



OECD Environment Working Papers No. 70

Environmental and Related
Social Costs of the Tax
Treatment of Company Cars
and Commuting Expenses

Rana Roy

<https://dx.doi.org/10.1787/5jxwrr5163zp-en>

ENVIRONMENT DIRECTORATE

ENV/WKP(2014)7
Unclassified

**ENVIRONMENT WORKING PAPER No. 70 - ENVIRONMENTAL AND RELATED SOCIAL COSTS
OF THE TAX TREATMENT OF COMPANY CARS AND COMMUTING EXPENSES**

By Rana Roy

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Authorised for publication by Simon Upton, Director, Environment Directorate.

JEL Classification: H20, H30, Q51, R41

Keywords: Tax benefit, Tax induced behaviour, Environmental effects, Vehicles, Company cars

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JT03362732

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ABSTRACT

This paper builds upon a recent OECD paper on the personal tax treatment of company cars and commuting expenses in OECD member-countries and aims to arrive at a better understanding of the environmental and related social costs of the tax treatment described therein.

The paper begins with an analysis of the larger transport market, which is the primary storehouse of evidence on the nature and extent of the environmental impacts of the various transport modes, the relative importance of the proximate and underlying determinants of these impacts, and the elasticities and functional relationships at work. Non-linearities in the relevant elasticities and functional relationships mean that the tax treatment of company cars may have a greater or lesser impact than is suggested by the size of the company car market. And distortions in relative prices between competing modes in the larger transport market mean that subsidies can have very different impacts depending on the mode in question.

The further analysis of the interaction of the current tax treatment of company cars and commuting expenses with the transport market yields several findings. The current under-taxation of company cars is likely to result in a disproportionately large increase in total distance driven, composed of both an increase in the number of cars in use and an increase in distance driven per car. In turn, this is likely to result in disproportionately large impacts on most relevant environmental and related social costs. And a favourable tax treatment of commuting expenses generally, and of employer-paid parking in particular, is likely to impact on the choice of transport mode in favour of the car relative to public transport and non-motorised modes. In turn, this is likely to impact on most relevant environmental and related social costs.

An Annex to this paper provides, for the OECD group of countries as a whole, some indicative estimates of the main relevant impacts of the under-taxation of company cars as well as an indicative estimate of its overall social cost. The largest quantified cost elements are additional congestion costs; additional local air pollution costs; and additional traffic accident costs. The overall social cost attributable to the current under-taxation of company cars is estimated at *circa* EUR 116 billion per year.

JEL Classification: H20, H30, Q51, R41

Keywords: Tax benefit, Tax induced behaviour, Environmental effects, Vehicles, Company cars

RÉSUMÉ

Ce document fait fond sur une récente étude de l'OCDE sur le traitement des voitures de société et des frais de déplacement domicile-travail dans le cadre de l'impôt sur le revenu des personnes physiques dans les pays membres de l'OCDE. Il vise à mieux cerner les coûts environnementaux et les coûts sociaux connexes de ce traitement.

Le document s'ouvre sur une analyse du marché des transports en général, qui offre le principal gisement d'informations sur la nature et l'ampleur des incidences environnementales des différents modes de transport, sur l'importance relative des déterminants immédiats et sous-jacents de ces incidences, ainsi que sur les élasticités et les relations fonctionnelles qui entrent en jeu. Si ces élasticités et relations ne sont pas linéaires, l'impact du traitement fiscal des voitures de société peut être plus fort ou plus faible que ne le laisse penser la taille du marché de ces voitures. En outre, en présence de distorsions affectant les prix relatifs des modes concurrents sur le marché des transports en général, les subventions peuvent avoir des répercussions très différentes selon le mode considéré.

Une analyse plus poussée de l'interaction du traitement fiscal actuel des voitures de société et des frais de déplacement domicile-travail avec le marché des transports permet de faire plusieurs constatations. La situation actuelle de sous-imposition de ces voitures est de nature à déboucher sur une hausse disproportionnée de la distance totale qu'elles parcourent, sous l'effet aussi bien de la multiplication des voitures de société en circulation que de l'augmentation de la distance parcourue par chacune. Cette évolution risque elle-même de se répercuter de façon disproportionnée sur la plupart des coûts environnementaux et coûts sociaux connexes. Par ailleurs, un traitement fiscal favorable des frais de déplacement domicile-travail en général, et de la mise à disposition d'une place de stationnement gratuite par l'employeur en particulier, est susceptible de faire pencher le choix du mode de transport en faveur de la voiture plutôt que vers les transports publics et les modes non motorisés, avec là encore des répercussions sur la plupart des coûts environnementaux et coûts sociaux connexes.

L'annexe du document présente, pour les pays de l'OCDE pris dans leur ensemble, des estimations indicatives des plus importantes incidences de la sous-imposition des voitures de société, ainsi que des estimations indicatives de son coût social global. Les principaux éléments quantifiés sont les coûts du surcroît de congestion, du surcroît de pollution atmosphérique locale et du surcroît d'accidents de la circulation. Le coût social global attribuable à la sous-imposition des voitures de société est estimé à environ 116 milliards EUR par an.

Codes JEL : H20, H30, Q51, R41

Mots-clés : Avantage fiscal, Comportement induit par la fiscalité, Coûts environnementaux, voitures de société

FOREWORD

This paper was prepared by Dr. Rana Roy. It builds on the discussion of personal tax treatment and commuting expenses in Harding (2014) and discusses in-depth the environmental and related social costs of this tax treatment.

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ENVIRONMENTAL AND OTHER SOCIAL COSTS OF THE TAX TREATMENT OF COMPANY CARS AND COMMUTING EXPENSES*

1. Introduction

1.1 Purpose, scope and method

Purpose

1. This paper builds upon *Personal Tax Treatment of Company Cars and Commuting Expenses: Estimating the Fiscal and Environmental Costs*¹ and aims to arrive at a better understanding of the environmental impacts of the tax treatment described therein.

2. The findings of that paper most relevant to this one are:

- The personal benefit to employees from the use of a company car is taxed more favourably than wage income in all OECD member countries, and significantly so in most cases.
- Relative to a counter-factual benchmark in which the tax treatment of this benefit and the tax treatment of wage income is neutral as between the two, no more than 50% of the personal benefit to employees from the use of a company car is captured as taxable benefit across the 26 countries for which calculations are reported.²
- The personal benefit to employees includes a “capital component”, a saving in the fixed costs of depreciation, financing, taxes, registration and insurance, and a “distance component”, a saving in the variable costs of fuel, repairs and maintenance. Most countries do not tax this distance component.³ And those that do tax it apply a fixed per kilometre rate regardless of the car’s fuel efficiency and therefore fail to capture the benefit of additional fuel consumed by less fuel-efficient cars.⁴ Consequently, a far lower proportion of this distance component, only 20%, is captured as taxable benefit across the 26 countries, as against 60% of the capital component.⁵
- Of the 26 countries surveyed, only two – Canada and Norway – succeed in capturing more than 90% of the total benchmark benefit.⁶ The estimated average annual subsidy per company car in

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¹ Harding (2014), “Personal Tax Treatment of Company Cars and Commuting Expenses: Estimating the Fiscal and Environmental Costs”, *OECD Taxation Working Papers*, No. 20, OECD Publishing.

² *Ibid.*, Chapter 3.2.3, “Results”. This is the mid-point estimate. Harding (2014) also provides lower and upper bound estimates. But here, as in all other cases, it is the mid-point estimate that is used in the present paper.

³ *Ibid.*

⁴ *Ibid.*

⁵ *Ibid.*

⁶ *Ibid.*, Figure 6.

these two countries is EUR 57 and EUR 240, respectively.⁷ In all other cases,⁸ the average annual subsidy per company car is large enough to suggest *prima facie* the likelihood of its triggering behavioural consequences. The weighted average annual subsidy across the 25 countries is EUR 1 600.⁹

- The tax treatment of commuting expenses in OECD member-countries – that is, whether and how employee-paid costs are deductible and whether and how employer-paid costs and parking are taxed – is much more variable.
- In several of the countries surveyed, employee-paid costs are not deductible and employer-paid costs and employer-provided parking are taxed neutrally.¹⁰ In several others, there is some element of subsidy to commuting, limited in a few cases to commuting by public transport.¹¹

3. This paper investigates the environmental impacts of this “non-neutral” tax treatment. In particular, it aims to arrive at well-founded answers to the following three questions:

- How does the tax treatment of company cars and commuting expenses impact on specific environmental pressures and how large are these impacts?
- Which particular features of the current tax rules have the largest environmental impacts?
- What modification of the tax rules would be required to ameliorate these impacts?

4. Whilst this paper is concerned with environmental impacts, it should be borne in mind that the non-neutral tax treatment in question impacts negatively on several other matters of public interest including, *inter alia*, government revenues,¹² social equity,¹³ the wider macro-economy.¹⁴ These additional concerns underscore the point that the precise extent of the negative environmental impacts is immaterial to the advisability of maintaining the present state of affairs. To conclude in favour of the status quo despite the negative impact on government revenues and potentially on social equity and the wider macro-economy, environmental impacts would need to be, implausibly, positive – and positive by a large margin *to boot*.

⁷ *Ibid.*, Table 11

⁸ See *ibid.*

⁹ *Ibid.*

¹⁰ *Ibid.*, Chapter 4.1, “Taxation of commuting expenses in OECD countries”.

¹¹ *Ibid.*

¹² This is the primary concern of Harding (2014). It estimates the total untaxed benefit from company cars across the countries surveyed at EUR 64 billion per year and the total tax revenue lost at EUR 27 billion per year – see *ibid.*, Table 10.

¹³ For example: a subsidy to company cars typically benefits employees and households with above-average incomes.

¹⁴ For example: under conditions of full or near-full employment, the augmentation of demand for cars as a result of the favourable tax treatment of company cars will lead to a re-distribution of resources from the rest of the economy to the car industry.

Scope and method

5. Intuitively, it seems obvious that the net environmental impact of the subsidy to company cars and commuting expenses is likely to be negative. As has been established over several decades of research, cars generate several negative environmental impacts in the course of their production, use and disposal: demands on scarce resources, emissions resulting in global and local air pollution, accidents, congestion, demands on scarce urban space, and so on. Company cars are an important and growing sub-set of cars in many OECD countries. A subsidy to company cars and commuting expenses is likely to generate *inter alia* an increase in the demand for cars and the distance driven in them. Hence, it is likely to generate negative environmental impacts as argued in Harding (2014).¹⁵

6. This intuition, though correct in itself, is however an insufficient starting point for the purposes of this investigation. It is also necessary to specify, at the outset, a sufficiently comprehensive scope and a sufficiently robust method.

7. The scope of the investigation must be broad enough to include the principal relevant features of the larger set of which company cars are a part: namely, the passenger transport market. The prevalence of negative environmental impacts in this larger market is an indication of the prevalence of sub-optimal taxation of externalities in this market, prior to and independently of the taxation of company cars. Harding (2014) is right to observe that:

“Even if the tax treatment of company cars were neutral relative to that of cash salary, company car use would continue to contribute to inefficient levels of other social costs (like air emissions, congestion and accidents) due to the inadequate pricing of transport-related externalities in some countries.”¹⁶

8. But the significance of this larger context is more directly related to the present investigation than the mere fact that the problem of externalities in the use of company cars would outlive the correction of company car taxation.

9. Thus, the larger transport market is the primary storehouse of evidence on the nature and extent of environmental impacts, the relative importance of the proximate and underlying determinants of these impacts, and the elasticities and functional relationships at work. Non-linearities in the relevant elasticities and functional relationships mean that the tax treatment of company cars may have a greater or lesser impact than is suggested by the size of the company car market: as is shown later, the subsidy to company cars has a disproportionately greater impact on most relevant environmental pressures. And distortions in relative prices between competing modes in the larger transport market mean that subsidies can have very different impacts depending on the mode in question: as is shown later, subsidies to commuting by car are likely to compound pre-existing distortions whereas subsidies to commuting by public transport can help to correct such distortions.

10. The method of the investigation must also be fit for purpose. In particular, it needs to be rigorous enough to distinguish causality from correlation and unique determinants from coincidental co-determinants. As a rule, this is best achieved by the method of counter-factual comparison. That is to say: the true effect of A on B is best measured by comparison to a counter-factual scenario in which B is allowed to operate in the absence of A – in the laboratory (in surveys and modelling) if need be, in the real world if real-world examples can be found.

¹⁵ See Harding (2014), Chapter 3.3 and Chapter 4.2.

¹⁶ *Ibid.*, Executive Summary.

11. The emerging literature on company car taxation provides much useful information on the characteristics of this segment of the market. But much of it has been too reliant on descriptions of the current state of affairs, and on deductive reasoning based on such descriptions, to provide sufficiently robust information and quantification on the impact of the tax rules in question. Fortunately, there are some recent studies which do provide evidence on the impact of real-world changes to the tax treatment of company cars – and provide, thereby, more robust information on the impact of the pre-existing tax rules. There is also some recent survey and modelling evidence that is of direct relevance. When combined with the more extensive evidence from real-world changes to transport taxation in general as well as other insights from this larger field, there is today enough evidence to support at least some well-founded answers to the questions that this paper seeks to address.

1.2 Summary of results

12. The main results arrived at in the course of the investigation may be summarised here as follows:

- The under-taxation of company cars is likely to result in a disproportionately large increase in total distance driven, composed of both an increase in the number of cars driven and an increase in distance driven per car. Conversely, corrections to company car taxation are likely to result in a disproportionately large reduction in total distance driven – and a corresponding mode shift to public transport.
- Because of its disproportionate impact on total distance driven and its components, the under-taxation of company cars is likely to result in disproportionately large impacts on most relevant environmental pressures. Conversely, corrections to company car taxation are likely to result in disproportionately large reductions in the sum of environmental costs.
- There is sufficient evidence to suggest that the widespread and multi-faceted under-taxation of the distance component is more important to environmental outcomes than the under-taxation of the capital component.
- There is insufficient evidence to establish the relative importance of environmental differentiation in company car taxation on the composition of the car fleet and thereby on environmental outcomes.
- There is insufficient evidence to arrive at a judgement on the impact of a favourable tax treatment of commuting expenses on the choice of residential location and commuting distance, and thereby on environmental outcomes.
- There is good reason to suppose that, unless otherwise restricted, a favourable tax treatment of commuting expenses generally, and of employer-paid parking in particular, is likely to impact on the choice of transport mode – in favour of the car relative to public transport and non-motorised modes – and thereby on most relevant environmental pressures.

