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'GREEN' FISCAL MEASURES FOR LESSENING THE ENVIRONMENTAL IMPACT OF PRIVATE VEHICLE OWNERSHIP – A REVIEW

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Abstract: Given the increasing concerns surrounding climate change, the paper focuses upon the transport sector and the use of taxation policy to help curb rising amounts of carbon dioxide (CO_2) emissions. Through various environmental reforms, Governments can send out 'pricing signals' to consumers in which to shape vehicle purchasing behaviour towards lower emission vehicles. The paper provides a review of taxation measures which can be implemented during three stages of the vehicle ownership cycle: at time of purchase, annually/biannually during the lifetime and through a charge on usage. Through an overview of strengths and weaknesses, including examples around Europe, the paper attempts to shed light upon the optimal combination of measures for the greatest emission abatement, which appears to lie in a combination of purchase and circulation taxes. However, there does not seem to be a one-size-fits-all solution, as different counties each have their own geographical, social, industrial and political considerations unique to their situation. The paper also considers the context of vehicle taxation amongst other factors in the vehicle purchasing decision, and gives attention to other situational factors and those more psychological in nature. The psychological aspects of taxation is identified as an area for further research, and details of a current research project is provided which aims to address this research gap.

Keywords: transport policy, fiscal, taxation, private vehicle ownership, environment, climate policy.

1. Introduction

Climate change has been recognised as an issue of major concern with serious repercussions worldwide; and although a major player in economic growth, the environmental impact of the transport sector is far from positive. As part of a wider toolkit, a range of policy measures have been identified (by Governments in both the United Kingdom (UK) and in other countries) as an important means to help reduce the environmental impact, including vehicle taxation. Focusing primarily upon the vehicle purchasing decision, the imposition of taxation can be used to influence the type of vehicle bought. Furthermore, a series of environmental reforms have taken place, increasingly towards carbon dioxide (CO_2) emissions – whereby financial penalising or rewarding vehicle owners depending upon the emissions intensity of the vehicle.

The paper begins with an overview of vehicle ownership in both the UK and Europe, and subsequent environmental consequences of private car ownership. This is followed by a discussion of three types of taxation measures which can be implemented during the lifecycle of vehicle ownership as a tool to mitigate these environmental problems. It then explores the wider aspects which influence individual vehicle purchasing decisions, including the various situational and psychological factors suggested to be important, as well as the role of taxation in this decision-making process. Finally, a short conclusion section containing recommendations for future research is presented.

2. Private Vehicle Ownership & Environmental Impact

In Scotland, the last decade has shown an increase of almost 30% in the number of private and light goods vehicles licensed, standing at 2.4 million in 2009 (Scottish Government 2010). Where the percentage of 1 car households has remained constant at around 45%, households with 2 or more vehicles have seen the greatest increase, rising from 17.7% in 1999 to 25.6% in 2009 (*ibid*). Further the numbers of people holding driving licences has risen from 63% in 1999 to 68% in 2009 (*ibid*). These trends all emphasise the current shift towards a car orientated society in Scotland. Similar trends are observed in the UK as a whole, where a growth of 20% was observed over the same period in the number of vehicles licensed (*ibid*) – although a slightly smaller amount than Scotland, the growth is still considerable. Moreover, three quarters of households had access to a vehicle in 2007 (3% greater than Scotland); and the number of vehicles per 100 popu-

lation is also greater at 57 in GB compared to 52 in Scotland (*ibid*). As shown in Figure 1, the level of car ownership (per 1,000 population in 2008) varies considerably across Europe. Luxembourg has the highest rate, 667 per 1,000 population, Lithuania the joint 9th highest rate (with France) at 500, Scotland the 18th highest rate with 436, and Romania the lowest at 187.

The rate of growth in car ownership as reflected by the number of new passenger cars registered also fluctuates significantly between countries. For example, in 2009 Luxembourg showed the greatest growth (96 new passenger vehicles registered in 2009 per 1,000 population), Scotland saw the 4th highest increase with 42, and Lithuania and Latvia showed the joint lowest number, both at 2.

