Economic Performance Impacts of Road Enhancements

Synthesis Report

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Ipsos with George Barrett and Tom Worsley

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2 Executive summary

Ipsos, in collaboration with George Barrett and Tom Worsley was commissioned by the Department for Transport (DfT) to carry out a comprehensive assessment of the nature and extent of the economic impacts generated by road improvements in England. This is known as the Economic Performance Impacts of Road Enhancements (EPIRE) project.

There were two complementary strands of work involved:

- A series of econometric analyses to quantify the effects of investments in the strategic and local road network on the performance of local businesses as well as on local labour, land, and property markets.
- A series of mixed-methods case studies exploring the impacts of individual schemes. These case studies were intended to provide further insights into the underlying explanatory mechanisms driving the patterns of economic impacts identified in this report.

This project involved an analysis of the local economic impacts of a total of 194 road improvement schemes completed between 2002 and 2021. This included road schemes completed on a mix of local roads and parts of the Strategic Road Network (SRN). A total of 79 DfT funded Local Major schemes and 117 National Highways funded schemes were covered.

Key findings from the econometric analysis

- Road improvement schemes are found to have positive growth impacts on local economies. The average scheme leads to an average expansion in employment of 0.11 to 0.15 percent and Gross Value Added (GVA) of 0.14 to 0.22 percent on areas within 30km of schemes. Effects on employment and GVA were statistically significant up to 6 years post scheme completion.
- The local growth impacts of road enhancement schemes are primarily driven by impacts on the manufacturing and transport and storage sectors (and to a lesser degree, the construction sector).
- Local growth impacts are partly driven by the spatial reorganisation of economic activity, with firms apparently opening new or relocating existing plants nearby to take advantage of improved connectivity. This was partly driven by incumbents relocating more distant operations (i.e. more than 30km from relevant schemes) to areas closer to the enhancements - implying that road infrastructure improvements may lead to some offsetting losses of economic activity in more distant areas.
- Road enhancements generate short-term labour productivity gains (measured as GVA per worker) but were no longer significant after 3 years.
- There was no statistically significant evidence from the econometric analysis that improved road networks led to increased international trade volumes amongst local firms in direct

terms (either in terms of spending on imports or exports). However, this does not mean that there are not indirect supply chain relationships via which there is an uplift in exports. This aspect requires new data on supply chain relationships to address this impact pathway.

- There was some evidence that the growth impacts of road enhancements are concentrated in areas that already display high levels of productivity. Additionally, growth impacts principally accrue to major urban agglomerations - and to a lesser degree, rural areas - with no statistically significant evidence of growth impacts (positive or negative) on suburban zones and smaller towns. Whilst this finding suggests that efforts to maximise the economic growth impacts of road enhancements could prioritise more prosperous places such a stance would of course strengthen rather than reduce regional wealth disparities.

- Improvements to road connectivity were found to have positive effects on local labour markets. It was estimated that road improvement schemes lead to an average ongoing increase in the hourly earnings of workers employed by firms located within 30km of 0.17 to 0.22 percent.

- Wage gains for workers employed by firms prior to the completion of road improvement schemes were smaller than found across all workers employed by firms within 30km. This finding is obtained by comparing wage gains for it workers that do not move employer whilst a scheme is completed. It indicates that incoming workers benefit more from wage increases than those who worked in the area prior to the scheme opening.

- Road improvement schemes encouraged the relocation of residents, with the resident population of areas within 30km of schemes increasing by 0.29 to 0.32 percent in response to improvements in road connectivity.

- Impacts on both wages and unemployment were concentrated in areas within 5 to 10 kilometres of road improvement schemes. This aligns with the spatial pattern of the local economic growth impacts of road improvement schemes.

- There was little evidence that road improvement schemes led to increases in labour supply via economic activity rates or by encouraging workers to increase their working hours.

- The findings also provided additional evidence that road improvement schemes reinforced existing patterns of economic agglomeration.

- Road improvement schemes increase demand for commercial floorspace in high productivity areas, leading to increases in commercial rents (as far as can be ascertained from changes in the rateable values of premises) of around 0.09 to 0.13 percent per square metre of floorspace.

- Similar patterns are also observed in housing markets. Road improvement schemes increase the value of residential properties within 30km by an average of 0.26 to 0.33 percent. These impacts are concentrated in high productivity areas.

- The findings raise possible questions regarding the role of the planning system in constraining the potential local economic impacts of road improvement schemes and determining how the resultant productive advantages are shared between firms, workers, and landowners.

Key findings from the case studies

A broad range of sources of evidence were used to develop the case studies: a process of extensive document reviews, a CATI telephone business survey for a sub-set of three case studies, group workshops and bilateral discussion/interviews with Local Enterprise Partnerships (LEPs) when they existed and with Local Authorities more generally, together with a set of interviews with business stakeholders. We also consulted internally within DfT on technical aspects of current traffic modelling methods relevant to business cases and the conduct of economic impact evaluations and the evolving thinking within DfT on Benefits Management at the local authority level (i.e., those post-opening monitoring activities that address economic impacts). This aspect of the study included collaboration with the contractors carrying out a one-year post-opening assessment for one of the case studies that pioneered an examination of noteworthy initial economic impacts.

The key findings are as follows.

- Individual scheme case studies are an invaluable source of qualitative contextual information and insights into the 'on the ground' realities of how economic impacts are achieved – and why they sometimes fail to meet expectations. Case studies can only rarely provide a robust basis for measuring causal economic performance impacts because too many other factors are in-play that create a 'signal to noise' ratio challenge. It is only possible to identify economic impacts via discrete case studies when the local economy is relatively simple in structure, and allows a clearly attributable impact to stand out in data (especially on the new employment created by a major investment linked to road enhancements and when they facilitate new housing developments). This means that, as a general principle, only portfolio-level econometric analysis can identify the general patterns by in effect screening-out multiple local aspects that mask the impacts.

- However, within those constraints, the case studies were still able to provide extremely useful examples of how Local Authorities were able to resolve planning consent barriers to major local employment-generating investments (e.g., in Dartford), and more generally generated several key insights that can shape future work by DfT, specifically the:

    - National scope of business supply chain dependencies revealed by an experimental exercise in freight supply chain mapping (via business surveys), that highlights the importance of network-level effects via the Strategic Road Network in driving local economic performance. This supply chain aspect will, in the future, have the potential to capture indirect trade performance aspects of road enhancements (how road transport facilitates exports via supply chain links between regions).

- Complexities of local-level interactions between causes and effects that determine how road enhancements generate economic performance impacts, and why this sometimes does not happen (captured in a detailed generic logic model that can be used by DfT to improve the links between ex post evaluations and ex ante appraisals/business cases). Local level consultations were key to achieving this advance in logic model architecture for future use (including in maximising the analytical value-added by future scheme case studies by providing a 'compare and contrast' framework for capturing and recording the findings in a consistent manner).

- Importance of applying a broad and comprehensive perspective on how road enhancements drive economic impacts via the combined consequences of close-proximity, extended proximity and network-level effects. All the case studies highlighted the need, in future work, to consider all three impact dimensions and to focus in particular on how their interactions as economic growth drivers can generate traffic congestion (a different challenge than induced traffic). The importance of extended proximity effects is clearest for the Manchester Airport Relief Road case study – for which the 2-hour travel radius is a key determinant of the airport's success as a business and associated co-location cluster.

- Future potential of using regional portfolio econometric analyses as a core economic impact evaluation method (a concept developed in particular by the Hindhead tunnel scheme case study given its extended proximity effects dimension). Regional econometric studies could have the advantage of over-coming the signal to noise ratio challenges encountered at the discrete scheme level

- Changes in local economic performance are observed across these schemes, but not uniformly and not in a manner that can be related to anticipated local economic impacts (where these are specified). In general, it is clear from examining data on local economic impacts that for these discrete schemes it is rare to be able to easily identify attributable local economic impacts.