13. Two conclusions follow from this investigation and its results:

- In regard to company cars: environmental outcomes across the OECD world would be greatly improved by ending the under-taxation of company cars, in particular, the under-taxation of the distance component.

- In regard to commuting expenses: environmental outcomes in the relevant countries would be improved by restricting any favourable tax treatment of commuting expenses to public transport and non-motorised modes.

14. A separate Annex to this paper provides, for the OECD group of countries as a whole, some indicative estimates of the main environmental impacts of the under-taxation of company cars, as well as an indicative estimate of its overall environmental impact – along with the necessary caveat that these estimates are no more than indicative.¹⁷ The indicative estimate reported in the Annex of the overall social cost attributable to the current under-taxation of company cars is *circa* EUR 116 billion per year.

15. This estimate can be compared to the EUR 64 billion per year estimated in Harding (2014) as the total untaxed benefit from company cars across the 26 countries surveyed and the EUR 27 billion per year estimated therein as the total tax revenue lost.¹⁸ The comparison suggests that the social cost of the environmental impacts of the current tax settings is greater than the fiscal cost. Importantly, it also suggests that the loss to society as a whole is greater than the gain to the winners.

2. Cars

2.1 *Environmental impacts of cars: production, use and parking*

16. The environmental impacts of cars have been studied extensively by independent experts, governments and international governmental organisations across the OECD world over several decades. In the European Union, in particular, these impacts have been monitored continuously since the European Commission's Green Paper of 1995,¹⁹ and highlighted most recently in its recent White Paper of 2011.²⁰ The latter may therefore serve duty as a guide to the present discussion.²¹

17. The sum of impacts is extremely complex and is not easily susceptible to a single metric. For the purpose of the present discussion, however, it is possible to assemble most of the relevant information under three separate parts, namely production, use and parking.

18. It is as well to begin with the impacts from the use of cars. It is the use of cars which generates the greater part of their lifecycle impacts. Moreover, it is the demand for the use of cars as a mode of transport that drives both the demand for their production and the demand for parking space.

Use

19. Cars deliver self-evident benefits to their users. But the dependence of modern economies on the use of cars as the dominant mode of passenger transport also generates several environmental impacts and related quantifiable costs to society as a whole. The list of impacts below is not meant to be exhaustive but each of the impacts listed merits mention:

¹⁷ See below, Annex 1, "Quantifying the environmental impacts of the under-taxation of company cars".

¹⁸ See Harding (2014), Table 10.

¹⁹ See EC (1995) and the White Paper that followed it: EC (1998).

²⁰ See EC (2011a) and the Impact Statement accompanying it: EC (2011b).

²¹ See also CE Delft, Infrac, Fraunhofer ISI (2011) for a more comprehensive and detailed report on and quantification of transport-sector external costs in Europe – and OECD (2014) for a major revision of the cost estimates for air pollution across the OECD world. These are put to use in Annex 1 for the purpose of arriving at quantitative estimates in billions of EUR per year. For the purpose of the present discussion, what is relevant is rather the broad pattern of external costs and the trajectory thereof.

- demands on scarce resources: in particular, oil;
- CO₂ emissions and the resulting contribution to climate change;
- emissions resulting in local air pollution;
- traffic accidents;
- congestion.

20. These impacts can be related to three main proximate determinants:

- the total distance driven, a product of the number of cars driven and the distance driven per car;
- the environmental characteristics of cars (fuel efficiency, emissions intensity, safety features, and so on);
- the distance driven in peak periods at particular locations.

21. Oil is a scarce resource; and transport, in particular road transport, relies on oil for more than 95% of its energy needs.²² The transport sector accounts for the greater part of worldwide oil consumption; and it is this sector's increasing demand for oil that has been primarily responsible for the increase in the overall demand for oil over the last four decades. Data from the International Energy Agency (IEA) show that the 55% increase in world oil consumption since 1973 breaks down into a 111% increase in the transport sector and a mere 10% increase in all other sectors.²³

22. Irrespective of the exact pace of resource depletion and its eventual consequences,²⁴ the concentration of oil supplies in particular geographical locations, when coupled with the cartelisation of the world oil market through the agency of the Organisation of Petroleum Exporting Countries (OPEC), means that the increasing demand for this scarce resource has translated into a traded price for oil considerably above its cost of production and its (hypothetical) competitive market price. Thus, as the US Energy Information Administration reports, the average annual import price has increased more or less uninterruptedly from USD 29 per barrel in 2001 to USD 100 per barrel in 2013 (in May 2014 dollars).²⁵ It has thereby delivered a continuing transfer of wealth to net oil exporters from the world's oil-importing countries, including most of the member-countries of the OECD.²⁶

23. A recent study by the European Commission provides a useful description of the nature and costs of the road transport sector's dependence on oil. Based on its own projections for oil prices, roughly in line with those of IEA (2010), the European Commission's reference scenario anticipates that the annual

²² See *ibid.*

²³ See IEA (2010), OPEC (2010), and the further analysis of the data in Roy (2011).

²⁴ Considered in geological rather than economic terms, this is not a near-term problem. At current rates of production, it is estimated that several OPEC member-countries have enough reserves to continue producing into the 22nd century, and at least one, Venezuela, into the 23rd century: see BP (2011).

²⁵ See EIA (2014).

²⁶ For one approach to calculating the resulting cumulative loss for the US economy, see Greene and Ahmad (2005). Its estimate for the wealth transfer from the US for the year 2005 was over USD 100 billion, assuming an average import price for 2005 of USD 45 per barrel. For comparison, as was noted above, the annual average imported crude oil price for 2013 was USD 100 per barrel – see EIA (2014).

bill for fuel costs in the EU transport sector, overwhelmingly imports, will increase by EUR 300 billion in the period to 2050 – a *circa* 70% increase from its present-day level.²⁷

24. That said, it should be added that, whilst the increased annual bill for fuel imports remains a problem for the EU and all other oil-importers, there is not as yet a scientific consensus on how to calculate its net social cost. There are at least three difficulties here. First, it is not an easy matter to establish a baseline for the hypothetical competitive market price and, with it, the excess price, or rent, which constitutes a transfer of wealth. Moreover, whilst this wealth transfer does impose a net social cost – that is, the consumer loses more than the producer gains – part of it is simply a transfer from one party to another. Finally, the matter is complicated by the presence of externalities: given its contribution to climate change and other external costs, it could be said that oil should be made available to the consumer not at its competitive market price but rather at a considerably higher price.

25. An important finding reported in the Commission's White Paper is that, hitherto, the increase in traffic volumes, that is, total distance driven, has been strong enough to drive an increase in total fuel consumption *despite* the achieved increase in the fuel efficiency of new vehicles produced and in the consumer take-up of more fuel-efficient vehicles.²⁸

26. The same dynamic can be seen in the record of CO₂ emissions in the transport sector, which has exhibited a near-continuous growth of over the past two decades. The Impact Statement accompanying the Commission's 2011 White Paper sums it up thus:

New vehicles have become more fuel efficient and hence emit less CO₂ per km than earlier models did in the past, *but these gains have been eaten up* by rising vehicle numbers, increasing traffic volumes, and in many cases better performance in terms of speed, safety and comfort [emphasis added].²⁹

27. The Commission's reference scenario anticipates a continuing growth in transport-sector CO₂ emissions, albeit at a more moderate pace than in the past two decades.³⁰ Moreover, by virtue of its continuing dependence on fossil fuels (specifically, oil and oil products), the sector's share in economy-wide CO₂ emissions in the EU is expected to increase strongly in both absolute and relative terms – from around 25% of total CO₂ emissions today, less than elsewhere in the OECD world, to almost 50% by 2050.³¹

28. The record of emissions of local air pollutants is a more complex story. Since 1990, and despite the increase in traffic volumes, cleaner vehicles have delivered a strong reduction in emissions of some pollutants, including particular matter, PM₁₀, and some ozone concentrates.³² In more recent years,

²⁷ See EC (2011b), in particular, Para 53, and n. 32. In fact, successive reports by leading national and international agencies since that time have projected successively higher prices: see especially EIA (2010) and IMF (2011).

²⁸ The achieved increase in fuel efficiency observable on roads today is partly the intended result of policy measures, including in particular tighter fuel-efficiency standards, but also partly the fortuitous result of an otherwise unwelcome development, namely, the increase in the pre-tax price of oil. For passenger cars, the Commission expects total fuel consumption to moderate and decline over time as a result of ever-tightening standards: see EC (2011b), Para 55, and n. 37. The likelihood is that a continuing increase in the pre-tax price of oil will also play a part in such an outcome.

²⁹ *Ibid.*, Para 35.

³⁰ *Ibid.*, Para 56, Figure 1.

³¹ *Ibid.*, Para 58.

³² See *ibid.*, n. 20.

however, the downward trend in NO_x and NO₂ emissions seems to have come to a halt.³³ In cities in the UK, and in cities across Europe, roadside measurements show emissions stabilising in the last decade, and indeed increasing here and there.³⁴ This halt to progress on local air pollution is, in large part, the result of the rising share of diesel cars on the road – and thus not only an increase in the distance driven by diesel cars but a proportionately greater increase – when coupled with the fact that, unlike petrol cars, new generations of diesel cars have not been noticeably cleaner in regard to these pollutants.³⁵

29. Moreover, and quite apart from this mixed record of progress on combating the problem of local air pollution, recent evidence has established that the problem itself is much more serious than has been recognised hitherto – in particular, the epidemiological evidence on mortalities and morbidities attributable to air pollution tabled in the Global Burden of Disease project³⁶ and the related cost calculations undertaken by the present author and published by the OECD.³⁷

30. Compared to all other transport modes, or indeed compared to other forms of economic activity in modern society, road transport also exacts a high toll on life and limb as a result of traffic accidents – even as the value of individual life and limb increases in line with the wealth of society. Here, too, one can observe the same dynamic witnessed in regard to fuel consumption and CO₂ emissions. An improvement in environmental characteristics – in this case, enhanced safety features in cars as well as improvements in road infrastructure and traffic management – can be thwarted by the increase in traffic volumes. Thus, by 2050, the Commission's reference scenario expects accident costs in the EU to increase by EUR 60 billion per year over current levels.³⁸

31. Last but not least in this list of the negative impacts of car use is the cost of congestion – the value of the time lost in delays and stoppages when traffic is forced to slow or stop altogether as roads becomes congested. This is, in part, an external cost imposed on all existing users by the entry of new users into the road system whenever the system is operating at or near or above full capacity – as well as being, in part, a cost borne by the users responsible. On the assumption that the road system provides adequate capacity for traffic in most times and places – an assumption that seems reasonable in the case of OECD member-countries – congestion is thus a function not only of total distance driven but also and more specifically of the distance driven in peak periods at particular locations.

32. However localised in its incidence, congestion imposes a large, and increasing, cost on the wider economy. For the EU, the Commission's reference scenario expects the cost of congestion to climb to around EUR 200 billion per year – a near 50% increase over its already high level.³⁹

33. Importantly, congestion also leads directly to an increase in several other environmental impacts⁴⁰ – to increased fuel consumption and consequent CO₂ emissions, to increased local air pollution,

³³ See the evidence assembled in Carslaw *et al.* (2011).

³⁴ See *ibid.*, and in particular Chapter C for results for European cities outside the UK.

³⁵ See *ibid.*, and in particular Chapter A. See also the more recent evidence in Carslaw and Rhys-Tyler (2103) where the authors argue that “emissions from diesel vehicles of all types have not shown significant reductions in NO_x for the past two decades ...”

³⁶ See in particular Lim, S. S. *et al.* (2012) and Institute for Health Metrics and Evaluation (2013).

³⁷ See OECD (2014).

³⁸ See EC (2011b), Para 59.

³⁹ *Ibid.*, Para 60.

⁴⁰ See *ibid.*, Para 44, and related footnotes and references.

and, potentially, to more accidents if users attempt to find riskier private solutions to the lengthening of journey times under conditions of congestion.

34. It follows that the distance driven in peak periods at particular locations also needs to be counted as a determinant of several environmental costs in addition to congestion.

Production

35. Prior to their use on the road, upstream, but clearly as a result of the downstream demand for their subsequent use, cars must of course be produced. And the production of cars, including here the production of all its constituent inputs, also generates several environmental impacts. These include:

- demands on a range of scarce resources;
- emissions, in particular, CO₂ emissions;
- industrial accidents, in particular, in the extraction and transportation of oil and other raw materials.

36. The two main proximate determinants of these impacts are:

- the number of cars produced, the demand for which is a function of the number of cars driven.
- the relevant environmental characteristics of the production processes deployed.

37. As noted earlier, the demand on scarce resources has immediate consequences long before the absolute depletion of these resources comes into view. Geology delivers a concentration of resources in particular locations; the self-interest of the favoured locations translates this advantage into varying degrees of monopoly pricing power. The resource-exporting countries and the private producers they host gain an economic rent; the resource-importing countries are obliged to pay that rent and absorb the loss in wealth.

38. The point was noted in regard to the demand for oil products in the use of cars and other vehicles. But the production of cars and other vehicles also entails a demand for oil and several other scarce resources. If any one of these is to be singled out here for special mention alongside oil, it is iron ore – the second most traded commodity after oil, and a necessary input to steel and thereby to the production process of anything that requires steel, including cars.

39. That the resulting economic rent is quantitatively significant is not in doubt. The twelve member-countries of OPEC, with a 40% share of the world's oil supply, were able to translate rising demand into a *circa* 250% increase in the traded price of oil over the first decade of this century.⁴¹ Over the same period, iron ore producers in the two countries with a 70% share of the world's supply of the resource, Australia and Brazil, were able to translate rising demand into a *circa* 900% increase, a ten-fold increase, in the traded price of iron ore.⁴² And directly or indirectly, the consumer countries, including the vast majority of OECD member-countries, were obliged to absorb the losses corresponding to this transfer of wealth.

40. However, the point made earlier in regard to the wealth transfer to oil-exporting countries applies equally to the wealth transfer to other resource exporters. There is not as yet a scientific consensus on how

⁴¹ See Roy (2011) and the sources cited therein.

