

Planes, Trains and Automobiles: The Economic Impact of Transport Infrastructure

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This version 27/07/2017 revised to correct Figures 2 and 3, which previously showed current rather than capital expenditure per capita and as a share of GVA.

Introduction

In the run up to the 2015 general election, the main political parties have very mixed views as to what should be done about transport in the UK. Big transport investment proposals – expansion of London’s airports and high speed rail – dominate the election landscape.

More generally, some parties want to invest more in roads, and railways, build inter-city high speed rail and expand airport capacity. Others present a mixed bag of opposition to some or all of these things. Some want to include transport spending in fiscal targets, while others do not. Many parties say very little about capital investment but implicitly champion further subsidy and public regulation of public transport through fare caps or re-nationalisation.

Although the policy aims are not always clearly spelled out, the big aims are presumably to reduce costs to businesses and commuters (either by reducing congestion or fares) and stimulate the UK economy through capital investment in transport infrastructure. The underlying question is whether we are spending enough and on the right things? This policy paper summarises some of the key theories and evidence regarding the impact of transport on the economy. The basic message is that the economic benefits of transport infrastructure spending are not as clear-cut as they might seem on face value.

Spending on transport

Annual transport expenditure in the UK was around £21 billion annually between 2009 and 2013 (HMT, 2014a). This amounts to 3.8% of public spending or 1.4% of GDP, of which 42% (£8.8 billion) was capital spending. OECD figures too indicate that we allocated about 0.7% of GDP to investment and maintenance of transport infrastructure in the 10 years up to 2011. This is comparable to Germany (0.7%) and the United States (when figures were last reported, 0.6% in 2004) but 25% less than the OECD average (0.9%). This investment in UK transport was stable for 20 years up to 2011.

After 2011, investment fell rapidly with general cuts in public spending, by 30% to 0.55% of GDP in 2013. Given that there is a cost-based argument for more investment during economic downturns, when there are underutilised resources and borrowing costs are low (IMF, 2014), the drop off in transport investment in the UK after the Great Recession is worrying. The government’s National Infrastructure Plan 2014 sets out £143 billion (HMT 2014b p.11) in future investment in transport up to 2020, which, given the above figures on spending over the past decades, roughly translates as ‘business as usual’ .

Of course these figures are not very informative in isolation. The crucial current policy question is whether we should be investing more in our infrastructure (or less) and if so ‘where’ and ‘in what’. To answer this question we need to understand something about the links between transport investment and economic performance, and the objectives of transport spending.

Macroeconomic evidence based on international or regional comparisons over time shows a small but significant association between infrastructure and economic performance. These studies suggest that a 10% increase in infrastructure is associated with a 0.3-0.5% increase in output on average (see Melo, Graham and Brage-Ardao 2013 for a survey or Jiwattanakulpaisarn, Noland and Graham 2012 for a recent study for the United States). An emerging body of research on the effects of the historical expansion of transport networks in developed countries and the current expansion of networks in developing countries also points to localised economic gains. But in the macro-economic studies it is hard to establish that transport infrastructure is causing better economic performance. And evidence

from the developing world is difficult to generalise to the UK. All in we should be wary of interpreting these findings as evidence for the economic benefits of transport investment in the UK.

Key policy questions

There are two key policy issues from a UK perspective. The first is related to congestion and whether the UK is investing the right amount to keep pace with growing demand, where this demand is generated elsewhere in the economy. Arguments for greater investment are that inadequate infrastructure leads to increased congestion, longer travel times and costs to producers and consumers, which constrain growth. On the basis of this kind of “ameliorative” argument, we should invest more in places where the economy and transport demand is growing, that is, we should build and improve roads, railways and airports in order to reduce congestion.

One counter-argument is that making travel easier in this way simply encourages more travel. This diverts resources from other places and sectors, with little economic gain and big environmental costs. Another argument is that this kind of policy exacerbates spatial inequalities by targeting resources at places which are already prosperous and growing.

A second question is whether transport infrastructure can in itself act as a driver of growth. Arguments for greater investment to meet this objective are based on better transport saving time, allowing more efficient allocation of resources. They are also supported by evidence that connecting people, firms and places more closely generates “agglomeration economies”, which increase productivity and stimulate investment. Proponents of this transformative objective can argue for greater investment to stimulate national growth, and also to tackle spatial disparities within the UK (e.g. City Growth Commission 2014). Based on this argument, we should target more resources to places where economic performance is lagging, in order to stimulate productivity.