- Evidence for displacement effects (for business location and re-location) are found in this evaluation. The default assumption for economic impacts in TAG guidance is 100% displacement, and scheme promoters can move away from this if there is credible evidence of additionality provided. This assumption reflects a recognition of potential for displacement, and highlights that it is important for scheme promoters to consider this factor.

- The schemes examined indicate the need to broaden our understanding of how road enhancements generate economic impacts. We need to broaden our understanding by augmenting the 'close proximity' effects captured in the EPIRE econometric work (distance-decay and accessibility effects up to 30km from scheme(s)) with a consideration of 'extended proximity effects' up to a two-hour road travel radius, and the 'network-level effects' that apply in particular to business supply chain connectivity and general whole of network derived accessibility benefits. This will provide a more 'rounded' policy framing.

- The scheme case studies highlighted the importance of considering both positive and negative aspects of this combination of close-proximity, extended-proximity and network-level effects – the ways in which each domain combined drive growth, but in so doing can create additional traffic congestion.

Lessons learned and policy implications

- It would be useful for DfT to consider the technical feasibility of carrying out portfolio-based econometric analyses at a regional level. Whilst technical challenges exist in how/where to define regional boundaries for regional econometric studies, such work would align with the government's interest in establishing broader regional 'compacts' of local authorities in the post-Local Enterprise Partnerships era.

- Future work should adopt the following three-element distinction for understanding the economic performance of impacts of road enhancements: close-proximity effects up to 30km from the scheme(s), extended proximity effects up to a two-hour road travel radius, and network-level effects that apply in particular to business supply chain connectivity and general whole of network derived benefits. This will provide a more 'rounded' policy framing.

- It is useful, in future DfT work, to explicitly consider the historical background of business floorspace structure and use it order to understand the potential future economic impact of a road enhancement scheme or bundle of schemes. A floorspace-oriented approach has the major advantage of providing a tangible and easily grasped link between Local Authority perspectives and their planning for economic development and DfT and National Highways concerns.

- It would be useful to translate the complex and sophisticated traffic modelling that is carried out at the *ex ante* appraisal/business case stage into an *ex post* economic impact evaluation tool able to pick-up how the schemes have changed overall accessibility for all three traffic impact domains (close proximity effects, extended proximity effects and network-level effects).

- In the opinion of the research team who delivered this study would be useful if DfT considered the opportunities to develop a portfolio-level evaluation solution to measuring economic impacts that would allow Local Authorities to discharge this specialist aspect of their road investment Benefits Management and M&E reporting obligations were to be developed. This would be separate from existing standard post-opening evaluations of journey time impacts etc. This portfolio-level approach would be able to provide the necessary data and technical expertise that can be hard to resource in individual Local Authorities. There would be substantial efficiencies from economies of scale in providing such a collective M&E mechanism. If DfT invested in providing the analytical infrastructure for this (based on the EPIRE study) then Local Authorities would have the option to buy into this via funding contributions to discharge any economic impact aspects of the reporting obligations. Alternatively, Local Authorities, via the Business Board Network, would be free to organise a similar solution based on the EPIRE study with interested Local Authorities

pooling their funding. In either case, the economies of scale would create a far more efficient delivery mechanism than separate studies that are unable to benefit from the ability to compare and contrast diverse scheme economic impacts using econometric methods.

3 Introduction

3.1 Aims and objectives of the study[1]

Ipsos, in collaboration with George Barrett and Tom Worsley was commissioned by the Department for Transport (DfT) to carry out a comprehensive assessment of the nature and extent of the economic impacts generated by road improvements in England. This is known as the *Economic Performance Impacts of Road Enhancements* (EPIRE) project.

There were two complementary strands of work involved:

- A series of econometric analyses to quantify the effects of investments in the strategic and local road network on the performance of local businesses as well as on local labour, land, and property markets.
- A series of mixed-methods case studies exploring the impacts of individual schemes. These case studies were intended to provide further insights into the underlying explanatory mechanisms driving the patterns of economic impacts identified in this report.

As such, the main contribution to understanding (and policy) is intended to come from the econometrics analysis, with the scheme case studies providing a supporting role via addressing aspects that the statistical work is unable to address.

This project involved an analysis of the local economic impacts of a total of 194 road improvement schemes completed between 2002 and 2021. This included road schemes completed on a mix of local roads and parts of the Strategic Road Network (SRN). A total of 79 DfT funded Local Major schemes and 117 National Highways funded schemes were covered.

3.2 Policy context

The enhancement of road infrastructure has long been recognised as a catalyst for economic development, with potential benefits spanning increased connectivity, improved accessibility, and stimulated national and regional growth. At a general level, a modern economy (and society) is made possible by a road network. Arguably, our road network is our key national capital asset because it makes possible, directly or indirectly, such a vast proportion of our prosperity and future economic growth potential.

3.3 The structure of the report

[1] Ipsos would like to acknowledge the advice and useful suggestions provided by the expert advisors to this study, Goerge Barret and Tom Worsley, together with invaluable inputs from the project Steering Group. A special thanks to Matthew Clark at DfT for advice and ideas throughout this project that were critically important to its success in generating useful finding and insights.

The report is structured as follows. It commences by considering the main findings from the econometric analysis. This strand of the study focused on measuring the impacts on employment, Gross Value Added (GVA), and spatial dynamics, providing a macro-level understanding of how road improvements influence economic performance indicators (based on experience in England). This is followed by a discussion of the main findings from the case studies. These offer a more nuanced, context-specific insights into how local economic changes are achieved and what can limit impacts at the local level. Finally, the report concludes with a discussion of the lessons learned and the implications of this study for future policy and investment decisions.

4 Key findings from the econometric analysis

4.1 Introduction

The econometric analysis provides an in-depth exploration of the macro-level economic impacts resulting from road improvements. These findings are crucial for understanding how enhanced road infrastructure can serve as a catalyst for economic transformation across multiple dimensions:

It should be noted that the study focused exclusively on road enhancements where the principal strategic objective is to improve connectivity between places by reducing journey times – either by creating new links on the road network or increasing the capacity of, or otherwise improving, existing links. These schemes are what are referred to as the 'road improvement schemes' throughout this report. A total of 43 road schemes were excluded based upon the above criteria for inclusion. The DfT and National Highways also fund road enhancements that have a wide variety of other objectives, such as facilitating downstream development or regeneration objectives. Consequently, the findings of this study cannot be generalised to road enhancement schemes with objectives of this nature and should not be taken as an assessment of the local economic impacts of all types of road improvement (although the scheme case studies do reveal that there are re-generation-related economic impacts from schemes that do not have regeneration as a core objective).

Findings were generated through the application of two broad econometric approaches with the results consistent across both. These approaches were a distance decay type approach and accessibility modelling extension that sought to identify the causal impacts of road schemes on local economies. Details of both approaches are described in the main body of the report.

The key findings are as follows.

4.2 Impacts on firms

- Road improvement schemes are found to have positive growth impacts on local economies. The average scheme leads to an average expansion in employment of 0.11 to 0.15 percent and Gross Value Added (GVA) of 0.14 to 0.22 percent. Growth impacts are concentrated within areas up to 20km from road enhancements. This finding is broadly consistent with the results of prior studies employing similar methodologies to a smaller sample of road enhancements. Effects on employment and GVA were statistically significant up to 6 years post scheme completion.

- The local growth impacts of road enhancement schemes are primarily driven by impacts on the manufacturing and transport and storage sectors (and to a lesser degree, the construction sector). The study did not find significant evidence that road enhancement schemes stimulate significant growth of the tradable or non-tradable service sectors. This

implies that any induced effects are either negligible or that additional demand for these services places upward pressure on wages or prices (leading to offsetting reductions in demand elsewhere in the local economy).

