Rail passenger	35.63	35.63	42.39
Underground passenger	12.24	12.24	14.56
Walker	12.24	12.24	14.56
Cyclist	12.24	12.24	14.56
Motorcyclist	21.60	21.60	25.70
Average of all working persons	23.52	23.52	27.99
Values of Non-Working Time by Trip Purpose (£ per hour, 2022 prices, 2022 values)			
Trip Purpose	**Factor Cost**	**Perceived Cost**	**Market Price**
Commuting	12.15	14.46	14.46
Other	5.55	6.60	6.60

Formula for employers' business value of time by mode (car and rail only) (£ per hour, 2022 prices, 2022 values)

$$VTTS = \frac{U}{\left(1 + e^{\frac{x_{mid} - D}{k}}\right)}$$

Parameter definitions for employers' business value of time by mode	
Parameter	**Description**
D	distance (km)
VTTS	value of time
U	upper limit (asymptote) of function
Xmid	distance at the inflexion point of the curve (where *VTTS* = *U* /2)
k	scale parameter (inversely proportional to the steepness of the curve)

Parameter values for employers' business value of time by mode		
Parameter	**Car**	**Rail**
U (factor cost)	£36.04	£52.99
U (perceived cost)	£36.04	£52.99
U (market price)	£42.89	£63.06
Xmid	66.53	107.04
k	67.02	63.95
VTTS where *D=0* (factor cost)	£9.74	£8.37
VTTS where *D=0* (perceived cost)	£9.74	£8.37
VTTS where *D=0* (market price)	£11.60	£9.96

Values of Working (Employers' Business) Time by mode per person (distance banded)			
Mode	**Resource Cost**	**Perceived Cost**	**Market Price**
Car (driver or passenger) 0-50km	12.24	12.24	14.56
Car (driver or passenger) 50-100km	19.79	19.79	23.55
Car (driver or passenger) 100-200km	26.86	26.86	31.97
Car (driver or passenger) 200km+	34.54	34.54	41.10
Rail passenger 0-50km	12.24	12.24	14.56
Rail passenger 50-100km	19.79	19.79	23.55
Rail passenger 100-200km	34.46	34.46	41.01
Rail passenger 200km+	49.72	49.72	59.16

Source: DfT TAG Databook, accessed 27th February 2023

5 Drawing everything together

The purpose of this section of the report is to synthesise the analysis conducted under Tasks 1 to 4 of this study, and thereby inform the conclusions which follow in section 6.

5.1 Rationalising the theoretical basis of transferring DfT's value of time for leisure

Section 1 developed a commentary to rationalise the theoretical basis for FCA's practice of employing DfT's unit value of travel time savings (VTTS) for leisure journeys as a proxy for the unit value of time gained/lost by consumers as a result of FCA interventions. The following key definition was introduced:

Value of travel time savings (VTTS) = Value of leisure (*VoL*) *– Value of time assigned to travel* (*VTAT*)

If there is equilibrium in the allocation of time to work and leisure, then this can be re-stated equivalently:

Value of travel time savings (VTTS) = Wage rate (w) + Value of work (*VoW*) *– Value of time assigned to travel* (*VTAT*)

In principle, the VoL term is sector-generic and thus transferable from transport to finance[11]. By contrast, the VTAT term is specific to the transport sector. Whilst intuition suggests that there will be an analogy to this in the finance sector – which might be referred to as the *value of time assigned to finance* (*VTAF*) – there currently exists no empirical evidence on its value.

Of course, the ideal would be to conduct a bespoke valuation study in the finance context to estimate a sector-specific version of 'VTTS' – i.e. given by the difference between VoL and VTAF – and section 4 of this report outlined what this would entail. That said, this would require non-trivial investment by FCA, and it is debatable whether such a commitment would be proportionate when time gains/losses are typically a minor contributor to the costs and benefits in FCA's CBAs. On this basis, the research conducted in this study has sought to build assurance around FCA's practice of transferring values from transport, under effectively two scenarios.

[11] Slight discrepancies in the socio-economic characteristics of travellers and consumers of financial products/services have been identified, but these are unlikely to be material.

5.2 Scenario I

This scenario considers that the value of time assigned to travel represents a reasonable proxy for the value of time assigned to finance (i.e. VTAT≈VTAF) – such that DfT's VTTS for leisure journeys can be readily transferred to the financial products/services context.

That said, even under this scenario, there is opportunity to strengthen transferability further:

- depending on the representativeness of the sample;
- depending on whether time is gained or lost;
- depending on the 'deltaT' assumption, i.e. the absolute size of the time gain/loss relative to the reference point.

