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A vehicle quota integrated with road usage pricing: a mechanism to complete the phase-out of high fixed vehicle taxes in Singapore

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Abstract

This expository paper suggests a way to integrate a vehicle quota with usage based charging, including road pricing. It thereby challenges assumptions that ownership control requires high fixed vehicle costs. It focuses on Singapore, which famously has high purchase taxes and a Vehicle Quota System. These are effective but as a result of arguments against high fixed vehicle taxes, Singapore's authorities are gradually relaxing ownership control and increasing reliance on usage charges. This paper proposes a mechanism to 'variabilise' fixed taxes, including the vehicle permit price, in a way that is compatible with the vehicle quota. In particular, it proposes to integrate the vehicle quota with a new generation of electronic road pricing. This could make Singapore's shift to usage-based charging more efficient, complete and flexible while retaining the option to control vehicle numbers precisely.

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Introduction

This expository paper offers suggestions for easing and completing a difficult transition in Singapore's land transport policy, although they may also be of wider interest. Singapore is famous for its strong transport demand management which relies especially on disincentives for private motor vehicle ownership, including a vehicle quota system, and to a lesser extent usage charges, especially a simple congestion pricing system. However, there are drawbacks to a heavy reliance on ownership restraint, so Singapore's transport policies now seek to gradually relax ownership restraint and increase reliance on usage restraint.

An alternative approach is suggested here, which retains ownership control while nevertheless shifting more completely and easily from fixed to usage-based charges. The core of the proposal is to variabilise the vehicle taxes, so that previously fixed taxes become equivalent to usage-based fees, yet do so in a way that retains the vehicle quota mechanism. This has wider significance because it challenges the assumption that ownership restraint using fiscal tools must necessarily involve high fixed vehicle costs. Further, it will be shown that ownership restraint with a vehicle quota and fiscal policies to influence vehicle choice can even be integrated with congestion pricing.

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Ownership restraint, road pricing and variabilisation in context

This section provides important background on the main policy tools discussed. Fiscal tools to restrain vehicle ownership are relatively little used. Purchase taxes and ownership taxes are widespread but tend to be revenue instruments rather than demand management tools, although there are exceptions such as Denmark, Norway, Hong Kong and Singapore (Hirota and Minato, 2002; ACEA, 2003). Quantity-based approaches are a related possibility and Singapore's vehicle quota is the key example so far, although Shanghai has also adopted a variation (Lee, 2004).

Fixed taxes are generally dismissed in the road pricing literature for being a blunt and poor tool with which to address most transport externalities. They also send a perverse incentive for higher rates of use of each vehicle (De Jong, 1990). Nevertheless, there are arguments in favour of fixed taxes, including those aimed at ownership restraint. Ease of implementation and the practical or political barriers to marginal pricing are widely mentioned arguments. Budgetary and luxury tax considerations are also valid and potentially welfare-improving goals. Others argue that fixed taxes can be more revenue efficient than usage taxes (Chia et al., 2001). De Borger (2001) analyses optimal taxation of car ownership and use in order to correct for external costs, finding that fixed taxes may have a role in certain circumstances, for example to sway purchase decisions towards low externality vehicles.

An awareness of path dependence associated with some of the systemic changes that can accompany motorisation provides further arguments in support of ownership restraint. The experiences of Seoul, Hong Kong and Singapore in the 1970s and 1980s suggest that slowing motorization can provide 'breathing space' and open up a transport development trajectory emphasising alternatives to private vehicles (Barter et al., 2003). There is also evidence of hysteresis in the price elasticity of demand for car purchases, with cars perceived as a luxury before they are owned but more as a 'necessity' afterwards (Dargay, 2001). Vehicle purchase drastically changes household travel behaviour and vehicle ownership is a key predictor of vehicle use. Even in a public transport-oriented city like Hong Kong there are 'car dependent' individuals and households (Cullinane and Cullinane, 2003).

Transport economists have long argued that usage charging, with prices varying according to vehicle characteristics, location, time and current road conditions in order to closely match marginal costs, is superior to other tools to deal with the externalities of vehicle use (Pigou, 1920; Vickrey, 1963; various contributions in Button and Verhoef, 1998). Much of the literature has focused on congestion pricing (eg Hau, 1992). Distance-based charging has been getting increased attention, especially when aimed at heavy vehicles (Hyman and Mayhew, 2002; Jansen and Denis, 1999; Ubbels et al., 2002; Balmer, 2004). Fuel taxes offer another second best option that is widely used.

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In the transport policy context, 'variabilisation' refers to shifting private vehicle costs away from fixed towards variable costs (the first three categories in Table 1) in order to counter drawbacks of fixed costs and improve usage disincentives (INFRAS, 2000). This is generally taken to involve a politically pragmatic revenue-neutral shift. Variabilisation potentially offers significant traffic restraint (Litman, 1997) but an associated increase in vehicle ownership may tend to counter the effect unless other factors limit ownership growth (Proost and Van Dender, 1998). This paper addresses this by identifying a way to achieve both ownership control and variabilisation simultaneously, or in an integrated way.

Table 1 Overview of how well different fees represent total marginal vehicle costs

Rank	General Category	Examples
Closest to first-best, marginal pricing	Time, location, and conditions-specific road and parking pricing	Variable road pricing, location-specific parking management, location-specific emission charges
	Distance-based pricing	Weight-distance charges, distance-based vehicle insurance, distance-based emission charges
	Input charges	Fuel tax, sales taxes on fuel, pay-at-the pump insurance, carbon tax, Hazardous Substance Tax, taxes on wearing vehicle parts
	Fixed vehicle charges	Vehicle purchase and ownership taxes; conventional vehicle insurance
Furthest from first best pricing	External costs not charged to motorists	Using general taxation to pay for roads and traffic services, parking subsidies. Uncompensated external costs

Source: adapted from Litman (1999)

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Singapore's demand management transition difficulties

This section briefly outlines Singapore's demand management and vehicle taxation system and its problems. It explains why the authorities are seeking to shift away from fixed costs towards usage charging and why this transition faces some challenges.

