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**Economic Performance Impacts of Road Enhancements (EPIRE)**

Preparatory Work – Final Report

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Executive Summary

1. Ipsos MORI, the Institute of Transport Studies and George Barrett were commissioned by the Department for Transport (DfT) in August 2018 to complete preparatory work for a potential evaluation of the economic performance impacts of road enhancements (EPIRE). This report sets out the findings of the work, setting out a range of quantitative and qualitative evaluation approaches that could be applied in such a study.

I Evaluation context and aims

1. The Department for Transport (DfT) has a requirement for additional evidence on the potential links between road network investment and economic performance in the UK. The aim of this project, as defined in the Terms of Reference issued by the DfT, was to assist the Department to prepare for a potential evaluation of the local and national economic impacts of road network investments made by the DfT and Highways England. The objectives of this study were to:
* Identify a set of relevant schemes that could be included in the EPIRE evaluation.
* Assess the data requirements for the evaluation.
* Explore alternative impact evaluation options.
* Consider the possible scope and value of case study research.

II Method

1. This report was developed by completing five separate tasks:
* **Scheme document review:** Review of documents to classify schemes according to their characteristics and economic performance objectives.
* **Evaluation framework development:** Development of a Theory of Change that describes the key economic performance effects expected and the mechanisms by which these are produced.
* **Consultations with data experts:** To understand how the data requirements of a proposed evaluation could be met, and the relevant advantages and disadvantages of data sources.
* **Development of impact evaluation options:** Review of literature and consultations to develop impact evaluation options.
* **Development of case study research approaches:** Review of DfT and Highways England monitoring and evaluation guidance and consultations with potential case study users to scope the design and assess the value of scheme level case studies.

III Evaluation scope

1. A portfolio of 219 schemes was supplied by the DfT and Highways England for an assessment of their possible suitability for inclusion in an evaluation study. Schemes were removed if they were not concerned with roads, or primarily focused on maintenance upgrades or linked to urban regeneration projects that were not primarily expected to affect journey times or economic performance. After this review, a total of 178 schemes remained (99 Highways England schemes and 79 Local Major projects) that could potentially be included in an evaluation of the economic performance impacts of road enhancements.

IV Quantitative impact evaluation

Outcome measurement

1. The development of an evaluation framework identified a range of economic performance outcomes of interest that could be assessed in an evaluation. The scoping study suggests that there is generally good availability of data across most areas of interest (though information on trade outcomes is likely to be most problematic). Implementation of the evaluation will require recalculation of accessibility indices, though this can potentially be externalised to a contractor. There will also be charges associated with some data relating to development outcomes and access will need to be secured to the data held in the ONS Secure Research Service. The table below summarises the data sources that should be exploited in the study.

Table A: Key outcomes for an evaluation of EPIRE

|  |  |  |  |
| --- | --- | --- | --- |
| Outcome Area | Outcome Measure | Data Source | Access/use Issues |
| Accessibility Outcomes  | Journey time statistics  | DfT; evaluation contractor  | At some additional cost |
| Firms Level Impacts | Employment | Business Structure Database / Annual Business Survey | Straightforward with low cost |
| Firm entry and exit  | Business Structure Database / Annual Business Survey |
| Firm formation  | Business Structure Database / Annual Business Survey |
| Productivity  | Business Structure Database / Annual Business Survey |
| Fixed capital investment | Business Structure Database / Annual Business Survey |
| International competitiveness  | HMRC; DfT Freight Statistics | Existing data not suitable for this evaluation |
| Labour Market Impacts | Population growth | Census of Population | Existing data may not be suitable for this evaluation  |
| Wages | Annual Survey of Hours and Earnings |
| Unemployment | DWP Benefits Database | Straightforward with low cost |
| Development Impacts | Planning Permissions | MHCLG; Glenigan | Likely available, but at significant additional cost |
| Housing Starts and Completions  | MHCLG; Glenigan |
| Commercial and Industrial Development | Glenigan / Costar |
| Land use change | Ordnance Survey | Further investigation required |

1. **Source:** Ipsos MORI (2019).

Econometric framework

1. A variety of quantitative approaches to impact evaluation are available that are comparatively straightforward to implement, offer acceptable levels of robustness, and are unlikely to be constrained by sample sizes.
2. **Defining the scope of the study:** There are two conceptually distinct types of accessibility outcome associated with road investment projects. The first relates to reducing the cost (in money and time) of accessing goods and services via the road network. The second relates to improvements to the network that allow specific parcels of land to be accessed by road that could not be previously (e.g. through provision of access roads). These two types of accessibility improvement should ideally be handled separately in an evaluation.
3. **Sample sizes:** Sample sizes are likely sufficient for detailed analysis of the impacts of accessibility improvements brought about by road enhancements, and support the desired comparisons (e.g. between DfT Local Majors and Highways England road schemes). There is more uncertainty regarding the scope to complete statistical analysis of the impacts of providing access to development sites.
4. **Proposed counterfactual:** A key challenge is that all locations may be affected by a road enhancement to some degree. As such any analysis should be restricted to postcodes (or small areas) within a certain distance of the sample of road enhancements in the population of schemes to limit possible biases driven by differences between areas that do and do not receive investment. A 30km distance appears reasonable from other studies though this should be probed in the initial steps of the analysis. Areas that receive investment in later years should then act as a counterfactual for those receiving investment in earlier years.

**Econometric approaches:** It is recommended that the methods listed below are implemented to maximise opportunities to validate any results produced:

* **Distance-decay models (SMS III)[[1]](#footnote-2):** Approaches based on comparing areas close to and further from road enhancements - offer a promising and straightforwardly implementable approach for assessing the impact of both road enhancements to improve accessibility, and the provision of link roads to facilitate access to development sites (assuming it is feasible to establish a database of relevant sites). The approach offers an acceptable level of robustness, but will not fully eliminate possible sources of bias. It is recommended that this evaluation strategy forms part of the evaluation programme.
* **Accessibility modelling (SMS IV):** Approaches based on using frozen measures of accessibility to employment offer a more robust way of evaluating the economic performance impact of components of road enhancements designed to improve accessibility (i.e. the approach could attain Level IV rather than Level III on the Maryland Scientific Methods Scale). Implementation of the approach will use much the same data as that required for distance-decay modelling, with the main practical issues likely to arise in constructing accessibility indices (as discussed elsewhere). It is recommended that this approach also forms part of the evaluation programme. The sensitivity of the results to the construction of the accessibility index should be tested in the evaluation. The index should be constructed based on (1) observed changes in traffic speeds, (2) observed changes in traffic speeds after one year, and (3) expected changes in journey times expressed in the Business Case. Additionally, the analysis should be completed with and without schemes with significant development objectives to test the sensitivity of results.
* **Generalised Propensity Scores (SMS IV):** The DfT should consider the value of including a Generalised Propensity Score (GPS) approach within an evaluation programme. The approach could offer additional robustness checks on the findings of other approaches, as well as additional information on the nature of the impacts of road enhancements. However, the approach is highly involved and will incur associated costs.

Key limitations

1. The proposed approach suffers from the following limitations, although several mitigations are discussed:

* **Isolating causality:** A subset of schemes with development objectives, will be bound up with other activities to bring forward sites for development. It will be impossible to separate the causal effects of the access road from those other activities.
* **Long distance users:** It is unlikely to be possible to detect the benefits borne to long distance users of schemes unless they are particularly significant and concentrated geographically.
* **Local impacts:** Theapproaches focus on establishing local impacts and will produce results that are net of displacement and crowding out at the local level. While in principle the methods could be extended to explore effects further from the enhancement, such effects may be difficult to measure in practice (or could produce spurious findings). A conservative approach to understanding the scale of national economic benefits could be adopted by focusing on the productivity gains realised by firms that were located in proximity to the road enhancement before construction began (and remained so following its completion).
* **Time horizon:** The time series used for analysis may limit the ability of analysis to observe all possible economic performance effects, some of which may only be realised in the long term (e.g. 30-60 years, as defined at appraisal of schemes).
* **Links to appraisal methods**: The methods will not discriminate between effects driven directly by reductions in generalised travel costs and wider economic benefits, which are given separate treatment in TAG. As such, the evaluation evidence can only help set an envelope for the maximum scale of potential economic benefits for appraisal.
1. **V Case studies**
2. **Existing evidence is limited:** Existing case studies of road enhancements (both evaluations of DfT Local Major Projects and POPE studies) give detailed attention to the transport outcomes of road enhancements but limited consideration of their economic performance outcomes or what steps can be taken to maximise those outcomes.
3. **Rationale for case study research:** Case study research will be required to develop a body of evidence that helps demonstrate the economic performance impacts of individual schemes and how and why they came about. To meet the needs of stakeholders, case studies should seek to (1) demonstrate and communicate outcomes to a range of stakeholders and (2) provide an understanding of the mechanisms that result in economic performance and barriers and facilitating factors that influence outcomes.
4. **Proposed specification:** The specification of case studies could follow a light-touch or detailed approach:
* **Light touch case studies:** To illustrate the results of econometric analysis. While this approach would provide some indication about the types of effects that might be produced, it does not provide any analytical insight into how or why effects may have arisen. **Not recommended.**
* **Detailed analytical case studies:** In addition to the above, this approach would support an understanding of the mechanisms that result in economic performance, if any, and how these might vary by context. **Recommended.**

Table B: Overview of specification

|  |  |  |
| --- | --- | --- |
| No. | Task | Description |
| Design | 1 | Case selection | Select 10-30 cases that cover range of scheme characteristics and expected outcomes. |
| 2 | Desk review and consultations  | Understand schemes, identify target areas and refine their objectives. |
| 3 | Evaluation Framework development  | Conceptual framework for the evaluation. |
| Data collection | 4 | Review and analysis of secondary data  | Assess any changes in local economic performance. |
| 5 | Stakeholder consultations | Assess and validate scheme context, additionality and mechanisms. |
| 6 | Business surveys | Collect more focused outcomes measures, only for schemes with significant associated costs. |
| Analysis | 7 | Analysis of individual schemes  | Within-case analysis to provide overall assessment of scheme performance. |
| 8 | Comparative analysis across schemes | Cross-case analysis to provide general assessment of performance/mechanisms and how they vary by context. |

VI Evaluation delivery

1. Delivery of the evaluation will require the following:
* **Contractor requirements:** A contractor will need to have access to skills and capabilities in evaluation, social research, and econometric methods and (potentially) transport modelling software. They should also have access to expertise in the appraisal and evaluation of transport infrastructure projects
* **DfT and Highways England inputs:** The delivery of this programme of research will require input from the DfT and Highways England during both the design and delivery of an evaluation. This includes confirming access to commercial and residential data and confirming whether the DfT can create the required accessibility indices.
* **Proposed length of evaluation contract:** It is expected that the evaluation could be delivered over a 9-month period.
1. Introduction
2. Ipsos MORI, the Institute of Transport Studies and George Barrett were commissioned by the Department for Transport (DfT) in August 2018 to complete a programme of preparatory work for a potential evaluation of the economic performance impacts of road enhancements (EPIRE). This report sets out the findings of the project, setting out a range of quantitative and qualitative evaluation approaches that could be applied in such a study.
	1. Project context
3. While there is substantial theory and appraisal evidence to expect economic performance impacts from road enhancements, ex-post evaluation evidence is less substantial. While some studies have demonstrated a causal link between investment in the road network and local economic performance, these effects are thought to vary across different types of areas and sectors. Existing monitoring and evaluation arrangements for DfT and Highways England road enhancements are also not expected to produce substantial additional evidence to help demonstrate these linkages. Strengthening the evidence base here is increasingly important because road investment has increased and has moved towards aiming for economic performance impacts.
	1. Aims and objectives
4. The aim of the project, as defined in the Terms of Reference issued by the DfT, was to assist the Department prepare for a potential evaluation of the local and national economic impacts of investments in the road network made by the DfT and Highways England (the EPIRE project). The objectives of the preparatory study were to:
* Identify a set of relevant schemes that could be included in the EPIRE evaluation.
* Assess the data requirements for the evaluation.
* Explore alternative impact evaluation options.
* Consider the possible scope and value of case study research.
	1. Activities completed
1. This report was prepared by completing the following activities:
* **Review of scheme documentation:** A sample of 219 road investment schemes completed between 2002 and 2019 (120 Local Major Projects and 99 Highways England road schemes) for potential inclusion in an evaluation study was identified by the Department for Transport. Documents describing the parameters of these schemes were provided to the study team and were reviewed to understand the nature of the expected economic performance effects of each scheme and to determine its suitability for inclusion in an evaluation focused on assessing their economic impacts.
* **Evaluation framework development:** A theoretical framework describing the mechanisms by which enhancements to the road network might be expected to produce economic performance effects in different sectors of the economy was developed to provide an organising structure for the study. This framework is presented visually as a summary using a logic model. The framework was aligned with existing TAG guidance as far as practicable.
* **Consultations with data experts:** Consultations were completed with representatives from Costar, DfT, Ministry of Housing Communities and Local Government (MHCLG), and the ONS to understand what data could be made available to measure the expected economic performance effects of road schemes as part of an evaluation, and their relative strengths and limitations.
* **Development of impact evaluation options:** The study team reviewed past academic studies seeking to quantify the economic impacts of road investments to identify a set of potential evaluation strategies that might be employed to evaluate the economic impact of road investment projects. This review produced a list of evaluation options to explore in more detail. Two academics (Professor Steven Gibbons and Professor Dan Graham), with expertise in developing robust methods for assessing the impacts of road investment projects, were then consulted to refine this set of approaches by collecting views on the relative advantages and disadvantages of the different approaches under consideration.
* **Development of approaches for case study research:** The study team developed an approach to undertake scheme-level case studies that consider changes in local economic performance resulting from road investments, how far those effects aligned with expectations, and how and why those effects came about. This task involved a review of existing scheme level evaluations and associated guidance, and consultations with representatives from Highways England and the DfT (local and strategic roads directorate) in policy and analysis roles. These consultations collected views on the relative strengths and weaknesses of existing scheme-level evaluation evidence on the economic performance effects of road investment projects, key evidence gaps and how case study research might be employed to produce additional evidence to support decision making in the Department.
	1. Structure of the report
1. The remainder of this report is structured as follows:
* **Section 2** summarises the results of the scheme review.
* **Section 3** provides a narrative Theory of Change, which describes how economic performance impacts are expected to be achieved through enhancements to the road network. This section concludes with a logic model – a visual representation of the Theory of Change.
* **Section 4** provides an assessment of the data that could be made available to measure the expected economic performance effects of road schemes, and an assessment of the strengths and limitations of these data sources.
* **Section 5** discusses the relative advantages and disadvantages of several relevant quantitative impact evaluation strategies, and recommends approaches to be integrated into a prospective evaluation.
* **Section 6** provides an overview of the potential uses of case study evaluation evidence. It highlights existing evidence gaps that might be filled by case study research and provides a discussion of how scheme level case study research might be organised, including suggested aims and objectives, research questions and research methods to be employed.
* **Section 7** provides an overview of the set of practicalities that should be considered when delivering the evaluation, including an estimate of the financial and other resources required and an assessment of the expected key evaluation delivery risks.

1. Scheme Classification and Selection

1. This section summarises the characteristics of a sample of 219 road enhancements provided by the DfT and Highways England that could be included in the scope of a future evaluation focussed on their economic impacts. The analysis focuses on identifying the subset of this sample that would be suitable for inclusion, and other features of the schemes that could influence the range of questions that could be addressed. The analysis drew on a review of documents associated with 219 road schemes that were shared with the study team by the DfT and Highways England.
	1. Approach
2. The DfT and Highways England provided documents relating to a sample of 219 transport investment schemes, defining a population of schemes that could potentially be included in an evaluation of the economic performance impacts of road enhancements. This included 120 Local Major projects and 99 Highways England (HE) road schemes approved between 2002 and 2018. This documentation made available included businesses cases, forecast and actual spending profiles, economic appraisals, project reports, and evaluation reports.
3. The objective of the analysis was to determine the subset of schemes that could potentially form the focus of a potential evaluation. This involved consideration of:
* **Out of scope schemes:** Only schemes involving the construction of new road links or the enhancement of an existing link were considered in the scope of the potential evaluation. Schemes that did not involve investments in roads or had predominantly non-economic objectives (e.g. road safety enhancements) were considered out of scope.
* **Mechanisms leading to economic benefits:** Schemes vary in the way that they produce economic benefits. A distinction was made between schemes that reduce the cost of accessing goods and service via the road network, and those that provide access to specific parcels of land to enable their development.
* **Scale of potential economic benefits:** It is anticipated that an evaluation will partly involve an assessment of impacts using statistical methods. The effects of schemes that are expected to produce small changes in accessibility may be difficult to detect using these methods.
* **Timing of a potential evaluation programme:** The pool of schemes provided by DfT spanned completed schemes and those expected to be completed in the future. This will have implications for the optimal timescale of a future evaluation programme, and the number of schemes that could be included at different stages.
* **Issues for further exploration:** Other features of schemes are of wider potential interest for an evaluation – such as the role of enhanced port accessibility in increasing international trade.
1. The following approach was adopted to classify schemes:
* **Initial sift:** A first sift of schemes in the sample to remove those deemed out of scope for the proposed evaluation.
* **Scheme classification:** Each remaining scheme was categorised in terms of its characteristics shown in the table in Appendix A using the available documentation. The initial coding of projects was checked by a second reviewer to ensure the framework had been applied consistently across projects.