- Local growth impacts are partly driven by the spatial reorganisation of economic activity, with firms apparently opening new or relocating existing plants nearby to take advantage of improved connectivity. Road enhancement schemes led to a net increase in the number of plants located within 1 to 5 kilometres of the improvement. This was partly driven by incumbents relocating more distant operations (i.e. more than 30km from relevant schemes) to areas closer to the enhancements - implying that road infrastructure improvements may lead to some offsetting losses of economic activity in more distant areas. Only new road links, as opposed to improvements to existing links, appeared to encourage the spatial reorganisation of firms.

- Road enhancements generate short-term labour productivity gains (measured as GVA per worker), but were no longer significant after 3 years. We found an increase of around 0.1 percent in the year an improvement is completed followed by 0.12 the year after, and 0.08 the year after that, before effects are no longer detected.

- The lack of long-term impacts is of note given the apparent effects of road enhancements in attracting new plants to proximate locations. One possible explanation is that the initial productivity gains are eroded by subsequent increases in journey time caused by additional unexpected local economic activity. It may also be the case that road enhancements produce positive improvements in economic efficiency that are capitalised into higher land prices and rental values owing to other constraints preventing property markets from responding to price signals. As noted above, these findings do not capture effects on the productivity of road users whose operations may be far from road enhancements (such as national logistics operators). The report contains a comprehensive set of hypotheses with the potential to explain the findings on productivity impacts (a list that DfT can extend in subsequent research).

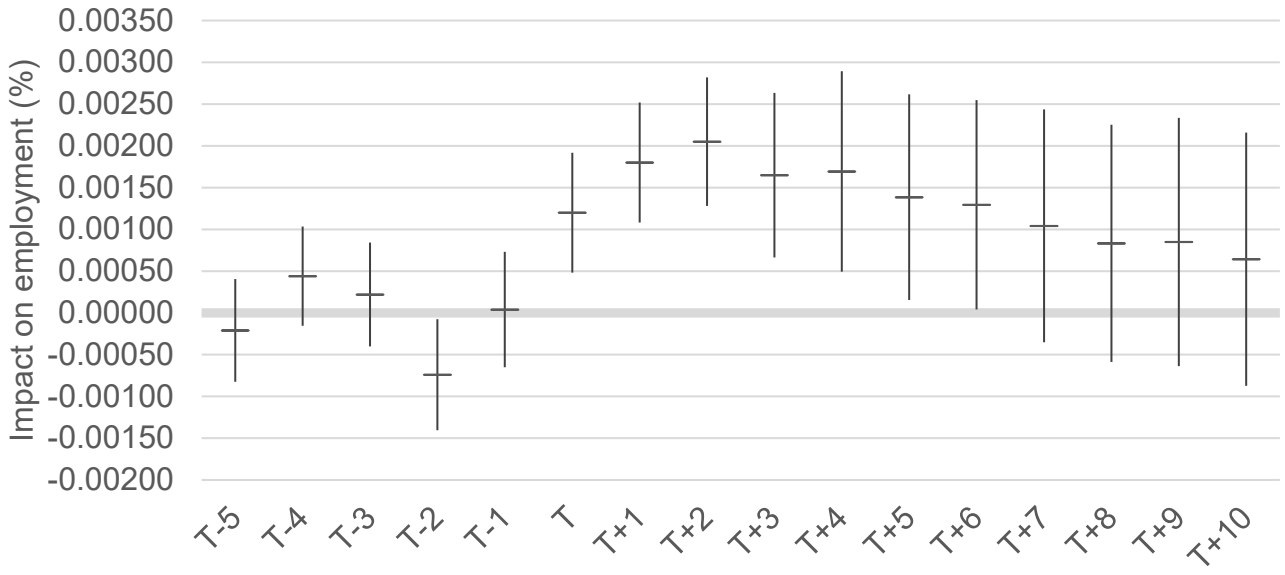
- Though improved road infrastructure might be expected to reduce the costs faced by manufacturers, the research was unable to detect an impact on international trade volumes amongst local firms (either in terms of spending on imports or exports).

- There was some evidence that the growth impacts of road enhancements are concentrated in areas that already display high levels of productivity. Additionally, growth impacts principally accrue to major urban agglomerations - and to a lesser degree, rural areas - with no statistically significant evidence found of growth impacts (positive or negative) on suburban zones and smaller towns. This has potential policy implications in that improvements to road infrastructure appear to reinforce - rather than rebalance - existing patterns of economic development and may not be effective in stimulating growth in lagging areas.

The use of a sophisticated econometric technique able to compare economic impacts across the large number of schemes analysed in terms of pre and post scheme opening reveals some policy-significant patterns.[2] This state-of-the-art method provides a timeline-based analysis of how economic impact measures behaved before and after a scheme opened. 'T' identifies the opening year, with the preceding years indicated by T-1, T-2 etc and the post opening years as T+1, T+2 etc. The degree of statistical confidence in the estimates is communicated by the vertical bars. In those cases in which the bars cross the horizontal (time) axis the results are not robust. These reductions in the confidence we can place on these results are caused by declining numbers of observations over time in the dataset used.

As such, this 'events analysis provides a useful profile on economic impact timelines, revealing how these impacts are sustained (or not). The analysis reveals that there are sustained impacts on employment, turnover and GVA that follow an initial 'peak' impact, but that GVA per worker dissipates (as noted above).

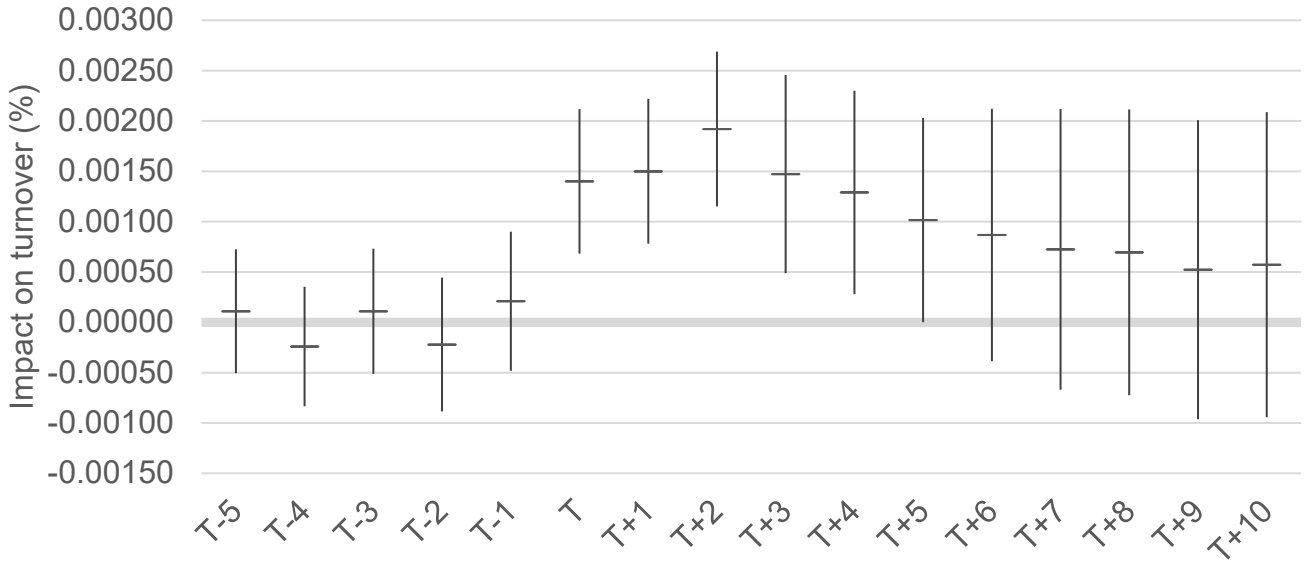
Figure 4.1: Timeline analyses of employment



Source: Business Structure Database, Annual Business Survey, ONS, Ipsos analysis. Error bars indicate 95 percent confidence intervals.