Existing transport demand management and vehicle taxation

Usage-based tools have played an important role in Singapore and been much discussed but ownership restraint has actually dominated. For example, throughout the late 1990s taxes and fees on purchase and ownership accounted for between 80 and 85% of total vehicle-related revenues (based on data cited in Chin, 2002). During the 1970s and 1980s, Singapore relied on increasing purchase and ownership taxes, including the Additional Registration Fee (ARF), the Excise Duty and the annual Road Tax, to dampen demand for private motor vehicle ownership.

In 1990, Singapore pioneered the use of a vehicle quota with auctions of rights to purchase a vehicle (Chin and Smith, 1997; Phang et al., 1996; Toh and Phang, 1997). This 'Vehicle Quota System' (VQS) involves the sale of a limited number of permits, known as Certificates of Entitlement (COEs), under a uniform-price auction twice every month. The Government thus controls precisely the number of motor vehicles entering Singapore's land transport system. Each new permit (COE) has a lifetime of 10 years after which a further COE must be purchased at prevailing prices or the vehicle must be scrapped or exported. If a vehicle is scrapped or exported early then the

owner may receive a rebate on the remaining COE value and that of the ARF. The ARF does not have a time limit but after 10 years there is no rebate upon scrapping. Both the COE and ARF thus depreciate in redeemable value and amount to part of the resale value of the vehicle. These arrangements counter the tendency for purchase taxes to prompt extended vehicle lifetimes. Singapore's vehicle taxes result in the purchase price of a modest sedan, such as a 1.6 litre Toyota Corolla, being around S$80,000 (about US$47,000) in late 2004. The fixed vehicle tax bill for owning such a car for 5 years is approximately $27,500 (or about $15 per day) regardless of usage.[1]

Singapore has also been a pioneer with congestion pricing beginning with the Area Licensing Scheme (ALS) in the mid 1970s. This manual cordon pricing scheme was replaced in the late 1990s by the Electronic Road Pricing (ERP) system, which is a form of congestion charging, with vehicles automatically charged time and location-specific point charges for passing a set of gantries ringing the city centre and a number of other locations (Toh and Phang, 1997). Replacement of this system is proposed within 10 years by a vehicle positioning-based road pricing mechanism that would come closer to first-best usage charges (Toh and Phang, 1997; May, 2004).

Problems and a cautious shift towards relying more on usage charging

These policies have successfully contained congestion and other traffic externalities (Ang, 1996; Willoughby, 2000). However, since the mid 1990s, Singapore's transport authorities (and others) have expressed concern over the high fixed costs of motoring

(LTA, 1996). Unhappiness over the lack of access to vehicles and high vehicle costs is heard from time to time (Foo, 2000). Apparently, as elsewhere, rising aspirations for convenient mobility tend to focus on car ownership, which however remains at only about 32 percent of resident households (Singapore Department of Statistics, 2001).

Fixed taxes are a blunt tool and unfair, at least in the sense that all motorists must pay them regardless of how much their particular usage patterns contribute to congestion or other impacts. High fixed taxes also undermine the usage restraints, since they seem insignificant compared with the large sunk costs (ERC, 2002). Data from Kenworthy and Laube (2001) show Singapore's mid-1990s annual car kilometres per car of about 18,500 km to be high relative to other high-income cities that are comparable in having compact urban structures and high roles for public transport.[2] These inefficiencies suggests that the costs to consumers of the demand management taxes will be higher than necessary to achieve tolerable congestion levels. To the extent that some of these costs are unnecessary, they contribute legitimately to concerns about the impact of high vehicle costs on business costs and the competitiveness of the country (Asher, 2002).

For these reasons, it is already Singapore's policy to gradually move towards greater reliance on usage restraint (LTA, 1996). The ARF has been progressively reduced in recent years from a high of 175% of the 'open market value' to 110% currently (Ministry of Finance, 2002). In 2002, the authorities began occasionally to release 'extra' COEs, arguing that ERP had been effective (Lee, 2002). In early 2004, COE prices for cars reached a 5-year low (Straits Times, 4 December 2003). The 3% growth

target is currently under review (Straits Times, 5 March 2005) and seems likely to be raised. An easing of ownership control is expected to result in higher vehicle ownership, which should trigger higher ERP charges as traffic levels increase.

However, this shift needs to be gradual since suddenly escalating ERP charges would be unfair to owners of older vehicles who paid high fixed taxes (ERC, 11 April 2002). Suddenly reduced COE prices and ARF rates would also impact upon the value of the existing vehicle fleet, causing problems to owners and possibly for the banking system (Willoughby, 2001). Similar anomalies have arisen before (Phang et al., 1996) and are currently apparent as a result of declines in COE prices over several years (Kaur, 2001; Tan, 2003). Time would also be needed for parking supply throughout the island to adjust (ERC, 2002). In addition, the authorities apparently worry that high ERP charges might cause public consternation (Tan, 2004).

Nevertheless, the need for road demand management in Singapore clearly remains very strong and can only become more pressing in future as the population continues to rise (in line with policy) and become more affluent. The population density (within the urbanised area) is approaching 100 persons per hectare (Kenworthy and Laube, 2001) and further road capacity increases are expected to be necessarily modest. The Government and some observers worry that a flood of new vehicles would be problematic even with strong usage restraint and argue that ownership restraint cannot be completely dropped in the Singapore context (Ministry of Finance, 2002; Willoughby, 2001). Therefore, the current policy involves proceeding with great

caution and with modest and gradual reductions in fixed vehicle taxes. Significant COE prices and other fixed vehicle taxes are expected to continue for the foreseeable future.