5.2.1 Representative sample

In the course of DfT's 2014-15 national VTTS study, behavioural estimates of VTTS were re-weighted using the National Travel Survey (NTS) to elicit representative averages of VTTS for application in appraisal. If, however, the UK population of consumers of financial products/services (as represented in the Financial Lives Survey (FLS)) is materially different from the UK population of travellers (as represented in the NTS), then there is a case for adjusting the TAG value accordingly.

With reference to Table 5.1, it can be seen for example that if DfT's VTTS for ONW journeys is adjusted for the difference between the gender splits in the NTS and FLS, then this implies that a multiplier of 1.0015 should be applied to the TAG value (i.e. factoring up by 0.15%). Similarly, adjusting for the age distribution implies a multiplier of 0.9936 (i.e. factoring down by 0.64%), and so on. Each of the multipliers reported in Table 5.1 is close to unity, but if all six multipliers are treated collectively as independent effects, then their product gives rise to an overall multiplier of 0.9895 (i.e. factoring down the TAG value by 1.05%).

Table 5.1: Multipliers for re-weighting representative sample

	Multiplier of TAG value
Gender	1.0015
Age	0.9936
Household income	1.0000
No. of self-employed	0.9962
No. of adults	1.0007
No. of children	0.9975
Combined	**0.9895**

5.2.2 Time gains and losses

The behavioural VTTS for leisure journeys estimated in the course of the 2014-15 UK national study derives from hypothetical time vs. money trade-offs embodying both time savings/gains (in exchange for monetary payment by the traveller) and time losses (in exchange for monetary compensation to the traveller) – wherein losses are valued more highly then gains. The appraisal values which appear in TAG do not however distinguish between gains and losses. This is because the behavioural model employed an averaging procedure over gains and losses, eliciting what is commonly described as a 'reference free' VTTS (at least in terms of gains vs. losses, but see below for the treatment of size effects)[12].

That said, there would seem to be something of a contrast between the operating contexts of DfT and FCA, since DfT's interventions are usually concerned with time gains/savings, whereas FCA's interventions are often concerned with time losses. For this reason, it seemed useful to 'undo' the aforementioned averaging procedure, with the objective of eliciting separate VTTS for time gains and losses.

This was attempted as part of the work undertaken here (see section 3.4.4 on separating out WTP and WTA values) but was not completely successful – further work beyond the scope of the present study would be required to fully resolve this. However, from the work carried out, it is possible to report the indicative multipliers given in Table 5.2 – such that the TAG value should be factored down by 0.9 in the case of time gains, and factored up by 1.15 in the case of time losses.

Table 5.2: Indicative multipliers for gains vs. losses

	Multiplier of TAG value
Reference free	1.0000
Gains	0.9000
Losses	1.1500

5.2.3 DeltaT

The behavioural VTTS for leisure journeys estimated in the course of the 2014-15 UK national study are sensitive to the so-called 'deltaT' parameter. This refers to the absolute time gain/loss relative to the reference point, which in the case of the 2014-15 study was the journey the traveller was undertaking when surveyed[13]. Therefore, in translating behavioural values into values suitable for use in appraisal, an assumption must be made regarding deltaT. Guided by empirical evidence from the

[12] See earlier comment in section 1.3.3 on DfT's position in this regard.

[13] At least this was the approach used for the intercept survey, which constituted 80% of the sample – see the discussion in section 4.4.3.

2014-15 study, in combination with findings from other national VTTS studies, DfT opted for a deltaT of 10 minutes. In other words, the TAG value assumes that, on average, DfT's interventions (which would typically be some form of new or renewed infrastructure) realise a time saving of around 10 minutes per journey.

Table 5.3: Multipliers for deltaT

deltaT	Multiplier of TAG value
1	0.5804
2	0.6819
3	0.7501
5	0.8468
10	**1.0000**
15	1.1031
20	1.1831
25	1.2494
30	1.3065
35	1.3569
40	1.4022
45	1.4435
50	1.4815
55	1.5168
60	1.5498

If FCA's interventions in the financial products and services markets realise a time saving (or loss) markedly less or more than 10 minutes[14], then there is a case for adjusting the TAG value accordingly. With reference to Table 5.3, it can be seen for example that if deltaT were 5 minutes rather than 10, then a multiplier of 0.8468 should be applied – thereby factoring down the VTTS. On the other hand, if deltaT were 15 minutes, then VTTS should be factored up by 1.1031. Caution should however be exercised in adopting multipliers for deltaT>40, since there is less confidence in the extrapolation beyond this level since most journeys in the NTS have a length shorter than 40 minutes[15].

