Transport, land use and economics

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Abstract Traditionally, transport schemes are valued on their user benefits, the most prominent of these being time savings. Increasing speed is always seen as being a good thing. This paper explains that transport schemes can result in unforeseen consequences; people often use the speed improvements as an opportunity to move further away, whereas increased density should be encouraged, as it is more efficient and generates economic benefits. It goes on to examine the relationship between transport and land use, explaining why this matters, and concludes that it is important for transport appraisals to have some way of including the land-use response.

Keywords: *Transport, land use, economics, density, infrastructure, accessibility, density*

INTRODUCTION

What is transport for? This may seem like a question with an obvious answer: transport is about the movement of people and goods, and making that movement as quickly and easily as possible. This is the basis upon which new transport infrastructure and policies are valued: speed = efficiency. Transport investments are judged almost entirely on the extent to which they deliver travel time savings to transport users. Citing a current example, roughly three-quarters of the £71bn of benefits from the full network of HS2 are expected to be due to rail time savings.[1]

Frequently in transport, however, changes have unforeseen consequences. Increases in speed may not reduce total travel times at all. This is represented in Figure 1, which shows travel data for the UK between 1970 and 2012 collected from the National Travel Survey by David Metz[2] of University College London. Despite the many transport infrastructure investments that were made during that period, the amount of time spent travelling per person per year remains remarkably constant at around one hour per day. The number of trips per person has also remained steady. The indicator that has grown substantially is the total distance travelled, which increased from 4,500 to around 7,000 miles per person per year.

Figure 1 strongly suggests that people have not used faster transport to save time. Instead, they have used it to travel further. Why might this be the case?

There are a number of reasons that may help to explain the trend. Faster travel means that people can travel further in order to access something better (or a better range of choices) than they could reach within the same amount of time previously. That could be a better job, shop or restaurant. The point is that, by travelling further, users are benefitting in some way. Under those circumstances, the

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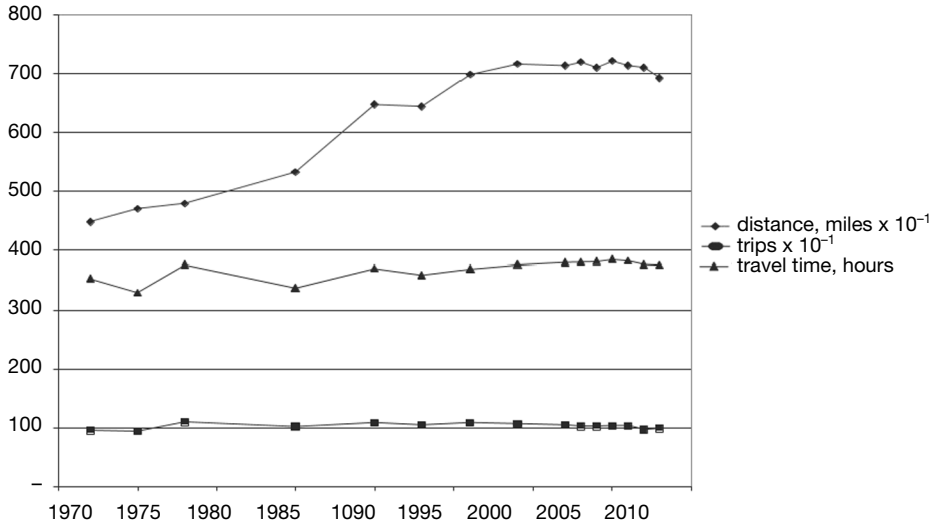


Source: Metz, D. (2010)[2]

Figure 1: Travel time, distance and trips per person per year, 1970–2012: travel time (hours per person per year), distance (miles pppy) and journeys (pppy)

value of the travel time saved might be a reasonable proxy for the benefit. The choice to use the time saving as an opportunity to travel further implies that the gain from travelling further is at least as great as the extra time and money required to get there. Businesses use faster travel times to compete over larger markets, thereby driving competition and efficiency.