Variabilising vehicle taxes in the context of a vehicle quota system

This section seeks a mechanism to variabilise fixed vehicle taxes, including the COE, without doing away with the vehicle quota system. The discussion above motivated this aspiration, having left us with strong arguments for reducing fixed taxes but also with important rationales for ownership restraint and reasons why any reduction in fixed taxes would need to be gradual and limited in scope. A mechanism that could achieve this is a variabilised permit price, which could be both an ownership controlling mechanism and a usage disincentive at the same time.[3]

There are three key requirements in order to variabilise fixed taxes in this case. Firstly, as with any variabilisation, we need to decide the usage basis for charging. Possibilities include taxing parts that wear with use, taxing fuel use, applying a distance charge or charging according to various measures or approximations of usage externalities (towards first-best road pricing) (INFRAS, 2000). Secondly, in any variabilisation we will usually need to accurately and reliably monitor and report usage. Thirdly, and uniquely to the case of a vehicle quota, we need a way to make the bidding process compatible with a variabilised bid price.

Usage-limit approach to variabilisation compatible with vehicle quota

Consider the third and unique requirement first. Making the bidding process compatible with a variabilised bid price can be achieved with a 'usage limit' approach. This means simply making the vehicle ownership permit valid for a block of usage instead of a time period.[4] So in the Singapore context, the 10-year lifetime of the COE would be replaced by an allowance for a certain amount of vehicle usage.

A usage-limit model could allow Singapore's VQS to retain many of its current features if desired. Instead of bidding for the right to own and use a vehicle for 10 years, bidding would be for the right to own and use a vehicle until the allowance of usage is exhausted, after which a new allowance would need to be purchased. Note that other fixed taxes, besides the COE price, could simultaneously also be variabilised by the same mechanism of applying usage limits and requiring renewal, except that their levels would of course be set by administrative mechanisms (as they are now) rather than a bidding process.

Such 'usage-limited vehicle permits' are clearly compatible with bidding under a vehicle quota and a usage-limit converts any vehicle tax to a usage-based charge, while also allowing it to remain payable up-front as a lump sum. Paying a lump sum for a block of usage should make motorists aware that each unit of usage has a price. This could be made more explicit with an in-vehicle display of the remaining tax-paid usage as it runs down, perhaps shown in both dollar terms and in units of usage.

Note that in general, different vehicles would have different effective prices per unit of usage. This is because they would vary according to the bid price paid and according to other differentiated vehicle taxes that apply to each vehicle according to its characteristics.

Usage-limited vehicle permits can be seen as akin to other quantity-based mechanisms, particularly tradeable fuel permits, 'tradeable vehicle-mile permits' or 'tradeable road-pricing smart cards' (Verhoef et al., 1997). However in this proposal allocation is by auction and the usage purchased with a successful bid is linked to the right to own a vehicle (under the quota) rather than to usage within some time period.[5]

Usage basis possibilities

The main candidates for the usage basis of the variabilisation of vehicle taxes are fuel-use, distance and road pricing (impact-weighted distance) (Table 1). Monitoring and enforcement issues arise for each. In Singapore the large sums of money involved mean that relatively expensive mechanisms may be cost effective.

A fuel-limited vehicle permit system could entail a mechanism (perhaps a smart card system or manual records) to allow fuel purchases only for vehicles with a valid permit and to deduct the relevant amount from the remaining allowance under the permit (see Verhoef et al., 1997; Crals et al., 2003;). However, let us quickly dismiss this option

which seems likely to be particularly problematic in the Singapore context. Complications include the risk of fraud, problems dealing with alternative fuels and electric vehicles, and boundary issues. Proost and Dender (1998) also suggest it could prompt excessive and inefficient investments in fuel efficiency and point to the very high fuel prices implied by such a variabilisation (see also Shepherd, 2002).

In the distance-limit option, a successful bid under the vehicle quota would purchase the right to own and operate a vehicle for a certain block of distance. Such a distance-limit approach would result in distance-based charging but choosing a mechanism to reliably monitor distances driven is not a trivial problem (Avontuur, 2001). Fullerton and West (2002) dismiss odometers as being prone to fraud while Jansen and Denis (1999) feel that it would require tamper proof odometers. However, Litman (2004) argues that fraud could be reduced to an acceptable level through regular low-cost odometer audits. Most proposals for distance-based charging, however, involve positioning systems of one kind or another.[6] At least one reliable approach to distance monitoring is proven, namely the system used for Switzerland's distance-based heavy vehicle fee (HVF), which has been operating successfully since 2001 (Balmer, 2004; Suter and Walter, 2001). It uses in-vehicle units linked to the vehicle tachometric pulse, backed up, calibrated and verified with a Global Positioning System (GPS) (Kallweit, 2003).[7]

In Singapore, a distance-based approach to variabilising the fixed taxes and COE using something like the Swiss system above is probably feasible for adoption in conjunction

with the existing DSRC gantry-based ERP system. However, the intention to update the ERP system to a positioning-based system means that most interest in Singapore may focus on the next option below, which involves integrating the vehicle quota's usage-limited variabilisation with the next generation ERP.

Impact-weighted distance limits (or 'road pricing' limits) achieved using an 'impact factor' approach

A usage-limit approach offers the intriguing possibility of integrating variabilised fixed taxes and the vehicle quota system into a comprehensive, positioning-based road pricing system. This could be achieved if the usage limit is in terms of 'units of road pricing'. However, this initially presents a problem. What is a 'unit of road pricing' if not simply an amount of money? So how can motorists bid for an allowance of 'road pricing units'?