The DfT and Highways England were only able to provide information if it had been retained and there was some variability in the documentation available for each scheme. Business case documentation was not available for 18 schemes and for others only an appraisal summary table was available. Where appraisals or ex-post evaluations were not available, judgements had to be made on the objectives and expected impacts of the scheme based on the available information. It was challenging to identify the budget allocations of road components of larger schemes that included more than one investment and the expected magnitude and type of anticipated benefits.

* 1. Initial sift
1. Not all projects were deemed suitable for inclusion in a potential evaluation following the initial sift:
* **Non-road schemes**: Thirty-six Local Major schemes were excluded became they did not involve investment in the road network. These schemes predominately involved improvements to bus infrastructure, and road maintenance and safety improvements.
* **Road schemes with non-economic objectives:** Five Local Major schemes were excluded because they involved the introduction of new transport systems.

After this screening, a total of 178 schemes remained (99 Highways England schemes and 79 Local Major projects).

* 1. Overview of portfolio
1. This section provides a descriptive analysis of the 178 schemes that were reviewed in detail.
	* 1. Scheme characteristics

The review found that the schemes can generally be classified into two types:

* Enhancements that sought to reduce journey times, congestions and generalised travel costs.
* Enhancements that allowed specific parcels of land to be accessed by road to enable their development for residential, commercial, or industrial use.
1. An individual scheme may involve one or more components of the above types. All 178 schemes had one or more component involving investment in new or enhanced road links. Thirty-one of the 178 schemes also involved the provision of link roads to development sites (almost all of which were Local Major projects). No schemes in the portfolio only provided link roads to development sites.
2. While this classification can inform the approach to an evaluation, the classification may not fully reflect the objectives or any resulting economic impacts of schemes. Feedback from those consulted indicated that if the journey time savings were sufficient to justify the costs of the scheme, little attention would be given to its economic objectives in the preparation of the Business Case. As such, there may be schemes with development objectives that were not visible in the scheme documentation. The approach taken to articulating the strategic case for schemes may also have been influenced by the wider policy objectives of the Government of the day, leading scheme promotors to emphasise different aspects depending on the prevailing policy context.
3. **Recommendation:** There may be merits in collecting additional information from scheme promotors – where possible - as part of the preparatory stages of an evaluation to determine how many schemes in the portfolio had explicit development objectives that were not mentioned in the Business Case. However, it should be noted that the objective of the evaluation is to identify any economic impacts that have arisen from the relevant enhancements, and there will be a limit to how helpful scheme documentation may be in supporting this understanding.
	* + - 1. Overview by type of scheme

|  |  |  |  |
| --- | --- | --- | --- |
| Combination of scheme types | No. of HE road schemes | No. Local Major Projects | Total no. of schemes |
| Number of schemes with accessibility objectives only  |
| New link only  | 25 | 30 | 55 |
| Enhancement of existing link only | 52 | 18 | 70 |
| New link and enhancement of existing link | 17 | 5 | 22 |
| Total | **94** | **53** | **147** |
| Number of schemes with development and/or accessibility objectives |
| Development site access only | 0 | 0 | 0 |
| New link and development site access | 1 | 3 | 4 |
| Enhancement of existing link and development site access  | 2 | 8 | 10 |
| New links, enhanced links, and development site access  | 1 | 16 | 17 |
| Total | **4** | **27** | **31** |

1. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.*
* **Indicative scheme cost:** Almost half of the schemes involved a cost of at least £30m. The average cost of a HE road scheme (£94m) was larger than the average cost of a Local Major Project (£37m).
* **Anticipated benefits:** Thedocumentation provided an indication of the expected impacts of schemes, although this was not provided in a consistent way across HE road schemes and Local Major Projects and the analysis presented below is not presented using the same base year. For HE road schemes, traffic modelling was completed to provide a pre-opening monetary estimate of the journey time benefits over a 30 or 60-year appraisal period (available for 77 schemes). The journey time savings were indicatively valued at of £234m on average over 30 years and £225m for those considered over 60 years. Benefit-cost ratios (BCRs) were available for 35 Local Major schemes. The average scheme BCR was £8.1 for every £1 spent and the distribution of expected benefits is shown below.
	+ - 1. Indicative overview of schemes by expected benefits
1.
2. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.* *N.B.****:*** *BCR bands are defined as follows: Very Poor (BCR less than or equal to 0); poor (BCR between 0 and 1); low (BCR between 1 and 1.5); medium (BCR between 1.5 and 2); high (BCR between 2 and 4); very High (BCR greater than or equal to 4). The monetised benefits reported were not rebased to give a common price year.*
3. The documentation also provided an indication of the expected residential and commercial development effects:
* **Residential development:** The documentation associated with 11 Local Major Projects and four HE road schemes identified the number of new residential dwellings expected (53 percent of schemes with anticipated residential development outcomes). An average of 12,000 new dwellings were expected to be developed as a result of the 11 Local Major Projects, in comparison to 1,500 dwellings for the four HE road schemes.
* **Commercial and industrial development:** Estimates of the amount of new commercial or industrial floor-space expected were available for six Local Major Projects and one HE road scheme provided. The average amount of commercial floor-space expected from Local Major Projects was 60,000m2, in comparison with 17,000m2 expected from HE road schemes.
1. It should be noted that there were variable levels of detail provided on the anticipated development impacts. While some Business Cases provided maps of the specific parcels of land that were being unlocked, this was not available in all cases. This could prove a constraint on how far it is possible to assess how far the development objectives of schemes were achieved in an ex-post evaluation, unless additional information can be recovered from scheme promotors as part of the preparatory stages of a study. However, an evaluation could also seek to observe any economic impacts that may have arisen as a result of investment, not just those that were set out in Business Cases.
2. **Recommendation:** The preparatory stages of an evaluation should involve – as far as practicable - the construction of a database of parcels of land that were expected to unlocked as a result of investments in access roads (as this would be needed for both process and impact evaluation of these types of schemes). It is acknowledged that this may involve challenges where information has not been retained. It may be possible to recover some information through consultations with scheme promotors where the required detail is not provided in the Business Case.
* **Scheme opening year:** The expected opening year was provided for all schemes. The figure below provides a summary of the distribution. All schemes were expected to be open at the time of writing. The apparent age of HE road schemes derives from the fact most were identified from published POPE studies which are completed five years following completion.

**Recommendation:** The portfolio of schemes will need to be revisited as part of the preparatory stages of an evaluation to determine the actual (as opposed to expected) completion dates of the portfolio of the schemes. This could lead to a small reduction in the number of schemes that could be included within the analysis.

* + - 1. Overview of schemes by completion year

**Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.*

* **Region:** The distribution of schemes by region is shown in the table below. The highest number of schemes were located in South East (just under one fifth). The lowest number of schemes were located in the North East (six percent). No schemes in the portfolio supplied for the review were located in London because Transport for London was not asked to provide information for the scoping study.
	+ - * 1. Overview of schemes by region

|  |  |  |  |
| --- | --- | --- | --- |
| Region | HE road scheme | Local Major Project | Total |
| No. | Percent (%) | No. | Percent (%) | No. | Percent (%) |
| Yorkshire & the Humber | 17 | 17 | 13 | 16 | 30 | 17 |
| South East | 21 | 21 | 9 | 11 | 30 | 17 |
| East Midlands | 16 | 16 | 12 | 15 | 28 | 16 |
| South West | 12 | 12 | 12 | 15 | 24 | 13 |
| North West | 11 | 11 | 9 | 11 | 20 | 11 |
| East of England | 11 | 11 | 6 | 8 | 17 | 10 |
| West Midlands | 4 | 4 | 14 | 18 | 18 | 10 |
| North East | 7 | 7 | 4 | 5 | 11 | 6 |
| Total | **99** | **100** | **79** | **100** | **178** | **100** |

1. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.*
	* 1. Outcomes
2. Schemes were also classified by their expected short-term outcomes. The main direct outcomes of projects were in terms of reducing journey times and improving reliability:
* **Journey times and reliability:** All HE roads schemes and 70 Local Major Projects (96 percent) focused on reducing journey times and costs by alleviating congestion or improving in reliability. The remaining four percent had primary objectives focusing on access or maintenance.[[2]](#footnote-3)
* **Safety:** Eighty-nine HE road schemes and 66 Local Major Projects (85 percent overall) had secondary aims to improve road safety through reducing the likelihood of accidents.
* **Environmental benefits:** In total 54 HE road schemes and 58 Local Major Projects had an objective of producing environmental benefits (rather than just mitigating against adverse environmental effects). These were largely secondary to journey time and reliability and safety benefits produced.
1. This classification was based on the text prepared for the relevant business case, and scheme sponsors may have elected to highlight aspects of the scheme that aligned with wider policy priorities of the time in which it was conceived.

Impacts

1. Schemes were categorised by their expected economic impacts as expressed in the Business Case documentation, illustrated in the table below. Business cases for Local Major Projects were more likely to explicitly reference economic development objectives than HE road schemes. Again, this based on the text of the business case and other documentation, and again, scheme promoters may have sought to highlight aspects of the scheme that aligned with wider policy priorities. The working assumption is that the primary expected economic performance benefit of many schemes is improvements in productivity arising from reductions in generalised travel costs, even if not expressed explicitly in the business case.
2. Other accessibility impacts were also defined in some Business Cases including better access to public transport and reduction of community severance (or isolation). HE road schemes were more focused on community severance (or isolation) issues and less focused on access to public transport than Local Major Projects.
	* + - 1. Overview of schemes by expected economic benefits described in the Business Case

|  |  |  |  |
| --- | --- | --- | --- |
|   | HE road scheme | Local Major Project | Total |
| Expected economic benefit | No. | Percent (%) | No. | Percent (%) | No. | Percent (%) |
| Business activity location  | 19 | 19 | 54 | 68 | 73 | 41 |
| Job creation  | 18 | 18 | 47 | 59 | 65 | 37 |
| Productivity growth | 8 | 8 | 26 | 33 | 125 | 70 |
| Commercial development  | 15 | 16 | 16 | 20 | 32 | 18 |
| Residential development  | 14 | 14 | 16 | 20 | 30 | 17 |

1. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.* *NB: Schemes coding permitted a scheme to have more than one expected economic benefit i.e. coding not mutually exclusive. Additionally, the table refers only to economic benefits explicitly mentioned in the Business Case, and will often not include productivity gains resulting from journey times savings.*

Other scheme characteristics

Schemes were broadly classified into their geographic focus:

* **Urban scheme:** A scheme connecting locations within a single central urban locality.
* **Urban-suburban scheme:** A scheme is connecting an urban centre and one or more nearby sub-urban centres.
* **Inter-urban:** A scheme connecting two or more urban centres.
1. A summary of the distribution of these schemes is given in the table. Most HE roads schemes were urban-suburban or inter-urban schemes whereas Local Major Projects were mostly urban or urban-suburban schemes.
	* + - 1. Overview of schemes by geographical focus

|  |  |  |  |
| --- | --- | --- | --- |
| Geography | HE road scheme | Local Major Project | Total |
| No. | Percent (%) | No. | Percent (%) | No. | Percent (%) |
| Urban | 5 | 5 | 30 | 38 | 35 | 20 |
| Urban-Suburban | 31 | 31 | 35 | 44 | 66 | 37 |
| Inter-Urban | 63 | 64 | 14 | 18 | 77 | 43 |
| Total | **99** | **100** | **79** | **100** | **178** | **100** |

1. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.*

* 1. Summary
1. The analysis above highlighted a range of implications for the design of any evaluation of the economic performance impacts of roads. These implications are summarised in the list below:
* **Schemes for inclusion in a potential evaluation:** Of the initial portfolio of 219 schemes provided, 178 are potentially suitable for inclusion within the scope of an evaluation of their economic performance impacts (99 Highways England and 79 Local Major Projects).
* **Size of journey time savings / development impacts:** The analysis suggests that the expected effects of schemes are of a reasonable magnitude to support analysis with statistical methods.
* **Scheme type:** All relevant schemes reviewed had objectives to improve accessibility between areas through reducing generalised travel costs. A further 31 also had explicit development objectives through provision of link roads to parcels of land. There were variable levels of detail provided on the location and size of these parcels in the Business Cases, and the preparatory stages of any evaluation should seek to develop a database of relevant sites.
* **Time horizons:** The majority of schemes were due to complete at some point between 2002 and 2018, implying an evaluation completed in the near future could explore short- and long-term effects of road enhancements. Information was not available on whether schemes had completed against their anticipated timescales, and there is a possibility that a small number of schemes may have been delayed which would need to be investigated ahead of a full evaluation.
* **Region:** The portfolio of projects was geographically diverse and would support an assessment of the relative effects of road investments in areas with differing levels of productivity and/or resource utilisation.
* **Local Majors and Highways England schemes:** There are differences in nature of DfT Local Major Projects and Highways England schemes. The former was more likely to involve a more local focus (connections within urban areas or to suburban zones) and the Business Cases involve a greater emphasis on stimulating residential and employment land development – with the latter tending to involve longer distance inter-urban connections.
* **Links to port:** Only a small number of schemes involve improving links to ports, and a statistical assessment of the impacts of these road enhancements on port activity may be challenging – though these types of scheme could usefully form part of case studies.
*
1. Evaluation Framework
2. This section provides an outline evaluation framework describing the potential local and national economic performance impacts of DfT Local Major Projects and Highways England Road schemes. The purpose of this section is to define the economic outcomes that could be explored in a possible evaluation, the mechanisms by which they might arise, and how they may vary across different contexts. The framework considers those aspects that might be covered as part of an economic appraisal of road investments and those that may be more central to the strategic case. The expectation is that this will serve as an organising framework for both case study research and econometric analysis.
3. This section was developed through a review of relevant economic theory and TAG[[3]](#footnote-4) guidance. In addition, the steering group expressed an interest in the potential trade effects of road enhancements, and some possible mechanisms through these impacts might arise have been drawn out in the following analysis.
	1. Inputs and activities

A range of inputs are used to make enhancements to the road network which vary substantially across the different schemes funded. Typically, schemes receive financial and resource inputs from scheme promoters, the UK government more widely, local authorities (LAs) and in some cases, third-party developers.

1. Scheme promotors contribute time and resources to support the development and management of schemes - for example, in the development of business cases or the completion of appraisal activities. LAs may provide input to a scheme’s delivery by supporting the initial planning and scheme development process – for example, by supporting planning applications or the legal permissions process. In addition, LAs may also coordinate and manage the delivery of schemes, which could involve the management and contracting of construction firms or reviewing projects plans and making suggestions for appropriate mitigating measures. Finally, some schemes may receive contributions from third party developers if it offers opportunities to undertake a programme of commercial and/or residential development.
2. The construction of the road enhancement may produce temporary local economic impacts in the form of construction GVA and employment (though to the degree that there are supply side constraints, the additional demand may simply crowd out other construction activity elsewhere).
	1. Outputs
3. The resources described above are used to deliver road enhancement projects:
* **Development of new and enhancement of existing road link:** Road enhancement projects may include development of entirely new links in the road network or enhancement of existing links. Improvements could be made for a number reasons such as improved new access to urban centres, bypassing traffic away from urban or rural centres or creating links between one or more urban and/or suburban centres. The primary objective is generally to reduce journey times or costs, though not all improvements will be funded to deliver against economic objectives, for example – a bypass may be built with a primary objective of reducing congestion, traffic, noise or emissions in residential areas.
* **Link road to development sites:** In other cases, the creation of a new link could also be driven by the need to facilitate access to new or existing commercial and/or development sites – for example, the creation of an access to road to reach a brownfield site to facilitate development.

The schemes in the scope of the potential evaluation may produce other outputs, such as traffic management systems. These have not been considered in scope for the purposes of this study either because they are not considered to be key drivers of economic performance impacts (but may produce other important benefits - such as enhanced safety), or that their potential economic benefits will too diffuse to be captured in case study research or detailed quantitative analysis.

