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## SOLVING CONGESTION

(When we must not build roads, increase spending, lose votes, damage the economy or harm the environment, and will never find equilibrium)

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### SOLVING CONGESTION

**(when we must not build roads, increase spending, lose votes, damage the economy or harm the environment, and will never find equilibrium)**

**P B Goodwin**

At this minute, thirty years ago today, Reuben Smeed, first Professor of Traffic Studies in UCL, started his inaugural lecture, 'Traffic Studies and Urban Congestion.', which I attended, in the back row, as one of his first group of research students. You can imagine the pleasure for me to return to UCL, as the first Professor of Transport Policy, and to encourage whoever might be sitting in the back row today.

My appointment to the UCL chair was followed by my recent appointment to a different sort of chair - as chairman of the panel of advisors on the forthcoming White Paper on Integrated Transport Strategies. This means that I have to start with a caveat. *Nothing* I say today may be taken as the views of that Panel, or the Deputy Prime Minister, or the Minister of Transport, or the Government, or as hints about the content of the White Paper, which is, of course, not yet decided anyway. I really have no idea yet whether I shall be able to say, in a few months time, that this is what I have spent the last thirty years preparing for.

I also want to acknowledge the help of many colleagues and organisations, though of course responsibility for error or conclusions remains mine.

So you must take this purely as a personal statement.

The 1960s were a period of great change in transport thinking - the Buchanan Report on Traffic in Towns, the Smeed Report on Road Pricing, Foster's: 'The Transport Problem', the work of the Mathematical Advisory Unit at the Department of Transport, the merger of the Ministries of Transport and the Environment, an important White Paper by Tony Crosland, and an exciting Minister in Barbara Castle; There is something of that mood again now, and we must remember that by no means was all that rethinking carried forward successfully. But some was, and some which was only of theoretical importance then, has acquired a new, practical, importance now.

For example, my first introduction to formal transport analysis was Smeed and Wardrop's 1964 paper, written before they both came to UCL, surely one of the great classic papers of transport studies: 'An Exploratory Comparison of the Relative Advantage of Cars and Buses in Urban Areas'.

Their argument had that immediate attraction (to the intellectual, though not always to the politician), of the counter-intuitive: if everybody travelled by the slow method of transport, bus, they might all travel faster than if they all travelled by the fast method, cars.

The reason why it is true is the fundamental defining relationship of our field, the speed-flow curve. This shows that the more traffic uses a road, the slower it goes, the effect becoming more and more severe as the traffic flow approaches the maximum capacity of the network, until finally overload is so extreme that all vehicles are unable to move. We may define congestion as the impedance vehicles impose on each other due to this relationship. It helps us to understand, that the underlying cause of congestion is not roadworks or taxis or accidents: it is trying to operate with traffic flows too close to the capacity of the network, when any of these transient incidents will have a disproportionate effect.

Armed with this law, Smeed and Wardrop calculated that since the number of cars required to move a given number of people is much greater than the number of buses, then a transfer from car to bus would enable the traffic to go faster, and in certain circumstances this is enough to offset the extra time spent waiting for the bus, walking to your destination and so on.

But there is a catch. whatever anybody else does, for each individual, it is nearly always faster for you to travel by car, and there is normally little or no incentive to do otherwise. It is one of those cases where Adam Smith's individuals pursuing their own best interests do not add up to Jeremy Bentham's greatest good for the greatest number. The benefit can only be delivered by Intervention, either in the allocation of road space bus lanes and so on or by pricing.

And another important contribution by Smeed to transport policy was his chairmanship of the committee on road pricing, which in 1964 gave a sort of official endorsement to Alan Walters' proposition that economic welfare would be increased if road use, perceived as a 'free' good, were charged for. (I say 'sort of official endorsement' a flow retired civil

servant told me that as a young man he found in the Ministry of Transport files a note, in the personal hand of the Prime Minister, Sir Alec Douglas Home, saying 'let us take a vow that if we are re-elected we will never again set up a study like this one'. I wonder if that had a connection with Smeed not becoming Director of the Road Research Laboratory, and coming to UCL? It's an odd thought that so much of my career might have been influenced by Lord Home's dislike of road pricing. Of course, the vow was not kept. Ever since, Governments, whether left, right or centre, have set up numerous studies of road pricing in numerous countries, all of which came to roughly the same conclusion as Smeed).