However, the extent of vehicle ownership is not necessarily all negative, as it does bring both social and economic advantages which impacts upon the quality of life for citizens. Nevertheless, there are inherent problems which accompany this. Congestion, increased road safety issues and various environmental concerns will inevitably result due to increasing numbers of vehicles on the existing road networks, and an increased amount of vehicle emissions.

Although greenhouse gas (GHG) emissions arise from all sectors of industry, the share from Scotland's transport sector has almost consistently risen from 20.6% in 2000 to 25.8% in 2008, where passenger cars were accountable for just under 6 million tonnes of CO_2 equivalent (*ibid*). Whilst the net emissions of Scotland as a whole have fallen by almost 15% since 2001, the transport sector has witnessed a growth of 7.3% during the same time (*ibid*), with a similar picture for the UK as a whole (Department for Transport 2009). Passenger vehicles in the UK were accountable for 77.7 million tonnes of CO_2 equivalent during 2007, which corresponds to 12.2% of total net emissions from all sources (which was 11% ten years prior) (*ibid*). Statistics from EuroStat 2010 present a similar picture across Europe, whereby the extent of CO_2 equivalent emitted in EU15 countries grew in the transport sector by 19.9% from 1990 to 2008, whereas total emissions during the same period managed to reduce by 6.5%. For EU27 countries, the figures are even more extreme (+23.6% in transport, and -11.3% overall).

The environmental consequences of rising GHG emissions will manifest itself via changes in temperature/weather conditions, and the resulting impact upon health, wildlife, agriculture and the economy (Hulme *et al.* 2002).

3. Vehicle Taxation as a Policy Measure

Alongside that of technological innovations in the motor industry (e.g. electric and hybrid vehicles), a range of economic measures can and have been implemented at Government level. In a market where motorists often focus greatly upon the financial considerations of an action (Lehman *et al.* 2003), these measures have the potential, in theory, to shape demand through pricing signals.

Taxation of private motoring has been well recognised as an established means of raising revenue (Reggiani & Schintler 2005). More recently, reforms have taken place in response to various concerns, including the environment. In this context, taxation instruments can help to 'internalise' the externalities of private motoring, such as the cost of congestion and climate change (known as a *Pigouvian tax*). Where the private costs of car use would include the more immediate costs of vehicle acquisition, running costs, wear and tear etc; the further costs to society may be overlooked, which may encourage overconsumption. The imposition of taxation can thus help to raise awareness as to the full costs associated with a decision or personal activity.

A system of taxation and subsidies (the inverse) can be tailored towards the CO_2 emissions of a vehicle. This effectively operates through an arrangement of significantly lower taxation payments (and/or greater subsidies) for energy efficient and low CO_2 emission vehicles, and the opposite for high emitting vehicles.

Vehicle taxation can essentially be implemented at three stages of the vehicle's lifetime (Ison & Rye 2008): first, at the time of initial purchase; periodically for the ownership of a vehicle; and on a pay-as-you-go basis relating to use – aptly named purchase, circulation and road fuel tax respectively. The use of different weighting systems during the stages of vehicle ownership can be