There are alternative explanations, however, the main one being that people are staying in the same job and visiting the same shops/restaurants, but are moving their homes and living further away. Typically, the reason for this outward sprawl is that it enables people to have a better quality of life — through having a bigger house and/or a larger garden, for instance. While a better quality of life is a good thing, it is not at all clear that this benefit equates to the value of time saved on their original trip patterns — for one thing, it would require the property market to be a perfect market.

It looks as though the total time savings that formed the basis for justifying the infrastructure investment in the first place have been balanced out by location preference choices with higher travel times associated with them. That is not saying that everyone has moved further out, but that the proportion of people who have moved out has served to balance the total time spent travelling.

This idea of transport is central to the 'Sociable cities' work by Sir Peter Hall and Colin Ward.[3] This work — which builds on Ebenezer Howard's 'Garden cities'[4] — suggests that clusters of self-sufficient cities in South East England with high-speed rail links to the capital are the answer to housing shortages in London. Hall and Ward argue that these are necessary because of the reliance on brownfield sites for new development, which are often poorly connected and of bad quality, and the 'not in my backyard' (NIMBY) attitude putting constraints on density in/near existing suburbs. They believe that these 'satellite' cities would be a sensible solution, but one that would lead to further increases in distance travelled.

There is an alternative view of transport that says transport itself is a bad thing, something that should be reduced or

minimised, certainly not maximised. One way of achieving that would be by increasing density. If everything were closer together, there would be less need for transport. The level of distance travelled is closely related to the level of development density; the higher the level of density, the shorter the distance that needs to be travelled in order to find the same job opportunities, quality of restaurant or a specialist shop. In this model of the world, transport should be less about speed (which encourages sprawl because people travel further) and more about capacity (which enables density of land use by allowing more people to get to the same place). Higher density not only reduces the need for travel, it also delivers important economic gains with clear, positive links between employment density and productivity.

TRANSPORT AND LAND USE

The links between transport and land use are strong — transport infrastructure sets the patterns in which cities grow. Residential location decisions are made primarily on access to work, and commercial location decisions are based on access to labour and customers. Despite this, the standard assumption in transport appraisal is that land use is fixed. New transport infrastructure is only incremental to an existing system and hence does not change land use. While this is clearly true for marginal changes to a network such as a new bus lane or roundabout, it is much less clear that it is true for very large transport investments such as Crossrail or HS2 or even for a sequence of smaller investments such as gradually upgrading a length of existing highway or railway.

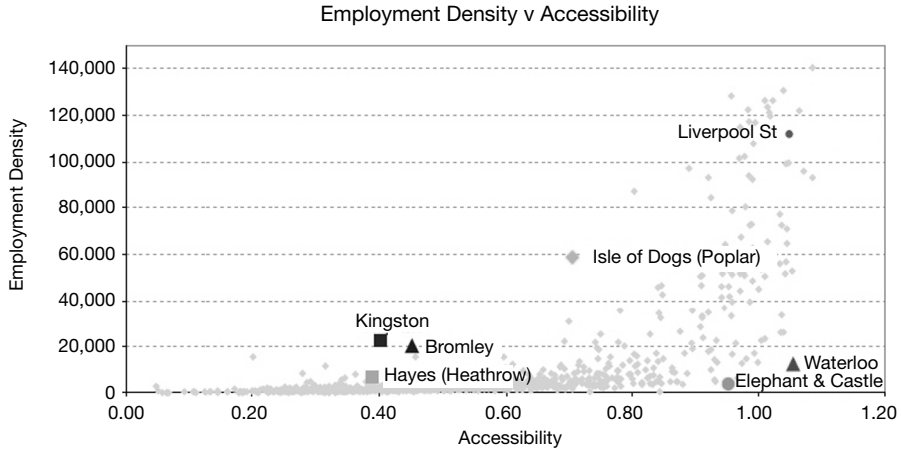
Cities are increasingly dominating global economic growth. According to McKinsey,[5] from 2010 to 2025 the GDP of the 'City 600'[6] will rise by over $30tr, equivalent to almost 65 per cent of global growth. Alongside this, it is expected that the world population growth could add another 2.5 billion people to cities by 2050.[7] The role of transport in increasing productivity and enabling that growth is therefore very important.