The reason why road pricing gives a benefit is congestion. Each driver, in using roads in congested conditions, imposes delays on everybody else, and these delays have a cost not taken into account in his personal choices. Therefore sortie journeys are undertaken for which the benefits to each driver are less than the costs they cause to everybody else, and the overall use of resources - *waste* of resources - is greater than it should be.

But so far the practical history of road pricing has been marked by flirtations, studies, cold feet, pricing interruptus. The reason for this in my view is because for a quarter of a century nobody took seriously the implications of a couple of lines of calculus in Thomson's Appendix to the Smeed report, which revealed - but obscurely, as through a glass, darkly - that although pricing certainly reduces congestion, the larger part, of actual benefit from road pricing does *not* consist of this congestion relief. The benefit sits, 'locked-up', in the revenue collected, and it is only released when the revenue is used.

More subtle recent analyses show that, if road pricing were implemented in a way which also had environmental benefits, and was geared to providing economic advantages to freight vehicles and buses, then the direct benefits can be magnified. But the core point remains: the calculated benefits to a considerable extent are crystallised in the revenue streams. This is why discussion of road pricing without explicit attention to the use of revenue streams is *inherently* unlikely to be able to command a consensus in its support. I treat this as an axiom of contemporary transport policy.

So we have these two important policy propositions, that have now been with us for a generation: that congestion could be less if people travelled by slower methods of transport, and if they paid for what they now think of as free. Well, what do you think? As policy statements, they somehow lack that magnetic lure which could bring them into the manifestos. The banner 'slow and expensive' fails to inspire.

But let me suggest another axiom. If there is a policy which genuinely increases efficiency, then there should be *some* way of implementing it that can win support: there are benefits to be had; there are more people who stand to gain than to lose.

So why does it sound so unattractive? Where is the flaw in the argument? Where *was* the flaw in the argument, 30 years ago?

Well, one flaw was that the tools we had for understanding how individuals make their travel choices were misleading and tendentious, and another was that economic orthodoxy, quite wrongly classifying the revenues produced by charging for congestion costs as a 'tax', treated them as a heresy called hypothecation.

But the real barrier to implementation was that the spirit of the time was heading in an entirely different direction. There was on offer an easier, more comfortable, painless, modern, more exciting way of solving congestion. We could simply build our way out. If traffic levels get too close for comfort to capacity, increase the capacity.

Here I have to introduce a rather well-rehearsed few minutes into my lecture, which some of my old friends here have since 1991 patiently sat through on more occasions than I can understand. But for my new friends you can't really judge what I am on about without it.

From the late 1950s onwards, the transport planning orthodoxy was what Susan Owens has called 'predict and provide'. *The axiom was: first we forecast how much traffic there will be, and then we build enough road space to accommodate it.*

This was the axiom that resulted in a rapid, huge, expansion of road capacity, and produced the national network of motorways - now, we cannot imagine life in a modern economy without them. It was also the axiom that resulted in some things that we now, mostly, have come to realise were a grievous mistake, like the destruction of the heart of some of our city centres to make room for urban motorways. Here, our imagination of life without them is easier, and in many places town centres road capacity is indeed now being reduced or closed, and the space returned to more productive use, though alas many historic structures have gone for ever.

Good or bad, the axiom's high point was, by one of the ironies of history, its final hour: the 1989 programme of road building, based on the 1989 national road traffic forecasts, called 'Roads to Prosperity'.