National policy reports on the UK’s transport problems have tended to emphasise and propose solutions to the first of these questions. Nearly 10 years ago, a high profile report on the UK’s transport network highlighted the problems of congestion and the potential economic benefits of an improved system, estimating that a 5% reduction in travel times nationally would be worth around 0.2% of GDP annually (Eddington 2006). The report recognised the UK was already well interconnected, and recommended that improvements should come from increasing the performance of the existing network through management and pricing.

The key policy priorities were identified as growing and congested areas, urban areas and major congested inter-city links. According to this analysis, transport infrastructure investment should aim to relax the constraints that a congested system imposes on travel and business costs. Investment should be targeted to places where there is growing demand for transport, implying that investment should flow to the fastest growing cities and regions.

The LSE Growth Commission (Aghion et al 2013) echoed many of these conclusions and proposed a set of new independent institutions to unblock major transport infrastructure planning decisions including a Strategy Board to determine long-term infrastructure plans (then ratified by Parliament), a Commission to deliver this plan (including generous compensation for losers to deflect Nimbyism) and an Infrastructure Bank to help with both finance and private expertise.

Nothing has changed about our understanding of the interactions between transport and the economy to make us think that these recommendations are wrong. But the Great Recession has led to a renewed

focus on disparities between major cities (London in particular) and the rest of the country. A recent report by IPPR (Cox and Davies 2013) on regional infrastructure issues highlighted some stark differences in planned spending per person in different regions, arguing the case for greater spending in lagging areas in the North of England. Recent reports such as these have once again raised the question of whether we can stimulate economic activity - locally, regionally or nationally - through infrastructure investment, rather than simply targeting it to meet underlying demand.

Reducing congestion

Everyday experience suggests that the UK's roads are congested, trains are overcrowded and subject to delays, and main airports are at full capacity. Delays imply economic costs because time spent travelling for longer than necessary could be used more productively. Delays raise costs for firms and constrain production. In international comparisons of objective measures of congestions, business opinions of quality and spending, UK transport infrastructure looks bad.

The UK ranks poorly on congestion indicators and satisfaction with infrastructure quality. We currently sit second in the world's-worst rankings based on live traffic flow indicators (just below Belgium, INRIX <http://www.inrix.com/scorecard/>) and third in the world according to OECD data based on vehicle km travelled per km of road network (Figure 1). According to the World Economic Forum Global Competitiveness report (WEF 2014), the UK ranks 24th in the world in surveys of the opinions of the quality of transport infrastructure, behind most countries in Western Europe, though just ahead of the United States.

Figure 1: Top 10 countries for congestion (traffic relative to capacity)

Country	Thousand vehicle km per km of road network
Israel	2,700
Spain	1,454
United Kingdom	1,182
Germany	1,059
Netherlands	1,015
Switzerland	896
Luxembourg	784
United States	742
Greece	698
Austria	697

OECD (2013)

Taken at face value, these figures raise a red flag, warning us to invest more.

But delays do not imply there is 'too much' congestion. Congestion is an outcome of travel and economic activity and congestion is higher in successful economies. The relevant question is whether the current level is optimal given the trade-off between what we would need to spend to reduce it and alternative uses for those resources. Headline figures about the economic costs of congestion can be misleading if they are based on delays relative to unrealistic free-flow or night time travel time. Rankings like those in Table 1 tend to be distorted by big sparse countries like the United States where there are miles of empty land and unused road.

We should, however, be very worried about rising congestion, since this clearly signals that investment and transport policy is not keeping pace with demand. Again, perceptions are sometimes out of step

with the evidence. The available statistics on congestion on England's roads suggest that not much has changed in recent years. Average weekday morning peak journey times were 2.44 minutes per mile in 2006/7, and fell – in part probably due to the recession – to 2.37 minutes per mile in 2012 and have since gone back up to 2.4 minutes per mile. This figure is much higher in London, at around 3.7 to 3.8 minutes per mile.

Reliability of rail journeys, as measured by the percentage of planned trains arriving on time, fell abruptly from 90% in 1998 to below 78% in 2002 but has improved steadily since 2002 (when Network Rail was established) and was back up to over 90% since 2009 (DfT 2014c).