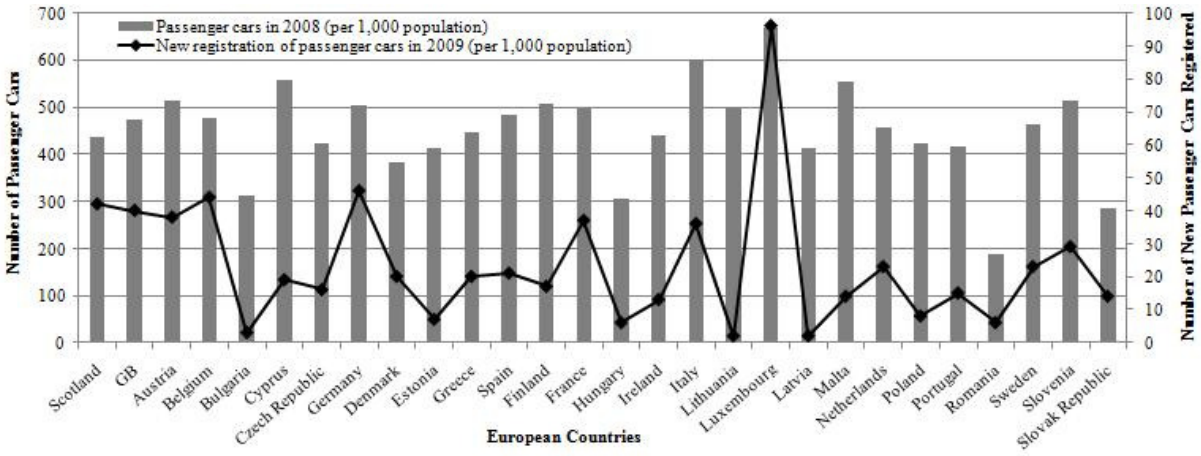

Fig 1. Comparison of Passenger Vehicles and New Vehicle Registrations in Europe (Scottish Government 2010)

used to influence both purchasing and travel behaviour, which will all thus impact upon the 'carbon footprint' during the vehicle's life (Hayashi *et al.* 2001).

Vehicle taxation across Europe is not currently harmonised, which Sterner 2007 argues is due to the initial goal of revenue raising rather than environmental enhancement. Hence, the amounts charged and the tax base (e.g. engine size, vehicle price, CO_2 emissions) can vary substantially between counties. Plus that of geographical, social, industrial, energy and environmental considerations are all reported to have an additional bearing upon national policy (European Commission 1997). Nevertheless, Ryan *et al.* 2009 advocate the majority of European countries to impose a 'framework' encompassing a vehicle registration tax, value added tax (VAT) on the purchase price, annual circulation tax, and excise duties on fuel (see Association of European Automobile Manufacturers 2010a for an overview of measures, rates and tax bases currently used throughout Europe).

4. Purchase Taxation

Owing to the timing of payment, taxes at the time of sale perhaps have the greatest potential to shape vehicle purchasing behaviour at a time when it is easiest and most convenient for motorists to change between various models.

The UK operates a system of vehicle excise duty (VED) which is required for legal use of a vehicle on the public highway. From April 2010, this payment has become differentiated from the time of purchase (initial registration of a new vehicle only) compared with the standard rate payable thereafter. Based upon a CO_2 emissions scale (ranging from A to M), the 'first year rate' (FYR) now provides a stronger financial signal at the time of purchase: either offering a greater incentive or disincentive depending upon the emissions intensity of the vehicle. In relation to the standard rate, a discount (including nil payment) in VED is awarded for lower emission vehicles (130g/km of CO_2 or less); and greater financial penalties exist for vehicles emitting over 165g/km of CO_2 (the rate is equal to the standard rate when between the two emission thresholds). In essence, this reflects a purchase tax and purchase subsidy scheme. Giblin and McNabola 2009 suggest a system such as this, which further increases the financial penalties on the purchase of high emission vehicles, which can reduce CO_2 emission intensity by around 5% depending upon the extent of the deterrent.

The tax base across Europe varies substantially, alongside the actual rates. Some countries encompass a variety of measures, whilst others operate in isolation. For instance, vehicle registration tax in Malta is based not only upon price, but also CO_2 emissions and vehicle length (Association of European Automobile Manufacturers 2010a). The age of the vehicle and fuel consumption/MPG is used in Belgium and Austria respectively; and engine size is still used in numerous countries, and in others (including Lithuania) a flat rate payment (*ibid*).

A possible issue may arise when high vehicle registration fees deter the purchase of a first-registered vehicle, thus shifting demand towards that of older/used vehicles. This can be demonstrated, for example, in Denmark where a registration tax of 105% is charged on the first portion of vehicle price inclusive of VAT (depending upon vehicle age, this is at its highest when purchasing new) and 180% on the remainder, which is then subject to VAT at 25%. Berri *et al.* 2010 reports that second-hand vehicles made up the majority of new vehicle acquisitions from that time. This may in fact undermine the environmental agenda as newer vehicles will typically be more fuel efficient and pollute less. Similarly, motorists may decide to hold onto existing vehicles for longer, thus delaying the purchase of newer, more expensive (but possibly cleaner and safer) vehicles (European Commission 1997). For instance, Hayashi *et al.* 2001 concluded that increasing the level of purchase tax reduces the likelihood for motorists to make a disposal/repurchase decision due to the increased costs of vehicle acquisition.