This was the last time when any Government transport policy tried - even partially, and with caveats and exceptions - to devise a roads programme intended to 'meet the demand'. It was launched with the greatest of fanfares, but even by the time of the launch the process which would lead to its abandonment was under way, and was, indeed, largely completed under the previous Government - this is not a party-political difference. The flaw was, the programme would not keep pace with traffic growth.

Indeed, one unchallenged study showed that even a fantasy roads programme, 50% larger than 'Roads to Prosperity', would not keep pace with traffic growth.

Now, suppose road capacity is expanded at a rate less than traffic growth. What follows?

The consequence is a matter of arithmetic, not politics. On that trend, the *ratio vehicles per mile of road* can only increase, and therefore logically congestion is likely to get worse, not better (either in intensity, or in duration, or in geographical spread, or some

combination of these). Supply of road space will not - because it cannot be increased to match demand, therefore demand will have to be reduced to match supply. In practice, 'Predict-and-provide' actually meant, inevitably, 'predict-and-underprovide' and a strategy with road building at its heart would not deliver improvements in travel conditions. We called it the new realism.

In the mid-1990s, the same idea started to be extended to inter-urban roads also, especially after 1994 when the advisory committee SACTRA reported that road construction in conditions of congestion normally results in an increase in the total volume of traffic, hence a shorter period of relief from congestion, thereby consigning to history the untenable assumption that the total volume of traffic is unaffected by travelling conditions. This opened the way to recognising that the volume of traffic is - in part - the *result* of policy, and is therefore subject to some degree of choice.

So two propositions: we cannot match the supply of road capacity to the forecast demand for it. And, that demand is not an inexorable, external, given: it is subject to influence.

Taken together, these propositions marked the change from 'self-fulfilling forecasts' to 'self-defeating forecasts'. Predict-and-provide became predict-and-prevent. This was the reason - not just a change in fashion or shortage of funds - why during the 1990s **demand management** has become part of the transport policy of every political party. Transport policy *in principle* now is nearly everywhere developing certain common themes.

The growth of traffic will have to be slowed down, and in some locations the actual traffic level will have to be reduced, or even removed.

In part that implies reversing the long-term decline in public transport. We are probably talking about an overall market for public transport which should expand at around 3% to 5% a year, sustained for thirty years, and in some locations the logic of policy suggests growth of 25% in two years, 100% in five - achieved by changing relative prices, or the re-allocation of road space, or both, and investing in new systems where the old ones cannot be sufficiently improved, and in all cases with a strong contractual commitment between public agencies and commercial operators - favourable treatment, but only in exchange for better services.

But that's only part of it. We now recognise the need to reinvent safe, attractive streets in which it is normal for children to walk or cycle to school; to reinvent the old custom of home delivery of shopping; to rediscover the role of land-use planning to reduce journey distances; to look for ways of participating in social activities that generate less traffic. The new policy tool-box includes pedestrianisation, traffic calming, traffic management aimed at maintaining a quality margin of reliability by reducing flows to significantly less than capacity; and once again pricing is everywhere discussed, as the only tool of traffic restraint which has the double whammy of ensuring that resource costs are covered in the choices people make, and also providing the funds to pay for improvements.

The list was in Brian Mawhinney's debate, as it is in John Prescott's consultation.

There is an important point about this list of policies. While the *overall impact* is intended to reduce the total amount of traffic, it does so by a combination of measures some of which are restrictive - (which, on their own, could hardly expect enthusiastic public support) - and others provide improvements in the quality and attractiveness of travel conditions - (which, on their own, would certainly be popular but do not result in a reduction in traffic).

Within this policy context, decisions about road capacity are quite logically at the end of the list, not the beginning - not because we shall never again see any new road capacity, which would be absurd, but because it is not possible to design a new road until it is decided what traffic load to design it for, and that now implies a policy choice, not a forecast. It can only be assessed *after* taking account of the combined effect of the whole policy package. The new National Road Traffic Forecasts, issued last week, at last recognise this explicitly: 'different policies will result in different forecasts' - seven words that unpack seventeen years of practice: they must, I think, displace the 1980 House of Lords ruling that the national road traffic forecasts could not be a subject of discussion or challenge at local road enquiries. And not before time.