5.3 Scenario II

This scenario considers that DfT's VTTS for leisure journeys undervalues the corresponding value in the financial products/services context. In particular, this

[14] In finance, presumably this would be per interaction (with financial services) or per transaction (with financial products).

[15] More generally, it should be noted that the level of confidence around these multipliers will gradually diminish as deltaT increases – for the simple reason that the NTS journey length distribution is highly skewed (i.e. capturing more short journeys than long journeys).

scenario considers the polar case where the value of time assigned to finance is zero (i.e. VTAF=0), such that VTTS reduces to the value of leisure (VoL).

Such a scenario could be rationalised as representing a 'pure' value of leisure unpolluted by travel-related factors, because the VoL is in principle directly transferable to other domains such as financial products/services. Under this scenario, VTTS captures the full opportunity cost of reallocating time from leisure to financial products and services (and *vice versa*), but omits the direct (positive and negative) utilities of spending time on financial products/services (or assumes that such utilities net to zero[16]).

These direct utility implications may reflect displeasure (e.g. heightened financial worries) or pleasure (e.g. improved financial security) resulting from the activity, as well as the actual financial benefits associated with spending more time on financial products/services (assuming customers are able to make more informed decisions as a result).

Since evidence on the size of VTAF, representing these direct utility implications, is in any case unavailable, it seems an appropriate sensitivity test to adopt the neutral standpoint VTAF=0 – where the positive and negative utility implications are omitted or cancel each other out.

That said, it is not a straightforward exercise to extract VoL from VTTS, and indeed this exercise is rarely undertaken in VTTS studies[17]. Therefore, section 2 of this report reviewed 11 academic studies, conducted across a range of countries, which *have* sought to extract distinct estimates of VoL. The objective of this exercise was to elicit an indicative multiplier for VoL/VTTS, which could then be applied to DfT's recommended VTTS in TAG, and thereby derive an approximation to VoL for the UK.

Since the majority of these 11 studies focus on the estimation of VoL, and only a minority estimate VTTS, the analysis was undertaken in two stages: firstly, by eliciting estimates of the ratio of VoL to the wage rate (i.e. VoL/w), and secondly, by employing evidence from the 2014-15 UK national VTTS study to calculate the ratio of the wage rate to DfT's VTTS (i.e. w/VTTS), thereby enabling the ratio (VoL/VTTS) to be derived for the UK.

Based on this analysis, it was found that the VoL/VTTS ratio for the UK is approximately 4.65. This means that, if the travel-specific aspects of time are extracted from DfT's TAG value (i.e. VTAT=0), then the 'pure' value of leisure time is worth approximately

[16] For example, VTAT would net to zero where the disutility (utility) of time assigned to finance is exactly offset by a positive (negative) return on the investment.

[17] This exercise was not within the scope of the 2014-15 UK national VTTS study.

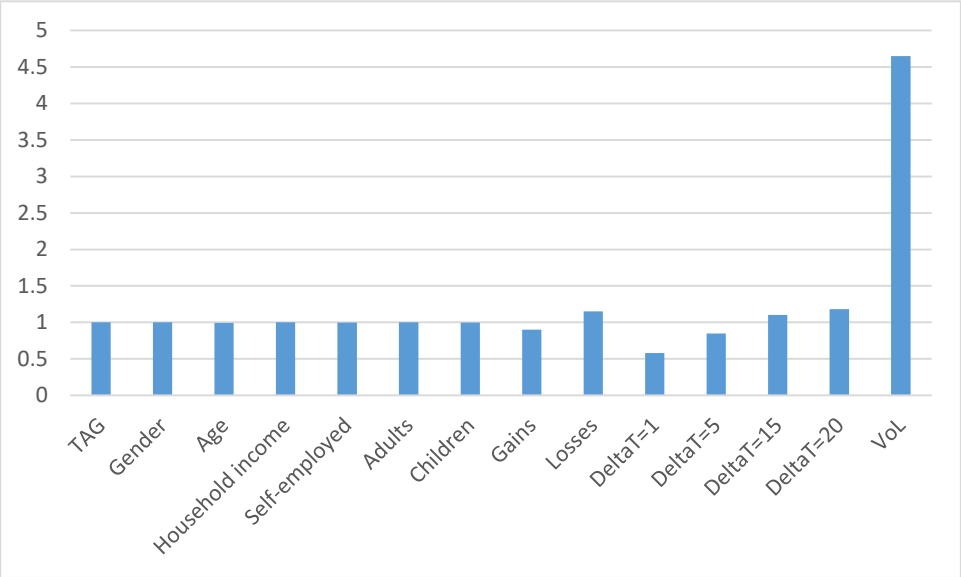
4.65 times the TAG value. This gives us an upper bound that could potentially be used by FCA in appraisal.