⁴² See *ibid.* and the sources cited therein.

to calculate the net social cost involved. It is for this reason that the present investigation does not attempt to include any estimate of this social cost – other than to note the simple fact that the production of cars does indeed entail a demand for scarce resources that helps to generate significant economic rents.

41. The production of cars also contributes to CO₂ emissions as well as to emissions of various local air pollutants – even if there is considerable uncertainty as to exactly how significant that contribution is. Lifecycle analysis of carbon flows reported by the Carbon Trust indicate that, although the typical car generates 75-85% of its lifecycle emissions during its use, its “embodied emissions”, beginning with the extraction of raw materials required for its production through all stages of its manufacture and distribution, are responsible for a significant and increasing share.⁴³ On the other hand, recent US research still attributes as much as 96% of a conventional car’s lifecycle CO₂ emissions to its actual use.⁴⁴

42. Moreover, there is an important difference between measuring emissions from car use and measuring emissions from car production. One can be fairly confident that a reduction in the use of cars would be attended by a greater use of public transport and non-motorised modes as well as improved planning and use of technology to reduce the travel task itself – and would thereby result in a substantially lower level of fuel consumption and a lower level of external costs in the new scenario. But the matter is more complicated in the case of a reduction in car production. Here, it is more difficult to predict the sectors that would see an expansion in output to attend the contraction in car production.

43. What is not in question is that, although it is the use of cars that is the dominant source of the problem of CO₂ emissions, the production of cars does add to the problem. And just as improvements in fuel efficiency and CO₂ performance during actual use have been “eaten up” by the increase in distance driven, so too can improvements in the environmental characteristics of the production processes deployed be eaten up by the increase in the sheer numbers of cars produced.

44. Finally, there is the damage done by industrial accidents, in particular, in the extraction and transportation of oil and other raw materials required in car production – for example, in the Deep Water Horizon incident.⁴⁵ Moreover, insofar as deep-water ocean wells carry a greater risk of accidents and a risk of greater damage from accidents than do conventional oil fields,⁴⁶ and insofar as this turn to ocean drilling is part of the world’s response to the rising demand for oil,⁴⁷ the number of cars produced must also be counted here as a proximate determinant of industrial accidents and the damage done thereby.

Parking

45. Cars purchased to be used must also be parked when not in use. And they are parked not only in the user’s own residence but also off-street and on-street as part of the journey to work, to the shops, and to a hundred other sites. The parking needs of the world’s billion-plus population of cars thus creates

⁴³ See Carbon Trust (2011).

⁴⁴ See Aguirre *et al.* (2012).

⁴⁵ In its survey of transport-sector external costs, the Victoria Transport Policy Institute (VTPI) remarks of the Deep Water Horizon incident: “As an example, the 2010 Deep Water Horizon oil spill cleanup and compensation costs are predicted to total \$20-40 billion. Assuming one such catastrophic spill occurs each decade, this averages \$2-4 billion a year, or approximately 5% of total annual crude oil expenditures [i.e., in the US]. However, this only includes direct, legally recognized damages from major spills; it excludes “normal” damages caused by petroleum production and processing (oil wells, refineries and transport facilities) and by smaller spills, and uncompensated ecological costs such as existence and aesthetic losses from destruction of wildlife and landscapes.” See VTPI (2011), Chapter 5.12.

⁴⁶ See *ibid.*

⁴⁷ See Roy (2011).

demands on a particular scarce resource, urban space – which is also an increasingly valuable resource thanks to the increasing values of its potential alternative uses.

46. The resulting impacts are large. For the US, surveying the evidence from a range of studies, including Shoup (2005), VTPI (2011)⁴⁸ suggests that more than 80% of estimated annual parking costs per vehicle, USD 3 600 out of USD 4 400, consists in non-residential off-street and on-street parking. Of this, only 5%, or USD 180, is directly paid by the users themselves – the rest being provided “free” by employers, shops and other businesses, municipal authorities, and so on. The survey estimates the annual cost of unpriced parking in all its forms at around USD 500 billion. The US is perhaps something of an outlier in this regard but it is as well to note that the multi-country study on transport taxes by the European Conference of Ministers of Transport also identified high values for unpriced parking for a range of European cities.⁴⁹

47. The proximate determinant of parking’s demand on space is, simply, the numbers of cars driven.

2.2 *The proximate and underlying determinants*

48. The analysis above yields several findings on the proximate determinants of the environmental impacts from the production, use and parking of cars.

49. The first concerns the central role of the *use of cars* in generating car-related environmental impacts. It generates the greater part of the sum of impacts: the greater part of lifecycle emissions and accident costs, and all of the costs of congestion. More basically, it is the demand for cars that drives both the demand for production and the demand for parking space.

50. The second concerns the relative importance of *total distance driven*, its components and variations, as a proximate determinant of impacts. Thus:

- total distance driven, composed of the number of cars driven and the distance driven per car, figures as a determinant of fuel consumption and relatedly of CO₂ emissions, of local air pollution, of traffic accidents and of congestion;
- distance driven in peak periods at particular locations is a proximate determinant of congestion – and thereby also of fuel consumption, CO₂ emissions, local air pollution and traffic accidents;
- the number of cars driven is the proximate determinant of parking’s demand on space.
- the number of cars driven is a proximate determinant of environmental impacts in the production of cars.

51. The third finding, counter-intuitive though it may be, concerns the relatively *limited importance of technology* in the form of the environmental characteristics of cars and their production processes. Self-evidently, technology *is* a determinant. Improvements in car technology can and do lead to reductions in fuel consumption, CO₂ emissions, local air pollution and traffic accidents. And improvements in production technology can and do lead to reductions in resource consumption, CO₂ emissions, local air pollution and industrial accidents. But it is also evident that all such improvements can indeed be “eaten up” – the improvements in car technology by the continuing increase in total distance driven, the improvements in production technology by the continuing increase in the number of cars produced.

⁴⁸ See VTPI (2011), Chapter 5.4.

⁴⁹ See ECMT (2004).

52. For the foreseeable future, and for the purpose of the present discussion, this finding remains relevant – even if it were to be overturned in the more distant future by more radical breakthroughs in technology (electric vehicles powered by decarbonised electricity, eliminating emissions; driverless cars running on controlled highways, eliminating congestion and traffic accidents; and so on).

53. It remains now to identify the underlying determinants of these proximate determinants and the underlying determinants of the impacts themselves. By far the most potent of these can be summed up in a single word: *price*.

54. As noted earlier, *regulation* has played a positive role in driving improvements in fuel efficiency, in limits to emissions, and in the safety features of new cars.⁵⁰ And *taxes on cars*, including more recently the application of differentiated taxes based on fuel efficiency or CO₂ ratings, have played a part in limiting the demand for cars and in limiting some of their environmental impacts – though it should be noted here that the focus on CO₂ ratings may also have played a part in encouraging the observable shift to diesel cars and therewith the observable worsening of local air pollution impacts.⁵¹ But *taxes on the use of cars* have been insufficient and insufficiently targeted – thus leaving the price of use far below its marginal social cost and its relative price *vis-à-vis* public transport greatly distorted. When coupled with the prevalence of unpriced parking, this has sufficed to underpin the prevalent pattern of transport choices and its environmental impacts.

55. To spell out the elements of this underlying determinant in a little more detail:

- As is argued above, distance driven plays a central role as a proximate determinant of most of the relevant environmental impacts.
- As is established in the literature on elasticities,⁵² taxes closest to the point of use are the most effective in tackling the impacts of use: fuel taxes more so than car taxes in limiting fuel consumption and related CO₂ emissions; distance charges more so than fuel taxes in limiting congestion, and so on.
- Taxes on fuel have not kept pace with the value of CO₂ damages: they have remained low in historically low-tax countries (for example, in North America) and have either plateaued out or increased at a reduced pace in historically high-tax countries (for example, in the EU).
- There are as yet only a few examples of charging directly for distance driven, let alone distance driven in peak periods at particular locations, so as to manage congestion costs.
- There are as yet no examples of fully differentiated distance charging, by vehicle type, route of travel, and time-of-day, so as to manage the full range of external costs in a more precisely targeted manner.

⁵⁰ For the EU, see *inter alia* EC (2011a) and EC (2011b), on some of the observed effects of past regulations and some of the anticipated effects of future regulations.

⁵¹ For a survey of the manner and extent to which environmentally based tax differentiation has been applied in OECD member-countries, see OECD (2009); for an analysis of its utility and of the limits to its utility, see Roy (2009). Given the evidence reported in Carslaw *et al.* (2011) and most recently in OECD (2014), this is an area that needs urgent further investigation.

⁵² See for example Johansson and Schipper (1997).

56. The detail varies, as is to be expected, but the overall pattern is much the same across the OECD world: whether by sins of omission or sins of commission, the evolution of taxes has left the price of use far below its social marginal cost.⁵³ Suffice it therefore to cite the data from Britain as an indication of the overall pattern.

57. Here, a benchmark study for the Department for Transport in 2001⁵⁴ found that, in 1998, the ratio of revenues to marginal social costs in road transport was in the range of 0.36 to 0.50 – that is to say, road users were, on average, paying one-third to one-half of the costs that their trips imposed on society. Passenger and freight rail users were paying, respectively, just below and just above marginal costs. Updating for 2004 in 2007,⁵⁵ the Department found that the ratio of revenues to marginal costs for passenger cars was 0.15, cf. Table 1. As before, the ratio for buses and commuter rail, the most comparable segment of passenger rail, was close to unity.

58. Note, moreover, that this measure of the extent to which a car journey is under-priced does not include any estimate of the under-pricing of parking at the destination. When coupled with the latter, under-pricing at the point of driving suffices to explain why the car is in fact used all too often in preference to public transport.

Table 1. Car, bus and rail revenues in relation to marginal costs in Great Britain

	<i>GBP per passenger kilometre, 2004 data</i>		
	Marginal costs (including both internal and external costs)	Revenues (fares, vehicle excise duty, fuel duty and VAT)	Revenues/costs
Car	0.141	0.021	0.15
Bus	0.11-0.137	0.123	0.90-1.12
Commuter rail	0.117-0.126	0.107	0.85-0.91

Source: DfT (2007b).

59. It remains to note that “the proof of the pudding is in the eating”. That under-pricing at the point of use is indeed the key underlying determinant of transport choices and their environmental impacts is best demonstrated by what happens on the rare occasions when the problem is corrected in practice. Suffice it here to recall the example of the Central London congestion charging scheme.⁵⁶

60. Introduced in 2003, the scheme applies a daily charge on cars, vans or trucks driven or parked within the charging zone during specified charging hours. Importantly, if implicitly, the scheme is also underpinned by the extent and intensity of pre-existing on-street parking controls within the boundary of the charging zone. Recently, the scheme’s effectiveness has been affected by a number of unrelated developments.⁵⁷ But what is relevant here is the original set of results which persisted little changed over a period of years:

⁵³ For detailed evidence on five EU member-states, large and small, segmented by metropolitan-urban, other-urban and non-urban regions, see ECMT (2004).

⁵⁴ See Sansom *et al.* (2001).

⁵⁵ See DfT (2007a) and more especially DfT (2007b).

⁵⁶ The present discussion draws on Roy (2004) and Roy (2007), as well as the data from the several separate reports from Transport for London cited therein.

⁵⁷ These include a once-in-a-century renewal of underground works by Thames Water, as well as a number of recent policy decisions by the London administration.

Table 2. Environmental impacts of congestion charging in Central London

	Percentage Δ in relevant units, 2004
Number of cars entering charging zone	- 33%
Car vehicle kilometres driven within charging zone during charging hours	- 34%
Bus and coach vehicle kilometres driven within charging zone	+ 21%
Fuel consumption	- 20%
CO ₂ emissions	- 19%
Congestion	- 30%

Source: Roy (2004) and data from the Transport for London reports cited therein.

61. The de-congestion effect was of course the immediate aim of the exercise. And the elements of that effect – the overall reduction in vehicle kilometres, the mode shift to public transport,⁵⁸ maintaining mobility with reduced vehicle kilometres as a result of the mode shift,⁵⁹ and so on – were much as expected. Much the same has been witnessed in successful examples of congestion charging elsewhere.⁶⁰

62. What is perhaps more noteworthy here is that, by directly targeting distance driven, the scheme also helped to ameliorate a wider range of environmental impacts, including fuel consumption and CO₂ emissions – an outcome that has often eluded policies aiming to ameliorate these impacts through ways and means other than at the point of use. It thereby succeeded in making a point that is too easily overlooked: the simplest way to reduce CO₂ emissions from traffic is to reduce traffic.

3. Company cars

3.1 Company cars as a sub-set of cars

63. Across the OECD world, company cars are an important sub-set of cars. In the EU, they constitute around 50% of new registrations and around 12% of the total car stock.⁶¹ There is a growing body of work on company car taxation and its impacts.⁶²

64. The problem here is one of selection. As noted in the Introduction, empirical description of the current state of affairs is an insufficient basis on which to establish causality. Causality is best established counter-factually. The impact of a subsidy to company cars is best determined by reference to the outcome that would be realised in its absence – and the impact of a given quantum of subsidy by reference to the outcome that would be realised in the absence of that given quantum.

65. It follows that the evidence base that is most relevant to this investigation is that relating to the effects of *changes* to the tax treatment of company cars – preferably the effects of real-world changes but

⁵⁸ As noted in Roy (2007), the great majority of the motorists who were priced out by the scheme were priced into other modes. Of those who switched modes, 50% switched to London Underground or national rail, 40% to buses.

⁵⁹ As noted *ibid.*, the reduction in the number of people entering the charging zone, as distinct from vehicles, was only 5,000 – a very small number when compared to the Central London daily population of more than 1.5 million.

⁶⁰ See *ibid.*

⁶¹ For data on the EU, see Shiftan, Albert and Keinan (2010) and Shiftan, Albert and Keinan (2011) and the sources cited therein. See also Harding (2014) for data on individual OECD member countries.

⁶² Apart from Harding (2014), the works cited in this paper and listed here in alphabetical order include: Anable and Bristow (2007); Cornelis, Castaigne, Pauly, de Witte, and Ramaekers (2009); De Borger and Wuyts (2010); De Witte and Macharis (2010); Gutiérrez-i-Puigarnau and van Ommeren (2007); Gutiérrez-i-Puigarnau and van Ommeren (2011); Le Vine and Jones (2012); Næss-Schmidt and Winiarczyk, Copenhagen Economics (2010); Scott, Currie and Tivendale (2012); Shiftan, Albert and Keinan (2010); Shiftan, Albert and Keinan (2011); Van Ommeren and Gutiérrez-i-Puigarnau (2011).

also those measured in rigorous surveys and modelling, preferably linked to real-world changes under consideration. It is the *ex post* outcome of these changes that provides the most robust information on the impact of the tax rules that obtained *ex ante*. It provides thereby the most reliable guide to the likely effects of comparable changes under consideration.