* 1. Accessibility outcomes
1. A key outcome of road investment projects is increased ‘accessibility’ which can be understood in different ways depending on the specific nature of the project:
* **Reduced journey times, congestion and generalised travel costs:** Road network enhancements are expected to reduce journey times and congestion, resulting in more predictable journeys and reduced generalised travel costs. Enhancements may generate additional demand for the road network, e.g. encouraging marginal road users to make use of the network, increasing the capacity of the road network to accommodate traffic, or by stimulating additional local economic activity. The extent to which journey time savings are sustained, at least for existing users, is not always clear.
* **Access to specific sites:** Some road enhancements will allow specific parcels of land to be accessed by road. These include development sites and major transport hubs such as ports:
* **Access to development sites:** Road enhancements of this type may include a distributor road that opens greenfield or brownfield sites for development, or a new link or a junction improvement which makes access to an existing employment or residential site easier (or possible). There are challenges in attributing development impacts to those schemes involving provision of access roads, as the effect of the construction of a road is inseparable from the other activities involved in bringing forward the site for development (which may include activities that were funded before the road scheme was appraised). As illustrated in Table 2.1, there are no schemes that solely involve the provision of access roads to development sites. However, this type of activity does form an element of the 31 schemes reviewed.
* **Access roads to ports:** A subset of schemes in the portfolio under consideration sought to improve access to ports. This could include the creation of new access roads that specifically cater to users of the ports but also enhancements to the surrounding road network to increase the overall capacity of traffic flows at given times. Improved access is expected to result in reduced journey times and improved reliability for port users.

**Implication:** There are two conceptually distinct types of accessibility outcome associated with road investment projects. The first relates to reducing the reducing the cost (in money and time) of accessing goods and services via the road network. The second relates to improvements to the network that allow specific parcels of land to be accessed by road that could not be previously (e.g. through provision of access roads to development sites or ports). These two types of accessibility improvement are likely to deliver different types of economic impact, and should ideally be handled separately in an evaluation. As there are no schemes that solely involve provision of access roads, this would require the separation of those components of schemes that involve provision of new road links and those that provide access roads to land parcels).

There should also be an awareness provision of access roads (associated with a subset of schemes) will be bound up with other activities to bring forward sites for development, and thus it will be impossible to separate the causal effects of the access road from those other activities. These aspects of the schemes should arguably be treated separately in any analysis (and as highlighted in Section 6, there are also implications for types of method that may be appropriate).

* 1. Impacts on firms
1. Investments in the road network might be expected to deliver a range of outcomes depending on the specifics of schemes under review and firm characteristics such as sector or size:[[4]](#footnote-5)
* **Reductions in costs:** Reductions in journey times would be expected to reduce the costs associated with freight logistics and business travel. These effects may feed through into higher GVA per worker if workers spend less time travelling and allocate more time to production, if savings on freight logistics are not passed on to consumers, or if firms reorganise themselves more efficiently in response to more reliable or rapid journey times. These effects might be expected to be more important for those firms located near and/or making the most use of the road infrastructure (such as logistics, construction, and manufacturing industries) within the areas most affected by the schemes.
* **Firm expansion:** To the extent that firms reduce their output prices in response to lower costs, enhanced competitiveness may allow them to acquire new customers (or expand orders with existing customers), leading to higher output (GVA). Firms may need to recruit new workers to meet the additional demand, resulting in increases in local employment. On the other hand, increased exposure to competition may negatively affect local firms, resulting in contractionary effects.
* **Firm entry, exit and formation:** Road enhancements may also make the areas concerned more attractive to firms looking to expand or relocate or to those considering starting a business, leading to new investment and the creation of jobs and GVA within the local areas concerned. For the purposes of an evaluation it will be important to understand how far any efficiency gains are driven by (1) the enhanced road infrastructure itself, (2) other aspects associated with the relocation not directly related to the road infrastructure (e.g. local broadband infrastructure or features of the premises occupied), and (3) how far incoming firms are merely more productive than incumbents. Improvements to accessibility may also change the structure of the local economy by attracting firms which are more dependent on good transport links. However, new firm entry into a local area may result in displacement, and an evaluation will also ideally need to consider these offsetting effects.
* **Labour specialisation:** Changes in the road network may also make it more efficient for a firm to serve multiple locations from a single location, rather than multiple sites. As such, a firm may choose to close less efficient plants, producing specialisation, i.e. where some geographic areas are focus on the production of a smaller set of goods and services.
* **International trade effects:** Where firms realise productivity gains, UK businesses could expect to increase their competitiveness in international markets (at least those active in the tradable goods sector). Through achieving journey time savings, those businesses that are most reliant on the road network may become more competitive, because they can supply, and potentially export, more goods in a given time period than was previously possible. Improvements in the UK road network may also result in overseas firms reducing their travel costs when exporting to the UK (reducing import costs). A subset of schemes aims to enhance access to ports. Improving access to port sites, either through new or existing link enhancements or facilitating the development of employment land proximate to ports, may also decrease the costs of imports and exports, potentially resulting in increased trade volumes.
	1. Labour market impacts
* **Direct effects on labour supply:** Improvements in the road network may cause economically inactive individuals to enter the labour market, typically by increasing their returns to labour. This could reflect an increase in wages, due to being able to access more productive employment opportunities or a decrease in generalised travel costs associated with making use of the road network to access existing employment opportunities. For example, improvements in accessibility will reduce the time involved in commuting by road to employment centres, potentially increasing workers’ areas of job search and encouraging labour market participation or increased hours worked. This may also have wider benefits in alleviating labour supply constraints on firms and improving matching between the supply and demand for skills. Local impacts may not always be positive, as local firms may face increased competition for labour from firms based elsewhere. An increase in local labour supply may also place downward pressure on wages and GVA per worker, should demand for workers not change.
* **Sorting effects:** Where road investment schemes have acted as a spur for residential development, they have the potential to attract new residents and households to the areas involved (provided new housing is not purchased or rented by 'latent' households already resident within the local area). New residents may also alter the composition of local skills supply. If housing schemes attract more productive residents (who may not fill local jobs), then this may be observed in increases in the average wages of residents following the completion of construction activity. Similar types of outcomes may also occur without additional residential development – for example, if households are attracted by enhanced connectivity[[5]](#footnote-6). Such effects may accelerate further local economic growth through positive consumption effects in secondary markets e.g. leisure and retail spending (potentially creating new or higher value added jobs in these sectors). In addition, population growth will be accompanied by an increase in local labour supply. In tight local labour markets this could help alleviate constraints on local growth. In other cases, it could create downward pressures on local wage levels, at least in the short run (and likely accompanied by offsetting effects elsewhere).
* **Unemployment impacts:** As noted, road enhancements have the potential to result in the creation of new jobs at the local level. This may result in reductions in the rate of local unemployment should residents have the required skill sets to access the employment opportunities created and there is sufficient slack in the labour market to support these types of reduction.
	1. Land use change impacts
1. By improving access to developable sites, the delivery of road enhancements is expected to enable planned development to be undertaken and incentivise additional investment in the development of sites, providing plots or additional sites are available for development. Investment may impact on development through three main potential mechanisms:
* Making the development physically feasible.
* Making it acceptable in planning terms – for example, by averting adverse traffic impacts on local residential routes.
* Improving its commercial viability by increasing the attractiveness of the sites concerned to potential occupiers.
1. Developments will either be primarily commercial or residential in nature and effects could be direct or indirect:
* **Direct effects in commercial and residential property markets:** A subset of schemes has components that facilitate access to land supply. These schemes will increase the supply of developable land and ultimately result in the development of new commercial and industrial floor space, by, or for, potential occupiers, or on a speculative basis. This may alleviate potential factor price and supply constraints on the development of local firms with beneficial impacts on local investment, GVA and employment. There may also be effects in retaining firms within the area which might have otherwise chosen to relocate in whole, or part to expand. To the extent that any increase in supply of land with residential planning designation addresses constraints on the availability of suitable plots, such schemes should lead to effects in terms of starts and completions of new homes. However, there is a possibility that such activity may be offset through the crowding out of housing development on less attractive plots.
* **Indirect effects in commercial and residential property markets:** Increased demand for commercial floor space or residential properties resulting from road investment schemes may also place upward pressure on local rental/land values, which in turn may result in incentives for additional development to take place.

The nature of the causal contribution of the road investment is more difficult to interpret, as the effects of the access road cannot be separated from a range of other inter-dependant activities that comprise the development process. As such, an evaluation of these types of scheme will assess the causal effects of all activities involved in bringing the site forward for development, rather than just the investment made in the road infrastructure.

* 1. Agglomeration effects

Further positive impacts on firms’ performance may arise if the improvements widen the areas which firms can serve from the localities affected. Increases in economic density are likely to produce several knock-on effects:

* **External economies of scale:** Increases in economic density may benefit the economy more widely by creating positive external economies of scale. Local firms may become more productive by being in closer proximity to other firms, factors of production or infrastructure (static clustering). Changes in the size of local clusters as a result of induced investment by firms (dynamic clustering) may also boost productivity. The size of these effects is likely to be dependent on the scale of the economic masses involved, and the type and scale of connectivity enhancement delivered, or in some cases, the development site made available.
* **Congestion effects:** There may also be offsetting effects, however, resulting from increasing rentals and land prices or other pressures on factors in fixed supply, particularly if there are significant constraints on the local availability of development land/premises (as highlighted above).
* **Disagglomeration effects:** On the other hand, road investments may produce ‘disagglomeration’ effects if firms are incentivised by schemes to move from more to less economically dense areas (though such effects may be temporary if the resources made available by the relocation are quickly redeployed).
	1. Other impacts
1. Changes in journey times, travel costs, development and economic performance as described above are likely to result in a range of wider, indirect effects in the economy:
* **Displacement:** Displacement effects could occur through two mechanisms. Firstly, if the connectivity improvements or newly accessed development sites offer users a relative advantage over their competitors, the scheme may result in the displacement of output and jobs from other locations. Secondly, if firms are attracted to the area, there will be corresponding losses of employment and output from the areas from which those firms originate.
* **Multiplier effects:** The various potential direct effects on local economic performance will also potentially create positive multiplier effects on the growth of other firms in the area through a combination of increased purchases of inputs by firms from local suppliers (indirect effects) and increased consumers’ expenditure by those who derive increases in their income through the various direct effects (induced effects). However, these effects are typically constrained by supply-side factors, as noted below.
* **Equilibrating effects:** The outcomes produced by accessibility improvements may be dampened by the upward pressures these create on local prices of labour and other factors of production. The extent of such effects will depend on the significance of the local supply constraints and on the ways in which local firms respond to the cost increases involved. In the case of creating access to commercial development sites, the various effects described may be dampened by offsetting increases in the prices of existing and proposed designated employment land and commercial space as a result of the effects in stimulating local economic activity. Similarly, the increases in economic activity may create pressures on other factor prices which may dampen the initial stimulus effects. Overall, if the economy is in a long-term equilibrium any changes in employment and other factors will be offset by losses elsewhere in the economy. Although offsetting effects may not be observed at the local level.
* **Hysteresis effects:** The conclusion of the preceding bullet depends on an assumption that the relevant local economies are operating at full employment. However, it is possible that road enhancements stimulate demand in areas where workers have been less able to respond to past economic shocks and wider structural changes (e.g. areas of high unemployment affected by the decline of traditional manufacturing industries). In these cases, the output produced by the individuals filling vacancies created has potential to be additional at the national level, providing any vacancies produced (or vacancies released by the uptake of new opportunities created) are filled by those that would have otherwise been long-term unemployed. These types of effect are more likely to be outside the more productive urban regions of the UK (where levels of demand are already high).
	1. Logic model

A visual representation of the Theory of Change is provided overleaf.

* + - 1. Logic model
1. **Source:** Ipsos MORI (2019).
2. Measurement of Key Outcomes
3. This chapter explores the data sources that could be used to measure the outcomes and impacts defined in the preceding section. This data could provide underpinning evidence to support both case studies and a quantitative evaluation of the economic effects of road schemes using econometric approaches.
	1. Overview of outcome measures and data sources
4. Table 4.1 below provides an overview of the data sources that could be used the measure the outcomes identified in the previous section. A RAG system has been used to summarise the assessment of data availability for a potential evaluation, whereby green, orange and red denote good, partial and limited data availability respectively. As suggested in the table, there are potentially useful data sources for all outcomes of potential interest for an available, though in some cases there are constraints set by coverage, availability or costs. These constraints are particularly acute in the case of international trade outcomes and those relating to planning and housing outcomes.
	* + - 1. Key Outcomes and Data Sources

| Key Outcome | Source of Evidence |
| --- | --- |
| Accessibility Outcomes  |
| Reduced Journey Times and Congestion | Journey time statistics (previously called accessibility statistics) provide estimates of travel times from the centre of each lower super output area to different types of destination. These statistics provide an approximate measure of how far road enhancements have resulted in improved accessibility. **Annual releases have been compiled since 2007, and do not cover the full sample of scheme in scope.** |
| Firm Level Impacts |
| Employment  | The Business Structure Database is an annual snapshot of the Inter-Departmental Business Register (IBDR) and provides annual data on employment and turnover, firm formation, entry and exit of all firms registered for PAYE or VAT. The location of each firm’s site is recorded for firms, enabling analysis of relocations. **The BSD offers good coverage of firm employment, turnover, and relocations although some observations are subject to lags.**  |
| Firm Entry and Exit |
| Firm Formation |
| Increase in Productivity | The Annual Business Survey (ABS) is an annual census of firms with 250 employees or more and a sample survey of SMEs and can used to develop measures of productivity, GVA and total factor productivity. A proxy measure (turnover per worker) could also be derived from the Business Structure Database where data is unavailable. **Firm level** **measures of productivity should be straightforward to establish using the ABS and BSD (though with lags in availability).**  |
| Fixed Capital Investment | Data on capital investment is also collected through the ABS and is available through the ONS Secure Research Service. **Measures of capital investment will be straightforward to establish using the ABS though coverage of SMEs is less extensive than for large firms.**  |
| Increased Firm International Competitiveness  | The HMRC Datalab holds international trade and UK regional trade statistics, and can be used to measure the imports and exports of individual firms. Arrangements for access are being explored at present and it may be possible for commercial entities to access the data in the comparatively near future. The DfT also commissions surveys to understand trade volumes domestically and internationally but can only provide indicative measures at the local level. **A range of data is available to measure trade activity at the firm level, but there are constraints in terms of access and level of precision at the local level.**  |
| Labour Market Impacts |
| Population growth (Increase in Labour Supply / Change in Local Labour) | Population estimates at a small area level are available at 10 year intervals through the Census of Population and an assessment of the changes between the 1991 and 2011 Census years could be completed, although there are limits to its usefulness given the data gaps present across years**.** This analysis would need to focus on the subset of 104 schemes that were scheduled to open in or before 2011 (75 HE road schemes and 29 Local Major Projects). **Census data could be used at present to examine changes in the composition of local populations brought about by schemes opening before 2011.**  |
| Wages | The Annual Survey of Hours and Earnings (ASHE) provides annual observations of the wages of workers, which can be linked to their postcodes of residence and employment to explore wage impacts. The ASHE is based on a sample of workers, and its utility will be linked to how many sampled were affected by the transport schemes under consideration. **Wage effects can potentially be measured using the ASHE panel data, though its utility may be limited by the size of the sample of workers covered by the data.**  |
| Unemployment  | The claimant count can be used to approximate unemployment at the local level. However, the time series has been affected by the introduction of Universal Credit and, since 2017, the time series is not treated as a national statistic by the ONS. **Unemployment at small area level can be established using JSA claimant count, though there are limits in how far it offers a useful measure after 2016 owing to the introduction of Universal Credit.**  |
| Development Impacts |
| Planning Permissions | The **MHCLG** obtains site level data on planning permissions, housing starts and completions from private providers. The data could be obtained directly from LAs though this would require their engagement and co-operation and may be resource-intensive to collect. Alternatively, data can be obtained from commercial providers. **Data on planning permissions, housing starts, and completions are potentially available from a variety of sources though gathering the data will potentially come at a cost.**  |
| Housing Starts and Completions  |
| Land use change | Information on land use change is available from Ordnance Survey and potentially MHCLG (although further engagement is required to understand how MHCLG could make the data available for an evaluation). It captures changes in the use of parcels of land from 1986 onwards. The data could not be used to capture metrics of development intensity (e.g. numbers of dwellings or quantity of floorspace built in response to road investment schemes. **Data on land use change is available from Ordnance Survey.**  |
| House prices | Limited data was available on land values. It may be possible to secure local-level land valuation data but this would require further investigation by an evaluation contractor. Effects on land values should be capitalised into house prices. **Data on house prices are available from the Land Registry and the ONS**. |
| Commercial and Industrial Development | The Valuation Office Agency (VOA) publishes data on commercial and industrial floorspace and rental values at a premises level which could be used to explore the development impacts of schemes. The data is available for 2010 and 2017.[[6]](#footnote-7) Several third-party data processors provide an annual measures of commercial real estate activity, including building starts and completes, rental values and floorspace. **Ratings lists are now publicly available from the VOA for 2010 and 2017.**  |

1. **Source:** Ipsos MORI (2019). *N.B.: Green indicates that the data can be obtained straightforwardly with low or minimal cost. Yellow indicates that some useful data is available – though with constraints on its coverage, availability, or costs. Red indicates there insufficient data available for this evaluation.*
	1. Monitoring records
2. Access to monitoring records and background documents at the scheme level will be essential for implementing an evaluation. These documents are a key source of information on a scheme’s characteristics and most critically, the specific location of each enhancement created. Although it may be possible to collect this information from other sources, such as Business Cases or LAs, if necessary. For those schemes aiming to bring forward sites for development, an evaluator would need to have some understanding where any development was expected to occur. To do this, information would ideally be available on both the spatial co-ordinates (centroid points) of the development sites that were expected to be brought forward, and their size (in hectares). Information on downstream development at a site level would also be desirable, though this information can be obtained from other sources. Without this information, a set of assumptions could be developed and tested around the likely spatial distribution of impacts based on the location of the scheme.
3. This monitoring information required would ideally be integrated into scheme monitoring arrangements, although this is a challenge for schemes that have already opened. Details of some scheme characteristics are available in business cases, but clearly any revisions or updates would need to be provided in subsequent documents.
4. **Recommendation:** Prior to the commissioning of an evaluation the DfT should gain access to business case and monitoring and evaluation documents for all schemes under review, as far it is possible to do so. Alternatively, when specifying evaluation requirements, the DfT should state that additional validation work may be required by an evaluator to confirm the exact locations of schemes and their associated development sites, given the variation in available information, as discussed in Section 6. This could be completed through a combination of desk research and consultations with scheme stakeholders.
	1. Journey time statistics

An evaluation of investments in the road network will require estimates of changes in journey times for those making use of the road network. Although there are benefits in estimating the actual or expected journey time savings associated with road investments as precisely possible, these measures only need be indicative to support the econometric analyses described in section 6 (and can be subjected to sensitivity analysis).