In large cities, rail lines determine patterns of growth and, in smaller towns, roads are the key arteries, but in any location there is likely to be a relationship between the level of accessibility of a place and the density of development.

Work has been undertaken[8] to examine the relationship between accessibility and development density, principally in London, but also in other locations. Figure 2 shows the relationship between accessibility (measured by level of accessibility to population) and employment density in London. This indicates that, up to a certain level of accessibility, employment density remains relatively low. At this level of accessibility, employment is largely population driven — that is, it represents the type of local employment that serves people where they live, eg high-street shops, newsagents, hairdressers and cafés.

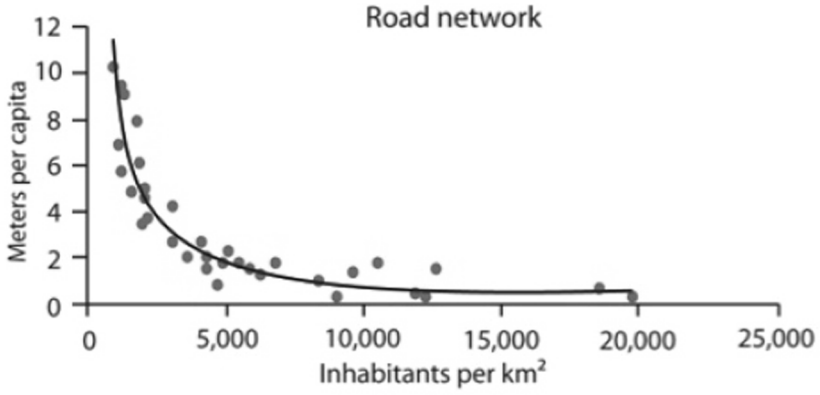
When accessibility reaches a higher level (ie the sort of level achieved in places such as the City, which has extremely good connections by tube and rail), this is when employment density increases substantially. Higher accessibility draws in the types of business (such as those in the financial and business services sector) whose clients are other businesses and which are mobile enough to be able to choose a location that benefits them most. They benefit from high density, because it drives higher levels of productivity. Higher density means a wider labour pool to choose from, more competition, which acts as a spur for improving efficiency, and greater opportunities to benefit from knowledge spillovers.

In contrast, increased road schemes have the opposite effect on density. Figure 3



Source: Colin Buchanan and Partners Ltd (2004)

Figure 2: Employment density vs accessibility, London, 2005



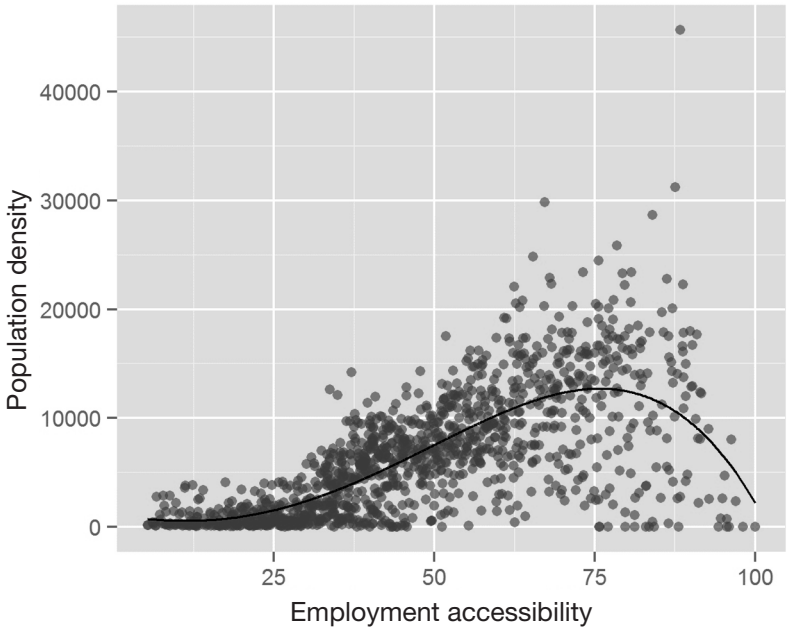
Source: Salat and Bourdic (2013); and Mueller *et al*. (2013)[9]

Figure 3: Highway supply vs population density, 2013

shows that the greater the road network, the lower the development density. This highlights the feature of cities where the car is dominant — sprawl.