This can be solved if we use an approach to road pricing that applies a weighting or impact factor instead of a price to each section of road or urban zone. 'Units of road pricing' can then be seen as impact-weighted distances and the usage limit can be expressed as a block of 'unweighted kilometres'.[8] A successful bid for the vehicle permit buys an allowance of a certain number of unweighted kilometres. Each road link or zone would have an 'impact weighting' or 'impact factor' that varies in time and this impact factor would modify the rate at which each vehicle's permit allowance runs down as it traverses an area. For example, driving in peak hour on congestion-prone

roads would see high impact weightings and the allowance would run down at a rate faster than one 'kilometre' per real kilometre driven. The remaining permit allowance could be displayed (in 'unweighted kilometre' and dollar terms) on an in-vehicle unit. It would probably be desirable for most driving in off-peak times and non-congested locations to be 'unmodified', so that the allowance runs down at one kilometre per real kilometre driven and so motorists can easily comprehend what their taxes and COE payments are purchasing.

So integrating road pricing and the variabilised vehicle quota requires a model of road pricing in which motorists are informed of impact factors rather than prices. The price per unweighted kilometre, as mentioned earlier, would be specific to each vehicle, and depends on the COE price paid and on the other (previously fixed) taxes. The actual price per real kilometre for using such roads at any particular time would then be some simple function of the prevailing impact factor, of each vehicle's own price per unweighted kilometre, and the vehicle's pcu value. Details of this function and precisely how the impact factors are determined are matters for the detailed design of the road pricing system.

Possible details in practice: variabilising using 'road pricing' limits

In order to illustrate and evaluate the proposal it is useful to make it more concrete by elaborating one specific possible set of choices for implementation in Singapore. The focus here is the road pricing-linked option discussed above, which seems to have most

potential. Clearly other alternatives are possible, but for argument's sake consider the following suggestions:

- The bases for levying the various non-COE vehicle taxes, as well as most of the other characteristics of the VQS, remain unchanged. In other words, we assume no significant reform of the rest of the vehicle tax system.
- Each vehicle's tax-paid allowance runs down according to distance, modified by 'impact factors' generated in a positioning-based road pricing system. This modification is calculated as one plus the product of impact factor and pcu value (1 + IF.pcu).
- Impact factors are set using a depoliticised triggering mechanism similar to that under Singapore's current ERP, with adjustments triggered only by an objective and transparent assessment of traffic conditions falling consistently outside a target range.
- Under these suggestions, most driving outside peak periods and away from busy locations would probably face an impact factor of zero, so that the tax-paid allowance runs down at exactly one kilometre per real kilometre driven. The minimum impact factor is zero. However, driving beyond Singapore's borders is exempted completely, so that the tax-paid allowance does not run down at all for such driving.
- A different usage limit is applied to each of the categories of vehicles, in proportion to their pre-reform average usage rates. This is a pragmatic choice arising from political acceptability considerations which would probably make it necessary to

seek category-by-category revenue neutrality or at least avoid having any major categories as obvious losers from the change. If taxis for example, faced the same usage-limit as private cars then introduction of the reform would shake the industry by a many fold increase in their COE and tax bill over a taxi's lifetime. A possible compromise is a phased equalisation of usage limits, in order to ease the transition to usage pricing for high usage vehicle categories.

- The usage limit (in 'unweighted' kilometres) for each vehicle category is set to roughly match 18 months of driving under status quo average driving rates within Singapore (although it is important to note again that the usage limit has no time limit). For private cars this implies that a winning bid and tax payment 'buys' a vehicle tax usage block of around 25,000 unweighted kilometres before renewal is required.[9]
- These intermediate-length usage limits would make it unnecessary to have any system of rebates for motorists who scrap or export a vehicle early with unused tax-paid usage on their permit. Renewals would not be so frequent as to cause high transaction costs and constant anxiety but frequent enough for the usage restraining incentives to be clear. Changed vehicle tax levels would flow through to most vehicle owners relatively quickly, reducing the likelihood of unfairness between vehicles of different ages or of perverse incentives arising when tax levels are changed.

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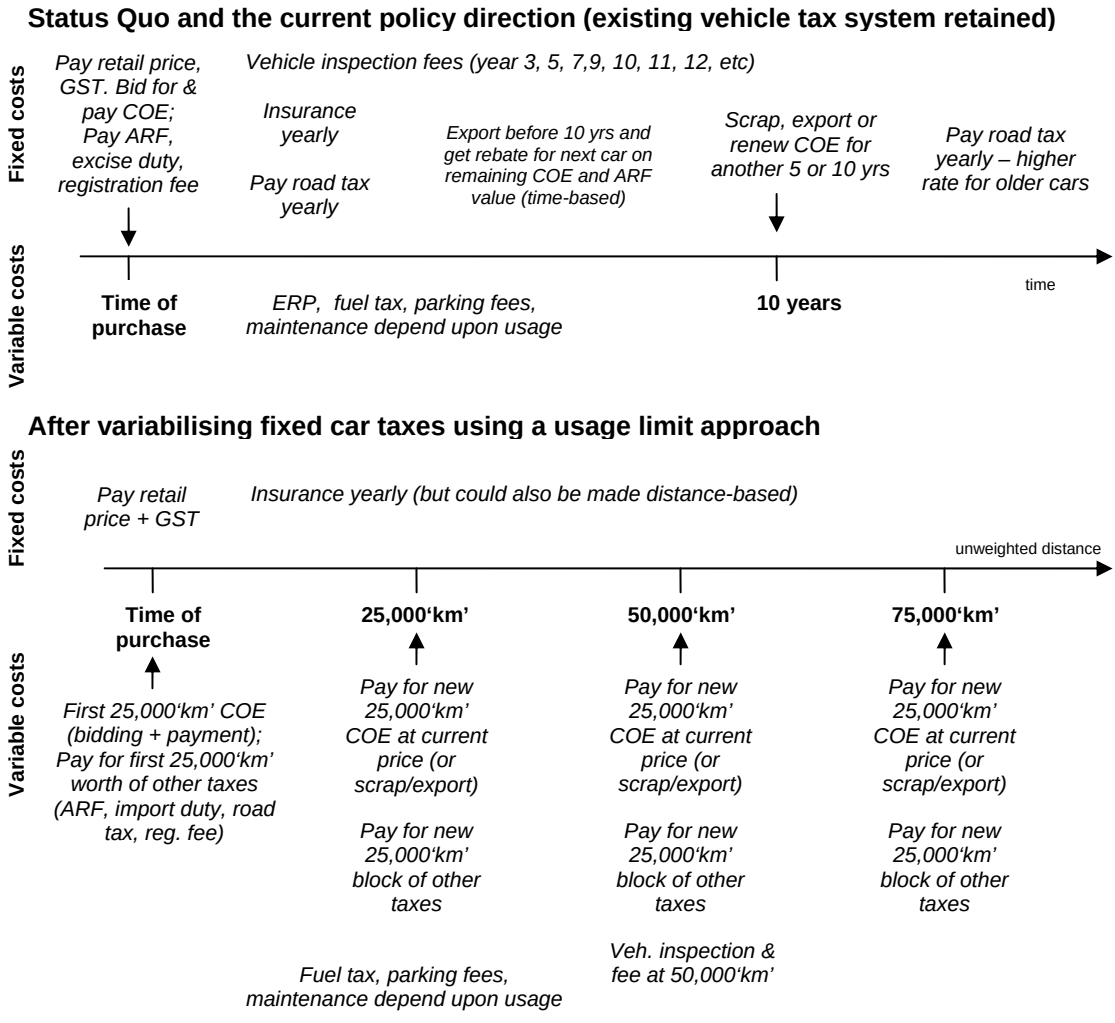
Illustrative examples