One approach for compiling journey time statistics has been developed by the DfT (Journey Time Statistics). These measures provide estimates of travel times from the centre each Lower Super Output Area (LSOA) to eight different types of destination (primary schools, secondary schools, and further education providers, centres of employment, town centres, food stores, GPs and hospitals). These measures are based on travel times by road and using the public transport network.

1. The statistics use an algorithm that the selects the road or public transport route that minimises the journey times from the set of origins and destinations of interest. The following inputs feed into the modelling of journeys on the road network:
* **Road network:** The road network data is supplied by the Ordnance Survey and feeds directly into the model. It is subject to a lag of between 1 to 2 years. The DfT retains all network data used for journey time statistics in each year.
* **Journey time data:** Speeds along specific road network links are based as far as possible on average speeds recorded in Trafficmaster data based on GPS tracking of individual vehicles. On links with insufficient observations to provide an average, an assumption is derived from the national average for the type of road. Data coverage varies by type of road, ranging from around 90 percent of links on the strategic road through to around 5 percent of minor roads and local streets, with coverage of B roads lying between these extremes. The data is subject to a lag of up to a year.
* **Employment:** Employment information feeding into some of the accessibility measures is derived from Business Register Employment Survey (BRES).
1. The Department began producing these statistics in-house from 2014 using TRACC (a multi-modal transport accessibility tool). This means that there is a greater flexibility and transparency when utilising this data for modelling purposes:
* **Freezing employment shares:** Employment shares in the calculations need to be frozen at pre-enhancement levels to implement the econometric methods outlined in the following chapter. This can be completed straightforwardly as weighting by employment is undertaken separately to the modelling of journey times using TRACC.
* **Specification of origins and destinations:** Origins and destinations are specified in terms of OS grid co-ordinates. Any number or type of origins and destinations can be fed into the modelling, and will not be affected to changes in administrative geography.
* **Removal or addition of links:** The TRACC tool has been developed with the modelling of the effects of new transport links in mind, and it is also straightforward to add or remove links of interest using its graphical interface. As such, overall changes in accessibility driven by schemes of interest can be separated from those driven by other enhancements.

However, there are some potential challenges in using this data:

* **Availability of statistics:** While some initial development of these statistics was completed for 2005, the first official year of the time series is 2007. This means schemes that were completed before 2007 could only be assessed by creating journey time statistics using entirely new data. Journey time statistics calculated by the DfT are also not comparable to those produced by the external consultant prior to 2014 due to differences in the way journey times are calculated. Journey time statistics created by an external contractor may need to be recalculated using the DfT approach.
* **Use of actual traffic speeds:** Journey time statistics can only be calculated using observed speeds from 2010. Prior to this, traffic speed estimates were used, which are thought to overstate actual speeds.
* **Resource requirements:** The recalculation of journey time statistics is expected to be a resource intensive exercise and could not be accommodated within the resources available to the DfT.
* **Licensing:** Commercial and legal access to the relevant road network and traffic speed datasets (and potentially TRACC) would be needed if the computation of local accessibility measures were to be contracted to an external provider. One possibility would be to extend access via the terms of the DfT’s own licences, though further investigation is needed to understand how this would work practically. TRACC is not the only software available to support a potential evaluation, and desk research completed highlighted a range of products, some of which are open source and available publicly.[[7]](#footnote-8)
* **Skills:** Based on a demonstration given by the DfT as part of a prior study, the TRACC tool is sufficiently user-friendly that any contractor with a degree of knowledge and understanding of GIS analysis could complete the analyses required (i.e. transport modelling expertise would not be a strict requirement).
1. There are also alternative, less resource-intensive, approaches that could be applied to derive more approximate measures of changes in journey times and accessibility:
* **Imputation of journey times:** Modelling software can be used to impute journey time savings made in each year. This is completed by subtracting new links from the road network or reducing traffic speeds on links that are enhanced.
* **Simplification of indices:** Computation of journey times could be simplified by decreasing the number of origins and destinations in the calculations (e.g. by using higher levels of geographical aggregation).
* **Expected journey time savings:** There is also a case for using expectations of journey time savings set out in Business Cases (or short term observed time savings) – in place of observed journey time savings to remove the effect of further growth on congestion and traffic speeds. This could potentially address the problems associated with reconstructing the measure for years prior to 2007.

**Recommendation:** It is recommended that the DfT adopts a pragmatic approach to developing journey time statistics as an effective evaluation can be completed with approximate measures of the accessibility impacts of road enhancements. In the first instance, the DfT Journey Time Statistics team should be consulted to understand if the business case for compiling these statistics in-house for a contractor is justified. If not, then these requirements should be externalised to a contractor. The index should follow the approach adopted by the DfT insofar as it is possible to do so, and impute journey time estimates as required. Any suggested changes to the DfT method should be discussed and finalised as part of the evaluation’s design stage. The Contract Manager should consult with the Journey Time Statistics team prior to the commissioning of any evaluation to (1) identify resource requirements for both approaches, and (2) develop an understanding of the support that could be provided by the Journey Time Statistics team to a contracted evaluator, e.g. providing source data for the index and/or advising on the method adopted.

* 1. Business Structure Database: Firm formation, entry, exit, employment and turnover
1. The Business Structure Database (BSD) is an annual snap-shot of the Inter-Departmental Business Register (IDBR) and provides annual measures of employment and turnover on all firms registered for PAYE or VAT, as well as the year of birth and death for those businesses, and their geographical location. The dataset includes details of enterprises and local units (branch sites). The BSD dates back to 1997 and is accessible through the ONS Secure Research Service, and could be used to generate longitudinal data at a small area level on the following metrics:
* **Employment**: Which can be disaggregated by sector using the Standard Industrial Classification (SIC).
* **Firm formation, entry and exit:** the birth and death of firms can be identified through the BSD, as well as tracking location decisions through postcode information.
* **Firm productivity:** Proxy measures of firm level productivity can be derived from the BSD (turnover per worker) which can potentially compensate for the gaps in coverage associated with the ABS, though clearly this is a lower fidelity measure. Turnover per worker may not provide an effective measure of efficiency in some circumstances – for example if road investments facilitate greater outsourcing.

There are some issues associated with the information in the Business Structure Database. It is based on a live snapshot of the IDBR, which in turn is based on PAYE returns, VAT returns, and the Business Register of Employment Survey (and in some cases, data between observations are imputed). These returns arrive with lags and a given observation from the BSD can be between 1 and 3 years out of date. Observations are not ‘time-stamped’ so these lags are in effect unknown. This can introduce challenges for evaluations looking at very short-term impacts (e.g. 1-year post completion of a scheme) but should be less problematic for long term studies. Access to the full postcode of individual firms was also withdrawn in 2019, though ONS have now appended Output Area codes to each firm in the dataset which permits the proposed analysis in Section 5.

* 1. Annual Business Survey: Capital investment and firm productivity

The Annual Business Survey (ABS), conducted by the ONS, is an annual survey of 55,000 firms using the Inter-Departmental Business Register as a sampling frame. It is a sample survey of SMEs and is mandatory for large firms with 250 employees or more (thus providing longitudinal records for this group). The ABS provides microdata on:

* **Fixed Capital Investment:** The ABS provides direct observations of investment in fixed capital by firms.
* **Firm productivity:** The ABS also provides GVA at a firm level (though not site level) which can be combined with figures on employment to provide a measure of average labour productivity. Road investment schemes may alter labour productivity at a firm level by altering the input mix, or facilitating expansion of output – in which case this may represent a scale effect rather than an improvement in efficiency[[8]](#footnote-9). As such, Total Factor Productivity (TFP) may offer superior metrics for evaluating the efficiency gains associated with transport schemes, which can be estimated from data collected through the ABS microdata.[[9]](#footnote-10)
* **Apportionment across local units:** While employment measures captured in the ABS are recorded at the level of local units (i.e. branch sites or plants), revenue and other financial variables are recorded at the level of the enterprise. This means that productivity measures can only be derived at the site level by assuming all sites are equally productive (a strong assumption, but also problematic as each site may be affected to greater or lesser degrees by the transport infrastructure). This issue is driven by the structure of the data and cannot be avoided, though it would be feasible to run analyses that exclude multi-site firms to explore the significance of such issues.
1. Implementation of such data would require a contractor organisation to gain access to the ONS Secure Research Service (SRS), to which any researcher can become accredited, free of charge, if the proposed research outputs of any activities are deemed to support public sector activities, which would be the case in this instance. The main issue associated with the ABS is coverage of SMEs: longitudinal information for individual firms is unavailable as they are covered only through a sample survey. If a road scheme primarily achieves its effects through improving the performance of small firms, then this could prove problematic, though proxy measures capturing the productivity of small firms can be produced using the BSD.
	1. Trade activity
2. Understanding the effects that road enhancement investments might have on trade is important for two reasons. Firstly, this data may help evidence the degree to which transport schemes lead to increases in trade activity. Secondly, evidence on exports can also help develop and establish the extent to which economic activity stimulated by transport schemes may have displaced other domestic activity in the short-term (i.e. on the basis that sales to overseas customers are at lower risk of displacement in the short term than sales to domestic customers). Two data sources were assessed to understand the feasibility of making use of them to support an evaluation of the trade effects of road enhancement investments: the HMRC Datalab and freight statistics developed by the DfT.
	* 1. HMRC Datalab
3. The study team consulted a representative of the HMRC Datalab to understand how trade statistics at a company level could be accessed for the purposes of an evaluation. The HMRC allows approved researchers to access administrative records for public research. From April 2018, access was extended to commercial organisations.[[10]](#footnote-11) The HMRC Datalab contains datasets describing the goods imports and exports of individual producers (by commodity) and could be used to establish changes in international trade activity stimulated by road investments.
4. While this data can be accessed at the aggregate level through UK Trade Info, consultations with HMRC suggest it would not be possible to access company level records under current arrangements because access is only granted for studies focused on issues that HMRC has a direct interest in. These constraints are likely to ease within 18 months – with microdata potentially accessible under the 2017 Digital Economy Act or under a parallel Datalab that may be being established by the Department for International Trade.
5. An additional concern is that trade statistics are typically recorded using the site of a business’s headquarters. This creates issues where businesses have more than one site. This issue could be resolved by restricting the focus of analysis to single site businesses, although any results produced cannot be generalised beyond this type of business (and there is a possibility that larger firms with multiple sites will account for the bulk of imports and exports).
6. **Implication:** The trade statistics held within HMRC Datalab would potentially be useful for a future evaluation but could not be used within an evaluation that was commissioned in the short-term.
	* 1. DfT freight statistics
7. The DfT administers the Continuing Survey of Road Goods Transport to understand the activity of GB-registered heavy goods vehicles (HGVs).[[11]](#footnote-12) This is composed of two surveys that cater for Northern Ireland and Great Britain separately and the time series begins in 2011. Details held by the DVLA are used to draw a random sample of HGVs to provide coverage across a range of vehicle type, vehicle weight, and the traffic area in which the vehicle is registered. The sample size decreased from 11,000 to 7,000 between 2004 and 2017. These surveys provide information on the destination and origin of goods, distance travelled, cargo type and weight. However, the route taken for each freight delivery is not recorded and it is not a requirement to record postcodes. The data is processed and published at the NUTS3 regions.[[12]](#footnote-13)
8. In addition, the International Road Haulage Survey (IRHS) has been used to obtain details of domestic and international activity of GB-registered HGVs since 2011. The information collected is similar to that described above, except that the destination and origin port is also specified, i.e. origin and destination data is given at the level of the port and place of loading / unloading (given as postcode or place name).
9. While the surveys could be used to provide an indication of changes in trade volumes, there are issues with their potential use in an evaluation. The surveys do not record routes taken or journey times and do not provide an indication of whether HGVs surveyed took advantage of the road enhancements delivered, so could only provide general information on the volumes of trade originating in an area. As such, while these surveys may provide a useful indication of any changes in trade activity, it is expected that their analysis may only be indicative in the context of the evaluation being scoped.
10. **Implication:** The spatial resolution of DfT gathered data on domestic and international HGV activity would be insufficient to drive a detailed econometric analysis but could provide useful information that could be examined in case studies in examining general freight movements in the local area or areas covered by road enhancements.
	1. Population growth, wages and unemployment
11. A range of data are available on the extent and quality of labour supply in local areas:
* **Population Growth:** Detailed population estimates at a sufficiently granular spatial scale are only available through the Census of Population (which took place in 2011 and is expected to take place again in 2021). As this information is updated at 10 year intervals, analysis would need to be restricted to long changes in population between the 1991-2011 Census years. This would need to focus on the subset of 104 schemes that were scheduled to open in or before 2011 (75 HE road schemes and 29 Local Major Projects). The Census can also provide useful control variables, such as measures of skills supply (in the form of the education of the resident population), age, unemployment and activity rates.
* **Wages:** The Annual Survey of Household Earnings (ASHE) collects information on the levels, distribution and make-up of earnings and hours paid for employees within different industries, occupations and regions in the UK, and began its series in 2004, replacing the New Earnings Survey. It is a one percent sample of employee jobs taken from HMRC PAYE records (in January of each year) which amounts to approximately 180,000 annual job records. The sample is drawn so many individuals are tracked over time. There are some issues with using the data. The series began in 2004, while some of the road schemes under review opened before this year. Methodology changes have also resulted in breaks in the series in 2004, 2006 and 2011 which may affect comparability across years (largely reflecting implementation of different revisions of SIC and SOC codes). The ASHE does not include self-employed or armed forces earnings.
* **Unemployment:** Unemployment at a small area level can be approximated using the number of Jobseekers Allowance (JSA) claimants in a given geographic area. This can be obtained at small area level from public sources (e.g. NOMIS or the DWP Stat-X-Plore tool). Records of all those receiving benefits have also been linked to HMRC PAYE records as part of the Work and Pensions Longitudinal Study.[[13]](#footnote-14) These datasets could be used to estimate the effect of road schemes on levels of local unemployment. However, measures based on JSA claimant numbers have recently been distorted by the roll out of Universal Credit (UC), which has required new claimants to transfer to the new benefits system which ultimately replace JSA and other income benefits. Differences in the eligibility criteria for JSA and UC have led to inconsistencies in measures of unemployed claimants, and have become increasingly problematic after 2016 as the pace of the roll-out increased. It may be preferable to limit the scope of analysis up to 2016 when examining unemployment.
	1. Planning Permissions, housing starts and completions, land use change, prices
1. Several expected outcomes relate to changes in land use for residential purposes. An evaluation would ideally need longitudinal information on residential planning permissions and starts and completes at the postcode or low level of spatial aggregation. Several data sources have been identified as part of this scoping study that could be suitable for this purpose.
	* 1. Planning permissions, housing starts and completions
2. Two sources of information on permissions and residential housing starts and completions were identified:
* **MHCLG Local Authority Returns:** The MHCLG collects annual data on residential planning permissions, housing starts, and completions.[[14]](#footnote-15) This information is compiled from returns provided by LAs and other administrative and survey data provided by Homes England, the Greater London Authority and the MHCLG. Information on the progress of construction on specific sites is collected through a survey of developers, and only covers larger development sites. Records are provided at the local authority level and at lower levels of granularity for larger developments. Information on the nature of residential development is recorded – for example, whether homes are classed as affordable, or whose construction is funded by a government scheme.[[15]](#footnote-16) Consultees advised that the quality of this data improves from 2007 onwards. Restricting analysis to schemes opened from 2007 would exclude almost half of the Highways England schemes in the portfolio (42 road schemes).
* **Glenigan:** MHCLG has a contractual agreement with Glenigan, a private data processor, which collates planning applications submitted to LAs since 2006. This data provides site postcodes and the number of homes expected to be built. Consultations suggested that there are some inconsistencies between the data and other sources (e.g. LA returns data) – for example, in the number of actual homes constructed at different sites and types of permissions secured. These inconsistencies were thought to be minor and are a product of Glenigan’s validation processes. Analysis using this data source would also be restricted to schemes that opened in or after 2006 and 33 Highways England road schemes could not be included.