Coming back to public transport accessibility, there is also a relationship between accessibility (measured by level of accessibility to jobs) and population density. This is shown in Figure 4, which uses data at a borough level (or half boroughs where they cross the boundary of the Central Activity Zone). It shows that there is a strong positive relationship between accessibility and population density. It is only at the highest levels of accessibility where this relationship drops off. It is at that point — again, in locations such as the City — that land becomes much more attractive for high-value employment uses.

So a single measure of transport accessibility explains approximately 80 per cent of the variations in density across the whole of Greater London. That is a significant explanatory power, given that employment densities vary from as low as almost zero to as high as 150,000 jobs per square kilometre in the City. It suggests



Source: Volterra (2015)

Figure 4: Population density vs accessibility, London

that transport infrastructure is very important in determining the distribution and density of employment and population.

WHY DOES THIS MATTER?

A system that does not take account of the interaction between transport and land use is a poor one for a number of reasons:

- the link between employment density and productivity, the basis of Wider Economic Benefits (WEBs)
- the external transport costs imposed by an outward sprawl of land use
- the inherent bias that a fixed land-use assumption brings to transport appraisal
- the loss of potential income that could be captured from the increase in land value

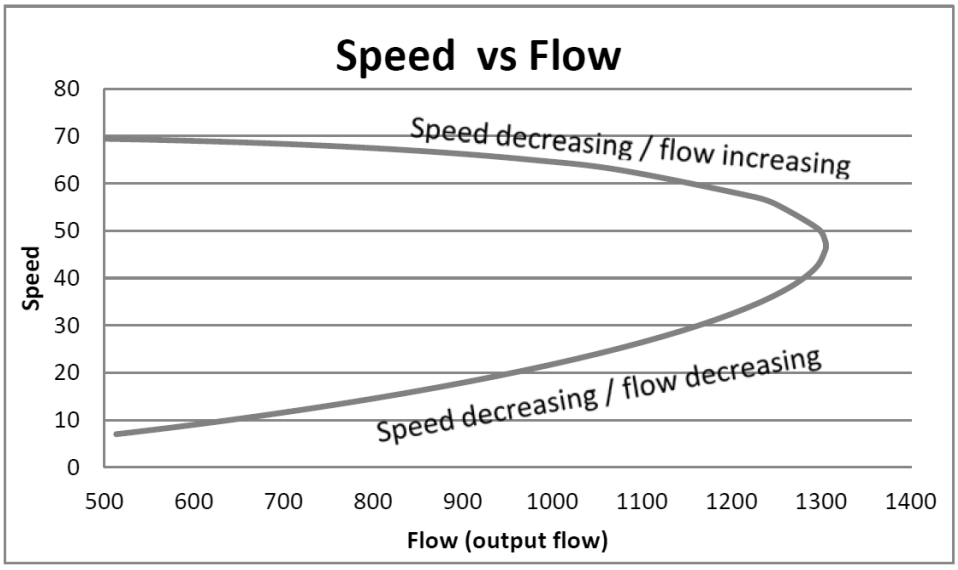
These implications are summarised below.

Employment density and productivity

Wider Economic Benefits were developed for Crossrail. Crossrail does not increase speed of travel much: the majority of the line east of Liverpool Street and west of Paddington runs at pretty much the same speed it does now. What Crossrail will do is provide a very significant increase in rail capacity to the West End, City and Isle of Dogs. That increase in capacity is what will enable additional development, higher productivity and economic growth. In broad terms, WEBs doubled the economic case for Crossrail from 2:1 to 4:1.

External costs of transport

Individuals take personal decisions as to whether to move further out following a change in transport, but they do not take account of the external costs that they impose on others through those decisions. Thus an individual may decide that an



Source: Volterra (2015)

Figure 5: Traffic speed–flow relationship

extra 30 minute drive in each direction to/from work is justified by the lower house price/larger garden available. But in driving to work, the external costs imposed on other drivers (through congestion) and on everyone (through environmental costs) can be many times greater than the individual cost. Hence, individual decisions worsen overall performance.