In a means to further advance the market for low carbon vehicles, the UK has introduced a new 'Plug-in car grant' from January 2011. The grant offers up to 25% (subject to a maximum of £5,000) off the cost of eligible electric, plug-in hybrid electric and hydrogen fuelled vehicles at the time of first registration (nine qualifying vehicles have been confirmed as of January 2011). Although conditions exist relating to vehicle range, speed, warranty and CO_2 emissions, the reduction in cost to purchase such vehicles is hoped to "build a flourishing early market as a path to the mass market" (Department for Transport 2010: 1). The purchase of a low carbon vehicle works on the basis that such vehicles have high initial capital costs, but lower running costs in the long run. In the UK, where the technology required is well advanced but is not overly widespread, the scale of production does not allow for costs to be minimised. A subsidy scheme can allow the market to mature to a level where low carbon vehicle technologies can successfully compete without financial assistance – and such resources can therefore be concentrated upon the next wave of advanced vehicle technologies (Reggiani & Schintler 2005). The imposition of a subsidy on the purchase price will help to reduce the burden of initial investment, which Ewing and Sarigöllü 1998 argue as the primary means of achieving the required shift in demand. Alternatively, other forms of incentive are available for the uptake of electric vehicles in Europe, including a reduction in personal income tax (in Belgium), and more commonly, an exemption from purchase and/or registration taxes (which includes the UK for any vehicle with emissions of 100g/km of CO_2 or less) (Association of European Automobile Manufacturers 2010b).

More generally, VAT is applicable at the time of sale in relation to the purchase price of a vehicle. In the UK, the rate is currently fixed at 20% for most vehicles carrying no more than ten passengers, and with no modifications for disabled use. VAT in Europe generally ranges from 15% up to 25%, and currently stands at 21% in Lithuania (Association of European Automobile

Manufacturers 2010a). Although a purchase tax in the current sense, with the tax base referring to price, it is also a sales tax: which will therefore raise the price of all vehicle features and thus have no influence upon purchasing decisions. With no consideration of environmental properties, VAT will penalise according to price – bearing in mind that many 'green' vehicles are typically more expensive when first brought to market. Suggestions have been put forward for varying the level of VAT according to emissions intensity of the vehicle. This would thus add a greater premium on the price of high emission vehicles as a further deterrent for its purchase; plus a cost reduction for lower emission vehicles. This is based upon a similar system in Italy where VAT was based upon engine size: 19% on 2000cc engine size or less (2500cc for diesel engines), and 38% for greater sized engines (Reggiani & Schintler 2005). A system such as this is reported to have played an important role in improving the fuel economy of Italian vehicles (*ibid).* However, the main issue with this lies with company car purchases as VAT can be reclaimed, thus limiting the effectiveness – but for private vehicles, this is not such a problem.

An interesting aspect is the 'hidden' nature of purchase taxes where the price is typically quoted *inclusive* of FYR of VED, VAT etc, which are not generally seen as an additional cost (Giblin & McNabola 2009). A breakdown of the exact components making up the eventual purchase cost tends not to be made explicit, which may limit the potential impact of purchase taxes. Although the overall price will alter, TIS 2002: 5 suggest a rebound effect where the car industry "smoothes retail prices in order to reduce the effects of higher registration [i.e. purchase] taxes", which will further curb the potential benefit.