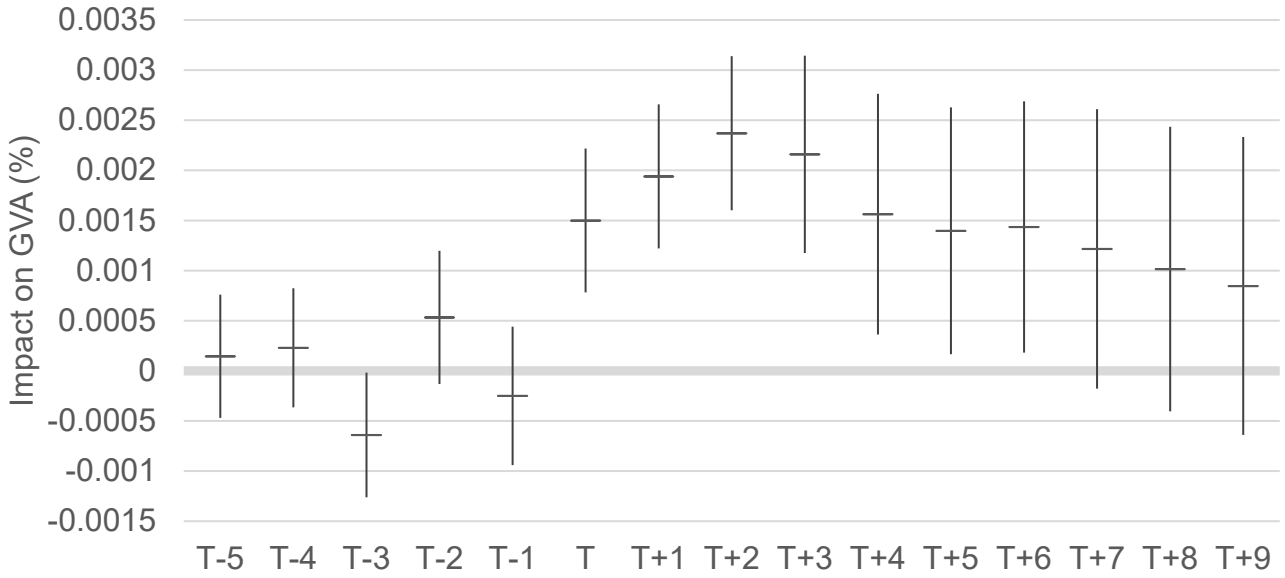
[2] A technique known as Staggard Difference-in-Difference, full details are available in the EPIRE Econometrics report. In essence, this analysis allows us to compare schemes with different opening years as if they had all been synchronised to open in the same year.

Figure 4.2: Timeline analyses of turnover



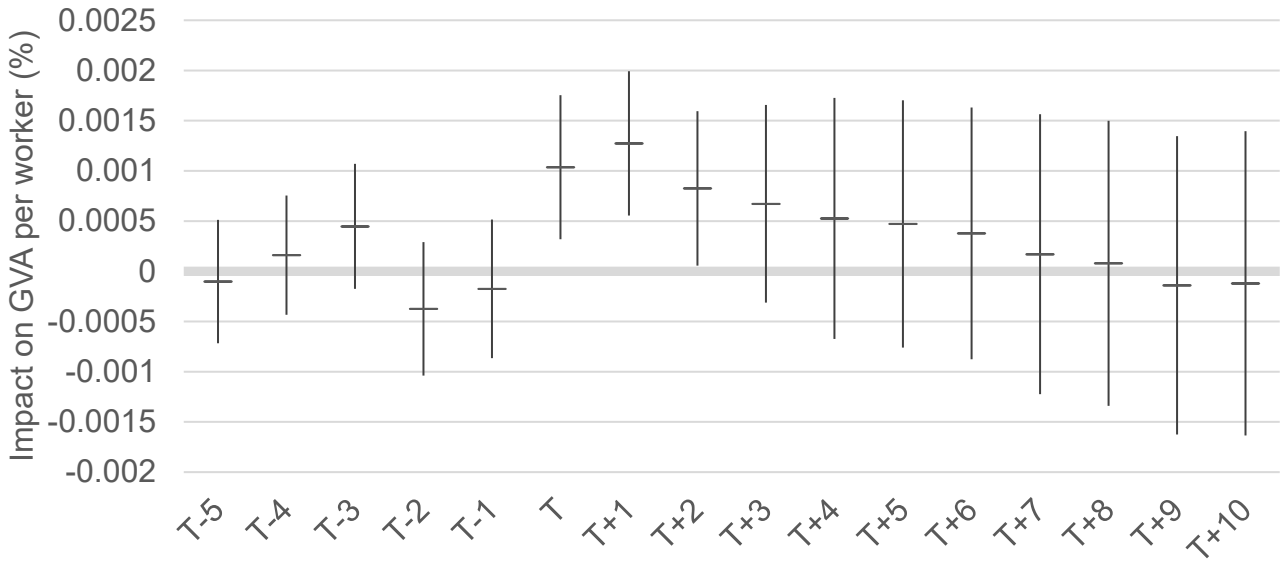
Source: Business Structure Database, Annual Business Survey, ONS, Ipsos analysis. Error bars indicate 95 percent confidence intervals.

Figure 4.3: Timeline analyses of GVA



Source: Business Structure Database, Annual Business Survey, ONS, Ipsos analysis. Error bars indicate 95 percent confidence intervals.

Figure 4.4: Timeline analyses of GVA per worker



Source: Business Structure Database, Annual Business Survey, ONS, Ipsos analysis. Error bars indicate 95 percent confidence intervals.

4.3 Impacts on the labour market

- Improvements to road connectivity were found to have positive effects on local labour markets. It was estimated that road improvement schemes lead to an average increase in the hourly earnings of workers employed by firms located within 30km of 0.17 to 0.22 percent. It also appears that additional labour demand induced by road improvement schemes supports reductions in unemployment, with the number of unemployed claimants falling by 0.5 to 0.6 percent on average in response to improvements in road connectivity.

- Wage gains for workers employed by firms prior to the completion of road improvement schemes were smaller than found across all workers employed by firms within 30km. This indicates that the overall wage effect may have been driven by incoming workers filling new vacancies associated with higher wages.

- This was consistent with other findings of the study. Road improvement schemes encouraged the relocation of residents, with the resident population of areas within 30km of schemes increasing by 0.29 to 0.32 percent in response to improvements in road connectivity. This was accompanied by an intensification of the supply of higher-level skills –with the share of residents with NVQ level 4 qualifications or higher increasing by 0.09 to 0.15 percentage points as a consequence of improvements to the road network.

- Impacts on both wages and unemployment were concentrated in areas within 5 to 10 kilometres of road improvement schemes. This aligns with the spatial pattern of the local economic growth impacts of road improvement schemes. As average labour productivity (GVA per worker) did not increase in response to improved road connectivity, it is possible that additional demand for labour may be placing upward pressure on equilibrium wages in

the presence of supply constraints. This would be unsustainable in the longer term without changes in productivity.

- The study found little statistically significant evidence that road improvement schemes led to increases in labour supply via economic activity rates or by encouraging workers to increase their working hours. Given that many jobs created were in the manufacturing and transport and storage sectors, there may be a mismatch between the preferences of economically inactive residents and the requirements of the roles. It should also be noted that economic activity rates have been rising to historically high levels over the period in question, potentially limiting scope for substantial increases.