Bias from ignoring land use

If land-use change happened in the same manner for road and rail, there would be much less of a problem, but in reality the two modes are at opposite ends of the scale. When a new road is built to relieve traffic congestion, it generally starts well, with significant improvements in speed. Pretty soon, however (faster in high-density, highly congested areas), traffic demand increases as users take advantage of the new route by switching route or by making different trips. That is the point at which people often make location choices and move out. These land-use, route-choice and trip-generation responses have the effect of rapidly filling the additional capacity and reducing travel speeds, often back to where they started. Roads have strongly negative speed–flow curves, so that increased demand reduces average speed, with the impacts becoming greater the closer to gridlock the system becomes. A speed–flow curve is displayed in Figure 5, showing that traffic speed declines as demand increases, but flow (throughput) continues to rise until maximum capacity is reached at FM, further demand increases then results in worsening congestion, and the throughput of cars falls dramatically.

Rail has very different characteristics. On rail systems, higher demand generally reduces overall travel costs, because frequency increases and wait time reduces. Trains run at the same speed irrespective of demand, but higher demand creates a better service and generates additional revenues.

The two modes therefore react very differently to land-use change. For rail, that change is almost always good, with

higher demand producing a better-performing scheme. For road, it is almost always bad, with higher demand increasing congestion and travel times. The type of land-use change is also very different. Rail schemes encourage high-density development around stations, whereas road schemes encourage much lower-density sprawling development. In more technical terms, rail has a downward-sloping cost curve with respect to demand, and roads have an upward sloping cost curve.

Transport and land values

An appraisal system that recognised land-use change as intrinsic to all major transport projects would be much better placed to consider how to exploit those changes by capturing some of the added value for the project. There are a variety of methods available, but all of them are impossible to implement in a system where the core assumption is that land use is fixed

CONCLUSIONS

Transport infrastructure is the architecture of cities, so powerful is the impact of the main road and rail routes on city form. That the approach to transport planning and economics ignores that impact entirely seems very strange. One reason is that having variable land use makes the transport modelling and economic appraisal much more difficult: the comparison between before and after is harder. The Department for Transport will under certain circumstances allow for a change in land use if a LUTI (Land Use Transport Interaction) model has been applied. In practice, LUTI models are extraordinarily difficult to build, and there are very few schemes for which they have been used.

That it is not possible to get a perfect representation of the future does not mean that a fixed land-use assumption is the best one to use. There are other, much simpler approaches available. One would be to use the accessibility:density approach developed for London, and calculate the change in accessibility in order to determine the change in density. It may be that, in the future, the change in density will be different from the current relationship, but that current relationship surely gives a pretty good idea of what will happen.

Even if that is not the case, some simple sensitivity tests showing how a transport project would perform if a land-use response took place, would be much better than doing nothing.

References and Notes

1. High Speed Two (HS2) Ltd (2013), 'The economic case for HS2', available at http://assets.hs2.org.uk/sites/default/files/inserts/S%26A%201_Economic%20case_0.pdf, last accessed on 30th July, 2015.
2. Metz, D. (2010), 'Saturation of demand for daily travel', *Transport Reviews*, Vol. 30, No. 5, pp. 659–674.
3. Hall, P. and Ward, C. (1998), 'Sociable cities: Legacy of Ebenezer Howard', Wiley, Chichester.
4. Ebineezer, H., (1902), 'Garden cities of tomorrow', London.
5. Dobbs, R. *et al.* (2012), 'Urban world: Cities and the rise of the consuming class', June, McKinsey Global Institute.
6. The top 600 cities by their contribution to global GDP growth, 2010–2025.
7. The world's population is increasingly urban, with more than half living in urban areas, available at http://www.un.org/en/development/desa/news/population/world-urbanization-prospects-2014.html, last accessed on 30th July, 2015.
8. Colin Buchanan and Partners Ltd (2004), Accessibility:density work for Greater London Authority.
9. LSE Cities (2014), Accessability in cities: Transport and urban form, NCE Cities, Paper 03.