This policy account is what many people here today, have been saying for some years. It is no longer a new idea. Much of the analysis has been accepted - more or less - by both the previous and present Government.

The final sentence in this much-told story, up to now, has also been standard: yes, many of us now agree on such principles, but converting them into practice has been painfully slow and unconvincing and inconsistent. That, to my mind, is the real challenge facing the White Paper.

But I want to leave that on one side and refer to some research - especially carried out with my colleagues Sally Cairns, Joyce Dargay, Graham Parkhurst and Petros Vythoukas - which bears on the practicality of some of these policies.

If road capacity will be inadequate to meet all the demands on it, are there ways of using it more effectively? This issue does not only, or even mainly, relate to pushing more vehicles along a road by clever traffic signals or one way Systems. It relates to reallocating space away from 'general traffic' to more selective uses: bus lanes, or cycle lanes, disabled travellers, emergency services? Or lorry-lanes. Or pedestrianisation. In each case we deliberately change the use of space as a tool to achieve more efficient use of the network, environmental advantage, enhanced street attractiveness or improved safety.

The problem is that all of these *improve* conditions of movement for the favoured users, but tend to *reduce* capacity for other classes of traffic.

Now, the technical assessment of such measures has most often been calculated on the assumption that all traffic displaced from one street will simply divert to another. If this is true, the predicted effect is at best displaced congestion, at worst total traffic chaos: For

this reason, time and again such measures have been considered, assessed, but rejected. Or implemented in the. most reduced, watered down, and ultimately ineffective, form.

But the interesting point is that many other cities - often led by politicians who arrogantly disbelieve such technical advice - have introduced such measures. And succeeded. Often there has been a short period of disruption lasting a few days, but no gridlock, and no prolonged traffic chaos at levels worse than those which already prevailed. Sometimes there has not even been a short term problem. The ubiquitous comment has *been 'the traffic has disappeared and we don't know where it has gone to'*. You may remember the tone of utter bewilderment with which the London 'Evening Standard' reported that when Hammersmith Bridge was closed for repairs, the anticipated total breakdown of traffic flow simply did not happen.

We need to understand exactly what is going on in such cases. Can it be that traffic really does 'disappear'?

We are currently studying some hundreds of these experiences. The results will be ready before the end of the year. It is already public knowledge (it) a dozen countries that in practice there are many occasions where capacity has been reallocated or reduced, without causing damaging disruption and chaos.

Of course, this is encouraging. But how can it be?

Consider what people actually do when travelling conditions change - they can change their driving styles to bunch up more, they can alter their route, the time of day they travel, the frequency of trips, the destinations they choose, the location of their home and workplace, the method of transport, the arrangements they come to with family or neighbours, the sequence of activities on a round trip, the substitution of trips for other forms of communication, and many others. All of these responses are influenced by the real world, but also by the complex and not always accurate perceptions people have of the real world.

This complexity is sometimes difficult for transport professionals to accept. Surely, we think, such a minor stimulus as a now one-way system or closing a bridge could not have such wide ramifications? And if it does, how on earth are we to carry out formal technical assessments of them?

You see, transport assessments are largely built around a view of travel as stable and repetitive - the commuter who makes the same journey every day, the shopper doing the same journey every week. Without question, such repetitive patterns exist, and they dominate our perceptions of our own lives, and our interpretation of other people's. Such a view is reinforced when we see roughly the same traffic conditions at roughly the same time, day after day.

But the apparent stability is composed, we now know, of volatile, unstable, changing undercurrents - what the pollsters call 'churn'. It is surprising (though Peter Bonsall and

Steve Atkins both noticed this years before its significance was realised), but actual individuals in the traffic queue even at the same time on two successive mornings are not, in most part, the same individuals. Every year anything up to a third of people change their jobs, up to one in seven move house. They get a pay increase. Or they get sacked. People leave home, get married, have babies. Their children change school, Some get divorced. They retire. A member of their family dies. If car ownership grows by a steady 2% in a year, what that really means is that 12% of households increase their cars, and 10% reduce them. At each of these life events there may be a reason to reconsider travel patterns and choices.