It is expected that the evaluator would need to construct the dataset manually or with the support of a data provider because records are stored in a format that is not immediately suitable for analysis. MHCLG also advised that the contract held with Glenigan is only available to MHCLG, Homes England and the Cabinet Office. Descriptive summaries can be shared with other departments under the terms of the contract, but underlying data and platform access cannot. The DfT would need to agree its own contract with Glenigan or seek to extend the existing MHCLG contract, which would involve costs (it was not possible to obtain an indicative cost). MHCLG may be able to support the DfT in securing access through either approach.

1. **Implication:** The spatial resolution of MHCLG gathered data on planning permissions, starts and completions would be insufficient to drive a detailed econometric analysis (though could be integrated into case studies). Proprietary data held by Glenigan does provide the level of detail required but would only be obtainable to DfT at a cost.
	* 1. Land use change

When a piece of land is used in a different way, this has been recorded by the Ordnance Survey (OS)[[16]](#footnote-17) as a land use change as part of the OS map revision process since 1985. Land use categories include those for residential, industrial, office (as well as other commercial activity sites) and retail sites. For each land use change, a range of information is provided including its grid reference, the new and previous land use and any change in the number of homes present (if relevant). The dataset records changes in land use, but does not describe the current use of all land parcels in the UK. These statistics could be used to assess land use change over time in proximate areas to a scheme site. For example, to understand the extent to which vacant sites have been converted into residential sites.[[17]](#footnote-18) It is understood that access to these data could be provided by the OS or MHCLG, but an evaluation contractor would need to complete further scoping to understanding the requirements of data access via MHCLG.

There has been a change in the methodology used to calculate these statistics from 2012 onwards.[[18]](#footnote-19) These changes include amendments to land use category definitions, the method for calculating how densely populated a piece of land is, and the introduction of quarterly estimates of the build out of residential sites. The new methodology is expected to more accurately allocate land to each category. The current guidance does not recommend that the two series are compared, meaning analysis over time would need to use each series separately. However, consultation with MHCLG suggested that the OS may be able to support recalculation of land use statistics using the 2012 methodology for years prior to 2012.

1. **Recommendation:** Annual observations on residential property market activity in target areas of interest would be desirable for the evaluation. Prior to commissioning an evaluation, the DfT should 1) consult MHCLG to understand the resource implications of expanding the MHCLG residential data Glenigan licence to cover DfT needs, 2) secure access to microdata on land use change from OS for evaluation use (confirming whether the data falls under the Public Sector Mapping agreement), and 3) inquire about the viability of an evaluation contractor to access OS land use change statistics to support the development of case study schemes.
	* 1. House prices
2. The Steering Group for the study signalled an interest in understanding the impacts of road enhancements on land values at a late stage. It has not been possible to identify an appropriately detailed database of land values, although changes in the value of land should be capitalised into house prices. Transaction level data is available from the Land Registry though this information does not capture the attributes of dwellings, and it may also be available from private providers although further scoping is required. The ONS publishes details of average house prices broken down by the characteristics of dwellings at an MSOA level. As this was identified as a priority at a late stage, there was insufficient time to fully explore the issues that may be encountered in compiling the data, although it is anticipated that the exercise will prove comparatively straightforward.
	1. Commercial and industrial property development
3. As discussed in Section 3 above, investments in the road network may result in economic performance effects through changes in commercial and industrial property markets. For example, a bypass road construction may increase the supply of land made available for the development of office space, or increase the rental value of nearby commercial lettings. An evaluation could attempt to observe these effects by collecting longitudinal information on commercial and industrial property markets, including measures of rental values, commercial ratings and commercial floor space. The study team reviewed commercial and industrial property market data from a number of sources, including privately managed data platforms and government departments:
* **Commercial development and rental values:** A range of data providers compile commercial real estate information from a range of different sources – for example, LA planning permission websites. One such platform is called Costar, which tracks over 500,000 commercial properties in the UK. It keeps records on a range of information, including annual records of planning applications, commercial building starts and completions, available floor space, and rental and sale values[[19]](#footnote-20). These measures could be used to understand the extent of any development within the vicinity of road enhancement schemes and assess whether commercial development objectives of specific schemes were met.

However, there are practical issues related to using the data. There is a cost associated access the platforms. The platforms do not readily provide information in a format that is useful for an evaluation, and there are likely to be additional costs associated with manipulating existing data. Finally, in the case of Costar, the platform was reported to be demand driven, and completion of data fields is prioritised by user needs. As a result, the information may not include all commercial properties or have complete records for listed properties.

* **Commercial rating values:** The Valuation Office Agency (VOA) publish central ratings lists, which are updated when properties are developed and at regular intervals for the purposes of setting business rates. Rating lists include an estimate of the rent the property could have generated on a specific date and their gross internal area. This dataset could provide longitudinal records of the supply of floor-space and rents to drive a later evaluation. The records are only available publicly through the VOA portal for the years 2005, 2010 and 2017, which means analysis is restricted to understanding long changes between these periods.[[20]](#footnote-21) Rating values may not always reflect market rents because valuations assumes that properties are vacant, to let and in reasonable repair, and that rent excludes other charges taxes and insurance.
1. **Recommendation:** It is desirable that the evaluation has access to annual observations on commercial property market activity in target areas of interest. Prior to commissioning an evaluation, the DfT should 1) as part of the Glenigan licence consultation, as described above, assess the resource implications of extending the licence to cover commercial property markets, 2) should this not be viable, the DfT should consult Costar to understand the financial implications for access for the context of an evaluation, and 3) in any evaluation commissioning documents provide clear signposting to commercial rating values published by the VOA.
	1. Summary
2. Table 4.2 below summarises the recommended data sources for the evaluation; it should be straightforward to gather the relevant data in most cases. The areas that are most problematic relate to domestic and international trade outcomes.
	* + - 1. Outcomes and data sources

| Key Outcome | Recommended Source | Issues |
| --- | --- | --- |
| Intended Scheme Outputs: New Road Links, Enhanced Road Links, and Development Sites |
| Scheme characteristics  | Scheme documents;Desk research; Stakeholder research  | * Economic development objectives not always explicit
* Scheme documents do not always detail the locations of development sites
* Additional desk research and stakeholder consultations may be required
 |
| Development site locations  |
| Accessibility Outcomes |
| Reduced Journey Times and Congestion | DfT Journey Time Statistics; Manually journey times  | * DfT statistics begin from 2007.
* Statistics may require recalculation to implement proposed methodologies.
* Recalculations could be externalised if DfT supply required input data.
 |
| Firm Level Impacts |
| Employment  | SRS - Business Structure Database  | * Data is associated with time lags of up to three years in some cases.
* Access to full postcode data has been recently withdrawn though the ONS has added Output Area codes to the dataset.
 |
| Firm Formation, Entry and Exit |
| Increase in Productivity | SRS - Annual Business Survey | * The ABS is a census of large firms and a random probability survey of SMEs. This can be handled in the analysis.
 |
| Capital Investment |
| Increased Firm International Competitiveness  | HMRC Data lab; DfT Freight Statistics | * HMRC records cannot currently be accessed to support an evaluation but are likely to be made available in the comparatively near future.
* DfT freight statistics are not provided with sufficient level of spatial detail.
 |
| Labour Market Impacts |
| Population growth  | Census - ONS | * Longitudinal observations only available every 10 years.
* Analysis of population impacts will need to be limited to older schemes.
 |
| Wages | SRS – Annual Survey of Hours and Earnings  | * ASHE began in 2004 meaning oldest schemes would need to be excluded.
* Methodology revisions feature in series that require acknowledgment.
* Does not include self-employed or armed forces earnings.
 |
| Unemployment  | NOMIS or the DWP Stat-X-Plore | * Data distorted by roll-out of Universal Credit. Analysis may need to be restricted to periods up to 2016.
 |
| Development Impacts |
| Planning Permissions | Third party provider  | * Potential associated data charges.
* Data series began in 2006 requiring exclusion of older schemes.
 |
| Housebuilding |
| Land use change | Ordinance Survey | * Data covers changes in land use only.
* Guidance does not recommend comparisons before and after 2012.
 |
| House prices | Land Registry/ONS | * May provide evidence of impacts on land values.
 |
| Commercial and Industrial Development | Third party provider; VOA  | * Potential associated data charges.
* VOA data only available for the years 2005, 2010 and 2017.
* Rating values may not accurately reflect property market values.
 |

1. **Source:** Ipsos MORI (2019). *N.B.: Green indicates that the data can be obtained straightforwardly with low or minimal cost. Yellow indicates that some useful data is available – though with constraints on its coverage, availability, or costs. Red indicates there is insufficient data available for this evaluation.*
2. Quantitative Impact Evaluation Approaches
3. This section provides an overview of the set of quasi-experimental methods that could be applied to measure the local economic impacts of road enhancement schemes.
	1. Introduction
4. A quantitative impact evaluation is expected to involve pooling the set of road enhancements identified in Section 2, and applying econometric methods to quantify their average effects on the outcomes identified in Section 3, using the data described in Section 4. The design of this evaluation involves two key sets of considerations:
* Areas benefitting from road enhancements need to be compared to areas that do not but are otherwise equivalent to generate credible quantitative estimates of impact. Different ways of constructing this comparator group and the issues they raise for the evaluation are explored in Section 5.2.
* Issues of comparability can only be partly addressed through selecting an appropriate comparison group of areas that do not benefit from road enhancements. An evaluation design also needs to consider how those comparisons are made, and potential approaches are considered in Section 5.3.
1. This section was developed through a review of academic literature and consultations with methodological experts. This section does seek to address issues in designing case studies of individual schemes, which are explored in Section 6.
	1. Development of counterfactual
2. Quantitative impact evaluations involve comparing those affected by a policy or programme (e.g. areas, individuals or firms) to a comparison group made of those that were not (or groups that were less intensively affected). If those comparisons are to provide valid insights into the impact of the policy or programme, those in the comparison group should be equivalent to those affected by the intervention in all respects other than that they did not benefit from the intervention. As random allocation of resources is not a feasible option in the circumstances[[21]](#footnote-22), there are several challenges involved in selecting an appropriate comparison group:
* **Reverse causality:** A central problem arises from potential biases driven by scheme placement decisions. There is a risk that the areas selected to benefit from road enhancements are chosen because firms located near the scheme are expected to grow in the future, or that past planning decisions have been made that may encourage greater levels of physical and economic development, stimulating local population and economic growth (a reverse causality problem). If so, areas that benefit from road enhancements might be expected to grow more rapidly than those areas that have not, regardless of the investments made. As such, basic comparisons between areas that do and do not benefit from road enhancements are likely to overstate their impacts.
* **Absence of areas not affected by road enhancements:** There is also a broader problem in that any given transport investment has the potential to improve accessibility to all areas in the UK. While the relative importance of these improvements may be negligible for areas a long distance from the scheme, an evaluation will need to be sensitive to the issue that there are no areas that do not benefit, just areas that benefit to variable degrees.
1. These types of difficulties can be minimised (though not fully eliminated) through choices made in the selection of the comparator group and/or the application of appropriate analytical techniques. The following subsections explore different possibilities for establishing a counterfactual group. It should be noted that there are other approaches to developing counterfactuals that could be applied – such as comparing out-turn data to the ‘no intervention’ predictions generated by transport models. These alternatives have not been considered as they are less effective in establishing causality as they do not establish the counterfactual scenario with empirical data.

Areas forming the focus of unfunded road schemes

One possibility that has been explored was to construct a comparison group of proposed schemes for which Business Cases were prepared but did not receive funding. In principle, those areas with the potential to benefit from unfunded schemes can be considered to share some features with the areas benefitting from funded schemes (e.g. in terms of underlying motivations to prepare a Business Case). While in principle this would be the preferred approach – particularly as failure mainly resulted from difficulties in securing planning or other legal permissions - conversations with the DfT and Highways England suggest that it is unlikely to be viable. There has not been a fixed application or approval process over the time frame of the potential evaluation, and the rationale for selecting schemes and those responsible for making investment decisions, have changed several times since the 2000s (e.g. there was reportedly an increased focus on the value for money of schemes from 2010 onwards). Additionally, the population of unfunded schemes was thought to be small as where schemes were not cost-effective, proposals dropped out of the process before the Business Case was formalised.

**Implication:** Discounted or unfunded project proposals could not be used as a possible counterfactual group of areas that have not benefitted from road investments, as the population from which a sample could be drawn is insufficiently large.

Early versus late (pipeline design)

1. An alternative approach would be to focus only on those areas that benefited from transport investment (e.g. areas within a certain distance of the relevant link), using road schemes that were completed in later years as a counterfactual for those completed in earlier years. This assumes that the effects of road enhancement schemes, if any, should be visible amongst the group of earlier schemes first. The benefit of this approach is that areas benefiting from road schemes funded may be assumed to have similar characteristics, reducing the problems driven by systematic differences between places that benefit from road infrastructure investment and those that do not. The set of schemes that could form the focus of an evaluation have been completed since the early 2000s, and exploiting staggering in completion dates is a practically viable.
2. The adoption of this approach requires alertness to two issues:
* **Availability of data:** Implementation of this type of approach carries restrictions in that it requires longitudinal (i.e. annual) data on the outcomes of interest, though as demonstrated in the preceding section, data availability is such that this would not impose significant constraints on the richness of a potential econometric study.
* **Systematic differences over time:** This approach will provide an unbiased estimate of the impacts if there are no systematic differences between schemes that were completed at different points in time. Results could be biased if there is a link between the timing of scheme completion and the outcomes of interest. As an example, if schemes funded in later years had greater focus on facilitating economic growth than those funded in earlier years, then basic comparisons would likely understate the effects involved. This is a possibility given the apparent changes in selection criteria and in the external economic environment over the period of interest. As shown in the figures below, there is observable variation in the type of investments made over time between 2002 and 2019. Schemes involving development of new links decrease in prevalence over the period. While restricting comparisons to areas that benefitted from road enhancements will mitigate some of the issues that could distort comparisons, there will still be residual issues that will need to be handled in the way that comparisons are made, which is the focus on the following section.
	+ - 1. Overview of scheme type by year
1.
2. **Source:** Ipsos MORI (2019). *Analysis of HE and Local Major Project scheme documentation.*

Summary of options

1. The table below provides a summary of the comparison group options discussed above and their associated analytical and practical issues.
	* + - 1. Comparison of options for constructing a comparison group

|  |  |  |
| --- | --- | --- |
| Approach | Description | Robustness |
| 1: Before and After  | Comparisons of key outcomes of interest both before and after the opening of a scheme. Any causal estimates produced will only be valid if no other factor contributed to the overall changes observed in reality. | SMS Level 1 |
| 2: Distance-decay models  | Comparing areas close to and further from road enhancements - offer a straightforwardly implementable approach for assessing the impact of both road enhancements to improve accessibility, and the provision of link roads to facilitate access to development sites (assuming it is feasible to establish a database of relevant sites). | SMS Level 3  |
| 3: Accessibility modelling | Using frozen measures of accessibility to employment to evaluate the economic performance impacts of road enhancements designed to improve accessibility. Implementation of the approach will use much the same data as that required for distance-decay modelling, with the main practical issues likely to arise in constructing accessibility indices (as discussed elsewhere). | SMS Level 4  |
| 4: Generalised propensity scores | The DfT should consider the value of including a GPS approach within an evaluation programme. The approach could offer additional robustness checks on the findings of other approaches, as well as additional information on the nature of the impacts of road enhancements. However, the approach is highly involved and will incur associated costs. | SMS Level 3 / 4 |

1. **Source:** Ipsos MORI (2019).

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| 1. **Recommendation:** The analysis should be restricted to postcodes (or small areas) within a certain distance of the sample of road enhancements to limit possible biases driven by differences between areas that do and do not receive investment. The boundaries should be drawn to include areas whose connectivity is materially enhanced by the nature of the enhancement. A 30km distance appears reasonable from other studies though this should be probed in the initial steps of the analysis.
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* 1. Estimating economic performance effects
1. The following subsections specify the set of analytical approaches that could be implemented to evaluate the economic performance impacts of road schemes. The discussion below focuses on how comparisons are made, drawing on the proposed set of comparison areas described in the preceding section.
	* 1. Approach 1: Before and after
2. The most basic form of evaluation would involve pre and post comparisons of key outcomes of interest, focusing only on those areas in the vicinity of the schemes that received investment. This requires the ability to observe key outcomes of interest before and after scheme completion but it does not require the selection of the counterfactual. This approach would produce credible estimates of impact only under conditions of high certainty that no other wider external factors contributed to changes in outcomes of interest. However, this will almost certainly not be the case in this scenario – local economic growth outcomes will be influenced by large number of external factors.
3. **Recommendation:** A before and after approach is unlikely to offer insight into the casual effects of road investment schemes and is not recommended for an evaluation programme.
	* 1. Approach 2: Distance-decay models

As highlighted above, an evaluation will need to be sensitive to the issue that all areas will benefit from the programme to a variable degree. One way of addressing this issue is to adopt proximity to the road infrastructure investment (or a development site to which the road provides access) as a proxy measure of this variability, on the basis that areas closer to the investment are likely to benefit to a greater degree than those further away. This borrows ideas from several recent studies examining the spatial impacts of policies and programmes, including an analysis of relocation of public sector functions motivated by the Lyons Review[[22]](#footnote-23), and a study assessing the local economic development impacts of investments in land and property funded through the Single Regeneration Budget[[23]](#footnote-24).