Even if we attempt to build our way out of congestion, the end outcome – particularly for roads - is not certain. Although small scale transport projects aimed at reducing congestion (like bypasses around bottlenecks) typically achieve their short-term objectives (Highways Agency 2013), the picture is more complex in the long run. Increases in capacity lead to increases traffic volumes and this offsets the initial reductions in congestion. In the United States, high quality empirical studies, suggest that traffic has risen one for one with increases in capacity (Duranton and Turner 2011, Graham McCoy and Stephens 2014).

This problem of 'induced demand' comes as no surprise. Congestion is part of the 'price' of undertaking travel, and lowering the price increases demand as users undertake more trips. This may not mean that the investment was worthless if the increased traffic is a manifestation of increased economic activity. But on standard cost-benefit metrics, a project that just stimulated traffic with no reduction in travel times would generate no user benefits. Presumably there are benefits from this new travel, although they are not easily captured by looking at the user benefits in the transport sector alone. It also implies that the problem of congestion does not go away simply by increasing capacity. Other mechanisms – pricing, traffic management – are needed to reduce congestion to 'optimal' levels.

Road pricing is a theoretically attractive option, and one that most economists advocate when the aim is to reduce congestion to optimal levels. Unfortunately, apart from well-known city cordon schemes such as in London and Singapore, congestion pricing has failed to take off in a big way.¹ This is sometimes because decisions about implementation are based around local business and resident opinion surveys or a referendum, and, unsurprisingly, get rejected (for example, the Greater Manchester congestion charge). A congestion charge forces road users to bear a cost – the impact of their road use on other users – that they could previously get away with without paying. It is unlikely that city residents will vote for such a scheme unless they don't drive and won't face the charge. A clear lesson from this is that congestion pricing is a difficult policy to get voted-in through democratic process.

This is disappointing, because the evidence on the impacts of congestion charging is reasonably encouraging, although the evidence base is not highly developed given the relatively few cases available to study. Transport for London's own impact monitoring reports on London's congestion charge (TFL, 2007) paint a general picture of reduced traffic levels, changes of mode from car to buses, taxis and cycles. On the downside, congestion measured as excess delays over night-time travel eventually returned to pre-charge levels (TFL, 2007, 2014).

¹ There are of course many toll roads where the aim is revenue generation rather than congestion reduction.

Stimulating the economy

An even bigger question is whether investing in new infrastructure can stimulate a lagging national or regional economy.

The main aim of new transport infrastructure is, self-evidently, to save time travelling (and reduce other costs like accidents and unreliability). Benefits to the economy materialise through releasing workers from the constraints of unproductive time spent travelling, allowing them to spend more time on productive or otherwise valuable activities (either in business or leisure). This is why the most fundamental input into transport infrastructure cost–benefits analysis has traditionally been the so called ‘value of travel time savings’. This is travel time saved, converted into monetary units. These monetised time savings are a crucial measure of the economic benefit from transport investment.

But over the past 15 years there has been greater interest in the potential for transport to generate ‘wider benefits’ that go beyond these travel times savings, by effectively bringing people and businesses closer together to form big agglomerations of economic activity. The logic follows from the observation that cities are more productive than rural places and big cities are more productive than smaller cities. So linking places together in ways that forms mega cities out of large cities and bigger cities out of smaller ones seems destined to generate productivity improvements. This thinking lies behind the idea to form a northern mega city in England, by linking existing cities with better transport connections.

It is easy to see how these ‘wider benefits’ add up with some back of the envelope calculations. Consider a transport scheme that reduces commuting times in Greater Manchester in a way that expands its effective labour market density by 5% (equivalent to an increasing employment by about 60,000 workers). Applying a mid-range estimate of how productivity increases with agglomeration implies a productivity increase in the city of only around 0.2%.² But given Manchester’s gross value added is around £50 billion, the aggregate benefit of this intervention to Manchester based on agglomeration alone is about £2.9 billion in present value terms.

A rough estimate of the value of time savings for commuters over the year based on 1.2 million existing workers, 60,000 new ones, average journey time of 30 minutes and a value of commuting time of about £7 implies a user benefit of about £2.8 billion³. This calculation is simplistic and has not factored in values for business users, reliability and host of other additional benefits and costs used in real appraisal, but gives some sense of scale: the agglomeration benefits typically more than double what you get from considering time savings alone. They can easily tip the balance between a project looking dismal on benefit-cost ratios and looking spectacular.