66. Nonetheless, it would be as well to summarise here some general characteristics of the company car phenomenon as described in the literature before proceeding to a more detailed examination of the more relevant evidence base.

67. First, it needs to be stressed that company cars are an integral part of the passenger transport market. Company cars are used for both business and personal purposes but they are not some separate and specialised species of “business cars”, comparable to, say, an ambulance or a police car. As it happens, they are used far more for personal purposes – commuting to and from work and miscellaneous private trips – than for business. Thus, a major study for the European Commission,⁶³ drawing on evidence from studies in Belgium and the Netherlands,⁶⁴ reported the split between personal and business use as follows:

Table 3. Purpose of company car usage: Belgium and the Netherlands

Country	Personal use	Business use
Belgium	67%	33%
The Netherlands	78%	22%

Source: Næss-Schmidt and Winiarczyk (2010).

68. It is not difficult to see how the subsidy to company cars might increase usage in all these categories. The widespread under-taxation of the capital component identified in Harding (2014) can reduce the cost of car ownership significantly. And the general absence of any taxation on the distance component can reduce to zero the marginal cost of driving – that is, the marginal cost to the driver, not the marginal cost to society. This will tend to increase car ownership, by encouraging the offer of a company car in place of other forms of compensation even when the car’s use for strictly business purposes alone would not justify the offer (or the purchase of it by the business concerned as part of its own fleet) – and by encouraging, with it, the growth of two-car households that retain the private car whilst accepting the new company car. And it will tend to increase the distance driven per car for all categories of travel:

- by promoting a culture of driving for business purposes, precluding consideration of alternative modes for business trips or indeed alternatives to the trip itself;
- by entrenching driving as the mode of choice for commuting;
- by encouraging unnecessary driving for miscellaneous private purposes.

69. Now the distance driven per car (annual mileage / vehicle kilometres) *is* in fact much higher for company cars than it is for the rest of the car population. To be sure, the extent of it varies across countries. But several country studies report the average distance driven by company cars at a multiple of 1.5-3.0 of the distance driven by private cars.⁶⁵ Britain, which has a claim to pioneering the widespread use of

⁶³ See Næss-Schmidt and Winiarczyk (2010).

⁶⁴ Respectively: Cornelis, Castaigne, Pauly, de Witte, and Ramaekers (2009) and Gutiérrez-i-Puigarnau and van Ommeren (2007).

⁶⁵ See *inter alia* Harding (2014), Annex B, and Scott, Currie and Tivendale (2012), Chapter 2.1.4, and the studies cited therein.

company cars, exhibits a multiple at or near the top of this range – before the major reforms to company car taxation examined below, a multiple of 2.8.⁶⁶

70. The Belgian studies cited earlier⁶⁷ suggest that the picture is a little more complicated than the aggregate figures suggest. Thus, there appear to be three segments of company car users. There are those who use it predominantly for business purposes (the “representatives”), those who use it predominantly for commuting (the “commuters”), and those who use it heavily for miscellaneous private trips (the “enjoyers”). And it is the “representatives” who exhibit the greatest distance driven per car. But this segmentation need not detain the present discussion. Environmental impacts can follow from increased driving, whether for business, commuting or private trips. Nor is there any reason to shield business trips from the investigation: as is shown later in the evidence from changes to company car taxation, business trips too are indeed susceptible to mode choices and mode shifts in response to under-taxation and to corrections to under-taxation.

71. From the previous analysis of the larger field of transport externalities, it is clear that there are several pathways by which the subsidy to company cars can impact on environmental pressures, relative to a situation where no tax subsidy for company cars exists:

- an increase in total distance driven, leading to higher levels of fuel consumption and relatedly of CO₂ emissions, of local air pollution, of traffic accidents and of congestion;
- an increase in distance driven in peak periods at particular locations, leading to higher levels of congestion, and thereby to yet higher levels of fuel consumption, CO₂ emissions, local air pollution and traffic accidents;
- an increase in the number of cars driven, leading to higher demands on parking space;
- an increase in the number of cars driven, leading to an increase in the number of cars produced, thus leading to higher demands on a range of resources and higher levels of emissions and industrial accidents.

72. There is of course another pathway to environmental impacts. Company cars also tend to be larger and more expensive than the rest of the car population. Thus, for new car registrations in 18 EU member-states in 2008, Næss-Schmidt and Winiarczyk (2010) show that company cars dominate the upper segments of the market.⁶⁸ Accounting for 50% of total registrations, they account for 65% of “medium”, 70% of “upper medium” and 76% of “large” cars registered. To be sure, these top three segments account for only around 25% of new registrations and the top two segments for only around 7%.⁶⁹ But all “new” company cars will age; they will be put on the second-hand market, generally within five years, and find their way thence into the general car population. Hence, their characteristic size may lead to a greater increase in the size of the average car over time.

73. As it happens, the Dutch studies cited earlier⁷⁰ develop a model of household behaviour in which the *main* effect of the subsidy to company cars provided by their favourable tax treatment is precisely on

⁶⁶ Le Vine and Jones (2012), Table 3.4.

⁶⁷ See Cornelis *et al.* (2009) and also De Witte and Macharis (2010).

⁶⁸ Næss-Schmidt and Winiarczyk (2010), Figure 1.1 and related text.

⁶⁹ See *ibid.*

⁷⁰ The series includes Gutiérrez-i-Puigarnau and van Ommeren (2007), Van Ommeren and Gutiérrez-i-Puigarnau (2011) and Gutiérrez-i-Puigarnau and van Ommeren (2011).

the *composition* of the car stock – the shift to larger and more expensive cars and hence to cars with lower levels of fuel efficiency and higher CO₂ ratings – rather than on the *number* of cars or the total distance driven.

74. In their study for the European Commission, Næss-Schmidt and Winiarczyk (2010) rely on a scaling up the Dutch results to derive, with caveats, EU-wide estimates for the increase in fuel consumption and CO₂ emissions resulting from the subsidy to company cars – and, with even stronger caveats, for the increase in local air pollutants and in congestion, accidents and noise.⁷¹ They do note that in the Dutch studies the elasticity implicit in the estimate of the shift to more expensive cars is “very high” – and that implicit in the increase in the number of cars is also “above conventional estimates” – but they also note that these studies may have underestimated the increase in distance driven.⁷² Hence, the low to high range in the scaled up estimates: an increase in total fuel consumption of 4% to 8% and an increase in emissions of 20 million to 40 million tonnes of CO₂.⁷³

75. It should be said, however, that the evidence on the first premise of this line of argument is by no means unambiguous. The evidence reported in Harding (2014) for the member-countries for which complete data are available show that the “mark-up” in the average price and CO₂ rating for company cars is small – not large. Thus:

Table 4. Average price and CO₂ rating for company cars in selected countries

	Average price (EUR)		Average CO ₂ rating	
	All cars	Company cars	All cars	Company cars
AUS	29 378	31 852	196	201
AUT	25 794	29 074	151	157
BEL	24 377	28 651	146	156
CAN	27 221	28 568	213	223
DNK	35 607	42 421	142	150
EST	18 565	18 565	166	166
FIN	30 920	36 704	157	168
FRA	22 093	22 093	137	137
DEU	26 417	33 203	157	166
HUN	21 183	22 886	156	160
ISL	24 998	24 998	168	168
ITA	20 942	26 228	139	162
LUX	28 924	32 372	152	156
MEX	35 988	35 988	194	194
NLD	24 923	32 396	143	152
NZL	27 017	27 017	187	187
NOR	44 762	46 609	156	165
PRT	23 838	24 639	152	155
SVK	21 483	27 028	152	159
SVN	21 352	22 203	150	152
ESP	23 344	26 136	145	149
SWE	28 953	31 187	159	164
CHE	33 134	33 134	168	168
GBR	23 895	24 880	151	154
USA	27 823	27 726	236	227
SAF	27 837	27 837	181	181
Total	26 444	28 361	188	189

Source: Harding (2014), Table 9.

⁷¹ See Næss-Schmidt and Winiarczyk (2010), Chapter 3.3 and Chapter 3.4.

⁷² *Ibid.*, Chapter 3.3.

⁷³ *Ibid.*, Chapter 3.4.

76. To be sure, in *some* of these countries, this *may* reflect the impact of recent reforms to company car taxation penalising cars with higher CO₂ ratings – a point that is explored further in the section below. But there is more to the matter than this. Surveying trends across the OECD world, a New Zealand study⁷⁴ reports that “very recent trends” show a change from the pattern observed in the past. There appears to be a shift away from larger, heavier, more fuel-intensive company cars – partly reflecting decisions by government and corporate fleet managers in pursuit of efficiency targets, but independently of any changes to company car taxation. It may be the case that the problem of an adverse change in the composition of the car stock is less of a problem than some have hitherto assumed it to be.

77. For the present, it is enough to note that the subsidy to company cars can lead to higher levels of fuel consumption and of CO₂ emissions – and to all manner of environmental impacts – through several pathways, one of which might be through its effect on the composition of the car stock.

78. Finally, across the OECD world, from Britain to Israel and down to Australia and New Zealand, the record of accidents in company cars is consistently reported as being worse than that in private cars – over twice as bad in the worst cases.⁷⁵ Some features of this record are clearly country-specific. Thus, the Israeli study reports a *lower* level of safety features in company cars and the predictable effects thereof – whereas the New Zealand study reports a *higher* level of safety features, leading to a “false sense of security” and “increased risk-taking.” But in both these cases, and indeed in all cases, there are at least some common features. Company car drivers are substantially shielded from liability. And, on average, they clock up substantially higher levels of mileage than do private car drivers.

3.2 *Impacts: evidence from corrections to company car taxation*

The impact on total distance driven

79. The first claim that can safely be made here is that a serious change to company car taxation does have a serious impact on total distance driven: both the number of cars driven and the distance driven per car. Evidence from Britain, and also Israel, tells a convincing story of the extent of this impact and its bearing.

80. From the early 1990s to the early 2000s, Britain initiated a series of sharp changes to its tax treatment of company cars, the detail of which is examined later. Harding (2014) shows that there remains a large measure of under-taxation: it estimates the average annual subsidy to company cars in Britain to be reasonably close to the OECD average.⁷⁶ But that is not the point here: given the base from which it started, the process of reform in Britain is significant enough to be instructive. And evidence of its impact on total distance driven has now been made available, as part of a detailed report on long-term travel trends in Britain, in Le Vine and Jones (2012).

81. Comparing the data from 2005/7 to the data from 1995/7, one finds a reduction in company car ownership of around 20%, a reduction in mileage per car of around 20% and a reduction in total mileage of around 40%. To be more exact:

⁷⁴ See Scott, Currie and Tivendale (2012), Chapter 2.1.2.

⁷⁵ See *inter alia* Shifan, Albert and Keinan (2010) and Scott, Currie and Tivendale (2012), Chapter 2.1.5.

⁷⁶ An average subsidy per car per year of EUR 1 118 for Britain as against a weighted average subsidy per car per year of EUR 1 600 for the 26 countries surveyed: see Harding (2014), Table 11.

Table 5. Company cars in Great Britain: change in total mileage

Change from 1995/7 to 2005/7	Percentage change
Company cars per person	-21%
Average annual mileage per company car	-22%
Company car total mileage	-38%

Source: data reported in Le Vine and Jones (2012).

82. At an aggregate level, it is not possible to establish the extent of any resulting decline in car ownership: after all, car ownership overall has continued to rise in line with the general rise in incomes. But even at this aggregate level, there is no apparent “leakage” from company car mileage to private car mileage: mileage per car has decreased for private cars. Thus:

Table 6. Company and private cars in Great Britain: change in mileage per car

Years	Car type	Average annual mileage per car
1995/7	Company	20 460
2002/5	Company	17 111
2005/7	Company	15 909
1995/7	Private	7 228
2002/5	Private	7 103
2005/7	Private	6 868

Source: Le Vine and Jones (2012), Table 3.4.

83. At a dis-aggregated level, the story is clear.⁷⁷ Those who previously exhibited the highest levels of company car usage, the “Professional” occupational group, have sharply reduced their company car mileage – *and* reduced their private car mileage. For the other main group of company car users, the “Employer/manager” group, there is a “small compensating increase” in private car mileage – but an increase less than the reduction in company car mileage. Both main groups of company car users, professionals and employer/managers, have simply reduced their total mileage.

84. So it only remains to explain how the reduced mileage in company cars that is observable for all purposes – commuting, business trips and “all other purposes” – has been replaced. The data from Le Vine and Jones (2012) provides a large part of the answer: namely a shift to rail.⁷⁸ Focussing on key segments of the market, the authors observe a clear shift – “a complete substitution” – in commuter mileage from company car to rail. There is also, if to a lesser extent, a shift in business mileage from company car to rail – “a partial transfer”, and doubtless supplemented with some combination of private car use, non-rail public transport, and reduced mileage through use of information technology and business planning. The decline in company car mileage for “all other purposes”, that is, miscellaneous private trips, is not matched by an increase in rail mileage; these trips appear to have been replaced entirely with some combination of private car use, non-rail public transport, and reduced mileage through use of information technology and household planning.

85. Evidence from the recent reform process in Israel – not so much the actual changes in response to the limited reforms enacted to date, but rather the detailed survey and modelling evidence compiled in the

⁷⁷ See Le Vine and Jones (2012), Figure 3.25, and the text related to it.

⁷⁸ See *ibid.*, Chapter 4.5.

context of this process and reported in Shiftan, Albert and Keinan (2011)⁷⁹ – complements the evidence from Britain.

86. The potential impact of step-changes in the “value of personal use” – that is, the taxable benefit from company cars – is large. If this were raised to the true value of the benefit, then, depending on the estimate of true value, a high proportion of current company car users (29% in case of an increase by NIS 1 000, 47% in the case of an increase by NIS 2 000) would be willing to give up the company car.