A relatively new form of purchase tax is starting to emerge in selected countries, known as 'feebates'. Peters *et al.* 2008 describes this as a combination of *fees* for highly polluting and generally inefficient vehicles; with *rebates* for vehicles with the opposite characteristics; which would be based upon the identification of a pivot-point. Greene *et al*. 2005 argues the use of feebates to be widely considered but not often implemented – although France and various states in the United States of America have implemented such schemes. France, for instance, recently adopted a system where vehicles emitting 130g/km of CO_2 received a bonus of up to €5,000 depending upon emissions; whilst those above 160g/km can add up to €2,600 extra on the cost (vehicles between the two pivot-points would remain unaffected). German and Meszler 2010 report that the average CO_2 emissions fell by 6% in 2008 (which was almost twice the reduction in the whole of the European Union). Sales of vehicles below 120g/km increased by 80% and vehicles above this threshold all reduced in number (*ibid).* Research by Ben-Dor and Ford 2006 suggest feebates can pave the way for limiting emissions, but this is dependent upon the time factor as older cars are replaced for newer ones. Peters *et al.* 2008 argue that consumers demonstrate a limited readiness for changing motoring behaviour in order to receive an incentive/disincentive such as a feebate. However, more recent research in California suggested the greatest degree of support for reforming tax/fee policy options was in fact for feebates (coming ahead of a proposed increase in both a flat-rate vehicle registration and mileage fee, and an environmentally differentiated one; Agrawal *et al.* 2010). Real-world experience, whether in the UK or abroad, is needed to examine the effectiveness of this relatively new form of tax policy.

5. Circulation Taxation

This is a registration tax on the ownership of a vehicle, with the payment becoming recurrent, typically annual or biannually. Although positioned away from the vehicle purchasing decision, the tax base generally corresponds to the vehicle itself (independent of usage). It can therefore have a strong influence upon vehicle ownership and act in a secondary role to the use of purchase taxes. Ryan *et al.* 2009 argues that a combination of both purchase and circulation taxes have the greatest level of CO_2 abatement than that of either measure applied in isolation. In contrast, the annual circulation tax is argued by both Hayashi *et al.* 2001 and Giblin and McNabola 2009 to be *more* influential upon the intensity of CO_2 emissions resulting from the vehicle purchasing decision of motorists, than those present at the time of sale. Ryan *et al.* 2009 suggests that motorists 'think ahead' to the circulation taxes they will pay on that vehicle at the time of purchase, which could explain this.

There is an increasing trend for reforming such payments towards the environment, as was demonstrated in the UK. Before the current tax base of CO_2 emissions, engine size was used up until 2001 (the rate was the same for all vehicles until 1999 which introduced differential rates by engine size). Although engine size did influence fuel consumption and emissions, it is by no means an accurate proxy for the environmental properties of the vehicle. For example, the fuel type, vehicle transmission and on-board technologies (air conditioning is a good example) can all impact upon the emissions; which a measure of engine size would fail to take into account. Although the use of engine size is lessening in popularity as a tax base throughout Europe, it is still joint top with CO_2 emissions with seven countries adopting its use in vehicle circulation tax (Association of European Automobile Manufacturers 2010a). In the UK, the change from a tax base of engine to CO_2 emissions (the first country in Europe to do so) helped to raise the environmental profile of vehicles in the planning process. For instance, Lehman *et al.* 2003 found that only 17% of motorists had looked up the CO_2 emissions of the vehicle they were planning to buy when the previous (engine size) system was in place – changing the tax base to CO_2 emissions had managed to raise this figure to 50% for future vehicle purchasing decisions.

The standard rate of VED, compared with the aforementioned FYR, is the simplest example of a circulation tax in the UK. This operates on the same 13-point CO_2 emissions scale as the FYR and on the same premise that higher emitting vehicles pay more in tax. Although

the rates are more conservative than the FYR, the requirement for the payment to be made either annually or biannually (at 55% of the annual rate) during the vehicle's lifetime can make the tax more significant.