In more sophisticated calculations of the benefits of high speed rail between Manchester and Leeds, the Spatial Economics Research Centre estimated that 20-minute reduction in journey times between Manchester and Leeds would result in a 6% increase in agglomeration for Manchester (Overman et al 2009). The implied agglomeration benefits for Manchester alone would therefore be in the order of £4.3 billion. The numbers look even bigger if you factor in the possibility that agglomeration attracts higher-skill workers, although it is unlikely that these gains from the spatial redistribution of workers are ‘additional’ to the national economy. Questions over these kinds of calculations lie behind debates

² An elasticity of about 4% from the DfT ‘webtag’ guidance (DfT 2014b) or our own estimates (Overman et al 2009)

³ The 30 minute figure comes from upscaling the average commute time in the NW region by the relative commute times in urban conurbations nationally. The £7 figure comes from current webtag guidance (DfT 2014a).

regarding the benefit cost ratio of major transport schemes and partly explain why there is little consensus over whether HS2 is a good thing.

When it comes to measuring whether actual transport projects led to real changes in economic outcomes after the event, the picture is not always so encouraging. A study looking at the impacts of US road building on productivity (Jiwattanakupaisarn, Noland and Graham 2012) suggests that an additional lane mile of interstate highway generates \$852,000 of benefits, but at a cost of \$5.5 million (in year 2000 prices).

SERC's analysis of the impacts on firms of the UK's road building programme between the late 1990s and late 2000s (Gibbons et al 2012) indicates that a year's investment in major road scheme at a cost of £1.8 billion generated about 3,600 jobs – that is, a cost of £2 million per job. This can look good or bad depending on how productive these jobs were. If they were minimum wage jobs, the productivity gain amounts to only £1 billion. Our study shows that these new jobs came from entry of new businesses into an area rather than expansion of existing firms – incumbent firms lost workers. We also found gains in output per worker for incumbent firms in the vicinity of the improvements, but only because these firms employed fewer workers. This finding raises the concern that many of the new jobs were simply displaced from elsewhere.

There is clearer evidence of benefits in developing countries where transport infrastructure is in a poor initial condition. For example, Ghani, Goswami, and Kerr (2015) show that manufacturing output grew by 50% in Indian districts located close to the central highway network when it was upgraded. Given the context, the authors note that the results are difficult to transfer to developed economies. Again, studies like these look at local economic gains in places affected by transport improvements relative to areas that were less affected. Many of the observed changes could be due to zero-sum displacement of economic activity from one place to another.

This issue of displacement versus general economic benefits is particularly evident in the claims made about airports. The arguments for new airports or runways like those being considered for the South East revolve around various impacts: direct effects due to employment at the airport; indirect and induced effects which are new employment generated by services to the airport from offsite and from consumption by airport workers; and 'catalytic effects', which are more general effects on the whole economy due to reduced travel times and better connections between places.

Many of the claims made about whether, say, Gatwick, Heathrow or a new airport on the estuary are better sites economically are centred around the first and second effects, plus environmental considerations. While indeed these employment impacts are local benefits – understandably championed by those with local interests at heart – they are national economic costs and would be treated as such in any guidance on cost benefit analysis. This is economic activity that is displaced from somewhere else in the economy either from other sectors, or from different geographical areas. The real gains nationally are the 'catalytic' effects, which are much less well understood, estimated analysed or publicised.

So the bottom line is that predicted productivity impacts of transport infrastructure investment due to time savings and agglomeration are in line with some of the macroeconomic cross country estimates cited in the Introduction. There is also reasonably good evidence that transport improvements bring local benefits to places made more accessible. But the evidence on the impact of specific transport improvements on the national economy is not so reassuring. Road, rail and airport building is not necessarily a sure-fire policy for stimulating the overall economy.