87. Nor is there any mystery in respect of where these users would go. 92% of company car users currently commute by car; without it, only 50% declare that they would choose to commute by (private) car. In Israel as in Britain, the alternative to commuting by company car involves a decisive mode shift to public transport.

88. The evidence above suggests that corrections to company car taxation can activate unusually high elasticities – and thus entail disproportionately large impacts. But it is not difficult to explain why this should be so. In contrast to the millions of dispersed decisions that make up the overall pattern of transport choices, what is involved here is a small set of concentrated decisions: a decision to shift the burden of daily commuting, and a decision to shift part of the business travel task, from the car to public transport. There is good reason to accept this evidence.

89. If so, it follows from the *ex post* outcomes of these actual and proposed corrections that the under-taxation that obtains *ex ante* entails disproportionately large increases in the number of cars driven, in the distance driven per car and thus in the total distance driven.

The consequent impact on specific environmental pressures

90. From the analysis and evidence presented to date, it is now possible to extrapolate that the consequent impact on specific environmental pressures, individually and in sum, will also be disproportionately large.

91. There are several separate elements here and it would be as well to separate these.

- As established earlier, total distance driven is a proximate determinant of a very large set of environment pressures. It is a determinant of all the environmental impacts in the use of cars – fuel consumption, CO₂ emissions, local air pollution, traffic accidents and congestion – and, by virtue of the number of cars driven, on all the environmental impacts in the production of cars and in their parking. This alone would result in a relatively large impact on the sum of environmental pressures, even if the direct impact of the subsidy on total distance driven were not *disproportionately* large.
- As evidenced above, the impact of the subsidy to company cars on this proximate determinant, total distance driven and the components thereof, *is* likely to be disproportionately large.
- Moreover, it is likely to be doubly disproportionate in the case of congestion costs. For the congestion function is not linear: depending on the initial conditions, the entry of a given number of vehicles can increase congestion costs disproportionately. As shown above, the subsidy to company cars is likely to increase total distance driven by a large margin, and at the largest

⁷⁹ See Shiftan, Albert and Keinan (2011), in particular, Section 4.

margin precisely at the system's most vulnerable point, peak-hour commuting. Hence, its impact on congestion costs is likely to be doubly disproportionate.⁸⁰

The impact of the distance component

92. Evidence from Britain, as well as from elsewhere, also permits some tentative conclusions on the relative importance of the various components of under-taxation: to begin with, the relative importance of the distance component.

93. At first sight, and given that Harding (2014) estimates the distance component of company car taxation in Britain at zero,⁸¹ it may seem odd to speak of evidence from a correction to the distance component. But the appearance is deceptive. A critical part of the reforms to company car taxation in Britain over the last two decades has been to eliminate the various anomalies through which the marginal cost of driving for the employee was not merely zero but negative.⁸²

94. From 1993/4 onward,⁸³ company car taxation in Britain has succeeded in capturing a relatively high value of the personal benefit from the capital component. Under the reforms enacted in that year, the user's tax liability, or 'scale charge', was set at 35% of the car's original market value, irrespective of its particular characteristics. The reforms of 2002/3 introduced CO₂ based differentiation into the tax rates, with rates ranging from 15% for the lowest CO₂ band to 35% for the highest – the impact of which is examined in the section below. As Harding (2014) records, company car taxation continues to capture effectively the personal benefit from the capital component.⁸⁴ The more important problem – and the more important correction – relates to the distance component.

95. The effective negative tax on the distance component took two main forms – as is detailed in Le Vine and Jones (2012).⁸⁵ First, the user would gain a reduction in tax liability, the 'scale charge', upon reaching certain thresholds in mileage – thus "providing a strong incentive for company car drivers to reach that threshold."⁸⁶ Secondly, in exchange for unlimited free fuel from the employer, the employee would incur an additional but fixed tax liability, or 'fuel scale charge', irrespective of the amount of fuel used. "Thus, driving high levels of mileage was further encouraged, as having fuel paid for by one's employer made financial sense only if enough fuel was consumed to justify the tax liability (the 'fuel scale charge')."⁸⁷

96. Step by step, the several reforms to company car taxation have reduced or eliminated these perverse incentives. The tax incentives for reaching mileage thresholds, the mileage-related reductions in the 'scale charge', were reduced in the late 1990s and then eliminated entirely in 2002/3.⁸⁸ And from the

⁸⁰ Relevant here are the findings of De Borger and Wuyts (2010). Modelling with Belgian data, and with admittedly simplified assumptions, the authors suggest that "eliminating the preferential tax treatment of company cars ... yields about half the welfare gain attainable through optimal congestion taxes."

⁸¹ Harding (2014), Table 12.

⁸² Such perverse incentives are not of course unique to the pre-reform British company car tax regime: for some other examples, see *inter alia* Næss-Schmidt and Winiarczyk (2010).

⁸³ See Le Vine and Jones (2012), Chapter 5.2.

⁸⁴ Harding (2014), Table 10.

⁸⁵ See Le Vine and Jones (2012), Chapter 5.2.

⁸⁶ *Ibid.*

⁸⁷ *Ibid.*

⁸⁸ See *ibid.*

late 1990s to the early 2000s, the tax liability for fuel, ‘the fuel scale charge’, was increased significantly, more than doubling in real terms from 1997/8 to 2001/2.⁸⁹

97. The impact of this is best seen in a single statistic presented in Le Vine and Jones (2012). From 1995/6 to 2009/10, there has been a 70% reduction in the number of company car users electing to receive free fuel and pay the fuel scale charge – from a high of 48% of all company car users in 1995/6 to a low of 28% in 2009/10 – as against a 16% reduction in company car users who were not in receipt of free fuel and thus unaffected by changes to the fuel scale charge.⁹⁰ The reduction in company car ownership and usage – and all that follows from it – has been driven in large part by tax changes that have taken away the attractions of “free fuel”.

98. The same basic relationship underscoring the importance of the distance component is evident in the survey evidence from Israel cited earlier.⁹¹ Here, the authors report that the employee’s willingness to give up a company car decreases “significantly” where either fuel or parking expenses are provided by the employer.

99. The weight of this evidence, when coupled with what the larger passenger transport market tells about the efficacy of charging at the point of use, strongly suggests that the distance component of the under-taxation of company cars is more important to environmental outcomes than the capital component.

100. Nonetheless, two caveats are in order. First, the capital component *is* important. The under-taxation of it will feature at a concentrated decision point: the decision on whether to accept a company car and, if so, the decision on whether to retain a private car. Moreover, the mere fact of under-taxation of the capital component may lead to a choice of larger and more expensive cars. And the extent, if any, of environmentally based differentiation of the tax on the capital component will also feature in the decision on the type of car chosen.

101. The second caveat is that the actual *rates* of taxation also matter, not only the components of it. For example, Norway does not tax the distance component but captures more than 100% of the capital component, and, with it, more than 90% of the total benchmark benefit – leaving Norwegian company cars users with a subsidy of EUR 240 per year, the second lowest of the 26 countries surveyed. In contrast, Germany does tax the distance component but captures only a low proportion of it plus a relatively low proportion of the capital component, and, with it, a relatively low proportion of the total benchmark benefit – leaving German company cars users to enjoy a subsidy of EUR 2 246 per year, the third highest of the 26 surveyed.⁹² It is entirely reasonable here to suppose that Norway’s system is more effective than Germany’s in reducing ownership and usage and all resulting environmental impacts.

The impact of environmental differentiation

102. The reforms to company car taxation in Britain can serve duty here for one last task: ascertaining the impact of environmental differentiation in company car tax rules on the composition of the car stock and thereby on environmental pressures.

⁸⁹ See *ibid.*, Figure 5.4, and related text.

⁹⁰ See *ibid.*, Figure 5.3, and related text.

⁹¹ See Shiftan, Albert and Keinan (2011), in particular, Section 4.5.

⁹² As reported in Harding (2014), Table 10 and 11.

103. As noted earlier, several studies by researchers at the Tinbergen Institute⁹³ have placed great weight on the impact that the under-taxation of company cars is likely to have on the composition of the car stock – a shift to larger and more expensive cars and hence cars with lower levels of fuel efficiency and higher CO₂ ratings – and thence on the environmental pressures in question. Since the more recent phase of the reforms in Britain, from 2002/3 onward, have focussed on differentiating company car taxes so as to penalise high-emission vehicles and “incentivise” low- and zero-emission vehicles,⁹⁴ the evidence from Britain has direct relevance to the thesis advanced in the Dutch studies.

104. At one level, the impact of these measures seems straight-forward. As Anable and Bristow (2007) reported:

Ten years ago newly bought company cars had engines about 10% larger than private cars.... The picture today is very different – newly bought company cars are about 3% more efficient than those bought privately.⁹⁵

105. And specifically in regard to CO₂ emissions:

In 2001, new company cars emitted over 2 g/km more than new private cars (179 g/km compared to 176.5 g/km); but by 2005, this had reversed, with new company cars emitting some 5g/km less than private cars (167g/km compared to 172g/km).⁹⁶

106. On a closer reading, however, there are several caveats to be reported. First, and as is also observed in Næss-Schmidt and Winiarczyk (2010), the changes to the tax treatment of employer-provided fuel noted above must have played a part in the switch to more fuel-efficient vehicles: the environmental differentiation of the capital component is not the only determinant here. Second, there is a problem of “leakage” from company-car purchases to private-car purchases such that the impact on the composition of the total car stock is less impressive than the impact on company cars. Thus:

The evaluation work also suggests that if drivers no longer have company cars, on average, they will choose private cars with CO₂ emissions figures that are around 5g/km higher as a result.⁹⁷

107. Last but not least, there is also an environmental cost to be counted. Part of the reason for the improved fuel-efficiency and CO₂ emissions-performance for company cars has been the rapid and large shift to diesel cars within this segment.⁹⁸ Thus, some part of the net gain in fuel-efficiency and carbon savings from this feature of the reform has been purchased at the cost of a worsening of local air pollution impacts in the manner noted above in Chapter 2.⁹⁹

⁹³ See above and the sources cited: Gutiérrez-i-Puigarnau and van Ommeren (2007), Van Ommeren and Gutiérrez-i-Puigarnau (2011) and Gutiérrez-i-Puigarnau, E. and J. N van Ommeren (2011).

⁹⁴ See *inter alia* Anable and Bristow (2007), Chapter 5.3, Næss-Schmidt and Winiarczyk (2010), Chapter 3.3, and Le Vine and Jones (2012), Chapter 5.2.

⁹⁵ Anable and Bristow (2007), p. 73.

⁹⁶ *Ibid.*, pp.74-75.

⁹⁷ *Ibid.*, p. 75. Nonetheless, the net effect is still a positive figure for carbon savings: see *ibid.*

⁹⁸ See *ibid.*, pp. 72-73 and p. 74-75.

⁹⁹ And reported in detail in Carslaw *et al.* (2011).

108. Mention should also be made of the evidence from the reforms to company car taxation in Denmark.¹⁰⁰ Here, it seems clear that changes to price thresholds did impact directly on purchase decisions, leading to reduced sales of luxury cars – though it should be said this down-sizing was also apparent in the larger car market. However, given the small share occupied by this luxury segment, the extent and importance of the environmental impacts from these changes is far from clear.

109. In view of this, it is not unreasonable to conclude that the sum of available evidence on this point – the evidence from these real-world reforms as well as the evidence from Harding (2014) suggesting a relatively small difference in CO₂ ratings as between company cars and private cars and the evidence from Scott, Currie and Tivendale (2012) suggesting a shift away from more fuel-intensive company cars independently of changes to company car taxation – is insufficient to establish a judgement on the relative importance of environmental differentiation in company car taxation on the composition of the car fleet and thereby on environmental outcomes. It is certainly insufficient to suggest that this is a more important pathway than the one that passes through the impact of under-taxation on total distance driven.

110. The same applies *mutatis mutandis* to safety. The outcome here shows a common pattern across the OECD world: the record of accidents is considerably worse for company cars than for private cars. But given the variety of possible pathways reported in country-specific studies¹⁰¹ – with company cars showing a lower level of safety features in some countries and a higher level in others – it is perhaps best to refrain from a judgement. That is: other than the obvious point that, insofar as it tends to increase distance driven per car as well as total distance driven, the subsidy to company cars will tend to increase traffic accidents *ceteris paribus*.

3.3 *Results for company cars*

111. From the evidence and analysis of the corrections to company car taxation reported above, and from the larger body of evidence and analysis presented to date, it is now possible to record four main results in relation to company car taxation:

- The under-taxation of company cars is likely to result in a disproportionately large increase in total distance driven, composed of both an increase in the number of cars driven and an increase in distance driven per car. Conversely, corrections to company car taxation are likely to result in a disproportionately large reduction in total distance driven – and a corresponding mode shift to public transport.
- Because of its disproportionate impact on total distance driven and its components, the under-taxation of company cars is likely to result in disproportionately large impacts on most relevant environmental pressures. Conversely, corrections to company car taxation are likely to result in disproportionately large reductions in the sum of environmental costs.
- There is sufficient evidence to suggest that the widespread and multi-faceted under-taxation of the distance component is more important to environmental outcomes than the under-taxation of the capital component.
- There is insufficient evidence to establish the relative importance of environmental differentiation in company car taxation on the composition of the car fleet and thereby on environmental outcomes.

¹⁰⁰ See Næss-Schmidt and Winiarczyk (2010), Chapter 3.3, in particular, figure 3.4, and related text.

¹⁰¹ See above, Chapter 3.2, final paragraph, and the sources cited therein.

112. And from the above results, and given the extent of the problem as revealed in Harding (2014), it is safe to conclude:

- Environmental outcomes across the OECD world would be greatly improved by ending the under-taxation of company cars, in particular, the under-taxation of the distance component.

4. Commuting expenses

4.1 Some caveats

113. Following the lead of Harding (2014), the analysis of the tax treatment of commuting expenses is conducted separately from the analysis of the tax treatment of company cars, and is conducted less definitively. This is so for several reasons.

114. First, as noted in the Introduction, the tax treatment of commuting expenses across the countries surveyed is much more variable.¹⁰² In several cases, employee-paid costs are not deductible and employer-paid costs and employer-provided parking are taxed neutrally. In several others, there is some element of subsidy to commuting limited in a few cases to commuting by public transport. There is not a common problem of under-taxation across the OECD world.

115. Second, even where there is a subsidy to commuting, the net environmental impact of it will vary greatly depending on which modes are favoured, how they are favoured, and to what extent. The environmental issues here are not the same as they are in regard to the subsidy to company cars.