So the response to changes in travelling conditions is composed of at least two quite different processes: first, there are responses by specific individuals, limited by habit, the desire to experiment (or not to), ignorance, preferences, and by binding - but not permanent - domestic and economic constraints. For these, minor adjustments may be quite swift, but bigger changes proceed at the pace of change in their own lives and the pace of evolution of their attitudes and tastes.. And secondly, each day or year some individuals simply leave the system, and are replaced by different people making a new set of trips. These, being new, can react to whatever prevailing conditions they find, sometimes bringing a more open mind to the new situation.

As a result, broadly speaking, the process of adaptation to a new policy starts on day one, but takes between five and ten years before it is near enough to completion to get lost in other even longer term processes.

Such responses are difficult to predict precisely, but they are vitally important because they are give us space and time to manage the effects of policies on traffic.

But what about the effects on the economy? The jury - the SACTRA jury - is still out on that, and I do not want to pre-empt their verdict on what the evidence shows.

But we can start to address this question.

First, I have to say I cannot endorse statements of the form 'congestion costs the economy £15 billion a year', updated from time to time by inflation, implying an annual dividend of £1000 waiting to be distributed to each family. This is a Convenient, consensual fiction. It is calculated by comparing the time spent in traffic now, with the reduced time that would apply if the same volume of traffic was all travelling at free flow teed, and then giving all these notional time savings the same cash value that we currently apply to the odd minutes saved by transport improvements. This is a pure, internally inconsistent, notion that can never exist in the real world. (If all traffic travelled at free flow speed, we can be quite certain that there would be more of it, at least part of the time saved would be spent on further travel, and further changes would be triggered whose value is an unexplored quantity). It is a precise answer to a phantom equation.

But while the number is suspect, I do not at all challenge the wide agreement that time, energy and money spent in traffic jams is a waste, and that traffic growth's continuing

current trends will have unacceptable effects on economic efficiency, primarily due to increased congestion resulting in slower, and more variable, journey speeds. This is not a fiction. Then the *prima facie* expectation about policies aimed at reducing traffic in congested conditions, should be that they will have *positive* effects on the economy.

Now it is surely axiomatic that this could only be true if the policies themselves are well-judged. The case is clearest in relation to road pricing which is itself based on an economic argument: policy instruments to reduce traffic which make firms and individuals pay the full marginal economic costs of their journeys, must increase economic efficiency and therefore create (or allow) greater economic welfare.

What then about the effects of policy instruments using regulation, restrictions, rationing or traffic management. My view is that this must depend on the form of discrimination used. Primarily, this means that instruments tending to favour economically productive or efficient travel by reducing economically unproductive or inefficient travel could improve economic efficiency. (So freight movements may sometimes need to be given precedence over passenger movements; high utilisation passenger vehicles given priority over low utilisation vehicles, and so on).

What I am saying here is that if we are in conditions where congestion is itself wasting economic resources, traffic restraint - clever traffic restraint - is good for the economy, not bad for it. This is primarily a theoretical argument, but we do have one set of crucial empirical evidence. It is now established that reducing traffic levels in town centres can improve the level of turnover and competitive position of those towns, provided this is done with style and ambition and favourable related policies including high quality public transport access. Much of that evidence has been brought to us, by Carmen Hass-Klau and others, from other European countries, some twenty years ahead of us in this area of policy, but we are now starting to grow our own experience, which tells much the same story.

In any case, we can be certain that the economic functioning of places like central London depends on being able to have access to a labour force who simply could not get to work under the traffic conditions that would obtain if they all travelled by private car.