This approach can be operationalised by creating a variable that captures the strength of exposure, considering:

* **Distance:** As shown in Figure 5.2, postcodes or areas near the scheme can be allocated to ‘buffer zones’ of increasing distance from entry points to new or enhanced road links, or the location of new sites opened up for development[[24]](#footnote-25). Comparing the outcomes of interest before and after the road enhancements within these zones - relative to enhancements that were funded later - will yield estimates of the effects of the road infrastructure in each of the zones[[25]](#footnote-26). These estimates will be sensitive to local displacement, multiplier and crowding out effects. If the investment causes the relocation of economic activity from zones further away to zones nearby, this will be visible in positive impacts in buffers closer to the scheme and negative impacts further away. This is illustrated in panel B, with positive effects in the first and second ring, but negative effects in the third.
	+ - 1. Visual representation of dose-response models

**B. Concentric circles around a development site**

**A. Treatment corridor around a new link**



**Source:**Ipsos MORI (2018).

* **Intensity:** This approach has simplistic elements in that the effects of the intervention are modelled in a binary fashion - postcodes in each zone are assumed to benefit from the new infrastructure from the point it is completed. This does not allow for variations in the size of the journey time savings or the scale of development activity potentially accommodated. For those projects facilitating access to employment or residential development sites, measures of distance could be combined with measures of the gross outputs associated with individual schemes (e.g. hectares of land made available for development) to give a measure of intensity that accounts for distance and intensity of treatment.A similar approach relevant to projects providing new and enhanced links is provided in the following section.

However, there are trade-offs with respect to robustness, as flagged in Gibbons (2017)[[26]](#footnote-27). The approach suffers from a risk of endogeneity problems, as the site locations or routes were likely to have been chosen based on their potential to accommodate expected economic growth. Areas closer to the developments may have been expected to grow more rapidly than those further away, creating a risk of biased estimates of impacts. These risks can be reduced through sample selection as recommended above (e.g. restricting the analysis to postcodes within a pre-defined distance of the road infrastructure) or by allowing for area level fixed effects. The approach would offer an acceptable level of robustness but it should be stressed that it would not be possible to fully eliminate concerns regarding possible bias driven by unobserved differences between areas.

1. **Recommendation:** Distance-decay approaches offer a promising and straightforwardly implementable approach for assessing the impact of both road enhancements to improve accessibility, and the provision of link roads to facilitate access to development sites (assuming it is feasible to establish a database of relevant sites). The approach offers an acceptable level of robustness, but will not fully eliminate possible sources of bias. It is recommended that this evaluation strategy forms part of the evaluation programme.
	* 1. Approach 3: Accessibility modelling

A small number of studies have attempted to measure the impacts of road improvements using accessibility measures. Gibbons et al (2017)[[27]](#footnote-28) used an index of changing employment accessibility[[28]](#footnote-29) to estimate the impact of new road links on firm employment and productivity. The index measures the amount of employment reachable from a given location per unit of travel time using the road network. Improvements to the network reduce travel times between locations and increase employment accessibility. The research found positive effects on employment and numbers of local workplaces, but no employment response amongst incumbent firms. The study also found effects on labour productivity and wages at the firm level (including incumbents). The study covered 31 improvements to major roads between 1997 and 2007 ranging in cost from £20.5m to £0.9bn.

1. The central analytical issue addressed by the study related to the reverse causality problems described above. The study adopted the following key measures to mitigate these risks:
* **Time invariant area and time effects:** It was anticipated that areas with a productive advantage would be more likely to benefit from transport connections. Econometric models were specified to allow for unobserved area level effects (accommodating these effects to the extent that these advantages do not vary over time). Allowances were also made for unobserved time specific effects to capture macro shocks affecting all areas.
* **Scheme objectives:** The study focuses solely on new linkages in the strategic road network (completed between 1998 and 2007) that have the objective of reducing journey times over long distances.
* **Spatial focus**: The study included an area within 20km of the improvements themselves (on the basis that variations in planning policy and the characteristics of local firms within those zones will be incidental to the main aims of the scheme). This focussed the analysis on local economic performance improvements and could omit benefits for users of the road network located far from the improvement. It would be possible to extend the analysis to areas further from the improvement to explore these potential effects. However, relative changes in accessibility at long distances are likely to be small and effects more difficult to detect. Limiting this type of sensitivity analysis to sectors that use the road network most intensively could be instructive.
* **Frozen employment shares:** Changes in accessibility at an area level can be caused by changes in the road network and changes in the spatial distribution of employment. As accessibility measures are directly affected by the outcomes (as well as unobserved economic shocks at a sub-regional levels), this also introduces a risk of generating biased results. This was addressed by recalculating local accessibility measures with the spatial distribution of employment frozen at pre-improvement level, to pick up changes in accessibility driven only by changes in the road network). This measure is correlated with actual changes in transport connectivity and uncorrelated with changes in the outcome variables so is a suitable instrument for identifying the causal effects involved.
* **Exclusion of areas very close to the improvement:** Areas very close to the improvement (within 1km) are excluded from the analysis. This step was taken to avoid the risk of bias driven by choices regarding the specific route of the scheme (e.g. if the route was chosen on the basis of low land prices then this may reflect low productivity at the local level) and because of any negative physical or environmental impacts in proximal scheme locations that might be caused during the completion of physical works. This step could also be incorporated into the distance decay approach.
* **Calculation of journey times:** Estimates of journey times between origin and destination pairs were generated using an optimisation algorithm that calculated the minimum journey time along the road network. Journey times were based on 2003 observations of traffic flows (with journey times for linkages opened after 2003 imputed on the basis of a regression analysis designed to predict journey times based on the characteristics of the links involved, such as length, classification, traffic volumes). This does not fully address issues of endogeneity for schemes completed prior to 2003. Journey times in 2003 will have been partly affected by congestion which in turn could be linked to employment growth that took place prior to this date. This issue was mitigated by focusing only on traffic flows in the non-busy direction (as these measures are less likely to be affected by economic growth in the interim period than flows in the busy direction).
1. **Recommendation:** Approaches based on using frozen measures of accessibility to employment offer a more robust way of evaluating the economic performance impact of components of road enhancements designed to improve accessibility (i.e. the approach would attain Level IV rather than Level III on the Maryland Scientific Methods Scale). Implementation of the approach will use much the same data as that required for distance-decay modelling, with the main practical issues likely to arise in constructing accessibility indices (as discussed elsewhere). It is recommended that this approach also forms part of the evaluation programme.

The method was developed explicitly to examine the impact of new and enhanced road linkages – and cannot be applied to schemes focused largely on bringing forward physical development (i.e. the instrument variable – accessibility - could not be expected to be correlated with the outcomes of interest for such schemes). There are also analytical issues:

* **Congestion alleviation, anticipation effects, and induced traffic:** Difficulties arise from the possibility that journey times themselves are endogenous. For example, if congestion alleviation leads onto further employment growth, this may increase congestion and then reduce accessibility. It would be preferable to use a measure of the traffic speeds that is frozen after the completion of the scheme (potentially observable at one year from the POPE studies). However, observed traffic speeds could be problematic if there are anticipation effects – i.e. firms or residents moving to an area in advance of scheme completion – or if the response to road enhancement is rapid. Using the modelled changes in traffic speeds from the Business Case, which give expected journey time savings, could be explored in sensitivity tested.
1. **Recommendation:** The sensitivity of the results to the construction of the accessibility index should be tested in the evaluation. The index should be constructed based on (1) observed changes in traffic speeds, (2) observed changes in traffic speeds after one year, and (3) expected changes in journey times expressed in the Business Case.
* **Separating the effect of link roads from development activity facilitated:** A subsample of 31 schemes involve road enhancements to improve connectivity and link roads to development sites. On the assumption that the development sites of interest will be close to the new or enhanced links, then there is a risk that the approach conflates the impacts associated with enhanced connectivity with those driven by development outcomes. Exclusion of areas within 1km of the development may help in removing these possible impacts, but further sensitivity analysis should be considered in the evaluation programme.
1. **Recommendation:** The analysis should be completed with and without the inclusion of schemes with significant development objectives to test the sensitivity of results to this.
	* 1. Approach 4: Generalised Propensity Scores

One final possibility explored is a Generalised Propensity Score (GPS) approach developed by Professor Dan Graham (2014) to examine the impact of urban road network capacity expansions in US cities[[29]](#footnote-30). The approach has similarities to the accessibility modelling approach, exploiting variability in the strength of the accessibility improvements brought about by transport schemes to identify their impacts. The approach offers flexibility to explore how far the strength of those impacts may vary over different changes in accessibility and how far there are diminishing returns to accessibility.

The focus of the study was on estimating the impact of increases in road capacity (measured in terms of lane miles) on traffic demand and productivity (measured in terms of wages) in US cities between 1986 and 2007:

* **Propensity scores:** The method involves adaptations of the propensity score matching approach which is applied in situations where firms or areas either benefit from a programme or they do not (a binary treatment). The approach involves applying statistical models (logit or probit models) to estimate the likelihood that firms or areas with a particular set of characteristics benefits from the intervention. A binary approach could not be used as each US city received a different ‘dose’ of the intervention (i.e. expansion in lane miles) over the period in question. Propensity scores were instead based on estimates of the likelihood that each city saw an expansion in lane miles of different sizes, based on the characteristics of those cities. The longitudinal structure of the data was exploited to allow for unobserved characteristics of cities that do not change over time. The approach could be adapted to the UK context - i.e. using small areas (OAs or LSOAs) as the unit of analysis, and deploying accessibility measures as the quantum of dose.
* **Common support:** The propensity scores are then used to identify the set of cities with similar characteristics (i.e. the region of ‘common support’ where cities share similar propensity scores), with other cities discarded.
* **Estimates of impact:** Regression analysis is then used to estimate the relationship between the outcomes of interest (e.g. productivity, employment) and the treatment (increase in lane miles or accessibility) while controlling for the propensity score. Averaging the predicted responses at different ‘doses’ gives estimates of how far the impacts of the road enhancements varies across the magnitude of accessibility improvements brought about by road enhancements.

In principle, the approach offers broadly equivalent robustness to Approach 2, in that similar strategies are taken to control for observed and unobserved confounders. The approach is substantially more involved requiring multiple modelling steps.

1. **Recommendation:** The DfT should consider the value of including a GPS approach within an evaluation programme. The approach could offer additional robustness checks on the findings of other approaches, as well as additional information on the nature of the impacts of road enhancements. However, the approach is highly involved, requires specialist skills and will incur associated costs.
	1. Sample sizes

The statistical power of any analysis is determined by the number of firms or areas affected by the schemes under evaluation.[[30]](#footnote-31) This cannot be known before beginning the evaluation exercise, so an approximate assessment of the sufficiency of sample sizes was made based on the number of schemes that could potentially be included within the analysis. This assessment was guided by the proof of concept provided by Gibbons (2017)[[31]](#footnote-32), in which 31 schemes (amounting to 318km of road) proved sufficient to identify statistically significant effects:

* **Accessibility improvements arising from new or enhanced link roads:** The review identified 99 Highways England and 79 DfT Local Major Projects that could potentially be included within the scope of an evaluation focused on accessibility improvements. This should provide enough schemes to both support an analysis at the aggregate level and enable comparisons between the relative effects of Highways England road schemes and DfT Local Major Projects (as well as other possible subgroups of interest). Should schemes before 2008 not be available due to difficulties in producing accessibility statistics, a total of 118 schemes (41 Highways England road schemes and 77 DfT Local Major Projects) could be considered to form the focus on a potential evaluation; just under 70 percent of all schemes in the portfolio.
* **Provision of access roads to development sites:** It is more challenging to establish on an ex-ante basis how the sample of 31 schemes with significant development objectives would be sufficient to support statistical analysis, as the total number of relevant land parcels and sites is currently unknown. It is suggested that this is revisited once a database of relevant sites has been assembled.
1. **Recommendation:** Sample sizes are likely to prove sufficient for detailed analysis of the impacts of accessibility improvements brought about by road enhancements and to support the desired comparisons (e.g. between DfT Local Majors and Highways England road schemes). There is more uncertainty regarding the scope to complete general statistical analysis of the impacts of providing access to development sites because it is not clear how many sites can be identified. This will need to be revisited once a database of relevant sites has been established as part of the planning stages of the evaluation.
	1. Controls
2. The analyses above could also be enhanced by controlling for other characteristics of the areas in the scope of the analysis that could determine the local economic performance outcomes of interest. Variables that could be considered include:
* Industrial structure (e.g. share of employment in primary industries, manufacturing, construction and services).
* Economic and/or population density.
* Skills supply, unemployment, and the productivity of the local workforce (as visible in wages).
* Planning designations.
* Other infrastructure (e.g. quality of local broadband infrastructure).
1. As these aspects could be influenced directly by the road enhancement (i.e. they are potentially endogenous), these controls should be frozen at pre-enhancement levels.
	1. Relative impacts of different types of scheme
2. The analysis will offer an opportunity to explore how far the economic performance impacts of road enhancements vary across different types of scheme and local contexts. Avenues of potential exploration could include:
* Type of scheme – new links versus enhancements to existing links.
* Nature of enhanced linkages – e.g. inter urban, urban, rural.
* Distribution of firm performance effects by sector.
* Distribution of effects by regional productivity and/or resource utilisation.
* Distribution of effects by baseline levels of traffic, congestion, and employment accessibility.
* Distribution of effects by local economic structure.

This could be achieved by restricting the analysis to subgroups of the relevant schemes or by interacting these variables with measures of exposure to the road enhancement.

* 1. Summary
1. In terms of a recommended approach:
* **Overall viability:** A variety of quantitative approaches to impact evaluation are available that are comparatively straightforward to implement, offer acceptable levels of robustness, and are unlikely to be constrained by sample sizes. There is uncertainty as to how far a database of sites can be constructed to explore the impacts of those components of schemes providing access roads to development sites.
* **Pipeline design:** Any analysis should be restricted to postcodes (or small areas) within a certain distance of the sample of road enhancements in the population of schemes to limit possible biases driven by differences between areas that do and do not receive investment. This approach effectively treats areas receiving investment later as a counterfactual for those receiving investment earlier. A 30km distance appears reasonable from other studies though this should be probed in the initial steps of the analysis.
* **Triangulation:** There are three plausible analytical strategies that can be applied to address potential reverse causality problems. It is recommended that multiple approaches are adopted (at minimum, the distance-decay and accessibility modelling approaches) to help confirm findings and raise confidence in robustness. An overview of the three strategies are provided below.
	+ - * 1. Analytical approaches

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| Approach | Description | Robustness |
| 1: Before and After  | Comparisons of key outcomes of interest both before and after the opening of a scheme. Any causal estimates produced will only be valid if no other factor contributed to the overall changes observed in reality. | SMS Level 1 |
| 2: Distance-decay models  | Comparing areas close to and further from road enhancements - offer a straightforwardly implementable approach for assessing the impact of both road enhancements to improve accessibility, and the provision of link roads to facilitate access to development sites (assuming it is feasible to establish a database of relevant sites). | SMS Level 3  |
| 3: Accessibility modelling | Using frozen measures of accessibility to employment to evaluate the economic performance impacts of road enhancements designed to improve accessibility. Implementation of the approach will use much the same data as that required for distance-decay modelling, with the main practical issues likely to arise in constructing accessibility indices (as discussed elsewhere). | SMS Level 4  |
| 4: Generalised propensity scores | The DfT should consider the value of including a GPS approach within an evaluation programme. The approach could offer additional robustness checks on the findings of other approaches, as well as additional information on the nature of the impacts of road enhancements. However, the approach is highly involved and will incur associated costs. | SMS Level 3 / 4 |

1. **Source:** Ipsos MORI (2019).
* **Sensitivity analysis:** The sensitivity of the results to the construction of the accessibility index should be tested in the evaluation. The index should be constructed based on (1) observed changes in traffic speeds, (2) observed changes in traffic speeds after one year, and (3) expected changes in journey times expressed in the Business Case. Additionally, the analysis should be completed with and without schemes with significant development objectives to test the sensitivity of results.
* **Relative impacts:** There is an opportunity to explore how far the impacts of schemes vary across different types of enhancement and local economic context.
1. Several limitations should be borne in mind:
* **Local impacts:** Theapproaches focus on establishing local impacts and produce results that are net of displacement and crowding out. While in principle the methods could be extended to explore effects further from the enhancement, such effects may be difficult to measure in practice (or could produce spurious findings).
* **Link to appraisal methods**: The methods will not discriminate between effects driven directly by reductions in generalised travel costs and wider economic benefits, which are given separate treatment in TAG. Additionally, the analysis will provide an estimate of all local economic impacts, which are only included in appraisals where justified by a specific market failure.
* **Timeframes:** The analysis would cover schemes that are up to 16 years old. This is a shorter time horizon than typically considered in appraisals.
1. Scheme Case Studies
2. This section considers the possible uses and design of case studies that focus on understanding the economic performance impacts of road enhancements. Case studies are defined as mixed methods studies examining the economic impacts of individual schemes based on evidence collected after they have been completed. Case studies add value to the methods set out in the preceding section by explaining how and why the observed efforts came about.as to how or why road enhancements bring those effects about. It was developed using the results from consultations with DfT and Highways England officials and a review of existing monitoring and evaluation approaches.
	1. Existing scheme-level evidence and key gaps

Scheme promoters complete a range of monitoring and evaluation activities focused on demonstrating the effects of individual road enhancements. This subsection provides an overview of these evaluation arrangements and the degree to which they produce reliable evidence on the ex-post economic performance impacts of road schemes.