The use of a banded tax system related to the environment can provide a strong message to the user. The UK Government believes that the graduate system linked to CO_2 emissions is "an important tool for providing signals to consumers about the environmental impact of their vehicles" (Department for Transport 2004: 28). As an example of past success, the company car tax system in the UK (which is applicable for employees using a company car for private use) was reformed in 2002 towards CO_2 emissions. Evaluations suggest average emissions of new company cars had fallen from 196g/km in 1999 to 182g/km in 2002 and 154g/km in 2004 (HM Revenue & Customs 2006). In terms of the environmental benefit (that is, the carbon saved), the estimated figures in 2003 was between 0.15 and 0.2 megatonnes (Mt) of carbon, rising to 0.3 Mt in 2005, 0.65 Mt by 2010 and projections of savings between 0.4 and 0.9 Mts by 2010 (*ibid*).

Awareness, however, of the link between CO_2 and the system of VED does seem to be somewhat low. In 2003 (when the reform had only been in place for two years prior), awareness was reported to be 'patchy' (Department for Transport 2004). More recently, The Royal Automobile Club 2009 reports that only 32% of motorists in their sample knew of the new tax bands in place; with only 16% of this group claimed to actually understand them. This is likely to lead to ignorance in the vehicle purchasing decision.

In spite of this, if awareness were to improve, research by Lehman *et al*. 2003 suggests a differentiation of only £50 between the tax bands would be enough to induce one third of motorists into choosing a different vehicle; whilst 72% would be influenced by a £300 differential (i.e. the financial saving from choosing a lower emission vehicle in a lower tax band). At the time of their research, differentials ranged from only £10 up to a maximum of £30 so financial savings from switching were somewhat immaterial. Nowadays, however, savings are much more substantial, particularly with the FYR of VED in the UK.

6. Road Fuel Taxation

The third and final type of taxation applies to the use of a vehicle and can manifest itself through various channels – the purchase of fuel being the most obvious. Because of the nature of payment, the imposition of tax can have a strong impact upon vehicle usage decisions. Nevertheless, the purchase of a vehicle with lower CO_2 emissions will bring with it environmental benefits in terms of usage. Such vehicles will burn less fuel, whereby reducing fuel consumption and thus having a greater miles per gallon. Therefore, as a secondary benefit, a lower contribution will be made towards usage taxes (e.g. those included in the cost of fuel). Plus, a consideration of future usage costs at the time of purchase may just influence the choice of vehicle. Both Giblin and McNabola 2009 and Hayashi *et al*. 2001 suggest this impact to be small – but whilst the primary purpose is to influence usage, this effect on the vehicle purchasing is nonetheless useful. Considering this from a supply point of view, road fuel taxes can also have an impact upon vehicle manufacturers and help encourage greater use of more fuel efficient technologies in their production (Kirby *et al.* 2000).

Taxation on fuel is the primary means of measuring and mitigating the degree of vehicle usage. Policies which directly target the extent of motoring (i.e. mileage) are often preferable for being somewhat direct and visible to the motorist (Goldberg 1998). In the UK, just over 60% of current fuel prices (petrol and diesel) are taken as tax (Automobile Association 2010) – made up of hydrocarbon oil duty and VAT. In terms of the former, lower duty payments are applicable on 'greener' fuels such as liquid petroleum gas (which pays only 56% of the full rate for ultra-low and sulphur free petrol and diesel), which can in turn help increase the attractiveness through the pricing signal. In addition, VAT takes 20% of the resource cost, plus the hydrocarbon oil duty (dependent upon the fuel type). A similar graded payment system for fuel types exists in Lithuania (see details below).

The UK holds the fourth highest rate of excise duty on unleaded petrol in Europe (behind the Netherlands, Germany and Finland) and the highest for diesel, with €617 in excise duties per 1,000 litres of fuel purchased for both fuel types (Association of European Automobile Manufacturers 2010a). Although the rates at present can be considered as substantial, in 1998 over 80% of fuel retail prices in the UK were taken in tax – again, the highest in Europe at that time (Department for Transport 2009). In contrast, the level of excise duty on diesel in Lithuania is the 2nd lowest in Europe behind Cyprus, at €274 in excise duties per 1,000 litres, and 8th lowest for unleaded petrol at €434 in excise duties per 1,000 litres (Association of European Automobile Manufacturers 2010a).