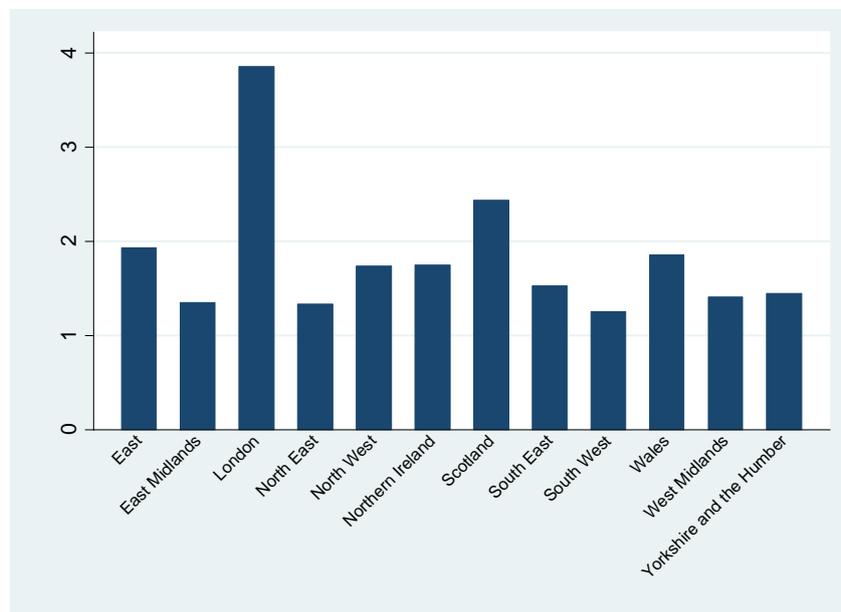
Fixing regional imbalances

Certainly, when a place is made more accessible, it can become more attractive to businesses and people. Demand for land increases, land prices increase, and we see new local capital investment in the form of commercial property development and new business, and/or new housing. Transport infrastructure could thus promote local area regeneration. There is plenty of indirect evidence for this in that transport investments increase land prices and housing prices (for example, Gibbons and Machin 2005).

If the policy objective is to ‘rebalance’ the economy spatially, that is to reduce regional disparities and bring the North closer to London in terms of its productivity and GDP, then concerns about whether these effects represent new private investment or private investment displaced from elsewhere might be set aside. An argument could be made that public investments that draw private investment away from London to the North are a good thing.

This line of thinking underlies recent arguments that the North is poorly served in by public infrastructure spending. Figures presented by the IPPR are startling. In terms of proposed spending per capita, the North looks like it is getting a terrible deal compared with London, with a projected spend of £770 per head in London compared with £5 per head in the North East on public sector transport projects (Cox and Davies 2013, p.10). These interpretation of these figures have been questioned (Overman 2014) and the actual historical figures on transport capital spending per resident don’t look quite this uneven (Figure 2). Still, evidently London does relatively well.

Figure 2: Public transport capital spending per capita, average over 2009-2013



Source: author’s own calculations from DfT (2014d) and HMT (2014)

Figure 3a: Public transport capital spending as a share of gross value added, average over 2009-2013

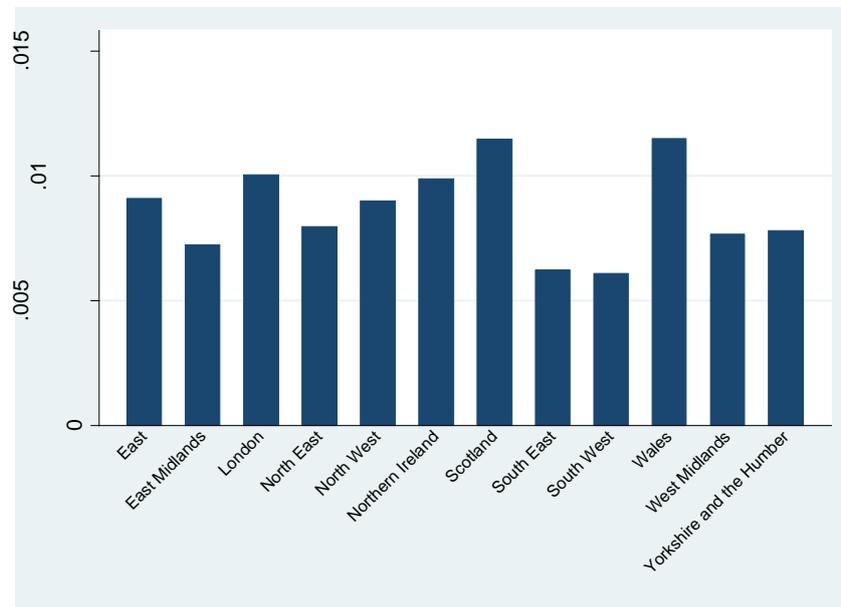
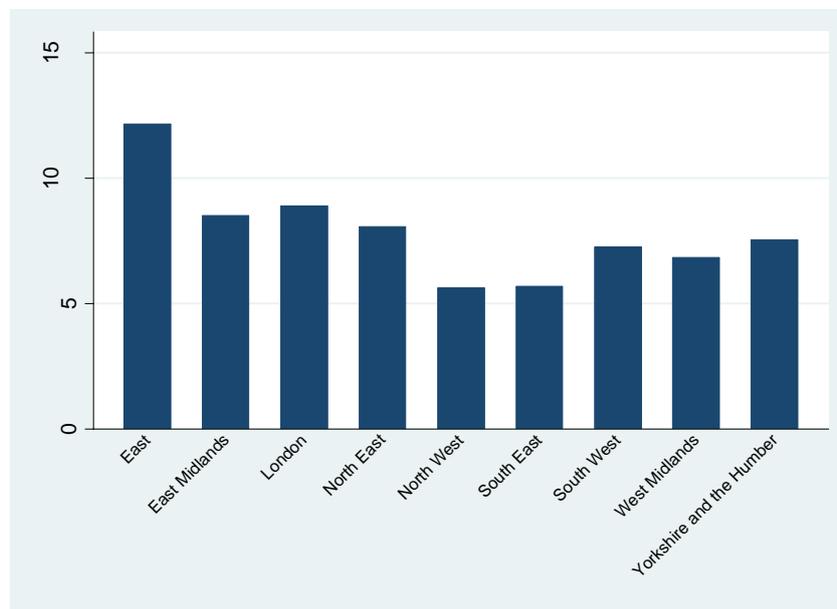