This section provides examples, with estimates of prices where possible, in order to illustrate how the proposal might work in practice, using the specific assumptions listed above. Figure 1 shows how payments could work compared with the status quo.

Figure 1 Vehicle tax payments (fixed and variable) in Singapore under the status quo/current policy direction compared with this paper's proposal for usage-limit variabilisation of vehicle taxes (private passenger car example)



Under the road-pricing linked option, road pricing varies the rate at which the tax-paid usage block is depleted depending on the 'impact factor' for that road link at that time. 'Km' above thus refers to unweighted kilometres.

First, it is useful to make a rough estimate of the tax bill for each 25,000 'km' unweighted distance block for a private car (with only simple discussion of COE price or market responses to the reform). Using the case of a modest 1.6 litre sedan that is exported after 5 years, the total 5-year fixed tax bill under the status quo is about $27,500. On average in Singapore, 5 years of driving is about 90,000 km. This amounts to about $7,500 for 25,000 km or about 30 cents per km. We can use this as a guide to think about the actual market-driven prices for the new usage-limited COEs under the reform. These might be forced higher if motorists perceive vehicle ownership under variabilisation to be less expensive than before, due to their ability to reduce costs by reducing driving, and because the proposal also reduces the up-front, time-of-purchase cost of a vehicle, to less than half the current level for a modest sedan. On the other hand, lower prices seem more likely for several reasons. The COE quota is likely to be further relaxed under the reform since driving rates per vehicle should drop and the congestion reduction effects of pricing will be better targeted at high-impact driving. Furthermore, because of driving in high-impact factor locations, the actual distance driven under each COE will usually be less than 25,000 km, also prompting lower COE prices perhaps. On balance, as a very rough first approximation, a price of the order of $5,000 for 25,000 'km' worth of COE plus taxes (or 20 cents per 'km') seems plausible.

Second, as noted earlier the distance charge for expensive cars would be higher than for cheaper cars, due to taxes that are calculated as a percentage of the pre-tax price. For

example, under the status quo a luxury vehicle with three times the pre-tax price of the modest sedan above, currently faces vehicle taxes of roughly $55,000 over 5 years if exported or scrapped at the end of that time. Assuming average usage, then this amounts to an average of about 60 cents per km or double that of the modest vehicle. By analogy with the discussion above we can roughly estimate a price under the proposed system of about $10,000 for 25,000 'km' or 40 cents per 'km'.

Third, let us also illustrate how this might work on the road for the modest sedan and the luxury car above. Table 2 illustrates the hypothetical operation of the system for two contrasting trips: an outer area Sunday morning recreational trip of 10 km and a 10 km radial trip to the centre in the peak of the peak period. The off-peak, outer-area trip would face simple distance-based pricing, and would see the display for each vehicle drop by 10 km. For the radial, peak-period trip, the impact factors are of course hypothetical but are plausible, bearing in mind that such a trip now faces between about $2.50 and $5 in ERP charges. For both vehicles this 10 km trip knocks 30 km from the allowance, which is equivalent to $6 for the modest sedan and about $12 for the luxury vehicle.

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Table 2 Illustration of road-pricing usage-limit variabilisation as it might work on the road for two contrasting cars and two contrasting trips

	Estimated COE plus taxes per 25,000 'km'	Trip segments and distances	Impact factors (hypothetical)	Deduction in km from tax-paid allowance [=distance.(1+ pcu.IF)]	Price (deduction in $ from tax paid allowance)
Trip to the park on Sunday morning: off-peak, outer area, 10km					
Modest car	$5,000	10 km	0	10 km	$2.00
Luxury car	$10,000	10km	0	10 km	$4.00
Radial work trip to city centre in peak of the peak, 10 km					
Modest car	$5,000	*2 km (local streets)*	*0*	*2 km*	*$0.40*
		4 km (radial arterials)	*2.0*	*12 km*	*$2.40*
		4 km (central streets)	*3.0*	*16 km*	*$3.20*
Total for trip		10 km		30 km	$6.00
Luxury car	$10,000	*2 km (local streets)*	*0*	*2 km*	*$0.80*
		4 km (radial arterials)	*2.0*	*12 km*	*$4.80*
		4 km (central streets)	*3.0*	*16 km*	*$6.40*
Total for trip		10 km		30 km	$12.00