7. Wider Aspect of Changing Vehicle Purchasing Behaviour

There is a need to try and understand people's motoring choices and behaviour, as a better understanding of this will help inform policy in which to most effectively influence these decisions. Behavioural models can be used, such as the Lane and Potter Model of Factors Influencing Car Buyer Behaviour (Lane & Potter 2007). As shown in Figure 2, the model shows the wider scope for the vehicle purchasing decision and the factors influencing car buyer behaviour – including those both psychological and situational in nature. In addition, feedback on both these parts will feed into future car buying behaviour.

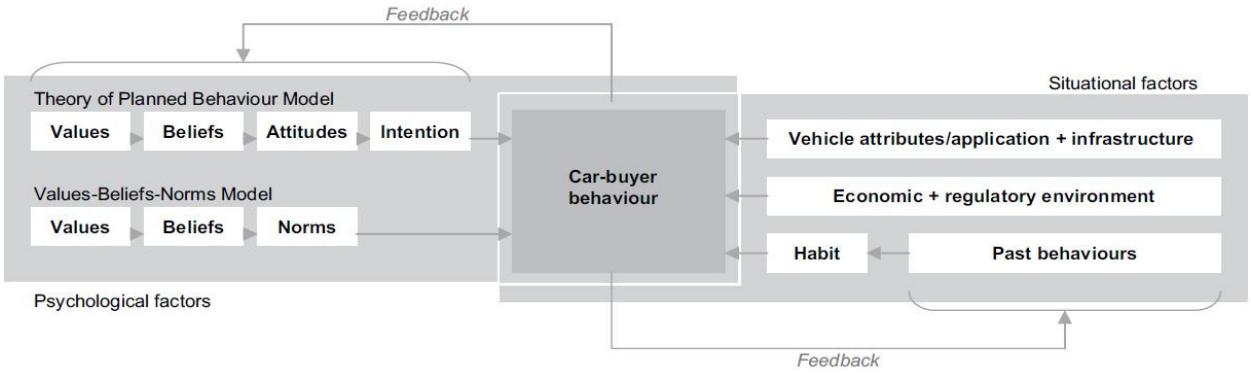

Fig 2. The Lane and Potter Model of Factors Influencing Car Buyer Behaviour (Lane & Potter 2007: 1087)

Situational factors aim to target the social conditions and structures in a means to alter individual preferences and attitudes (Schade & Schlag 2003). 'Vehicle attributes/application and infrastructure' refer to the more physical characteristics which define a certain mode of transport. The importance of selected vehicle attributes in a future vehicle purchasing decision was considered by Lehman *et al*. 2003, who found that financial considerations ultimately play the biggest part in the decision. On the other hand, environmental performance and vehicle taxation were found to be of least importance. In terms of 'infrastructure', the availability of relevant facilities can be a major factor in stimulating behaviour change as many pro-environmental actions can only be instigated upon the provision of necessary infrastructure (such as local charging points for electric powered vehicles) (Kollmuss & Agyeman 2002). The 'economic environment' relates to pricing instruments for transport modes through the use of subsidies, discounts and taxation. As described earlier, there are various forms of this, each with varying degrees of success at different stages in the cycle of vehicle ownership. The use of 'regulation' such as laws and standards is another way of influencing vehicle purchasing behaviour; but perhaps this relates more to the manufacturing side of the motor industry. For example, the introduction of new European Emission Standards will entail the production of new vehicles which will meet the more stringent limits for exhaust emissions. As to the final situational factor, it is interesting to observe that Lane and Potter 2007 have decided to place the notion of 'past behaviour' in which to create a 'habit' as a situational factor – in much of the academic literature, habits are generally viewed as being psychological in nature, which perhaps better places them on the left hand side of Figure 2. Be that as it may, Browning *et al.* 2000: 130 advocates a process of 'conditioning', i.e. "reinforcement through rewards and punishments" to be a key factor in determining behaviour as people learn from their past experiences which shapes future actions. The formation of habits can arise from frequently performed, every day behaviours which become 'locked-in', and thus hard to break. Dargay 2001 acknowledges the notion of car ownership to be clearly linked with the formation of habits and hence a resistance to change. On the other hand, Verplanken and Wood 2006 recognise that habits are maintained by the nature and level of incentives – which highlights the importance of tax measures (that is, economic incentives) in both making and breaking habitual behaviour.