Such an argument should not be used to justify careless restrictions in traffic, unaccompanied by appropriate other measures. But it is reasonable to argue that policy measures designed to slow the rate of growth in road traffic, or where necessary to reduce its absolute level, can protect economic efficiency from the greater threat of congestion, and should therefore be welcomed, not feared. The case for this is clearer when the measures are 'in tune' with economic principles, especially in relating prices to full marginal costs, though may also apply when using other measures.

At this stage, let me summarise my conclusions so far, in terms of the challenge of the title of this lecture. I argue that solving congestion does not depend on building new roads, and indeed liberating our minds from this assumption has been an important step in allowing us to consider wider and more effective methods. I maintain that, broadly, we

can do this, if we want, without increasing spending - or at least, without increasing taxation and public sector spending - because the cash flows already spent inefficiently on travel can be recycled in a way that reduces traffic and simultaneously improves the quality of streets, public transport and access to activities. And even if we decide not to use the price solution, reallocation of road space offers net benefits without high cost. I suggest that the policies which do this most effectively have converged with those that contribute best to environmental improvement, enabling a 'green-gold coalition' of environmental and economic advantage. I argue that - done properly - this enhances economic efficiency rather than diminishes it, and therefore provides the possibility of better material standards of living in a way which does not diminish the moral and spiritual quality of life.

That leaves me votes, and equilibrium, to discuss.

Equilibrium first. What is this all about?

My concern is that our ability to treat the new policies analytically; to understand their effects; to assess their costs and benefits; is seriously hindered by our inheritance of an analytical tool-kit that is bright, impressive, of unchallengeable intellectual achievement, and wrong.

It was Wardrop, nearly half a century ago, who provided the theoretical core of modern transport modelling practice in suggesting that drivers choose among alternative routes for the same journey by picking that route which gives the minimum journey time. If too many chose the most direct route, it becomes congested and less attractive. There is then an incentive for drivers to use an initially rejected longer route. Adjustments continue until equilibrium is reached when no individual can make a further improvement as a result of any individual choice. When this obtains, all routes used between any origin and destination have the same journey time, any other possible route being slower, and not used.

Now Wardrop's rules were originally worked out assuming that the only choice open to the driver is which route to take. This was initially only a simplifying assumption, but as often happens, it became entrenched in practice for many years - the Department of Transport made such an assumption for most new motorways between 1970 and 1994. Most small scale schemes in towns still make this assumption, though this practice, not before time, is declining. Increasingly it is accepted that other responses must be allowed for. But what has not been recognised is the implications of allowing for them on the concept of 'equilibrium'.

Suppose we accept that long term transport demand responses are different, and usually bigger, than short term responses, because behavioural responses are time-dependent, and include adjustments which take years to be completed. That observation is so in tune with what we know informally about the human condition as to seem commonplace, even trivial, and I do not expect it to be challenged.

So we can say, for example, that the effects of pedestrianisation are that there is an immediate impact on traffic, often a short term negative effect on trade that lasts a year or two, then a growth in the number of pedestrians and retail turnover. The effect of bus fare changes seems to be that passenger response after the first year may be doubled, or thereabouts, after five years. Motoring cost changes have a small immediate effect, but are still working their way through car ownership and use ten years later. The effect of changes in transport infrastructure on land use patterns start very swiftly (sometimes even before the infrastructure is opened) but may not be completed for a generation or more.

Such observations are absolutely crucial to political strategy. We need to know how long it takes for these effects to build up, in order to know which policies must be implemented first, and which may be left until later. There is hardly a more important political question.

But the most-widely used analytical tools have *nothing* to say about sequence and time scale, because they treat end-states: notional equilibrium conditions which may never apply at all, but even if they will apply, we cannot say when.

Not only that, but even their description of the end-state may be biased. In technical terms, the necessary condition for the sorts of model we use (mostly based on cross-section analyses, or on time series analyses which, quite unnecessarily, fail to take account of the delays in responses) to deliver correctly estimated equilibrium relationships is that the variables of interest should not have changed systematically in the period before the observation, for a time long enough to have allowed the effects to settle down.