116. Third, there is not here a readily available evidence-base on the extent of under-taxation and corresponding subsidy in the relevant countries comparable to that presented for company cars in different countries in Harding (2014).

117. In view of this, what follows is a more modest set of general remarks which may or not apply to individual countries. Once again, this is quite different to the analysis of company cars where the argument against subsidy presented in this paper applies to all the countries that were covered in the survey described in Harding (2014) – even including, at least in a formal sense, the two countries where the subsidy in question is relatively trivial.

4.2 Pathways to impacts

118. A favourable tax treatment can include any one or more of the following:

- Tax deductibility for commuting expenses paid by the employee;
- A full or partial exemption from tax of commuting expenses paid by the employer;
- A full or partial exemption from tax of “free” parking provided by the employer, whether on-site or off-site.

119. Unless otherwise stated, the use of the term “subsidy” in what follows applies to all of the above.

¹⁰² See Harding (2014), Chapter 4.1, “Taxation of commuting expenses in OECD countries”. See also the multi-country survey in Potter *et al.* (2006).

120. Harding (2014) identifies a number of pathways by which a subsidy to commuting can impact on environmental pressures.¹⁰³ The analysis below comments briefly on two potentially significant pathways: the incentive to increase the length of the commute and an incentive to substitute between forms of commuting.

121. A subsidy to commuting can enable employees to live further away from work and travel a greater commuting distance on the same household budget than would otherwise be possible – thus impacting on total mileage and thereby on several relevant environmental pressures. And there is a vast literature on the phenomenon of “urban sprawl”, on the possible contribution to it from transport choices and policies that affect transport choices, and, more recently, the possible contribution from a taxpayer subsidy to commuting expenses.¹⁰⁴ The problem here is that establishing causality and isolating the contribution of this subsidy with any degree of certainty is extremely difficult.

122. In part, this is a function of the complexity involved in the individual’s choice of residential location and the much greater effect of the cost of housing on that choice. But it is also a function of the limits to the range of choice available to the individual, limits determined by the patterns of land-use and the provision of infrastructure of all kinds, matters determined by the legacy of history as well as by present policy but in any case matters that are beyond the individual’s own choice.

123. The point is obvious enough at a cross-country level. In Harding (2014),¹⁰⁵ one finds for example that there is no explicit subsidy to any element of commuting in the Australian tax system. But this has not of course prevented Australia from finding itself at or near the top in international comparisons of urban sprawl.

124. Doubtless, a rigorous research programme could in time establish causality and quantify the contribution to trip lengthening from commuting subsidies. For the purpose of the present discussion, however, it is enough to note that there is as yet insufficient evidence to arrive at a judgement on the issue.

125. There is, however, sufficient evidence to arrive at a judgement on the second pathway, if not a quantification of the consequent impacts.

126. Thus, it can be said that if the subsidy affects the choice of transport mode in favour of commuting by car over commuting by public transport and non-motorised modes, then this will impact on several relevant environmental pressures, in the ways and for the reasons explored in the earlier analysis of cars and company cars. The question then is whether and how the subsidy to commuting might favour the car.

127. According to Harding (2014), none of the countries surveyed explicitly favours commuting by car in its provision of subsidy to commuting expenses. But much will depend on whether employer-paid parking is taxed and how its value is calculated. The case of New Zealand is instructive here. New Zealand treats employee commuting expenses as non-deductible and employer-provided public transport expenses as fully taxable. It also taxes employer-provided off-site parking. But it exempts employer-provided parking if provided on-site. Now if the latter is valued equally to off-site parking, then the value of this subsidy alone is equal to 100% of the comparable cost of public transport. As Scott, Currie and Tivendale (2012) report it:

¹⁰³ Harding (2014), Chapter 4.2, “Fiscal and environmental impacts”.

¹⁰⁴ See *inter alia* Scott, Currie and Tivendale (2012), the sources discussed in the text and the sources listed in the Bibliography.

¹⁰⁵ See Harding (2014), Chapter 4.1, “Taxation of commuting expenses in OECD countries”.

Table 7. Rail and bus fares versus value of parking in Auckland, New Zealand

Mode	Status	Annual Cost in NZD
Rail (monthly pass)	Non-deductible	2700
Bus (monthly pass)	Non-deductible	2700
Employer-provided on-site parking (valued as equal to city parking)	Tax-exempt if on-site	2725

Source: data reported in Scott, Currie and Tivendale (2012).

128. The *ex post* response to a change in this practice would of course provide the best evidence of its *ex ante* impact. Nonetheless, *in lieu* of such a change, the correlation of mode shares with the extent of employer-provided parking does provide good evidence on the issue. Thus:

Table 8. Parking provision and mode shares in Auckland, New Zealand

Extent of employer-provided parking	Car (drive-alone) mode share	Public transport mode share
>40% of staff provided with parking	45-81%	2-19%
<10% of staff provided with parking	21-32%	24-43%

Source: data reported in Scott, Currie and Tivendale (2012).

129. Moreover, even where employer-provided parking is not formally tax-exempt, the fact remains that it is all too easy to under-estimate the value of that provision – a good example being where employees share the parking space provided for customers.¹⁰⁶ As is noted in Baker, Judd and Oram (2010), this helps to explain why employer-provided parking *is* provided so widely, not only in the US, where the tax-exemption is capped, but also in those countries where it is not at all tax-exempt.

130. There is a related point to note: namely, the effect of widespread “free” parking that is available other than at the workplace itself.¹⁰⁷ From the perspective of the individual employee, the parking provided at the workplace can also be made to serve as a means of accessing free parking elsewhere, and as part of the daily round. It thereby helps to entrench driving as the mode of choice for commuting.

131. The point can be generalised. Not parking alone but this mode itself is, on average, radically under-priced; the available substitutes are not. To recall the figures from Britain quoted in Table 1: road users, on average, pay as little as 15% of the marginal social cost of their trips; if they were to switch to bus or commuter rail, they would be obliged to pay around 100%. A further subsidy, in the form of a subsidy to commuting, can only serve to confirm their default choice.

132. Conversely, if the subsidy to commuting were to be re-directed from the car to its alternatives, one should expect to see a mode shift to these alternatives, to a greater or lesser extent. Indeed, one should expect to see this in response to any serious change in that direction even if it falls well short of a full re-direction. Evidence from the US shows just such a response. The steady increase in the availability of employer-paid “transit benefit”, the later introduction of tax-deductibility for employee-paid transit expenses, and the more recent sharp increase in the tax-exempt cap, now matched to the tax-exempt cap for employer-provided parking, has indeed been attended by significant increases in public transport ridership in several US cities.¹⁰⁸

133. To be sure, the previous argument applies: the real benefit to the employee derived from the subsidy to parking is always likely to be greater than it seems. But the evidence from this partial re-direction is nonetheless an indication of what might be achieved in future by a full re-direction of the commuting subsidy.

¹⁰⁶ See Baker, Judd and Oram (2010).

¹⁰⁷ See *ibid*. Quoting 1998 data for the US as a whole, the authors report that “free parking is available for 99 percent of daily trips”.

¹⁰⁸ See *ibid*.

134. The analysis of this second pathway has been conducted without reference to the first. Thus, *for any given trip length*, a favourable treatment of commuting expenses generally, and of employer-paid parking in particular, is likely to favour the car relative to public transport and non-motorised modes – and thereby contribute to higher levels of fuel consumption, CO₂ emissions, local air pollution, traffic accidents and congestion. Conversely, for any given trip length, a re-direction of the commuting subsidy to public transport and non-motorised modes is likely to cause a shift to these modes – and thereby contribute to a reduction in the said impacts. Moreover, any serious change in that direction is likely to show, albeit to a lesser extent, similar mode shifts and consequent environmental outcomes.

135. Suppose now that one re-introduced the first pathway, the possibility of trip lengthening as individuals use the subsidy to re-locate further from work. If the re-direction of the subsidy succeeded in causing a large enough mode shift, then the lengthened journey (presumably by rail) would be far less of a problem. Moreover, flat-rate subsidies, or caps, could be used to limit the (rail) journey. However, caps on the extent of subsidy *without* restrictions in regard to modes, would also re-introduce the risk of reverting to the car as the default choice. Hence, there is a judgement to be made on the relative importance of the two pathways.

136. There is also a judgement to be made on a potential bias to public transport relative to non-motorised modes. This is because *any* non-trivial financial subsidy will tend to penalise the modes with the least financial costs (walking, cycling, car-sharing).¹⁰⁹ The judgement made in this paper is that this is very much a second-order problem. For the great majority of commuters in the relevant countries, the choice is between the car and public transport.¹¹⁰ And given the enormous difference between the environmental costs of the former and the environmental costs of the latter, the first-order issue is the scope for a mode shift from the former to the latter.

4.3 *Results for commuting expenses*

137. From the evidence and analysis above, one can record these two results:

- There is insufficient evidence to arrive at a judgement on the impact of a favourable tax treatment of commuting expenses on the choice of residential location and commuting distance, and thereby on environmental outcomes.
- There is good reason to suppose that, unless otherwise restricted, a favourable tax treatment of commuting expenses generally, and of employer-paid parking in particular, is likely to impact on the choice of transport mode – in favour of the car relative to public transport and non-motorised modes – and thereby on most relevant environmental pressures.

138. And from the above results, but given the varied incidence of the tax treatment of commuting expenses as reported in Harding (2014), it is reasonable to conclude:

- In regard to commuting expenses: environmental outcomes in the relevant countries would be improved by restricting any favourable tax treatment of commuting expenses to public transport and non-motorised modes.

¹⁰⁹ As is noted in Harding (2014). Indeed, the bias could be eliminated only by using a cap corresponding to the financial cost of the least-cost mode – walking.

¹¹⁰ There are some important exceptions – most famously Copenhagen in Denmark, but also some of the cities in the Netherlands, some University towns in various European countries, and so on. But these are exceptions to a rule that fully applies to the great majority of commuters in the OECD member-countries.

ANNEX 1 QUANTIFYING THE ENVIRONMENTAL IMPACTS OF THE UNDER-TAXATION OF COMPANY CARS

A1.1 Preliminary remarks

139. This Annex provides, for the OECD group of countries as a whole, some indicative estimates of the main impacts of the under-taxation of company cars, as well as an indicative estimate of the overall environmental and other social costs.

140. It should be stressed that the estimates below *are* indicative – and *no more than indicative*. No attempt is done to provide a “bottom-up” calculation of impacts for each OECD country and to sum the results for the OECD group as a whole. Rather, and *in lieu* of the resources to do this, this Annex proceeds as follows:

- from the available evidence on company car taxes and tax changes, to establish where possible the impact of current under-taxation on the proximate determinants of environmental impacts;
- from the evidence base on the environmental impacts of cars in general, to establish where possible a “top-down” calculation of the share attributable to the under-taxation of company cars; and
- to scale up the results, insofar as they are derived from national or regional data, for the OECD group of countries as a whole, taking account of those cases where a simple proportionate scaling-up is not necessarily appropriate.

141. Importantly, the results cannot, and should not be, simply read back into the profile of individual countries in order to establish whether any particular country is likely to exhibit an above- or below-average response to distortions in current tax settings or to any proposed corrections to these settings.

142. In practice, and for the reasons explained in the section below, the proximate determinants selected for the calculation are the number of cars driven and the total distance driven – and also, albeit indirectly, the distance driven in peak periods at particular locations. The impacts of the under-taxation of company cars on these determinants are both quantitatively more important and more reliably quantifiable than the impacts on the several and various characteristics of the vehicle types driven.

143. In practice, and for the reasons explained in the subsequent section, the impacts selected for the calculation are the main impacts from the use of cars identified in the main body of the paper. Here, too, these are the impacts that are quantitatively most important and the most reliably quantifiable.

144. It remains to add that, although the estimates below are no more than indicative, there is a sense in which no more than this is required for the purpose of the present discussion. There are cases where economists’ estimates of external costs can serve a direct operational purpose: for example, estimates of marginal external congestion costs that are used to determine congestion charges. But this is not such a case. Given that current tax settings in relation to company cars have a large negative impact on government revenues, the primary question surely is whether they are offsetting positive impacts on other

social variables, and whether these are large enough to justify the fiscal losses. Having shown to the contrary that the impact on specific environmental pressures is negative – and large – it should suffice to provide only a rough indication of “how large” in order to close the question. If later research were to show that the true negative impact on environmental outcomes is a few billion euros more or less than the negative impact indicated below, it would not change the argument advanced here and its conclusion: namely, that the current tax settings have a large negative impact and should therefore be corrected.

A1.2 Quantifying the impact on the proximate determinants

145. As shown in Harding (2014), current tax settings deliver a more or less significant subsidy to company cars users in almost all OECD countries. And as shown in Chapter 3, there are several pathways by which this subsidy can impact on environmental pressures:

- an increase in total distance driven, leading to higher levels of fuel consumption and relatedly of CO₂ emissions, of local air pollution, of traffic accidents and of congestion;
- an increase in distance driven in peak periods at particular locations, leading to higher levels of congestion, and thereby to yet higher levels of fuel consumption, CO₂ emissions, local air pollution and traffic accidents;
- an increase in the number of cars driven, leading to higher demands on parking space;
- an increase in the number of cars driven, leading to an increase in the number of cars produced, thus leading to higher demands on a range of resources and higher levels of emissions and industrial accidents;
- a change in the composition of the car stock, in particular, a shift to larger and more expensive cars and hence to cars with lower levels of fuel efficiency and higher CO₂ ratings, leading to higher levels of fuel consumption and relatedly of CO₂ emissions.

146. Of course, the issue here is not the observable change in the company car sub-set itself: that is, the increase in numbers, the increase in distance driven, the change in vehicle type, and so on, within this sub-set. Hypothetically, for example, an increase in the number of company cars (and any other relevant variables) could be exactly offset by a matching reduction in the number of private cars (and any other relevant variables), leading to no net environmental impact. Whilst there is no reason to suppose that such an outcome can be found anywhere, it helps to define the impact that is at issue: namely, the net impact of the subsidy to company cars on the larger set of cars taken as a whole – on the overall numbers of cars, of distance driven, of vehicle types, and so on.