* + 1. Local Major Projects

The DfT requires all local scheme delivery leads to develop a monitoring and evaluation plan.[[32]](#footnote-33) These require scheme promoters to complete evaluations approximately one and five years after scheme opening. Since 2012, when the latest guidance was issued, evaluations have been tiered into three categories: standard monitoring, enhanced monitoring and fuller evaluation. The final category requires a more intensive assessment of the implementation and performance of a scheme and are required when the scale of investment is high.

The guidance states that all schemes should monitor impacts on the economy. For those schemes completing a fuller evaluation, an economic evaluation is also expected. Economic evaluations should update the ex-ante appraisal models using observed data (though this will only provide a useful guide to the impact of the scheme if the underlying modelling assumptions were appropriate). In addition to assessing journey times impacts and changes in rental values (as prescribed in standard monitoring requirements), an economic evaluation is required to assess the magnitude of any benefits relating to congestion relief, access to job opportunities and local services, development and job creation outcomes, including indirect effects via firm relocation and expansion.

There is a range of evidence that evaluations of existing schemes do not provide useful or rigorous material regarding their economic impacts. A meta-evaluation of scheme evaluations that reviewed evidence from 23 monitoring and evaluation reports prepared between 2007 and 2013 highlighted these limitations.[[33]](#footnote-34) The meta-evaluation suggested that good evidence was produced on changes in journey time savings and/or reliability, but little evidence was presented on the extent or nature of long-term economic impacts. A recently published ‘fuller’ evaluation reviewed by the study team sought to demonstrate the wider economic effects by describing changes in economic performance at the borough level relative to country averages, making no attempt to attribute those changes to the scheme (e.g. by incorporating evidence gathered from those affected or through the application of statistical methods). There was also no attempt to determine how far anticipated development activity came forward in the locations expected or the role of the scheme in enabling that development to take place.

Process evaluations incorporated as part of these studies also tend to focus on the process of road construction, rather than processes employed to ‘lock-in’ developers to secure the anticipated development impacts. For example, in the fuller evaluation mentioned, the process evaluation sought to understand what had been delivered and how efficient the delivery process had been.[[34]](#footnote-35)

* + 1. Highways England road schemes

Highways England undertake a Post Opening Project Evaluation (POPE) for one and five years after schemes open. The aim of POPE is to understand the extent to which impacts expected at the appraisal stage are achieved, and inform the improvement of current and future appraisal methods (by comparing achieved and forecasted impacts), identify examples of best practice, provide accountability to key stakeholders and promote transparency in the uses of taxpayer money.[[35]](#footnote-36) The criteria are applied shown in the table below. These effects are monetised where possible and reviewed against expectations. In addition, a meta-evaluation of completed POPE studies is delivered every two years, and in 2017, and a series of case studies were commissioned for eight Highways England major road schemes, as part of a wider programme of work on understanding how schemes affect economic performance.[[36]](#footnote-37)

* + - * 1. Overview of POPE criteria

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| POPE review categories | Assessment description |
| Scheme objectives  | Whether Schemes are achieving their objectives. |
| Traffic | Impacts of schemes on traffic flows, journey times and journey time reliability. |
| Safety | Impacts of schemes on numbers of collisions |
| Economy  | Overview of expected economic effects in terms of monetised effects of the previous categories |
| Environment  | Impacts of schemes on environmental factors, including noise pollution, air quality, water and landscape.  |
| Integration  | Extent to which scheme is positively integrated with other investment activity. |

1. **Source:** Highways England (2015). *Post Opening Project Evaluation (POPE) of Major Schemes Main Report – Meta analysis 2015. Available at:* [*https://bit.ly/2ZkrtEi*](https://bit.ly/2ZkrtEi)*. Date accessed: Aug 2019.*

A meta-evaluation of 81 POPE studies covering schemes delivered between 2002 and 2012 suggested they did not systematically account for wider economic effects and concluded there was only ‘anecdotal evidence to show that Major Schemes have assisted local and regional economic development.’[[37]](#footnote-38) Most schemes only produced qualitative evidence of wider economic impacts. Stakeholders also suggested that schemes only began to have explicit objectives associated with wider economic benefits in recent years, which may explain the limited availability of relevant evidence.

Highways England is beginning to examine how these wider effects could be incorporated more systematically but this is at an early stage.[[38]](#footnote-39) A recent Highways England sponsored study incorporated eight case studies of the growth impacts of past schemes was an attempt to address the gap in evidence on the regional development impacts of road enhancements.[[39]](#footnote-40) This study involved interviews with local authorities alongside a review of contextual data and considered how far the explicit development objectives of schemes had been met (e.g. the degree to which specific sites had come forward for development). However, the strength of the conclusions that could be drawn was comparatively limited in that issues of attribution were dealt with solely using the views of local officials with no validation from other local stakeholders (e.g. developers, property agents, or local businesses). There was also limited quantification of key measures of local economic performance, such as changes in the productivity and employment of local firms or issues regarding the entry and exit of local firms (and how far those aligned with ex-ante expectations), making it difficult to draw out conclusions regarding the scale of local economic impacts associated with schemes.

1. Finally, there was limited evidence presented on the factors explaining the results observed (e.g. why development failed to come forward at the scale anticipated) or attention to the procedural steps taken by scheme promotors to secure development. As such, the identification of factors facilitating or acting as barriers to local growth outcomes were limited to aspects of local economic context and the nature of local transport networks, but little insight into the steps that could be taken to maximise the likelihood that the desired results would be achieved.
2. **Recommendation:** Existing case studies of road enhancements (both evaluations of DfT Local Major Projects and POPE studies) give detailed attention to the transport outcomes of road enhancements but limited consideration of their economic performance outcomes or what steps can be taken to maximise those results. New case study research will be required to develop a body of evidence that helps demonstrate the economic performance impacts of individual schemes and how and why they came about. The DfT, Highways England, and any evaluation contractor will need to clearly outline how the objectives of any new case study research differs from previously completed exercises and the strategic need for the evidence collected to avoid perceptions of duplication.
3. In the long term, the DfT and Highway England could consider how the relevant guidance could be adapted to improve the evidence base. It is outside the scope of this study to suggest specific adjustments that could be made. However, one improvement could be making existing guidance more explicit and detailed about how to examine economic performance effects.
	1. Uses and objectives

This subsection explores the potential uses and objectives of a programme of case study research and how they could add value to existing evidence (as summarised in the preceding section).

* + 1. Potential uses of scheme case studies
1. Consultations with DfT and Highways England officials identified two main needs for evidence of the economic impacts of individual road schemes that could be gathered through case study research:
* **Demonstrating and communicating outcomes:** Consultees suggested that the empirical evidence underpinning the appraisal of road investment schemes in terms of journey times savings and agglomeration effects was comparatively strong. However, analysts had little evidence to demonstrate that road investment schemes produce local economic development outcomes driven by the development of residential or employment land or attracting different types of firms to the local economy. Where these objectives were central to the Business Case, the lack of evidence was thought to weaken confidence that proposed schemes would produce their intended effects and extend timescales for approval. Case studies of individual schemes can address this need by providing direct evidence of the degree to which road investments schemes can produce these types of benefit. The ability to illustrate the quantitative results of an evaluation with real-world examples was also reported as a key requirement by consultees.
* **Understanding the mechanisms that result in economic performance impacts:** While econometric analysis can estimate the size of effects, it offers limited insight into the mechanisms through which effects may be achieved. Consultees reported that evidence of how and why different types of scheme achieve their intended economic impacts (or otherwise) in different contexts would be beneficial in understanding which factors are important to consider in the development of new schemes. Case studies could address this need by exploring the conditions under which different types of scheme meet their economic development objectives (or produce locally important economic development outcomes) and helping to explain the results of econometric analysis (as flagged in section 6.4.1). For schemes with local residential and/or commercial development objectives, consultees expressed a desire for greater understanding what aspects of the scheme delivery process (e.g. agreements with developers or changes in local political circumstances) are influential in determining whether these objectives are met. Comparative analysis of individual cases studies could support this learning by isolating the role of the processes employed in scheme delivery.
	+ 1. Addressing these evidence needs
1. To meet the evidence needs specified above a programme of case study research could follow one of the following approaches:
* **Light touch case studies:** This approach would require less in terms of resources to implement and focus on the first evidence need highlighted in 6.2.1. This approach would provide some indication about the types of effects that might be produced and provide evidence of where these effects may have occurred, although it would not provide any analysis of the mechanisms through which any changes are achieved.
* **Detailed analytical case studies:** A more detailed approach would address this first evidence need and collect more focused evidence to develop an understanding of the mechanisms that may have resulted in economic performance and how these might vary by context. This approach would meet the evidence needs of all stakeholders consulted.

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| 1. **Recommendation:** The primary aims of case study research should be to develop a detailed understanding of whether schemes produced changes in local economic performance, and how and why these changes may have arisen, building on existing evidence sources where possible. As stakeholders reported a need to establish a more detailed understanding of the mechanisms through which economic impacts are achieved, a more detailed approach is recommended with the following objectives:
* Assess whether schemes have met their economic performance objectives.
* Understand the mechanisms by which economic performance changes occur and how this varies across contexts.
* Assess the effectiveness and efficiency in the delivery of schemes, with a focus on understanding the role of processes deployed to opening-up land for, and stimulating, development.
* Communicating evaluation results to non-technical audiences.
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* 1. Case study design
1. This section provides a discussion of the design considerations relevant for a programme of scheme case studies. This covers the development of scheme objectives, prospective analyses, and potential challenges and other practicalities associated with case study delivery.
	* 1. Selecting a sample of case studies
2. Understanding the mechanisms through which economic effects could materialise from different types of scheme is a key objective highlighted by stakeholders. Case studies should be selected so as to provide evidence across different categories of scheme and local contexts to support the type of comparative analysis required to answer these types of question. The identification of criteria should be ‘theory-led,’ guided by a set of starting hypotheses as to how the local economic performance outcomes are likely to vary across types of scheme and contexts. This would build on the overarching theoretical framework set out in Section 3, and could be developed further by reviewing existing theoretical and empirical literature to develop more detailed hypotheses for how performance effects might be achieved in different contexts.

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| 1. **Recommendation:** The programme of case studies should be underpinned by an initial review of the theoretical and empirical literature to develop a set of hypotheses as to how the economic performance impacts of local schemes. This would enable cases to be selected to test these hypotheses. The review could also be used to inform the econometrics.
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1. The types of dimensions that may be of interest could include:
* **Scheme type:** Schemes with different combinations of enhancements to the road network – for example, a bypass junction improvement, access road, road widening and smart motorway.
* **Scheme size:** Schemes that were associated with different levels of financial investment in the road network.
* **Scheme objectives:** Schemes explicitly expected to produce economic performance effects in different ways – for example, those expected to produce accessibility improvements versus those expected to produce development effects.
* **Geography:** Geographical comparisons were suggested to be useful in comparing performance achieved across different regions and the extent to which scheme effects have been targeted towards urban centres. This will support an understanding of the extent to which schemes have resulted in any rebalancing of economic activity across the country, in terms of regions, but also between urban and rural areas.
* **Funding programme:** Schemes are often approved as part of larger programmes of government funding. Comparing results achieved across different funding schemes could potentially aid an understanding of the relative effectiveness of these schemes.
* **Scheme opening:** Schemes that opened at different points in time will provide an understanding of the actual time scales to impact for a range of economic effects in different contexts.
* **Port schemes:** Understanding the effects of port schemes, and any resulting local trade effects was suggested to be useful for stakeholders looking to develop businesses cases for future schemes – i.e. providing evidence to support funding decisions and strategic priorities.
* **Baseline congestion and demand:** It may be useful to compare schemes that experienced different levels of demand and congestion at the point just prior to scheme construction. This could provide an understanding of the relative effects of schemes given issues of pent-up demand or seeking to relieve acute localised congestion.
1. The criteria listed above are extensive and it may be challenging to cover all of these dimensions systematically even with a comparatively large sample of 25 to 30 case studies. Priorities would need to be agreed at the outset.
	* 1. Development of a Theory of Change
2. Case studies would ideally focus on assessing whether the economic performance objectives (where explicit) of individual schemes have been met as well as understanding their economic impacts more generally, even in cases where economic objectives are not explicitly stated in Business Cases. These objectives will need to be understood at the outset to provide a comprehensive set of criteria against which the effects of the scheme can be assessed, guide the definition of the research questions to be addressed, and support the collection and interpretation of evidence. The specific objectives of each scheme are likely to vary substantially across cases, but could in general cover a combination of the following key parameters to aid comparative analysis:
* **Anticipated commercial or residential development:** Where road schemes were expected to deliver significant contingent development outcomes, it will be important to develop a view of the nature of the anticipated development impacts (e.g. residential/commercial/and industrial), the scale of those effects (e.g. in terms of square metres of floor space or number of dwellings), and the timescales over which they were expected to arise. Additionally, it will be important to define the key areas in which those effects were expected arise, including specific plots of land where possible.
* **Local economic development outcomes:** Additionally, it will also be beneficial to define the nature of the anticipated local economic development outcomes. This might most frequently be understood in terms of the jobs created in the local economy by incoming firms. In which case, it will also be important to be as clear as possible in relation to scale of these anticipated effects, the types of jobs expected to be created (e.g. by skill level or sector), the areas expected to benefit, and relevant time horizons. However, some schemes may be expected to produce important economic development outcomes through other mechanisms, such as easing local labour supply constraints.
* **Benefits for specific users:** Some schemes may have been explicitly designed to produce benefits for specific users (e.g. schemes providing enhanced links to ports, airports or other transport gateways). In these cases, it will be beneficial if the scale and nature of these anticipated impacts (e.g. increased trade volumes) can be defined in advance.
* **Local regeneration or transformation:** Some schemes may be delivered to support wider regeneration and transformation agendas in local communities. For example, those focused on the creation of job opportunities for local constituents, reduce unemployment, address income or standard of living inequalities.
1. In addition to defining the objectives of the scheme, it will also be important to develop some understanding of expectations regarding the specific mechanisms by which the road investments were expected to produce the types of outcomes described above. The evaluation framework set out in Section 3 could be used as the starting point for this analysis. This analysis can then be used to develop an overarching evaluation framework against which the scheme can be assessed.

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| 1. **Recommendation:** Case studies should begin with an initial planning stage to establish the ‘theory of change’ underlying the project, building on the general framework set out in Section 3. This would serve as an organising framework for the case study, defining a set of hypotheses to be tested, identify relevant research questions and the quantitative and qualitative evidence required. The theory of change could potentially be expressed visually in the form of a logic model.
 |

1. A review of scheme documents suggested that the underlying economic objectives of schemes are not always explicitly defined in scheme documentation. In other cases, wider regeneration, job creation and physical development are identified in general terms but are insufficiently precise in terms of the anticipated scale of those effects or the specific areas expected to be affected. A focus on the general economic outcomes of the scheme may be sufficient, though the following steps may be helpful in contextualising the project:
* **Review of other local documents:** The anticipated economic development benefits of road investment schemes may also be articulated in other types of local documentation (e.g. local economic development strategies or planning documentation).
* **Consultations with scheme promoters:** Supplementary consultations with scheme promoters may also be useful to understand objectives. This may not always be straightforward, particularly if schemes were completed some time ago.
* **Spatial analysis:** Analysis of accessibility measures described in the preceding section could help identify areas that were most affected by the scheme, helping to refine the focus of case study research.
* **Long-distance users:** A key limitation of this analysis is that some beneficiaries of road enhancements may not be captured through focusing solely on local economies identified in scheme documentation or spatial analysis. Haulage firms located at significant distances from the road upgrade may experience particularly significant benefits that would not be captured otherwise, and background research could be used to identify views of this nature that could be consulted through the study. Conversely an accessibility model approach may identify areas that benefited from changes in accessibility that were not anticipated in original Business Cases.