Moving onto psychological factors: these aim to influencing people's perceptions, beliefs, values and norms (Schade & Schlag 2003), and it is these factors (tending to be more subjective in nature) which make some people more susceptible, or ready, to change their motoring behaviour. Psychology offers a wide range of approaches and models in which to explain behaviour as there is yet no unified agreement towards one perspective.

Lane and Potter 2007 identify two behavioural models, which they deem to be most appropriate. The Theory of Planned Behaviour (TPB) posits that human behaviour is influenced by three main factors: a positive or negative appraisal of the behaviour; the apparent social pressure to perform or not; and the perceived ability to actually perform (MAX Success 2008). In the consideration of alternatives, the consequences will be evaluated according to individual beliefs, which will determine the attitudes towards possible courses of action, which then influences the intention to act.

On the other hand, the Values-Beliefs-Norms model (VBN) argues that the formation of personal norms will take into account the degree of awareness of environmental consequences of an action and individual responsibilities and obligations towards this. In turn, this can lead to pro-environmental behaviour, manifesting itself in the vehicle purchasing decision. Jackson 2005 argues that both the TPB and VBN can, and have been, widely used in respect of pro-environmental behaviour.

It is increasingly acknowledged that the process of behaviour change does not necessarily occur as a one stage process, but instead manifest itself during a series of transitional stages (Bamberg *et al*. 2011). Individuals progress through various steps in order to reach the final stage, where behavioural change actually occurs. The effectiveness of various interventions designed to influence behaviour (taxation for instance) are therefore likely to have varying degrees of success depending upon the position of the individual in the behaviour change process.

8. Conclusions & Further Research

The paper has provided a review of vehicle taxation as a tool for mitigating the environmental effects of climate change arising from private motoring. The use of taxation can be carefully devised to help deter the purchase of high emission vehicles and simultaneously encourage the uptake of vehicles with lesser emissions. The paper highlighted the three main channels in which to implement taxation: at the time of purchase; annually/biannually during the lifetime of ownership; and through a charge on usage. As was shown earlier, each have their own strengths and weaknesses; and different variations to policy (e.g. the tax base) can impact upon the end result. The optimal combination seems to lie with purchase and circulation taxes – although a one-size-fits-all model is not apparent due to individual circumstances unique to every country.

The paper also brought attention to the wider aspects of changing the purchasing behaviour of individuals – going beyond that of taxation. A behavioural model by Lane and Potter 2007 highlighted the importance of both situational and psychological factors in the vehicle purchasing decision. Going beyond the simple economic signals which are communicated through taxation, we suggest a greater need to understand the psychological impact of such measures. In context of the Lane and Potter model, this would involve better linkage of the two types of factors: particularly the psychology of taxation. This leads onto a research project underway at the Transport Research Institute of Edinburgh Napier University, which seeks to contribute to this under researched area of knowledge. Focusing upon private vehicle ownership in Scotland and national vehicle taxation measures relating to vehicle emissions, a questionnaire survey will be administered to 5,000 Scottish motorists in early 2011. In respect of vehicle taxation (focusing mainly upon VED, VAT, the plug-in car grant and hydrocarbon oil duty), the questionnaire examines the levels of tax which would be required to instigate different stages of attitudinal and behaviour change related to the purchase of low emission vehicles. That is, the level of incentive or deterrent required to a) start considering the purchase of a vehicle with lower emissions; b) seriously consider such a purchase; and c) actually make the purchase. This emphasises the notion of behaviour change being a process, which requires a level of taxation/subsidy for transition to the next stage. The questionnaire also considers the impact of new policy measures if they were introduced in the UK – such as the feebates system demonstrated in France. It will also assess the strength of various psychological constructs in a future vehicle purchasing decision, including some of those identified by Lane and Potter 2007 as part of the TPB and VBN model. The results of the survey will be available later this year, and will help inform future taxation policy decisions for Scotland and elsewhere.

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