- The findings also provided additional evidence that road improvement schemes reinforced existing patterns of economic agglomeration. The wage and population growth impacts of road improvement schemes were concentrated in high productivity areas. However, the effects of road improvement schemes in reducing unemployment tended to be higher in areas characterised by medium and low levels of productivity, suggesting that labour supply constraints may be less acute in these types of area.

4.4 Impacts on land and property markets

- Road improvement schemes increase demand for commercial floorspace in high productivity areas, leading to increases in commercial rents (as far as can be ascertained from changes in the rateable values of premises) of around 0.09 to 0.13 percent per square metre of floorspace. However, it appears that developers are unable to respond to price signals by increasing the supply of commercial and industrial floorspace in these areas. The inelastic nature of the supply of commercial and industrial floorspace may result in the productive advantages created by road improvement schemes being capitalised into rents (rather than being visible in firm level productivity gains).

- Similar patterns are also observed in housing markets. Road improvement schemes increase the value of residential properties within 30km by an average of 0.26 to 0.33 percent. Again, these impacts are concentrated in high productivity areas – which see average increases in house prices of 0.51 to 0.57 percent in response to improvements in road connectivity. Local Major schemes appeared to have had a larger impact on residential property prices. However, road improvement schemes do not induce the construction of additional dwellings, again indicating that the supply of residential property may be inelastic.

- The findings raise possible questions regarding the role of the planning system in constraining the potential local economic impacts of road improvement schemes and determining how the resultant productive advantages are shared between firms, workers, and landowners. Other factors may also play a role in constraining the supply of property such as overall confidence amongst developers, supply chain constraints (which may be more relevant post pandemic) and the presence of local plans/strategies to support scheme aims with complementary investments incentivising development.

- The results of the study again highlight the role of road improvement schemes in reinforcing existing patterns of economic agglomeration. Road improvement schemes do not appear to place pressure on either commercial or residential property markets in areas characterised by medium or low productivity – either because they do not induce significant levels of additional demand or because there is more flexibility on the supply side.

- The findings of the study provide some evidence of the negative social welfare impacts associated with the construction of road improvements. Residential properties within 1km of road improvement schemes lose 9.5 percent of their value following the completion of schemes. Under some strong assumptions, this could be taken as a signal of the value of the negative externalities associated with living in proximity to new road or improved road links (e.g. as a consequence of the loss of visual amenities or higher levels of traffic, noise, or pollution).

4.5 Overall findings and their implications

Overall, the econometric analysis suggests that road improvements have positive effects on local economic growth, wages, and population, yet they also reinforce existing patterns of economic agglomeration and may have limited impact on productivity. Further research is necessary to fully understand the long-term impacts, the role of supply chain connectivity, and the reasons for the observed disconnect between increased commercial rents/house prices and the lack of increase in corresponding property stock. Investigating alternative methodologies to address data limitations and account for structural changes in the post-pandemic era is also recommended.

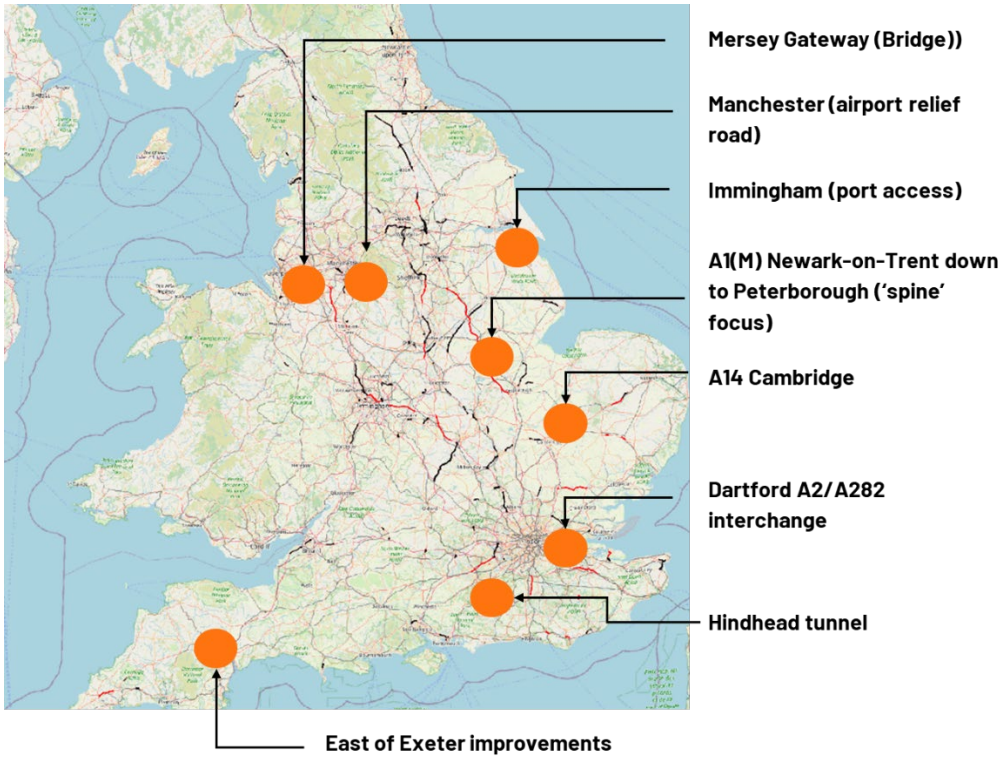
5 Insights from case studies

5.1 Introduction

The objective of the scheme case studies are two-fold. Firstly, to unpack and understand the average effects identified in the econometric work (insofar as that is possible given technical constraints), and secondly to identify detailed aspects of causes and effects that econometric analysis is unsuited to. In so doing, developing additional evidence and insights of use to the Department for Transport (DfT) and National Highways (NH) for explaining how economic impacts are achieved as well as informing the design and practical delivery of future business cases. The findings are also of interest and use at a local level in informing understanding of the complexity of the opportunities associated with obtaining economic impacts from road enhancements and the challenges faced in achieving this. The findings obtained are summarised below.

The following map overlays the set of road enhancement schemes contained in the EPIRE database with the overall road network, and identifies the case study areas within this broader context. Local Major road schemes are identified in black and National Highways schemes in red. This map helps to highlight the general north-south travel emphasis of these road enhancements augmented by a set of more specific schemes addressing congestion problems. The scheme case studies are identified in this broader context.