Whilst proposing 4.65 as an upper bound for the VTTS multiplier, it is important to stress that this should only be used with justification as to why there would be no (net) utility benefit from spending time on financial products/services relative to leisure activities. In most practical contexts of interest to FCA, the application of this multiplier will overstate the actual VTTS in the finance domain, because it does not account for the value of time assigned to finance (VTAF).

5.4 Summary of multipliers

Various multipliers emanating from scenarios I and II are summarised in Figure 5.1, expressed in terms of DfT's VTTS for leisure journeys in TAG which is assigned a multiplier of one.

Figure 5.1: Summary of multipliers



5.5 Implications for FCA practice

5.5.1 The baseline VTTS

Broadly speaking, the research conducted here supports FCA's practice of adopting DfT's VTTS for leisure journeys as a proxy for time gained/lost by consumers of financial products and services. This is for three reasons:

- Time gains/losses are typically a minor contributor to costs and benefits in FCA's CBAs, and it is questionable whether the commitment of funds to a sector-specific study would represent a proportionate response delivering good value-for-money.

- In the absence of any definitive evidence on the value of time assigned to finance (VTAF), it seems reasonable to conclude that VTAF is a number greater than zero and that the value of time assigned to travel (VTAT) represents the best available proxy. Indeed, such an interpretation is consistent with criteria given in HMT's Green Book for the transfer of DfT's values to other domains (as detailed earlier in footnote 1).
- When testing the sensitivity of the VTTS under Scenario I, most of the resulting multipliers are close to unity.

5.5.2 What does DfT's value represent?

As noted previously, the value adopted by FCA is DfT's value of travel time savings for other non-work (ONW) journeys as appears in TAG, which is a nationally representative average value across all travel modes and both time gains and losses, assuming a change in travel time from the reference journey (i.e. deltaT) of 10 minutes.

5.5.3 Sensitivity tests under Scenario I (i.e. where the value of time assigned to travel represents a reasonable proxy for the value of time assigned to finance)

Whilst recommending DfT's VTTS as the baseline, there is opportunity to strengthen assurance around this baseline through the following sensitivity tests.

Test 1: Representativeness of the sample

The first test, which should be implemented as a matter of course, is to adjust for the representativeness of the sample by applying the combined multiplier 0.9895 to DfT's VTTS (Table 5.1).

There is perhaps an argument for adopting this value as FCA's baseline value rather than as a sensitivity test, but it should be noted that each of the multipliers reported in Table 5.1 is very close to one (implying that the NTS population offers a very good proxy to the FLS population), and that the combined multiplier of 0.9895 is based on an assumption that the various multipliers in Table 5.1 represent independent effects (when in practice this is unlikely to be the case). All things considered, it is recommended that DfT's VTTS is retained as FCA's baseline value, with the 0.9895 multiplier being adopted as a sensitivity test.

In cases where FCA's interventions are targeted at specific consumer groups, there might also be an argument for the more disaggregated multipliers given in Table 3.2. However, any such practice would seem to depart from the notion of a representative consumer – and it would be sensible to consider the broader equity and efficiency implications of this before proceeding.

Test 2: Reference dependence

Since FCA's interventions tend to impose time losses on consumers rather that realise time gains, there is a case for applying the (indicative) multipliers given in Table 5.2.

If furthermore the anticipated time gain/loss resulting from a given FCA intervention is markedly different from the 10 minutes assumed by DfT, then there is a case for also applying the multipliers in Table 5.3. Note that deltaT<10 minutes would imply downrating the TAG value, whilst deltaT>10 minutes would imply uprating. Caution should be exercised in adopting the multipliers for deltaT>40 minutes, since there is less confidence in the estimated multipliers beyond this point.

5.5.4 Sensitivity tests under Scenario II (i.e. where the value of time assigned to finance is zero)

In effect, the baseline VTTS and sensitivity tests 1 and 2 assume that VTAT=VTAF. In cases where the latter assumption is considered questionable, then an **alternative**[18] sensitivity test would be to assume VTAF=0, such that VTTS reduces to the value of leisure (VoL).