147. Fortunately, there is reasonably reliable evidence available on the impact of the company car subsidy on some of these proximate determinants: as it happens, the quantitatively most important determinants. Therefore, and so long as one takes care to err on the side of under-estimating rather than over-estimating, it is indeed possible to proceed with reasonable confidence to indicate the extent of the overall environmental and other social costs.

148. In their study for the European Commission, Næss-Schmidt and Winiarczyk (2010) estimate the increase in the number of cars driven in the EU as a result of the subsidy to company cars at 9.0%. Their calculation begins with the estimates of the Tinbergen Institute researchers on the effect of the subsidy in the Netherlands and adjusts for the higher level of subsidy that can be found in the EU as a whole:

The [Tinbergen Institute] study finds that the subsidy-induced increase in the stock of cars in the Netherlands ... corresponds to 5.4 percent of the total stock of cars in the Netherlands....

Assuming that the subsidy effect on car ownership in the EU is the same as in the Netherlands, and given that the average subsidy level in the EU is 1.7 times higher than in the Netherlands, the corresponding increase in the car ownership due to subsidy amounts to 9.0 percent (5.37 percent multiplied by 1.68).¹¹¹

149. At the same, they also note that the elasticities implicit in the Tinbergen Institute estimates “seem in the high end”. Therefore, using the elasticities found in the “general literature” on car ownership, they also provide a “conservative estimate” of the increase in the number of cars as a result of the subsidy to company cars – at around 4%.¹¹²

150. On the basis of these available published estimates, it is not unreasonable to proceed here with an estimate that is roughly at a mid-point between the low and high estimates for the EU – in round numbers, 7%.

151. It should be stressed that the Tinbergen Institute studies, based as they are on an analysis of household micro-data, drawn from the three separate sources (the Dutch Central Bank household survey, the Dutch car survey and the National Travel Survey), provides the single most “intensive” evidence base on this issue.¹¹³ And the study by Copenhagen Economics for the European Commission, Næss-Schmidt and Winiarczyk (2010), provides the single most “extensive” evidence base on the same issue – with appropriate adjustments and low and high estimates provided on the basis of current European data and the general literature. Therefore, whilst it is not pretended in any sense here that the 7% estimate is the uniquely correct number, there is no reason to suppose that there is at present a more accurate number available.

152. Moreover, the 7% estimate is consistent with some other available evidence. Company cars constituted around 12% of the total car stock in the EU in 2008 and 13% in Israel in the same year, with the remaining 88% in the EU, and 87% in Israel, being privately owned.¹¹⁴ Given that they constitute around 50% of new car registrations, one may suppose that they constitute a slightly higher share of total car stock by now.¹¹⁵ Statistically, they may be said to “add” around 14%, or 15%, or slightly higher to the “pre-existing” car stock: thus, 12 “additional” company cars joining the 88 “pre-existing” private cars to make 100 (the total car stock) gives us an increase of 14% (12/88) on the “pre-existing” stock, 13 joining 87 to make 100 gives us an increase of 15% (13/87), and so on. Suppose now that half of these “additional” cars are indeed genuinely additional: that is, they would not be on the road if the subsidy were not available. (It is immaterial here whether this were to occur *via* the employee surrendering the company car or *via* the employee’s household surrendering the private car upon taking up the company car.) If so, given the data above, the subsidy-induced increase in the car stock would thus be 6.4% (6/94), 7.0% (6.5/93.5), or slightly higher – that is to say, remarkably close to the 7% estimate use here.

153. And there is indeed empirical evidence to support the proposition that around half the current stock of company cars is genuinely additional in the sense described – in particular, the survey evidence

¹¹¹ See Næss-Schmidt and Winiarczyk (2010), Annex A, and in particular Table 5.1.

¹¹² See *ibid.*, and in particular Table 5.5.

¹¹³ See in particular Gutiérrez-i-Puigarnau and van Ommeren (2007).

¹¹⁴ See Shiftan, Albert and Keinan (2010) and Shiftan, Albert and Keinan (2011) and the sources cited therein.

¹¹⁵ See *ibid* and also Næss-Schmidt and Winiarczyk (2010).

from Israel assembled in the context of an on-going real-world reform. As noted earlier, 47% of current company car users would be willing to give up the company car if the subsidy were entirely withdrawn – that is, by means of an increase in the “value of personal use” large enough to eliminate any subsidy.¹¹⁶

154. Now it may be objected that, even if half the employees with company cars were to give them up, their employers might still require them to drive for business purposes – and hence would provide them with either a company car or a car that was purchased as part of its own fleet. But this objection is not well-founded – it is based on what the Tinbergen Institute researchers describe as “a common misunderstanding”.¹¹⁷ As they explain it:

Arguably, for almost all professions, the number of jobs with an employers’ demand for using a car for business purposes is much less than the number of employees with a demand for driving to work with a car.... Therefore, given efficient matching, any employer with a demand for a car for business purposes may find an employee who commutes by private car. In this case, the firm will only pay for the marginal costs of use for business purposes.¹¹⁸

155. For the present discussion, the assumption is weaker still: it is only assumed that the employer will find an employee who either commutes by private car or is one of the 50% or so of company car users who choose to retain the company car as an additional car – an entirely reasonable assumption.

156. The difficulty lies in extrapolating these findings from European and Israeli research, based on European and Israeli experience, in order to apply the 7% estimate to the OECD group of countries as a whole.

157. Harding (2014)¹¹⁹ shows a considerable variation in the extent of under-taxation in the various member-countries. It is true that there is not a generalised difference between EU and non-EU countries. However, without research grounded in the experience of these countries, their history of tax concessions and corrections and the behavioural responses of firms and employees, any application beyond Europe and Israel needs to be qualified with the caveat that the necessary research has yet to be undertaken. Hence, it is only with this caveat that we proceed with the application – an application that is thereby limited to yield indicative results, and no more than indicative results.

158. It goes without saying that applying the 7% estimate to the OECD group of countries as a whole does not imply that this is the estimate that applies to *each country*, even within the EU. Clearly, it does not. The actual subsidy-induced increase in the stock of cars in the individual countries will vary depending on the actual incidence of subsidy, its extent and its components, as well as the behavioural changes induced and entrenched by the previous history of taxation in this field.

159. Nonetheless, if this one estimate, a 7% increase in the overall number of cars driven as a result of the subsidy to company cars, can be taken as a reasonably reliable basis on which to proceed for the limited purpose of the present discussion, most of the rest can fall into place with less difficulty.

¹¹⁶ As reported in Shifan, Albert and Keinan (2011) and cited above in Chapter 3.2.

¹¹⁷ See Gutiérrez-i-Puigarnau and van Ommeren (2007).

¹¹⁸ *Ibid.*

¹¹⁹ See Harding (2014), in particular, Table 10 and Figure 6.

160. As noted earlier, the average distance driven by company cars in the relevant countries is generally at a multiple of 1.5-3.0 of the distance driven by private cars.¹²⁰ Of course, some part of the mileage now driven by the subsidy-induced “additional” cars would continue to be driven even in the absence of subsidy – partly as a result of some employees continuing to commute, and to conduct personal trips, by private car, rather than by public transport, and partly as a result of some employees undertaking business trips by private car, rather than by public transport, with the employer bearing the marginal cost. Equally, however, some part of the mileage now driven by the “non-additional” cars – that is, the cars that would continue to be used as company cars in the absence of subsidy – would no longer be driven if the subsidy were indeed to be withdrawn.

161. Recall here that the partial corrections to company car taxation in Britain that delivered a *circa* 20% reduction in company car ownership over a period of years also delivered over the same period a *circa* 40% reduction in company car total mileage.¹²¹ And recall too that this reduction in mileage was evidenced for all categories of travel: not only for commuting and miscellaneous private trips, but also for business travel. How this mileage is replaced – whether by rail and other modes of public transport, or by the use of information technology, or by better planning on the part of households and businesses – is not relevant to the present discussion. What is relevant is simply that some part of the mileage now undertaken by company cars would cease to be undertaken by cars of any type if the subsidy to company cars were to be withdrawn.

162. In the absence of sufficient hard evidence on which to base a precise calculation, one must rely on a judgement on the basis of the evidence that is available. The judgement applied here is as follows:

- if the company car subsidy-induced increase in the overall number of cars driven is 7%;
- if the average distance driven by company cars in the relevant countries is at a multiple of 1.5-3.0 of the distance driven by private cars;
- if the partial correction in Britain delivered a reduction in company car mileage that was twice as large as the reduction in company car ownership;
- given that British company car mileage was (and is) at a higher multiple to private car mileage than elsewhere – but given that the reduction delivered was the result of a partial correction;
- then it is reasonable to suppose that a full correction would deliver a reduction equal to at least the lower multiple of 1.5.

163. It follows that the company car subsidy-induced increase in total distance driven may safely be estimated at 10.5% (7% x 1.5).

164. Once more, be it noted that this is no more than an indicative estimate. It is not pretended in any sense that the estimate 10.5% is the uniquely correct number. On the other hand, there is no reason to suppose that there is at present a more accurate number available.

165. Clearly, it is a little more difficult to establish an estimate for the induced increase in distance driven in peak periods at particular locations – the pattern will vary significantly depending upon the location. But it would be all too easy to under-estimate this increase. Company cars are likely to have a

¹²⁰ See *inter alia* Harding (2014), Annex B, and Scott, Currie and Tivendale (2012), Chapter 2.1.4, and the studies cited therein.

¹²¹ See above, Table 5, and the data reported in Le Vine and Jones (2012).

disproportionately high share in peak-period commuting everywhere: after all, almost all company cars *are* used for commuting. Moreover, since the congestion function is non-linear, the contribution of company cars to congestion costs is doubly disproportionate.¹²² Therefore, and given the evidence supplied in De Borger and Wuyts (2010),¹²³ it is proposed to estimate the induced increase in congestion costs as a result of the subsidy to company cars at 21% – that is, double the induced increase in total distance driven – without attempting to advance a specific estimate of the impact on the intermediate variable, the distance driven in peak periods at particular locations.

166. What is seriously more difficult to estimate is the induced change in the composition of the car stock. For the evidence here is seriously ambiguous. On the one hand, there is published literature on why and how the subsidy to company cars is likely to result in a shift to larger and more expensive cars, and hence to cars with lower levels of fuel efficiency and higher CO₂ ratings.¹²⁴ On the other hand, there is evidence from Harding (2014) suggesting a relatively small difference in CO₂ ratings as between company cars and private cars; evidence from Scott, Currie and Tivendale (2012) suggesting a shift away from larger, heavier, more fuel-intensive company cars independently of changes to company car taxation; and evidence from real-world reforms – in Britain in particular – suggesting ambiguous results from the established policy of CO₂-based differentiation in the taxation of company cars.¹²⁵

167. Therefore, *in lieu* of a more detailed research effort, it is proposed here to proceed without calculating a value for this intermediate impact. Rather, it is only through the intermediate impact on total distance driven that additional fuel consumption, additional CO₂ emissions, and so on, is calculated. This procedure is likely to result in under-estimating the overall impacts to some extent: clearly, the subsidy to company cars is likely to have a non-zero impact on the composition of the car stock. Nonetheless, this is the procedure adopted here on the grounds that it is better to err on the side of under-estimating rather than over-estimating.

A1.3 Quantifying the environmental and other social costs

Fuel consumption

168. As argued in Chapter 2, cars place a demand on a singularly important scarce resource, the world's most traded commodity, oil. The concentration of oil supplies enables a cartel of leading suppliers, OPEC, to exert monopoly pricing power (and other suppliers to surf the high-price wave). The exporting countries gain an economic rent; the importing countries are obliged to pay that rent. The result is a continuing transfer of wealth to net oil exporters from the world's oil-importing countries, including most of the member-countries of the OECD.¹²⁶

169. However, as was also argued in Chapter 2, there is not as yet a scientific consensus on how to calculate the net social cost in question. *Inter alia*, there are difficulties in isolating the component of rent within the traded price, difficulties in isolating the net cost to society from the transfer from one party to another, and difficulties arising from the presence of externalities which suggest that oil should be made available to the consumer at a price considerably higher than its competitive market price. In view of this,

¹²² See above, Chapter 3.2, and the argument advanced in De Borger and Wuyts (2010).

¹²³ See *ibid.*

¹²⁴ See *inter alia* Gutiérrez-i-Puigarnau and van Ommeren (2007), Van Ommeren and Gutiérrez-i-Puigarnau (2011) and Gutiérrez-i-Puigarnau and van Ommeren (2011), and also the use of this line of research in Næss-Schmidt and Winiarczyk (2010).

¹²⁵ See above, Chapter 3.2.

¹²⁶ See above, Chapter 2, and see Roy (2011) for a fuller treatment of the issue.

it is proposed here simply to note the fact of a social cost in this regard – but proceed straightaway to a calculation of social cost for those several environmental impacts that can be calculated with greater confidence.

CO₂ emissions

170. As is generally recognised, any attempt to count the social cost of carbon – and therewith, any attempt to count the cost of transport-related CO₂ emissions or any sub-set thereof – is critically dependent on the choice of the discount rate, the rate at which one *discounts* the future streams of costs and benefits. And as Arrow (1995) eloquently demonstrates, the choice of discount rate – and in particular the choice of one component of it, the “pure rate of time preference”, independently of assumptions about future income growth and the marginal utility of income – is an irreducibly *ethical* choice. Citing Rabbi Hillel’s words in support (“If I am not for myself, then who is for me? If I am not for others, then who am I? If not now, when?”), Arrow argues that the individual agent has obligations to *both* the self and the universal other.¹²⁷ Hence, to translate this ethical insight into the mathematics of discounting, it follows that the pure rate of time preference should be positive – but not so high as to discount away to nothing the welfare of future generations. Arrow chooses a pure rate of time preference of 1% per year. This paper chooses likewise.

171. Nordhaus (2011) provides a rigorous set of modelled estimates of the social cost of carbon based on a set of choices in regard to the pure rate of time preference (PRTP) and therewith the discount rate. His own choice is a PRTP of 1.5% per year. And this choice leads to an estimate of the current social cost of carbon at USD 44 per tonne of carbon, or USD 12 per tonne of CO₂. Importantly, he also provides two variations. One is based on a “low” discount rate run – with a PRTP of 1% per year, equivalent to a discount rate of 3% per year for the 100-year period from 2005 to 2105 – leading to an estimate of USD 138.21 per tonne of carbon, or USD 37.66 per tonne of CO₂. Another, *a la* the Stern Review, is based on a “near-zero” discount rate – with a PRTP of 0.1% per year, equivalent to a discount rate of 2% per year from 2005 to 2105 – leading to an estimate of USD 288.35 per tonne of carbon, or USD 78.57 per tonne of CO₂.¹²⁸ In line with our choice of a PRTP of 1% per year, this paper now proceeds with the results from the low discount rate run in Nordhaus (2011) for the purpose of this calculation.