Brief comparison of the suggested approach and the existing approach to lowering fixed taxes

This section provides a brief and qualitative evaluation of the proposal to variabilise Singapore's vehicle taxes relative to the existing policy direction of a gradual reduction in fixed taxes, relaxation of the vehicle quota, and subsequent greater reliance on usage-based charges. Most of the comments here could apply equally to the distance-based or the road-pricing usage-limit options. The focus here is not on comparing these with each other but on comparing the usage limit variabilisation approach generally with the existing policy approach to the problems of high fixed taxes. The main criteria upon which the comparisons rest are: policy flexibility (in the sense of retaining the ability to

exercise policy choices); efficiency and effectiveness (for example, how well targeted charging can be made, or the extent to which key policy goals can be realised); feasibility (including technical feasibility, implementation and transition issues); and equity and public acceptability (discussed together). Table 3 summarises the key comparisons.

Retaining flexibility in choosing the size of the vehicle fleet

Continued flexibility under this proposal to choose to control vehicle ownership, even as fixed costs are reduced dramatically, is in strong contrast with the current policy direction, in which policy-makers have no choice but to relax ownership control in order to reduce fixed costs.

Congestion is not the only impact of traffic and large increases in total traffic levels and parking demand, as would be expected under existing policy, could threaten liveability throughout this densely settled urban environment and escalate energy demand. However, this paper's model for variabilisation actually offers the potential for traffic reduction, if desired, since the traffic reduction potential of variabilisation would not inevitably be undermined by increasing vehicle ownership, as it would under the existing policy.

More specifically, we can think of the benefits of the reform as a 'dividend' that could be 'spent' in several possible ways (Goodwin, 1989). Firstly, we could allow the

vehicle fleet to expand very much faster, in effect 'giving' the traffic dividend to new motorists. Secondly, if the variabilisation proposal is implemented with continued tight control of the vehicle fleet but without other changes, then it would result in less total traffic, higher traffic speeds and reduced congestion delays. This choice 'gives' the traffic dividend benefits mainly to existing motorists. A third choice would also control growth in the vehicle fleet but also reclaim more space for pedestrians, cyclists, on-road public transport and quality public space. Only this option would reap a permanent environmental improvement and would give traffic dividend benefits to a wider range of people. How to balance these three options is essentially a political choice.

Feasibility in transition and implementation

Although both the distance-based and road pricing-linked options discussed here raise technical implementation challenges compared with the status quo, these are no more formidable than those involved in developing the next generation ERP, which forms part of the existing policy direction.

This approach to variabilising vehicle taxes could be implemented very quickly without causing unfairness to owners of vehicles for which high fixed taxes had been paid. Unlike the existing policy, existing ERP charges would not necessarily increase during the phase-in process because traffic would not necessarily increase. ERP rates might even drop slightly if traffic is initially reduced by the reform. It would therefore not be problematic to have some vehicles under the new system and others under the old

system during the phase-in period. If desired, rapid phase-in could be achieved if older vehicles are also encouraged (or required) to shift to the new scheme, while providing for a rebate (on future vehicle tax payments as in the existing system) on their remaining 10-year COE and ARF as if they were scrapping or exporting their vehicle.

The fact that under the usage limit approach each vehicle has its own unique price per unit of usage may seem confusing but could provide important advantages. For example, it means that these models for road pricing or distance-based charging could easily include differentiation, such as emissions characteristics or a luxury tax component for equity purposes.[10] Furthermore, such taxes are still paid as a lump sum at time of purchase or at renewal of the permit, and able to exert an influence on purchase decisions (Hayashi et al., 2001).

The feasibility of impact-factor based road pricing mechanism may be enhanced by its extremely simple public information requirements, even with the differentiation mentioned above. At any particular time for each road link or charging zone, only one number, the impact factor, needs to be conveyed to motorists, regardless of their vehicle characteristics. A single map (colour-coded perhaps) could easily convey all of the necessary information for each time period.

Charging for foreign registered vehicles presents similar technical and practical challenges for the status quo and for both scenarios but arguably the proposal in this paper offers more scope for improvement. On working days, foreign private passenger

vehicles present in the Republic are charged a flat daily fee as a notional equivalent for the high fixed vehicle costs for locally registered vehicles The flat fee is widely resented in Malaysia, and probably dampens Malaysian visits excessively. Recent reforms, pushed by tourism and retail interests, have aimed at reducing the burden and limited its times of application (Tan, 2004b). However, reducing it too much would seem unfair to Singapore's motorists so long as their own fixed costs are high. The usage limit variabilisation proposal here removes these fixed costs and so may present an opportunity to charge foreign vehicles on a basis that should seem fairer from both sides of the border.[11]

The taxi industry also presents some tricky design challenges with a risk of unintended consequences. The usage limit approach and the existing approach each face distinct difficulties with taxis. Without special ERP concessions, the current policy would impact especially upon high-use categories such as taxis, as ERP pricing inevitably becomes more important and expensive under this approach. Arguably, the usage limit model can more easily address this, through the approach of seeking revenue neutrality within each major vehicle category (such as through longer usage limits for taxis than for cars). However, with a resulting low price per 'km', drivers and/or their customers might be too insensitive to congestion pricing signals under the impact factor approach, unless taxis are (somewhat arbitrarily) assigned a higher pcu value in order to compensate for this effect. The usage limit approach also presents challenges in ensuring that price signals under the reform are shared among taxi companies, drivers,

and customers in a way that is fair and simple but informs their choices in the ways desired.[12]

Efficiency and the extent of variabilisation

The usage-limit variabilisation proposal goes much further in variabilising fixed taxes compared with the existing policy direction, which would continue with significant fixed taxes far into the future. As a result, congestion and other externalities should be more efficiently managed with less bluntness and less conflict between fixed and usage price signals. This implies that costs to motorists (and revenues) should be lower compared with the current policy for the same results in terms of congestion control. It seems likely that a revenue-neutral implementation of usage limit variabilisation would control traffic 'too strongly' resulting in political pressure to ease the vehicle quota.[13]

The reform also offers potential for variabilisation of additional fixed costs. This is because highly reliable distance monitoring would be a by-product of the vehicle-positioning technology involved, which could facilitate reforms to make both vehicle insurance and vehicle leasing have more distance-based pricing structures (Litman, 1999). Reliable distance information should also increase the extent to which distance driven can be taken into account in the estimation of depreciation of vehicle value during resale, thereby variabilising a proportion of the capital cost itself. This is currently hindered by an understandable mistrust of odometer readings.