Figure 3b: Public road capital spending per minute of time on the roads (£1000s per million vehicle mile minutes), average over 2009-2013



Source: author's own calculations from DfT (2014d) and HMT (2014)

But is this the right way to think about imbalances in spending? Should we be aiming to spend the same per person in every place regardless of congestion and demand for transport services? Possibly not. As shown in Figure 3 and 4, if we use other denominators, these wide disparities vanish or reverse. Public spending on transport has been relatively even across the English regions, as a share of gross value

added (GVA) and is also relatively high in Scotland, Wales and Northern Ireland. Public spending on roads or as a share of vehicle minutes on the road also shows a fairly even pattern across many of the English regions, with the North East similar to London.

These comparisons highlight the tensions in infrastructure policy. On the one hand, we want to target congestion and build infrastructure to meet economic demand. This means spending more per head in high GVA places with a lot of transport use and less in others, so spatial disparities in spending per head inevitably emerge.

Arguments for spending more in areas that are less economically successfully hinge on the hope that new transport is a cost-effective way to stimulate new economic activity. As discussed above, the theoretical arguments and empirical evidence on this are ambiguous. Better transport may encourage local investment, but this investment is as likely to be displaced from other places within a region as it is from other regions, with no impact on large scale regional imbalances. Moreover, improving the accessibility of a peripheral region opens up its markets to core, dominant regions, and there is no guarantee that this leads firms towards a peripheral region rather than away from it (Puga 2002).

Conclusions

The general lessons of all this are that transport infrastructure policy clearly needs to be geared towards keeping congestion under control and meeting the demands of a growing economy. But claims that big transport infrastructure investment is a cost-effective way of generating new growth either nationally or regionally should be treated with some caution. While compelling as a policy option, it is a hard one to be confident about based on the evidence.

On the other hand, any idea that we can scale back on transport use, by reducing travel and trade, and still sustain economic growth and improvements in living standards is just not credible. Alternative communication channels provided by broadband internet might replace some of the functions of transport, bringing customers and businesses together and facilitating the sharing of information. But goods still need to be transported, and face to face contact is still crucial. Moreover, the evidence on the impact of broadband on the economy is just as ambiguous as that on transport (WWCLEC, 2015).

There are evidently a broad range of other issues. A big controversy is of course the environmental impact of transport, both globally through general emissions levels and locally through the pollution, noise and impacts on landscape. Environmental impacts have dominated debates over the planning of specific transport schemes like HS2 and the London airports now, or the M11 link road and Newbury bypass in past decades.

There are potential ways to smooth over some of these local planning controversies, which can hamper productive development, by financially compensating local residents for their losses. Tackling the broader environmental impacts is a bigger challenge, although road pricing and other means of charging transport users for their social and environmental impact presents one way forward. Of course, increasing costs for users in this way is not an electorally attractive policy.

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