Figure 5.1: The coverage of the EPIRE scheme portfolio in geographical context



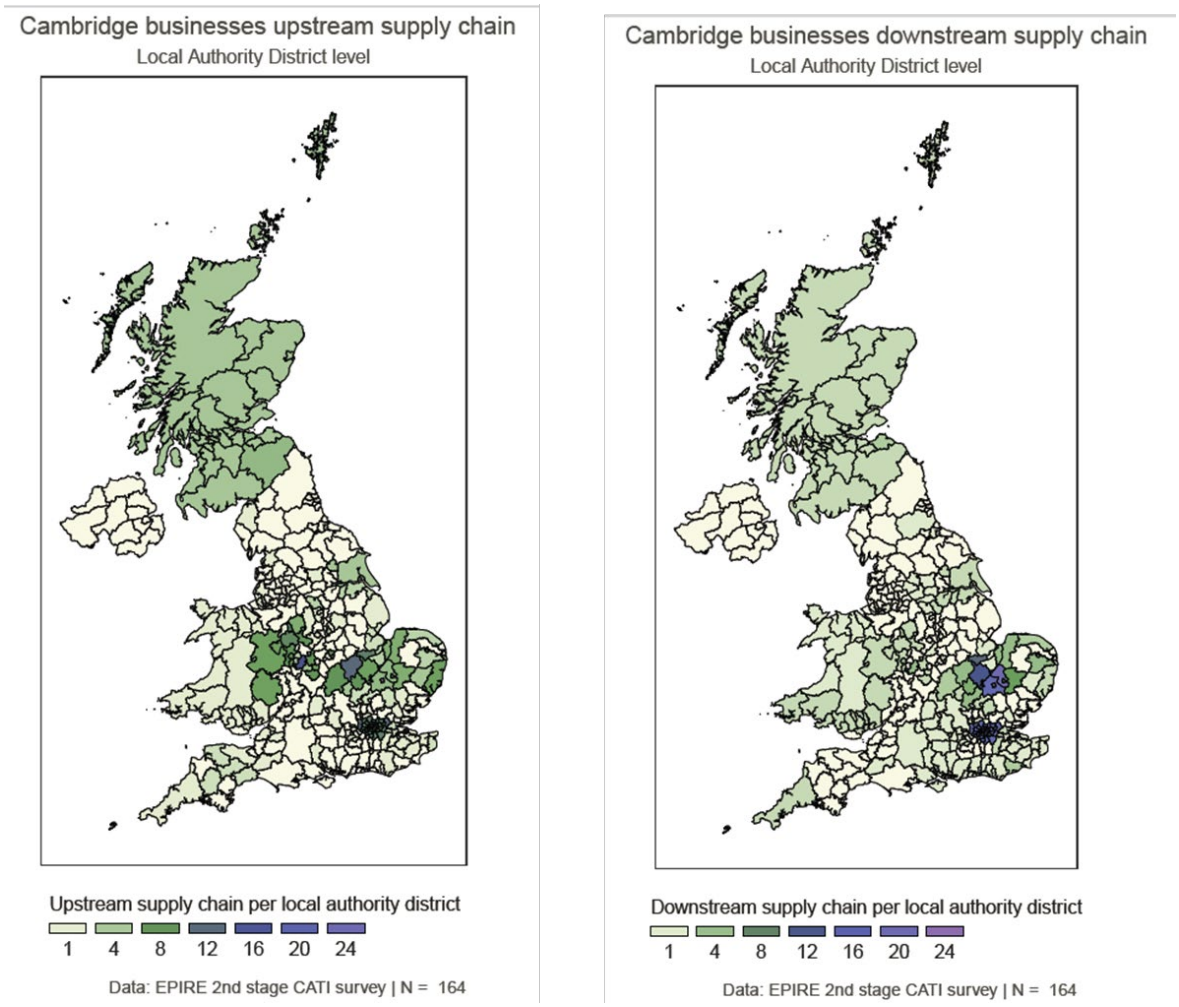
Source: Ipsos

A broad range of sources of evidence were used to develop the case studies: a process of extensive document reviews, a CATI telephone business survey for a sub-set of three case studies, group workshops and bilateral discussion/interviews with Local Enterprise Partnerships (LEPs) when they existed and with Local Authorities more generally, together with a set of interviews with business stakeholders. We also consulted internally within DfT on technical aspects of current traffic modelling methods relevant to business cases and the conduct of economic impact evaluations and the evolving thinking within DfT on Benefits Management at the local authority level (i.e., those post-opening monitoring activities that address economic impacts). This aspect of the study included collaboration with the contractors carrying out a one-year post-opening assessment for one of the case studies that pioneered an examination of noteworthy initial economic impacts.

Before discussing details of the findings from the case studies we take the opportunity to highlight two novel aspects of the case studies work. Firstly, the experimental testing of supply chain mapping via business surveys (see Figure 3). Secondly, the development of a detailed logic model that reflects local level processes and behaviours in a manner that draws-out the reasons why road enhancements drive economic performance improvements – and why these complex cause-effect relationships can sometimes fail to deliver on anticipated benefits if impact pathways are weak or are disrupted (see Figure 4). Methodological and other relevant details can be found in the Case Studies report.

For the purposes of this Synthesis Report it is sufficient to note that the supply chain maps only cover direct upstream and downstream supply chain links and are based on a random sample of businesses surveyed. The finding that supply chain links are pervasive in geographical terms provides evidence of the importance of network-level effects.

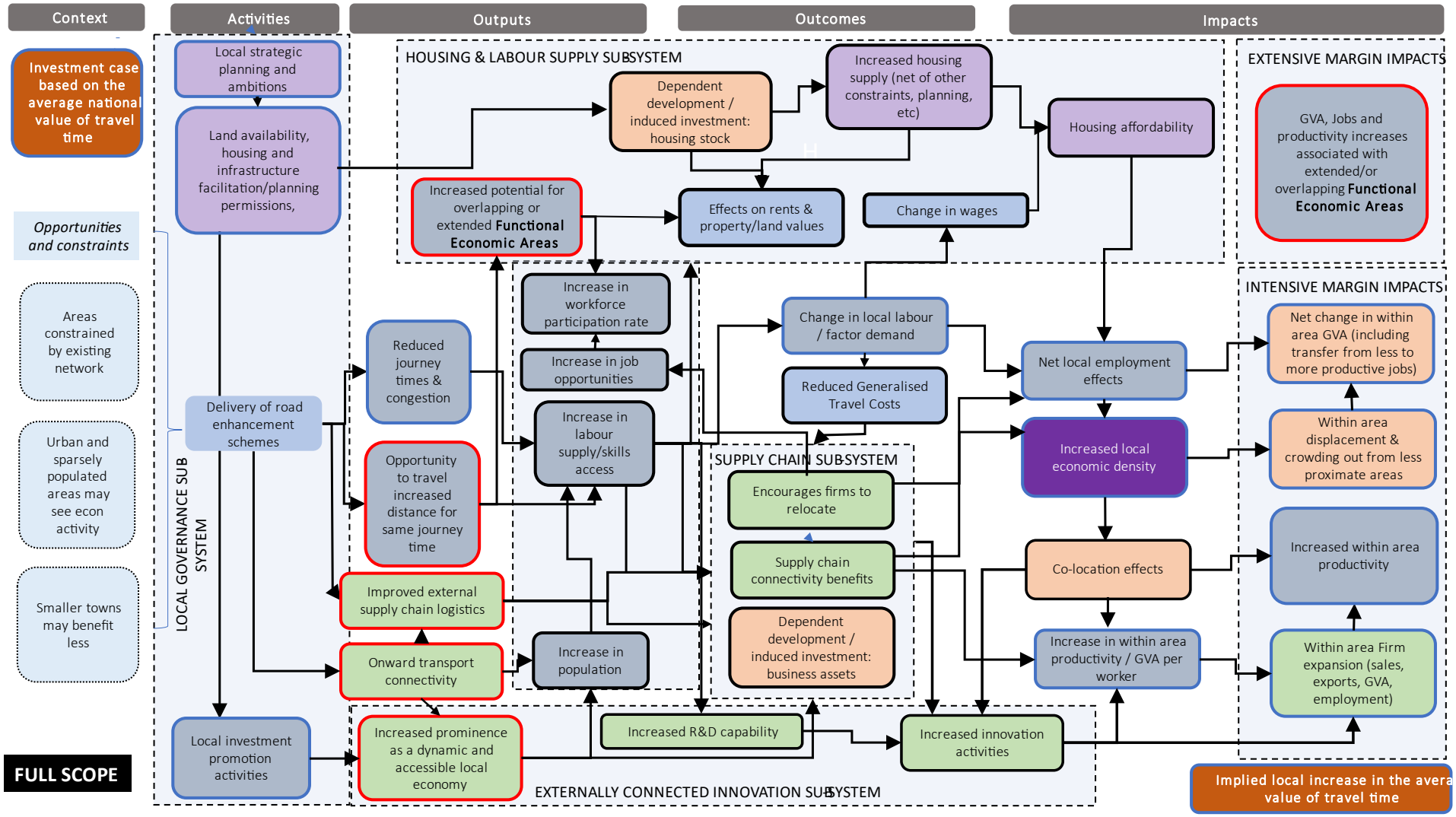
Figure 5.2: Supply chain connectivity maps for Cambridge



Source: Ipsos business survey

The detailed logic model provides a comprehensive 'rounded' depiction of the key causal relationships, and is organised into three main sub-systems: (a) housing and labour supply, (b) supply chains and innovation, (c) a more familiar journey time saving element (in the central part of the logic model).The logic model also distinguishes between intensive and extensive margin aspects of how road enhancements generate local economic performance impacts in terms of whether impacts are driven within an existing Functional Economic Area (FEA), or extend the geographical size of the FEA (including creating overlaps with adjacent FEAs).