Test 3: Value of time assigned to finance is zero

In practice, this entails applying a multiplier of 4.65 to the TAG value, giving a VTTS in the region of the wage rate[19]. This multiplier should be seen as very much an upper bound, which is applicable only where justification can be given as to why there would be no (net) utility benefit from spending time on financial products/services relative to leisure activities.

5.5.5 Example

Assume that a given FCA intervention involves a requirement for financial services providers to issue additional advice to consumers to help them choose an investment solution that is aligned to their objectives. It is estimated that, on average, this entails an additional 30 minutes of disclosure.

Based on the synthesis presented above, a range of sensitivity tests could be formulated on the VTTS pertaining to this intervention, as shown in Table 5.4 (with the relevant multipliers given in brackets).

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[18] Since Scenario II implies a lack of confidence in the transferability DfT's VTTS, it is not recommended that the additional multipliers from Scenario I are applied (which are intended to 'fine tune' values that are essentially transferable).

[19] Note that some of the earlier FCA appraisals actually used the wage rate rather than VTTS to value consumers' time.

- The baseline is the currently recommended VTTS – which is a direct transfer of DfT's all-mode ONW value here expressed in 2022 prices (baseline 1.000).
- Sensitivity test 1 applies a multiplier (0.9895) to correct the sample for representativeness.
- Sensitivity test 2 also applies multipliers to adjust for the intervention imposing a time loss (1.15), and for the magnitude of time loss being more than 30 minutes (1.3065).
- Sensitivity test 3 **instead** applies the 4.65 multiplier to reflect a situation where the utility benefit from spending time on financial products/services relative to leisure nets to zero.

This produces a VTTS in the range £6.60/hr to £30.69/hr. Sensitivity test 3 should only be used in specific circumstances as detailed above.

Table 5.4: Indicative sensitivity tests

Scenario	Rationale	Baseline	Test 1	Test 2	Test 3
I	representative sample	1.0000	0.9895	0.9895	1.0000
I	time loss	1.0000	1.0000	1.1500	1.0000
I	deltaT=30 mins	1.0000	1.0000	1.3065	1.0000
II	value of time assigned to finance is zero	1.0000	1.0000	1.0000	4.6500
	overall multiplier	1.0000	0.9895	1.4867	4.6500
	VTTS for ONW (£/hr 2022 prices/values)	6.60	6.60	6.60	6.60
	Implied VTTS (£/hr 2022 prices/values)	6.60	6.53	9.81	30.69

6 Conclusions

C1 In the context of appraising the costs vs. benefits of time lost/gained by consumers of financial products and services due to the FCA's interventions, the practice of transferring DfT's unit values of travel time savings represents a reasonable approximation.

C2 Following from C1, DfT's 'all-mode' value of travel time savings for the other non-work (ONW) journey purpose represents the most appropriate basis for this transfer.

C3 Notwithstanding C1, it should not be overlooked that the transfer of values of time from transport to finance represents an approximation – which will likely be subject to some degree of error. It would therefore be prudent for FCA to review the basis of this practice at regular intervals, taking into account relevant considerations from both policy and analysis perspectives, including: a) the likely degree of error; b) the options for mitigating that error through further analysis; c) the cost of commissioning a valuation study bespoke to the finance context; d) the proportionality of action c), given the contribution of time gains/losses to FCA CBAs.

C4 Should FCA wish to explore the commissioning of a bespoke valuation study, then an appropriate next step would be to first commission a scoping study from an appropriate supplier. Such a study should consider the candidate valuation methods, the possible format of the experimental games including payment vehicle, data collection and analysis methods, resource requirements, and delivery risks.

C5 In order to give additional assurance around the practice of transferring values from transport to finance, this report has proposed a series of sensitivity tests which could be conducted around the baseline of DfT's VTTS. As a next step towards implementation, it would be advisable for FCA to 'road test' these sensitivity tests, so as to determine their usefulness and the practical impact on FCA CBAs.

C6 In cases where FCA's interventions target specific consumer groups (for example, those on low incomes, or those above retirement age), there could be an argument for developing further sensitivity tests which customise VTTS accordingly. However, if there is appetite to explore this possibility, then it would be sensible for FCA to consider the broader equity and efficiency implications of departing from the notion of a single representative consumer.

C7 In the course of preparatory work undertaken by FCA before commissioning this study, it has become apparent that DfT's values of travel time are used as a proxy not only by FCA but also by the Department for Business, Energy & Industrial

Strategy (BEIS). There is perhaps a case for some form of cross-Whitehall co-ordination on this topic – with DfT logically in the lead, but also involving FCA, BIES, HMT and any other interested departments.

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