If the adaptation period is in the order of years, this condition is rarely, if ever, likely to apply in conditions observable in modern economies in the real world. Therefore the parameters estimated from cross section observed data will not, in general, be successful in describing equilibrium relationships from observation of uncompleted processes.

This suggests that improved understanding will depend on treating travel behaviour as a process, not a state. In this way, we will be better able to comprehend the process by which travel habits are formed, or broken, the process by which cultural values and patterns of travel behaviour are transmitted from person to person, between producer and consumer, or from generation to generation, and how the constraints acting as barriers to change themselves get stronger, or relax, in the course of individual, household and social growth.

Of course, it may be that in understanding these processes, a mental construct of conditions under which things would be stable, could be helpful in defining the rules of motion under which they actually operate. Martin Mogridge has pursued an approach like this which gives useful insight into how a decline in public transport can lead to lower speeds of car travel. But our current assessment techniques have a flavour of predicting the result of the match from a photograph taken in the middle of it. We cannot sustain the

assumption that we observe equilibrium in travel surveys, or the assumption that a future forecast describes the equilibrium on any specific, known, date.

Abandoning these substantially weakens the scope of cross-section analysis, and the credibility of current methods of long term project evaluation which discount a 'known' time profile of future costs and benefits to a net present value.

On the other hand, a move from ideas of equilibrium to ideas of process strengthens our ability to assess issues of great importance for policy - how long it takes for policies to have an impact, the consequences of different order of implementation, and the special problems involved in seeking to reverse well-established trends. And it may, as David Simmonds and John Swanson have both argued, actually lead to the adoption of simpler, more transparent, and more tractable models, rather than adding another layer of complexity to an already incomprehensible set of black boxes. This should be simplest of all for the national forecasts, for which there is no great technical obstacle to use such an approach already: a bit of a lost opportunity, I think, which I hope will be corrected soon. Until then, there are reasons for being very alert to the possibility of bias when using the new procedures to assess the effects of new policies.

As an academic, I see the transport agenda as requiring three changes. A change in policy, for which the time feels ripe. More difficult, a change in methodology, which until now has seemed less welcome. And third, which at the moment I feel least confident to define, perhaps we need to rewrite the textbooks as well, and reconsider the skills we want our students to learn. That's for a later year.

Meanwhile, the title of this lecture demands a last comment that is not strictly my territory at all. What about votes?

I like to think that if there is a policy that makes peoples' lives easier, more comfortable, less stressed, and which improves the quality of the air they breathe, and makes the economy more efficient, and improves their own health and that of their children, and which offers some chance of making things better rather than just slow down the pace at which they get worse; I like to think they will vote for it. You might think that is unrealistic. Perhaps you would be right, although I interpret the opinion surveys and the focus groups and the public mood as supporting this. There has been a distinct and clear move in favour of such arguments over the 1990s.

What I would say is rather broader. I think we are engaged in one of those historic transitions which looks quite different when you are in the middle of it, from what it looks like in retrospect - a bit like the great liberal reforms of the 19th century. The abolition of slavery, and of child labour; the introduction of free, compulsory education; the concept of public health; the construction of a system of drains; running clean Water; the right to vote. All of these, at the time, seemed revolutionary, or threatening, or infringements on the liberty of the citizen; or too expensive, and there were long arguments. In retrospect, they seem logical, fair, efficient, and absolutely good value for

money. Subsequent generations even wonder why it took so long, and why there was so much fuss about it.

I see transport as similar. Mass car ownership offered us a control over time and space which no previous generation has ever had, and we took it up willingly and enthusiastically. But it has got out of hand. It has now started to defeat its own advantages: There is much talk of a 'level playing field' - but playing fields are never level, which is why we change ends at half time. It's now half time - literally: we are probably about half way to the levels of traffic that would eventually apply if trends continue unchecked, and that just won't do. So we need to find a better way, or better ways.

It may all seem very complicated just at the moment. But we do our children no favours if we confine them to a car-dependent mobility. And I think our grandchildren will wonder what took us so long.

Footnote:

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