172. CE Delft *et al.* (2011) provide what is arguably the most detailed set of estimates available of transport-sector external costs in Europe (as at year 2008).¹²⁹ This includes the contribution of the sector and its various sub-sectors to climate change *via* their CO₂ emissions – more precisely, *via* their total CO₂ equivalent greenhouse gas emissions. They provide, as is appropriate, a range of estimates, including a “low” estimate based on a social cost of carbon at EUR 25 per tonne of CO₂. This yields a total of EUR 14.407 billion as the contribution of passenger cars to climate change costs across the 27 European countries for which the costs are calculated.¹³⁰

173. To proceed from here with our chosen value for the social cost of carbon, one first needs to apply a multiple of 1.2 to the CE Delft estimate (thus, USD 37.66 per tonne of CO₂ = EUR 30 per tonne of CO₂ = 1.2 x EUR 25 per tonne of CO₂). To translate this estimate for the 27 European countries in the CE Delft study – the EU 27 minus Cyprus¹³¹¹³² and Malta plus Norway and Switzerland, with a combined

¹²⁷ See Arrow (1995).

¹²⁸ See Nordhaus (2011), in particular, Table 1 and Table 2.

¹²⁹ See CE Delft, Infras, Fraunhofer ISI (2011). More precisely, these are estimates for transport-sector external costs in the EU-27 *minus* Cyprus and Malta *plus* Norway and Switzerland.

¹³⁰ See *ibid.*, Table 2, and see Chapter 3.3 for a detailed discussion of climate change costs.

¹³¹ Note by Turkey: The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey

population of *circa* 515 million – to the OECD group of countries as a whole, population data is used to apply a multiple of 2.4. This is necessarily imprecise – for example, it is known that certain non-European OECD countries such as the US and Australia are amongst the highest per-capita emitters of CO₂ – but it will suffice for the purpose of arriving at indicative estimates. Finally, to estimate the share of the cost attributable to the subsidy to company cars, the estimate of the subsidy-induced increase in total distance driven is used – once more, without using any multiplier to estimate additional fuel consumption as a result of the induced purchase of less fuel-efficient cars. Thus, the share attributable is 9.5% (= 10.5/110/.5).

174. From the above, and choosing to err on the side of under-estimating, one can estimate the current annual cost of the additional contribution to climate change induced by the subsidy to company cars in all OECD countries, as follows:

$$\text{EUR 14.407 billion} \times 1.2 \times 2.4 \times 0.095 = \text{EUR 3.9 billion.}$$

Local air pollution

175. For local air pollution, it seems at first sight a relatively straight-forward exercise to proceed from the estimate provided in CE Delft *et al.* (2011).¹³³ The problem here is that this 2011 estimate is no longer tenable in light of the new evidence that has now emerged and must serve here as the point of departure – in particular, the epidemiological evidence on mortalities and morbidities attributable to air pollution tabled in the Global Burden of Disease project¹³⁴ and the related cost calculations undertaken by the present author and published by the OECD.¹³⁵ This permits an estimate of USD 864.144 billion as the contribution of *road transport* to the cost of the air pollution across all OECD countries¹³⁶ – or EUR 691.315 (at purchasing power parity). If the *circa* 50% estimate of the contribution of *passenger cars* to road transport-generated air pollution costs provided in CE Delft *et al.* (2011) can serve duty here – more precisely, a 53% estimate rounded down here to 50%¹³⁷ – the result for the OECD countries as a whole can be thus be directly estimated at EUR 345.668 billion. And to estimate the share of this cost attributable to the subsidy to *company cars*, the estimate of the subsidy-induced increase in total distance driven can now be applied: thus, 9.5% (= 10.5/110.5).

176. From the above, the current annual cost of the additional local air pollution induced by the subsidy to company cars in all OECD countries is estimated as follows:

$$\text{EUR 345.668 billion} \times 0.095 = \text{EUR 32.8 billion.}$$

recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.

¹³² Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

¹³³ See *ibid.*, Table 2, and see Chapter 3.2 for a detailed discussion of local air pollution costs

¹³⁴ See in particular Lim, S. S. et al. (2012) and Institute for Health Metrics and Evaluation (2013).

¹³⁵ See OECD (2014).

¹³⁶ See *ibid.*, Table 29.

¹³⁷ See CE Delft, Infrac, Fraunhofer ISI (2011), Table 2.21.

Traffic accidents

177. For traffic accidents, one can proceed once more from the estimate provided in CE Delft *et al.* (2011). Their estimate for the contribution of passenger cars to traffic accident costs in the 27 European countries is EUR 157.1 billion.¹³⁸ A multiple of 2.4 is applied to scale up the result for the OECD group as a whole. And to estimate the share attributable to the subsidy to company cars, the estimate of the subsidy-induced increase in total distance driven is used: thus 9.5% (= 10.5/110.5).

178. From the above, one can estimate the current annual cost of the additional traffic accidents induced by the subsidy to company cars in all OECD countries as follows:

EUR 157.105 billion x 2.4 x 0.095 = EUR 35.8 billion.

179. As it happens, and was noted earlier, the rate of accidents for company cars is generally reported as being *more* than 50% higher than for private cars.¹³⁹ Hence, the use of a multiple of 1.5 over the subsidy-induced increase in the number of cars driven (7%) to estimate the subsidy-induced increase in total distance driven (10.5%) is likely to flow through into an under-estimate of the subsidy-induced increase in traffic accidents. Thus, once more, the calculation errs on the side of under-estimating.

Congestion

180. CE Delft *et al.* (2011) report a range of indicators and a range of estimates, or “minimum” and “maximum” values, for congestion costs, defined as “the economic costs of time losses plus an addition due to additional fuel and vehicle operating costs under congested conditions”.¹⁴⁰ For passenger cars in the 27 European countries, the minimum value reported for the delay costs indicator is EUR 98.416 billion.¹⁴¹ As before, a multiple of 2.4 is applied to scale up the result for the OECD group as a whole.

181. As noted earlier, the increase in congestion costs as result of the subsidy to company cars is not proportional to the subsidy-induced increase in total distance driven but, rather, doubly disproportionate. By virtue of their near-universal use in peak-period commuting, company cars will add to distance driven in peak periods more than they add to total distance driven. By virtue of impacting at the steep end of the upward-sloping congestion function, they will add to congestion costs more than they add to distance driven in peak periods. In view of this, and in view of the high values reported for Belgium in De Borger and Wuyts (2010), perhaps the only study to address directly the contribution of the company car subsidy to congestion costs, it seems reasonable to apply a multiple of 2 over the increase in total distance driven to estimate the increase in congestion costs: that is, 21%. It follows that the share of congestion costs attributable to the subsidy is 17% (= 21/121).

182. Thus, the current annual cost of the additional congestion induced by the subsidy to company cars in all OECD countries is estimated as follows:

EUR 98.416 billion x 2.4 x 0.17 = EUR 40.2 billion.

¹³⁸ See *ibid.*, Table 2, and see Chapter 3.1 for a detailed discussion of traffic accident costs.

¹³⁹ See *inter alia* Shifan, Albert and Keinan (2010) and Scott, Currie and Tivendale (2012), Chapter 2.1.5 – and cited above in Chapter 3.1.

¹⁴⁰ See CE Delft, Infras, Fraunhofer ISI (2011), Chapter 3.5, for a detailed discussion of congestion costs.

¹⁴¹ See *ibid.*, Table 2.

183. But the discussion of congestion cannot be closed just here. As was argued in the body of the text, congestion also contributes directly to an increase in several other environmental impacts in the use of cars. By virtue of its contribution to increased fuel consumption – be it noted that the European Commission continues to cite the estimate of 30% for the increase in fuel consumption under conditions of heavy congestion¹⁴² – congestion increases CO₂ emissions as well as the wealth transfer from OECD countries resulting from additional oil imports. It contributes to an increase in local air pollution. And it contributes to an increase in traffic accidents.

184. In estimating the impact of the company car subsidy on each of these variables, it has been erred consistently on the side of under-estimating – by choosing lower rather than higher values from the source data, by not using any multiplier to estimate additional fuel consumption as a result of the induced purchase of less fuel-efficient cars, by not using a multiplier to account more precisely for the accident rates of company cars, and so on. It would be unreasonable, however, to assign a default value of zero for the increase in all these environmental costs as a result of the clearly indicated subsidy-induced increase in congestion. It is therefore proposed to add a low 5% increase to each of the estimates provided above – the share of costs attributable to this being, in round numbers, the same as the attributed increase

185. Thus, revisiting the estimates for (a) the current annual cost of the additional contribution to climate change, (b) the current annual cost of additional local air pollution, and (c) the current annual cost of additional traffic accidents, the contribution of the additional congestion induced by the subsidy to company cars to the above-named environmental costs is estimated as follows:

$$\text{(EUR 3.9 billion + EUR 32.8 billion + EUR 35.8 billion) x 0.05 = EUR 3.6 billion.}$$

Production

186. The subsidy to company cars induces an increase in the number of cars driven which is estimated at 7%. In turn, this will lead to an increase in the number of cars produced, thus leading to higher demands on a range of resources and higher levels of emissions and industrial accidents.

187. However, as indicated in the discussion in Chapter 2, there remains considerable uncertainty in regard to the quantification of these impacts. Unlike the set of impacts generated by the use of cars, the set of impacts generated by the production of cars has not been captured in a comprehensive database, with a range of low and high estimates, compared across countries, updated over time, and revised in the light of emerging evidence. CE Delft *et al.* (2011) provide some discussion as well as some quantification of they call “upstream and downstream processes” – but they provide it in a heavily qualified form.¹⁴³

188. The tentative estimates provided in CE Delft *et al.* (2011) suggest that the overall social cost of these upstream and downstream impacts is below 10% of the total: thus, by far the greater share of the total is that generated by the use of cars.¹⁴⁴ This is more or less in line with some of the findings quoted earlier in Chapter 2.

189. None of this carries the implication that these impacts should be ignored: on the contrary, what is indicated here is the need for greater research in this relatively unexplored field. For the purpose of the present discussion, however, there is a compelling case to refrain from entering uncertain numbers into the relevant cell – and to make it clear that just that is being done.

¹⁴² See EC (2011b), Paragraph 44, and related footnotes and references.

¹⁴³ See CE Delft, Infrac, Fraunhofer ISI (2011), Chapter 3.5.

¹⁴⁴ See *ibid.*, Table 1 and Table 2.

Parking

190. The subsidy-induced increase in the number of cars driven also leads to higher demands on parking space. And this variable has indeed been studied and quantified over some time and in some detail – *in the US*. But there is not a comparable international database on this issue, with cross-country and time-series comparisons, that would allow one to provide an international estimate with a sufficient degree of confidence. Nonetheless, it may be useful to offer the following remarks.

191. From the discussion in Chapter 2, and from the estimates discussed in VTPI (2011), the estimate of USD 500 billion may be taken here as the annual cost of unpriced parking in the US. Suppose now that the increase in the demand on parking space attributable to the subsidy to company cars is assumed to be equal to the subsidy-induced increase in the number of cars driven: 7%. The share of the cost of unpriced parking attributable to the subsidy would thus be 6.5% (7/107). There would still remain the question of what proportion of this cost should be regarded as a net cost to society, as distinct from a transfer from some agents to others. It is clear, however, that the net cost to society of unpriced parking is very large and that the share attributable to the subsidy to company cars is also large.

192. As noted, it is difficult to generalise beyond the US to the OECD group countries as a whole. But there are several OECD member countries, in particular those in the EU, where the provision of unpriced parking is nowhere near as abundant as it is in the US. Suppose therefore that in order to calculate an indicative value for the rest of the OECD world, a multiple of 1.5 would provide a better indicator than the multiple of (approximately) 3 as suggested by the population data. As before, the increase in the demand on parking space attributable to the subsidy to company cars would be given by the subsidy-induced increase in the number of cars driven, 7%, and the share attributable to the subsidy would be 6.5%. And the exchange rate used would be, as before, the purchasing power parity rate at USD 1 = EUR 0.80.

193. From the above, the current annual cost of the additional unpriced parking induced by the subsidy to company cars in all OECD countries – and prior to its sub-division between intra-social transfers and the net cost to society – could thus be estimated as follows:

$$\text{USD 500 billion} + (\text{USD 500 billion} \times 1.5) \times 0.065 = \text{USD 81.25 billion} \times 0.8 = \text{EUR 65 billion.}$$

194. Given the several caveats noted above, it is not possible at present to advance this particular estimate – or carry it over into a summary table of impacts – with sufficient confidence. But what can be said is that, if the data from the rest of the OECD world is at all comparable to that of the US, an accurate estimate of this impact is likely to be large.

A1.4 Summary Table

195. At the risk of repetition, be it noted once more that the quantitative estimates provided in this Annex are (a) no more than indicative, (b) incomplete in their coverage, and (c) downwardly biased. With these caveats duly noted, the set of estimates of environmental and other social impacts resulting from the current under-taxation of company cars in OECD member countries can now be tabled. Thus:

Table A1.1 Summary table of indicative social costs of company car tax settings in OECD member-countries

Variable	Indicative social cost in EUR billions per year
<i>In the use of cars:</i>	
Wealth transfer from OECD countries as a result of additional oil imports	Not quantified
Additional contribution to climate change	3.9
Additional local air pollution	32.8
Additional traffic accident costs	35.8
Additional congestion costs	40.2
Contribution of additional congestion to the above-named environmental costs	3.6
<i>In the production of cars:¹</i>	
Wealth transfer from OECD countries as a results of additional resource imports	Not quantified
Additional contribution to climate change	Not quantified
Additional industrial accident costs	Not quantified
<i>In parking:²</i>	
Cost of additional unpriced parking	Not quantified
Total cost for above-named quantified impacts	116.3

Source: as documented in Annex 1.

¹ The available evidence suggests that these impacts are likely to be relatively small in relation to the size of the impacts from the use of cars.

² The available evidence suggests that this impact might well be relatively large.

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