Figure 5.3: The detailed generic logic model developed for the EPIRE case studies



Source: Ipsos

The following questions were addressed in this strand of the EPIRE work.

5.2 Have these schemes resulted in any changes to local economic performance, whether anticipated or not?

Evidence from the business interviews suggested that manufacturing and logistics firms gain several benefits from road improvements in their local area, which ultimately contribute to a more reliable supply chain:

- **Reduced transit times:** Improvements in roads led to faster delivery times, which translates to quicker movement of goods throughout the supply chain. This reduces lead times, allowing manufacturers to respond to customer demands more rapidly and was particularly important for time-sensitive goods.
- **Improved consistency:** Road improvements were said to have led to fewer delays caused by poor road conditions, traffic congestion, or need to use longer routes. This consistency in transportation allows for better planning and adherence to delivery schedules, improving overall reliability. However, gains were not expected to be directly visible in a GVA per worker uplift.
- **Lower transportation costs:** Small gains in fuel savings were highlighted as being likely as were gains in maintenance and repair costs driven by more efficient routing and reduced wear and tear on vehicles respectively. However, these were not quantifiable by firms included in the research.
- **Decreased inventory holding costs:** Faster and more reliable routing allowed manufacturers to optimize their inventory levels. In a handful of cases, road improvements had led to a reduction in safety stocks, freeing up capital and reducing storage costs.
- **Reduced spoilage and waste**: For manufacturers dealing with perishable goods, improved roads and faster transit times reduced the risk of spoilage and waste, leading to cost savings. However, these were again not measured by firms directly.
- **Improved customer satisfaction:** Road improvements enabled faster deliveries and more reliable order fulfilment which led to improved customer satisfaction.

The message conveyed by these businesses is that, in their experience, the improved reliability and speed of road freight transport made possible by road enhancements boosts productivity in a general sense. However, linking such benefits to businesses to formal productivity measures is more complex due to the technical details of how changes in productivity are calculated. Additional supporting evidence from the CATI business survey supported this general conclusion.

- Changes in local economic performance are observed across these schemes, but not uniformly and not in a manner that can be related to anticipated local economic impacts (where these are specified). In general, it is clear from examining data on local economic impacts that for these discrete schemes it is rare to be able to easily identify attributable local

economic impacts. Within this sample of schemes, and despite the fact that the EPIRE study did not cover schemes with an over-arching regeneration aim, identifiable scheme-level economic impacts were clearest when a regeneration aspect was present.

- Time series data for discrete schemes rarely exhibits shifts that could be attributed to the period after a scheme is opened. In general, local factors, particularly of a 'strategic fit' nature affect whether or not anticipated benefits are achieved in practice. The impact of other shared, economy-wide, factors also determines whether or not anticipated benefits are achieved in practice (notably the global financial crisis, Brexit and the COVID-19 pandemic).

- This contrasts with portfolio-level econometric analysis, which is able to identify statistically significant economic impacts once what are in effect local stochastic aspects have been screened out by pooling data and a large number of schemes.

- The Dartford scheme is an example of positive impacts (the scheme helped to attract a major Amazon facility creating 2,500 new jobs and increased industrial floorspace by around 8 per cent). Significantly, planning consent for that development was only granted when the developer agreed to fund an extra lane on a scheme bridge to alleviate congestion risks created by the interaction of local and long-distance HGV traffic at peak times. It is noteworthy that the Amazon facility opened in 2021, 12 years after the 2009 completion of the final phase of this scheme. This time-lag highlights the importance of avoiding examining economic impacts in too myopic a manner (an issue to consider for future econometric studies). The Dartford scheme is also an example, of negative unintended effects: the intended economic stimulus associated with growth around the Ebbsfleet rail terminal did not eventuate because Eurostar trains ceased stopping there in March 2020. Post-Brexit financial, border control factors and COVID-19 have all been referred to as causing the cessation of that service.

- Other schemes, such as the more recently opened Huntingdon to Cambridge A14 improvements, the A1 improvements and the Manchester Airport relief road also highlight the ways in which local and longer distance traffic can interact and cause problematic congestion. This suggests that traffic modelling (which does consider the interactions between various types of traffic that aligns with the emphasis on close proximity, extended proximity and network-level aspects) may still benefit from continued advances.

- Evidence for displacement effects (for business location and re-location) are found in this evaluation. The default assumption for economic impacts in TAG guidance is 100% displacement, and scheme promoters can move away from this if there is credible evidence of additionality provided. This assumption reflects a recognition of potential for displacement, and highlights that it is important for scheme promoters to consider this factor.

- General local government consultations highlighted that displacement effects are likely to be seen in some cases. One example of this is the decision for where on the M25 the major Amazon logistics facility was located, and the subsequent impact this had on the chosen location and surrounding areas.

5.3 How do these schemes help us to understand and demonstrate the mechanisms by which economic performance changes occur?

- The schemes examined highlight the need to broaden our understanding of how road enhancements generate economic impacts. The key finding is that we need, in the future, to broaden our understanding of augment what can be termed the 'close proximity' effects captured in the EPIRE econometric work (distance-decay and accessibility effects up to 30km from scheme(s)) in order to consider other drivers of economic impacts. These are 'extended proximity effects' up to a two-hour road travel radius, and the 'network-level effects' that apply in particular to business supply chain connectivity and general whole of network derived accessibility benefits. This will provide a more 'rounded' policy framing.

- The scheme case studies highlighted the importance of both positive and negative aspects of this combination of close-proximity, extended-proximity and network-level effects. The positive aspects reflect the ways in which road enhancements can exploit all three spatial domains at once. The negative aspects are our finding that this combination of positive economic impacts via all three dimensions can increase traffic congestion (for example at peak times when traffic exploiting network-level and extended-proximity connectivity clashes with local commuter traffic). These congestion-causing interactions are a major concern for planning consent decisions, and can block planning approval unless solutions are developed (e.g. via land developer funding contributions to alleviate potential congestion bottlenecks).

- Whilst DfT traffic modelling for business cases considers the interactions between these three domains, there is (currently) no general explicit consideration of how the positive interactions between all three spatial domains can create economic impacts via land use changes that increase employment and economic activities that, in turn, create additional traffic congestion that may not have been modelled. Several case studies highlighted this way in which economic success (as a 'first order' effect) can generate additional 'economic' congestion (as a 'second order' effect).

5.4 How effective and efficient were the processes deployed by scheme promotors to maximise the economic impacts of schemes?

- It is easier to judge the effectiveness of efforts to maximise the economic impact of schemes than to draw conclusions on the efficiency of those efforts (which would require access to data on resources and costs not available). As regards maximising effectiveness, these case studies highlight the importance of a strategic intent to actively exploit opportunities to attract investment linked to pragmatic decisions over planning consent. As the attainment of planning consent via a congestion risk reducing co-investment element for the Amazon facility in Dartford highlights, a partnership ethos between local government and business can be key to resolving impediments to benefits realisation. This was a case in which there were concerns that the substantial new HGV traffic servicing the Amazon facility would combine with commuter and shopping centre traffic at rush hour times, causing congestion. The solution was for the land developer to fund an additional lane on a bridge to reduce this congestion. The importance of these local partnerships is an important aspect of Benefits

Management to consider in the future (as aspect discussed in the sub-section immediately below).