Public acceptability and equity

In many respects the public acceptability and fairness implications of both the current policy direction and the proposed usage-limit variabilisation are similar. Therefore the discussion here, although drawing on the wider literature on fairness and acceptability (see reviews in Button and Verhoef, 1998), will focus mainly on the differences between them. Common issues include the relevance of the use of revenues and of complementary policies (Small, 1992; Goodwin, 1989; Levine and Garb, 2002). There is public scepticism about the fairness, effectiveness, privacy impacts, motivations and need for road pricing (Jones, 1998) and the equity implications of road pricing are complex and hotly debated.[14]

Turning to differences, ameliorating the impacts of usage-based charging on disadvantaged groups should be easier under the usage-limit proposal. If necessary, discounted or free tax-paid kilometres could be given for special cases and, as mentioned above, this approach can more easily retain (yet variabilise) differentiated taxes with a progressive element, such as the ARF. Having specific usage limits for each category of vehicle provided a simple way for the usage limit approach to avoid making clear-cut losers out of high-usage categories of vehicles, although the design difficulties for taxis were also noted above. A usage-limit variabilisation approach may also help with the public acceptability of comprehensive road pricing by reducing the extent to which it is seen as a new tax. Although both the existing trend and this proposal should eventually result in lower average vehicle costs than the status quo, the

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usage-limit approach could go much further and do so more quickly (as discussed above) which should also enhance public acceptance.

Table 3 The shift from fixed to usage-based charging in Singapore: comparisons between the current policy direction and variabilising with usage limits

	Current Policy Direction	**This Paper's Proposal**
	Shifting slowly from ownership to usage-based restraint with the existing vehicle tax system	*Variabilising fixed vehicle taxes using usage limits*
Policy Flexibility	(-) Loses some freedom to choose fleet size. Higher rate of growth in vehicle fleet is necessary in order to reduce fixed costs. Total vehicle travel increases, since traffic reduction from usage-based charging undermined by increase in fleet.	(+) Retains flexibility to control rate of growth in vehicle fleet. Variabilisation is independent of decisions over fleet growth rate. Traffic reduction from usage-based charging not necessarily undermined by growth in fleet.
	(-) Differential charging based on vehicle characteristics is problematic.	(+) Differential charging based on vehicle characteristics is simple.
Efficiency and effectiveness	(-) Only a partial shift to usage-based charges. Fixed taxes' conflict with usage pricing and bluntness remain significant.	(+) Variabilisation of fixed taxes is complete. Purchase and usage disincentives provided simultaneously and harmoniously. More efficient demand management so lower costs for same effectiveness.
		(+) Additionally, creates potential to variabilise other costs, such as insurance.
Feasibility, implement-ation	(-) Must be phased in gradually to avoid unfairness to owners of existing vehicles.	(+) Could be phased in quickly without unfairness.
	(+) No new technical feasibility issues until road pricing changed to positioning based system.	(-) New systems required to monitor usage (whether on distance or positioning-based ERP bases).
		(-) ERP-linked option requires novel impact-factor approach to road pricing
		(+) but which may have advantages, including information simplicity.
Equity, public acceptability	(+) Faster growth of vehicle fleet popular with new and potential motorists	(-) Public may resent continued ownership control
	(-) Certain high-use vehicle categories may be clear losers (and difficult to protect). Progressive taxes reduced.	(+) Easier to ameliorate equity impacts. Progressive taxes can be retained.
	(-) Slow progress towards lower total vehicle costs.	(+) Policy flexibility over who benefits most from 'Traffic dividend' (existing vehicle owners, new owners, wider public)
		(+) Faster progress to lower total vehicle costs.
		(+) Variabilisation approach may make road pricing expansion more acceptable perhaps.
		(+) Opportunity for fairer treatment of foreign vehicles

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Significance and conclusion

This paper has argued that the bid price in a vehicle quota system can be variabilised and thus provide simultaneous usage restraint and ownership control without bluntness or conflicting price signals. It has also shown that, surprisingly, vehicle quotas can be completely integrated with usage-based charging, including road pricing. The road pricing option involved an innovative approach which offers simplicity in information requirements, despite allowing for differentiated charging. The proposal removes several major drawbacks of vehicle quota systems and other purchase disincentives and so should prompt more interest in the potential of these approaches.

It was argued that an appropriate mechanism for variabilising with a vehicle quota system is the usage-limit approach. This approach could apply to any fixed tax and hence has potential beyond just Singapore, especially wherever there are already high purchase or ownership taxes that could potentially be variabilised.[15]. The ability of a usage-limit mechanism to variabilise up-front or lumpy vehicle tax payments may be useful wherever the intended incentives rely on the tax being paid as a lump sum.

Although of wider interest, the arguments in this paper apply especially to policy imperatives and opportunities for Singapore. The proposal addresses the country's existing transport policy priorities while avoiding key tensions and difficulties with both the current system and with current policy directions. It may offer an opportunity to achieve important transport policy goals more rapidly than expected, more

completely, more equitably, and with greater policy flexibility than with the current policy direction. It should be worthy of further study and consideration, especially in the context of Singapore's planning for future road pricing reforms.

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Footnotes

[1] After the 2004 Budget the fixed vehicle taxes for a Toyota Corolla with an Open Market Value (or 'OMV') of S$20,000 amounted to approximately the following over 5 years, assuming it is then exported (which is now typical). The time-of-purchase taxes are the COE (S$12,000, assuming a 10-year COE price for a small car of about S$24,000 and a 50% rebate when exporting at 5 years), the ARF ($5,500 assuming it is levied at 110% of OMV but with a 75% rebate after exporting at 5 years), the Excise Duty ($4,000, or 20% of OMV) and the Registration Fee ($140). Ownership taxes include the annual road tax (about $6,000 over 3 years).

[2] Hong Kong's car usage rate is about 12,700 km, in Japan's large cities it is between 8,000 and 10,500 km and in most European cities it is less than 12,000 km per car. However, Oslo and Copenhagen, which

also have high purchase taxes (Hirota and Minato, 2002), also have high rates of car km per car of about 17,000 km.

[3] This may seem surprising. But note that, although a fixed tax cannot also be a usage restraint (except indirectly by limiting ownership), any usage cost should have at least some ownership disincentive effect merely by increasing the costs of motoring (De Jong, 1990).

[4] Unknown to the author during the early drafting of this paper, a usage or distance-based validity limit instead of a time limit for the COE was proposed (apparently by a member of the public) to a Singapore Government review of the VQS system in 1998. However, the suggestion was apparently not developed further nor given more than brief consideration (Vehicle Quota System Review Committee, 1999).

[5] Other variations can be imagined when we notice that there are two distinct issues here, the validity of the permit, and the right that a successful bid buys for the bidder. In the existing VQS they are both the same, namely '10 years of ownership time'. In the proposal of this paper they are also the same, namely a certain block of vehicle usage. We could conceivably have permits with a validity in terms of years but in which the bidding determining a payment rate per kilometre of driving. Tradeable permit models for yearly distance allowances or fuel allowances (Verhoef et al., 1997) can be interpreted as another variation, in which the validity is time limited but with payment purchasing an amount of usage (tradeable if not needed).

[6] One insurance company in Texas uses a satellite positioning system for an optional distance and location-based insurance scheme (Litman, 2004). Several mass-distance charging systems in Europe are proposed to use GPS technology, including Germany's system for heavy vehicles (Kallweit, 2003).

[7] The Swiss system includes a DSRC microwave link to allow point charging for specific road links and to switch off charging when the vehicle leaves the country. For Singapore, such a combination of point charging, distance-charging and switching to a different state could provide distance based charging that is compatible with the existing ERP system (which also uses DSRC gantries of a different frequency) with a single in vehicle unit

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[8] In their 'tradeable road-pricing smart cards', Verhoef et al. (1997) count the tradeable object simply in terms of 'units from the smart card' rather than kilometres. This seems confusing, since it will be difficult for participants to know what they get for their money.

[9] This option is intermediate between two extremes. At one extreme, a long limit, such as 250,000 unweighted kilometres for a private sedan, would involve very intermittent renewals (similar to the existing 10 year time limit). At the other extreme, with very short limits such as 2,500 unweighted kilometres, COEs and other taxes would need to be renewed very frequently by most vehicle owners, who would face a new prevailing COE price each time.

[10] This also means that these differentiated taxes would disproportionately be paid by motorists who travel most through congested, high impact-factor locations. This might generate new design challenges to ensure close enough matching of pricing with specific externalities. Nevertheless, noxious emissions are arguably higher and more serious for driving in congested locations than elsewhere. There is also no reason why luxury taxation should not be applied to usage. This would increase the responsiveness to road pricing of those able to afford expensive vehicles and is likely to be widely viewed as fair.

[11] Frequent visitors would have an incentive to reduce inconvenience by purchasing an in-vehicle unit to join the mainstream pricing scheme for Singapore vehicles (as they do under the current system). They would also need to purchase blocks of Singapore usage at a price per unweighted kilometre that could be based on current prices for similar Singapore-registered vehicles. Occasional visitors could be charged on a distance basis with simple odometer inspections on entry and exit, or possibly could be able to rent an in-vehicle unit with a modest usage allowance. Technical and transaction cost issues arising from such arrangements seem broadly similar to those under the existing policy direction.

[12] Although taxi rental and fares could easily include an additional usage price component to cover COE and taxes, having this rate vary from taxi to taxi would probably be unacceptable. Drivers and customers would face variations in pricing but have no control over the choices that influence them (such as purchase timing and vehicle characteristics). Therefore it might be necessary to require each taxi

company to have a uniform usage surcharge rate across its whole fleet, which means that the companies would bear some risk from those choices that are within their control.

[13] It has been argued that the early stages of Singapore's Area Licensing Scheme (ALS) or cordon-based congestion pricing overcharged and hence reduced traffic 'too much' (Toh and Phang, 1997; Willoughby, 2000).

[14] Singapore has advantages in many of these respects. The principle that pricing is needed is widely accepted, even if grudgingly. Fixed charges are already high and a form of congestion pricing already exists. There is broad consensus that usage charges should be emphasised. Heavy investment in transport infrastructure (road and public transport) 'keeps faith' with highly taxed motorists (May, 2004).

[15] Countries with high annual ownership taxes include Japan, Argentina, Singapore, Hong Kong, Chile, Brazil, Finland and Sweden. In addition to Singapore, very high purchase taxes are found in Hong Kong, Norway and Denmark and are significant in many other countries, including Finland, Greece, Ireland and Portugal (Schwaab and Thielmann, 2002; Hirota and Minato, 2002; ACEA, 2003). A usage-limit approach offers a mechanism that might offer such places a transition away from high fixed costs, and towards road pricing.