- As DfT explores creating closer links between ex ante appraisal and ex post evaluation, it will be useful to understand further the processes followed at a local level (e.g. Benefits Management, the use of logic models). There could be a more explicit focus in using logic models in business cases that explicitly cover the 'drag factors' that may limit benefits realisation in practice.

5.5 What do these schemes tell us about how to facilitate the demonstration and communication of emerging evaluation results to a range of audiences, including policy makers and analysts?

- It would be useful for DfT to consider the technical feasibility of carrying out portfolio-based econometric analyses at a regional level. The Hindhead scheme, which addressed traffic congestion on the London to Portsmouth route, is an example of a scheme that aims to generate broad economic benefits in a geographically dispersed manner. Whilst technical challenges exist in how/where to define regional boundaries for regional econometric studies, such work would align with the government's interest in establishing broader regional 'compacts' or local authorities in the post-LEP era. Given that any increase in the geographical scope of an economic impact evaluation increases the likelihood of capturing any within-region displacement effects this would be an additional benefit.

- This type of broader regional analysis would avoid the limitations of discrete scheme level evaluations, and be more likely to reveal and demonstrate economic performance impacts via considering the full range of impact domains emphasised by these case studies: close proximity effects, extended proximity effects and network-level effects. These three distinctions are useful for communicating evaluation results to a diverse audience because they can be grasped conceptually, communicated visually (for close and extended proximity effects), and can capture the full range of impact pathways – both analytically (although new econometric methods would need to be developed as noted in the Lessons Learned report) and in terms of explanatory narratives ('stories') that communicate the findings.

- It could be useful for the presentation of data in POPE assessments, to include graphs of how effects evolve over time, alongside presenting data in tables. Drawing attention to this aspect of timelines is useful because it helps show how long-lived the economic impacts are, and also helps with comparisons to the econometric analysis. For stakeholders with less technical familiarity with statistical methods and significance, viewing timeline-based data may help to better communicate findings, and draw attention to important of benefits realisation. As DfT is refining updated guidance on benefits management and M&E methods it is useful to draw-out the implications for benefits management as well (that is to say for the non-counterfactually based monitoring methods that can be used more frequently and inform decision-making over benefits maximisation).

- Maps of an analytical nature provide an effective means of communicating evaluation results to stakeholders – at both central and local government levels.

6 Lessons learned and implications for analysis, policy and practice

6.1 Analytical lessons

The following analytical lessons emerge from the EPIRE project.

- Econometric analyses of one aspect of road-generated benefits (distance-decay and accessibility/travel time aspects) confirms the significance economic growth impacts of road enhancements. If more general network-level effects were measured (an aspect yet to be undertaken as it would require methodological advances) then these economic impacts would be even stronger. In general, econometric analysis provides the most robust means of assessing these economic impacts, but case studies are useful (as in this project) for generating insights with the potential to improve future econometric analyses.

- Individual scheme case studies do not provide a robust basis for measuring economic performance impacts. Too many other factors are in-play, only econometric analysis can identify the general patterns by in effect screening-out multiple local aspects.

- It would therefore be useful for DfT to consider the technical feasibility of carrying out portfolio-based econometric analyses at a regional level. Whilst technical challenges exist in how/where to define regional boundaries for regional econometric studies, such work would align with the government's interest in establishing broader regional 'compacts' of local authorities in the post-LEP era.[3] These 'bundles' of inter-related schemes could also be used at the business case stage, thus creating a useful link between *ex ante* appraisal and *ex post* evaluations that, in some circumstances, is more likely to generate useful benefits management findings and policy learning.[4] DfT's experience with these programmatic appraisals is that whilst useful (where examining scheme inter-dependencies is warranted) the significant additional costs are a limiting factor for their use. As the case studies have highlighted, given the combined importance of close-proximity, extended proximity and network-level effects, future work will need to develop new methods for addressing network-level effects that distance-decay and similarly framed more regionalised accessibility methods cannot address.

[3] The rationale for broader representative bodies is to reflect business and economic concerns, including transport related concerns, at a broad enough level to avoid overly 'parochial' perspectives and to allow more integrated and collaborative consultations and planning.
[4] For a discussion of 'programmatic' scheme appraisals that consider the potential interactions between a number of schemes see: Programmatic appraisal of road schemes - GOV.UK

- Whilst displacement effects are prevalent, from the perspective of network-level effects, displacement is an aspect of efficient markets in operation enabled by a modern transport system, hence not necessarily a negative aspect. It would therefore be useful to examine the benefits of displacement in greater detail via the suggested regional portfolio-based econometric analyses.

6.2 Recommendations for future work

It will therefore be useful, in future work (both econometric and scheme case study-based) to:

- Use the following three-element distinction for understanding the economic performance of impacts of road enhancements: close-proximity effects up to 30km from the scheme(s), extended proximity effects up to a two-hour road travel radius, and network-level effects that apply in particular to business supply chain connectivity and general whole of network derived benefits. This will provide a more 'rounded' policy framing.

- Translate the complex and sophisticated traffic modelling that is carried out at the *ex ante* appraisal/business case stage into an *ex post* economic impact evaluation tool able to pick-up how the schemes have changed overall accessibility for all three traffic impact domains (close proximity effects, extended proximity effects and network-level effects). This three-domain aspect is important because there is the potential for traffic flows to interact in unwanted ways (e.g. by success in extended proximity effects to increase congestion in the close proximity domain). Existing traffic modelling carried out for investment appraisal addresses these aspects, however these 'interference' effects will also need to be analysed in ex post evaluations in order to provide a complete picture of the overall balance of economic performance impacts.

- It is useful, in future DfT work, to explicitly consider the historical background of business floorspace structure and use it order to understand the potential future economic impact of a road enhancement scheme or bundle of schemes. GVA and employment can be increased via a combination of expanding business floorspace (facilitated by road enhancements), an extensive margin effect, and/or using existing floorspace more productively (an intensive margin effect). This distinction being captured by considering the past behaviour and future potential of GVA per square meter and square meters per FTE employee.

- This floorspace-oriented approach (using business floorspace as an 'anchor variable') has the major advantage of providing a tangible and easily grasped link between Local Authority perspectives and their planning for economic development and DfT and National Highways concerns. Local Authorities consider the potential for a road enhancement to facilitate investment in adding to the stock of business floorspace and also pay considerable attention to new housing developments in the same manner. In so doing, addressing the key issues of the local demand for labour and the local supply of labour.

- There are many reasons why anticipated and actual business floorspace and housing stock additions may not eventuate, and these tend to be of a 'strategic fit' nature (other things need to happen in order for the potential economic performance benefits to be achieved). It is

therefore useful to use a Theory of Change and associated logic model depiction (of the type experimentally developed by the EPIRE study) to ensure that investment planning and subsequent monitoring and evaluation give due consideration to these ‘strategic fit’ aspects.

Given these conclusions, it could be useful if a portfolio-level evaluation solution could be developed to capture the economic impacts of road investment schemes. This approach could:

- Exploit the economies of scale that can be achieved from pooled funding (in so doing providing Local Authorities with a more cost-effective means of discharge their reporting obligations on economic impacts than ‘go it alone’ approaches (other standard obligations are unaffected by this).
- Allow a consistent generic method to be deployed (using a consistent generic logic model to facilitate comparative analysis and information sharing).
- Exploit the methodological advantages of drawing on portfolio-level analysis to complement the individual scheme aspects.
- Benefit from a standard, collectively developed and maintained ‘data quarry’ optimised for this type of evaluation work (to include business floorspace and its GVA and employment density as an ‘anchor’ metrics set).

For more information

3 Thomas More Square
London
E1W 1YW

t: +44 (0)20 3059 5000

www.ipsos.com/en-uk
http://twitter.com/IpsosUK

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