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| 1. **Recommendation:** As the economic performance objectives of schemes or expectations as to how they will come about are not always explicitly defined Business Cases, a review of other local documentation, consultations with scheme promotors, and spatial analysis of the areas potentially affected will be beneficial as part of any case study planning.
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* + 1. Definition of research questions
1. To address the above aims and objectives, case study research could seek to explore a range of different research questions focusing on determining the character of the economic performance outcomes associated with the scheme, the mechanisms through which any changes arose, and the extent to which any changes are additional at the local and national level. These questions should broadly reflect the specifics of each individual scheme. Although, in order to understand all possible changes to local economic performance, it is anticipated that the questions would need to address the following broad areas:
* **Transport outcomes:** What were the nature of the transport outcomes brought about by the schemes? Which key areas, communities, and development sites benefitted from enhanced accessibility?
* **Development outcomes:** What levels of development of residential and employment land have come forward in the areas affected (and did this come forward at the scale and in the locations expected)? How did the transport outcomes brought about by the scheme influence these outcomes?
* **Firm relocations:** What types of firms and have been attracted to or have relocated from the areas affected? How did the road enhancement influence those outcomes?
* **Firm performance:** How has local firms’ usage of the road network changed as a result of the road enhancement? How far has firm performance (e.g. employment, productivity, investment) changed since completion of the scheme? How did the road enhancement influence firm performance?
* **Labour market outcomes:** How has the composition of the local population changed since the completion of the scheme, and how has this been influenced by the road enhancement? How have commuting patterns, skills supply, economic activity rates and unemployment rates been influenced by the road enhancement?
* **Procedural issues:** What steps were taken by scheme promotors to maximise the local economic impacts of the road enhancement? How did these enable (or act as barriers to) the realisation of anticipated economic outcomes?
* **Local context:** How aspects of local context (e.g. local industrial structure, productivity, political environment) influence the results observed?

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| 1. **Recommendation:** The development of an underlying theoretical framework for the evaluation should be complemented by the specification of a detailed set of research questions and the set of quantitative and qualitative evidence required to address those questions.
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* + 1. Secondary data analysis

Case studies should make proportionate use of the available secondary data to provide an understanding of the degree to which economic development outcomes have been realised (or the nature of changes in local economic performance that have occurred since the completion of the scheme). Such an analysis should go beyond the analysis of general trends at the level of the LA, and exploit the availability of spatial datasets (as described in Section 4) to link results more closely to the objectives of a scheme as per its original Business Case or those developed as part of the study to support an assessment of economic performance. This analysis would draw on the datasets identified in Section 4:

* **Transport outcomes:** Although transport outcomes are not the core focus for the case studies, it will be vital that the case study incorporates some assessment of the nature of the journey times savings achieved and communities benefitting from enhanced connectivity to aid contextualisation of results. This could be drawn primarily from existing studies (e.g. POPE studies).
* **Development and property market outcomes:** Data on planning permissions and subsequent development activity should be used to identify the extent of any major residential and commercial site development within the target areas for the schemes (including specific sites identified within Business Cases). This will help establish the degree to which any underlying development objectives have been met.
* **Firm formation, entry and exit:** Firm microdata available from the Business Structure Database (available in the SRS) can be used to identify patterns of firm formation, entry and exit (e.g. by sector, productivity, etc.) in scheme target areas since completion of the scheme. The data can also be used locations from (or to) which relevant firms have moved, and establish any changes in their spatial structure as discussed in Section 4.3.
* **Changes in firm performance:** The BSD can also be used to establish how far the performance of relevant local firms have changed since the completion of the scheme, providing measures of local job creation (or losses), turnover growth, and approximate measures of productivity. These changes can be broken down across different sectors of the economy to explore in more detail how far the types of anticipated economic development outcomes have been achieved in practice.
* **Information specific to scheme objectives:** Dependent on the specific nature of the objectives of the scheme, there may be a need to gather additional data to fully explore the degree to which the anticipated outcomes have been achieved. For example, it may be instructive to examine trade volumes from ports that have benefitted from enhanced access.
* **Contextual factors:** Finally, there may be value in exploring wider trends at the level of the LA or region to determine changes in contextual conditions that may also have influenced the outcomes observed. This could potentially be supplemented by reviews of other local documentation to identify specific local factors that may have been influential, such as the entry of a large manufacturer, the approval of significant development proposals, or changes in local political circumstances (e.g. rising opposition to development activity).

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| 1. **Recommendation:** The case studies should begin with a review of the available quantitative and documentary evidence to both establish the nature of changes in local economic performance in the areas affected (and how far these aligned with expectations) and characterise the local context for the project in more depth.
 |

* + 1. Stakeholder consultations
1. While analysis of secondary data will provide one view on the degree to which economic performance outcomes have been achieved, they will not offer evidence on the extent to how and why they came about, how far they can be attributed to the road investment, and the degree to which specific scheme implementation arrangements were critical in their realisation. Consultations with a range of audiences could provide useful insight into these audiences, with the following stakeholder groups likely to offer informative views:
* **Scheme implementers:** Representatives that were involved in the planning management or delivery of a scheme, as well as those involved in any appraisal or evaluation activity. This group can provide detailed views on the extent to which the delivery of schemes was successful, whether any associated changes in economic performance took place, and understand the effectiveness of any processes employed to ensure economic performance improvements took place – for example, ensuring residential development took place.
* **Developers, planning officials and property market agents:** For schemes expected to produce commercial or residential development impacts, consultation with relevant property developers and planning authorities will provide views on how far development projects have come forward in response to the completion of schemes. Consultations will provide detailed insight into the factors influencing the scale and nature of development activity, processes that have been employed to support development, and provide an overview of any barriers or facilitating factors that may affect development.
* **Local businesses:** Consultations with local businesses could provide detailed views on why schemes may have affected their business activities. Consultations could focus any changes in use, or satisfaction with the road network as a result of the scheme and assess the extent to which schemes may have results in changes in wider business activity, such as firm investment or expansion. Firms could be sampled to ensure a diverse coverage across size, sector and location. Alternatively, consultation objectives could be more focused on collecting views form a particular type of firm – for example, high-technology SMEs, or firms located in newly created employment centres.
* **Transport hub representatives**: In schemes with a focus on improving access to major transport hubs, it may also be beneficial to speak with management representatives from relevant hubs to collect views on the extent to which a scheme resulted in changes to the activities and/or performance of those hubs.
1. The table overleaf provides a possible outline topic guide outline for stakeholder consultations, grouped by theme, that could be adapted to meet the evaluation evidence needs specified above. As above, this list is not exhaustive and questions will need to be tailored to each scheme under review.
	* + - 1. Stakeholder consultation topic guide outline

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| Theme | Questions |
| Additionality  | * To what extent can any outcomes observed be attributed to the delivery and opening of a scheme? For example:
* changes in business activity
* changes in the residential or commercial development of sites
* changes to the international competitiveness of firms
* wider changes in local economic conditions
 |
| Underlying mechanisms | * How and why might schemes bring about changes in business activity and commercial and residential development?
* Could the design of the scheme have been changed to better meet its economic objectives?
* How effective were processes employed to ensure the successful delivery of the scheme?
* How effective were any processes employed to ensure commercial or residential development took place?
* How might scheme delivery challenges or process issues affect its ability to meet its economic objectives?
* Could key property market and planning authorities have been engaged in different way that meant the scheme was able to achieve its objectives, or achieve them more efficiently?
 |
| Context | * To what extent were any changes in economic performance associated with certain groups in particular e.g. business sector or size, geographies?
* Are there any other economic, political or technological factors that have influenced any changes in economic performance described above?
* How important were any other government programmes of support in securing any changes in economic performance described above?
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**Source:** Ipsos MORI (2019).

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| 1. **Recommendation:** At a minimum, case studies should involve a consultation programme with an array of stakeholders associated with the scheme covering both the scheme promotor as well as the variety of communities that may have been affected by its delivery (e.g. businesses, developers, etc). The consultations should focus on establishing views on why and how the observed economic performance outcomes came about (including the importance of the road enhancement and the role of any specific steps taken by the scheme promotor), any contextual factors that may have influenced those results, and any unintended impacts of the scheme (adverse or positive). It may be appropriate to engage 15 to 20 stakeholders as part of this process, depending on the key parameters of the scheme and the numbers of stakeholders involved.
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* + 1. Firm Surveys
1. Surveys of local businesses could be implemented to provide information on additional aspects of potential interest. Survey research is beneficial because of the following:
* **Focused data collection:** It enables the collection of targeted quantitative measures that cannot be captured through other means – such as how firms have responded to the completion of the scheme.
* **Representative:** While consultations provide an understanding of how and why businesses may have changed their activities, a survey would provide an understanding of the magnitude of any changes in a given area or for specific subgroups.
1. The table below provides an overview of the range of data that could be collected through business surveys. Again this list is not exhaustive and would need to be refined for each scheme under review. However, the value of including a survey within the scope of works would need to be balanced against the potentially high costs involved. Additionally, there may be limited value in surveying firms where schemes were completed a long time in the past, as it may be difficult for respondents to recall key aspects of interest.
	* + - 1. Overview of business survey question options

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| Topic Area | Line of Inquiry |
| Business characteristics  | * Business characteristics (detailed sector, products/services offered, business model)
* Business performance (employment, turnover, profitability, trade, R&D)
 |
| Road use  | * Size and use of vehicle fleet
* Reasons for road use, (i.e. specific business activities)
* Scale of road use (distance and origin destination points)
* Fleet routing
* Journey times
 |
| Scheme delivery satisfaction  | * Satisfaction with scheme delivery process
* Satisfaction with road network since scheme opening
 |
| Business activity  | * Changes in road use since scheme opening
* Changes in business activity or commercial performance since scheme opening
 |
| Additionality  | * Self-reported counterfactual, i.e. extent to which scheme has effect on business performance
 |
| Wider effects and context  | * Other business effects produced since scheme opening
* Other factors reported to have affected business activity since scheme opening
 |

**Source:** Ipsos MORI (2019).

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| 1. **Recommendation:** A telephone survey of firms located in the areas affected by the scheme could yield useful evidence where schemes have completed relatively recently. However, firm surveys would likely incur significant costs, so the use of this method would only be proportionate in exceptional cases.
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* + 1. Comparative analysis
1. There are also options to incorporate comparative analysis into case studies to help provide clearer quantification of the net impacts of the scheme.

Propensity Score Matching

1. One possibility would be to draw a comparison sample of areas that did not benefit from road investment schemes (e.g. output areas more than 30km from completed schemes) but otherwise shared similar characteristics – in terms of the control variables defined in Section 5. A propensity score matching approach (as discussed in Section 5) could be one comparatively straightforward way of achieving this. Difference-in-difference or fixed effects methods could be applied to the resultant matched sample to provide estimates of impact reaching Level 3 on the Maryland Scientific Methods Scale.

Synthetic Control Groups

1. An evaluator could also assess the potential effects of some road schemes using an approach known as ‘synthetic control groups’. This approach was developed to assess the effects of a policy where the number of units experiencing the policy is small e.g. regions, large businesses or ports – and could provide useful supplementary information to support the development of case studies, whilst achieving Level 3 on the Maryland Scientific Methods Scale.
2. The approach involves the construction of ‘synthetic’ comparator for the treated unit expected to benefit from schemes. This comparator would be the weighted average of all possible comparator units, with the weights chosen so that trends in the key outcomes of interest – and factors thought to influence these outcomes, such as local business sectors or labour supply – are as similar as possible prior to scheme opening. Units with similar trends to the treated units expected to benefit from a road scheme will carry a high weight, and those that are dissimilar will carry a very low weight (or they will not form part of the comparator at all). Differences in economic performance between the treated units expected to benefit and the ‘synthetic unit’ created after a road scheme has opened can then be interpreted as the impact of the programme.
3. The approach could be applied in both general terms and to a specific class of scheme of interest:
	* **General application:** Thiswould compare the areas affected by single scheme to a ‘synthetic’ comparator area that did not benefit from any road enhancement. The main challenge in applying the method in this context is defining an appropriate and consistent set of spatial ‘units’ that have and have not benefitted from road enhancements (as these interventions are not at the level of convenient administrative areas). This could be tractable by defining the set of LSOAs within a certain distance of the road enhancement (e.g. say within 30km) as a notional treatment zone, and include all LSOAs that were not within 30km of any road enhancement within the population of comparators.
	* **Port schemes:** A further specific application could provide an indication of the trade effects of those schemes aiming to enhance access to ports. One indicative outcome measure that could be adopted is inward or outward trade tonnage, although this does not provide any sense of the value of trade activity. An analysis of DfT port freight statistics suggests that of the 53 major ports in the UK, nine are linked to schemes in the portfolio.[[40]](#footnote-41) Given that no minor ports were shown to be linked to schemes as part of the scheme classification process it is feasible to exclude these from the analysis, given the likely differences in trade activity and volumes, and still generate reasonable synthetic controls.
4. Implementation of the approach would be driven by the data described in Section 3.

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| 1. **Recommendation:** Case studies could be usefully supported by the application of synthetic control group methods to provide a quantitative ‘backbone’ that directly addresses the problem of attribution with statistical methods. These methods compare the areas benefiting from specific road enhancements to an otherwise equivalent set of areas that did not. The approach would find most straightforward application in relation to port activity (where the set of ports that have and have not benefitted from road enhancements is clearly defined), but could be extended to road enhancements on a more general basis provided there is a sufficiently large pool of LSOAs that saw no road enhancements over the period of interest.
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* 1. Analysing case studies
1. The analysis of case studies is expected to be an iterative process, drawing on new information as it becomes available. Case study analysis should typically involve within-case analysis to identify key themes and results for one scheme. Between-case analysis is then completed to explore similarities and differences in the themes and results produced across different cases to provide an understanding of the required conditions for a scheme to produce effects in a given context. Cross-analysis requires the implementation of a comparable evaluation framework across cases and analytical procedures to systematically review cases.
2. Analysis completed as part of case study development will likely require triangulation and synthesis of results from different data sources. Two non-experimental approaches to analysis that could be adopted which are not mutually exclusive are discussed below:
* **Contribution Analysis:** Mayne’s (2001)Contribution Analysis (CA) is a theory-based evaluation approach.[[41]](#footnote-42) It aims to understand the contribution of a scheme to changes in performance, rather than attributing changes to schemes using causal inference. It relies on developing a detailed theory of change and testing it using different evidence sources in an iterative manner.
* **Qualitative Comparative Analysis:** Qualitative Comparative Analysis (QCA) is a research method that provides a logical way of establishing causality with case study data in medium sized samples (where n≥10).[[42]](#footnote-43) QCA is a two-stage approach: a qualitative first stage and a systematic second stage using a quantitative framework. The first stage involves traditional case based evaluation techniques – triangulating qualitative and quantitative evidence to determine the nature of the outcomes associated within each case and how any other factors may have influenced any results achieved. In the second stage, case study results are coded into a quantitative framework – categorising the outcomes achieved and the presence of potentially influential conditions. The coding of case study results and conditions can identify the various pathways to achieving economic performance, by checking for patterns of necessity and sufficiency, i.e. what are the necessary and sufficient conditions in which the desired outcomes are observed? As such, QCA is helpful analytical tool for evaluation questions that seek to address ‘realist’ evaluation questions focused on ‘what works, in what contexts, for whom?’.
	+ 1. Links to econometric analysis
1. The analysis of case study findings will link to the econometric analysis in two ways:
* **Causal explanation:** The econometric analysis described in the preceding section will describe the average size of the economic performance impacts of road enhancements across different contexts but will offer little insight into how or why these effects come about. The case study analysis should be used to build out causal explanations as to the underlying mechanisms at play and how far they align with theoretical explanations as identified through the suggested literature review.
* **Refinement:** The analysis may also yield further hypotheses as to how and why the economic performance impacts of schemes may vary across contexts. To the degree that these factors can be measured in a reasonable way at the local level, it will be possible refine any econometric analysis completed as part of the study by to provide formal tests of these hypotheses. This could be achieved by either including additional interaction terms in the underlying econometric models that allow treatment effects to vary across the contextual dimensions identified, or by restricting the analysis to groups of schemes sharing the key contextual characteristics of interest.
	+ 1. Analytical outputs
1. Two analytical outputs could be produced from case study research:
* **Scheme case study report:** Consultation results indicated the preference for the production of a technical report and non-technical executive summary. A detailed analytical report should be written for each case study that presents the results of the case study mapped against its respective evaluation framework. These reports should be accompanied with a concise executive summary that highlights the key results and implications of the study in non-technical language. These summaries should be developed consistently across cases to enable readers to draw comparisons.
* Cross-case analysis report: The results of scheme case studies can be synthesised to produce a report that summarises the results of any cross-case analysis. These reports could focus on particular themes or areas of interest or address the entire scheme.
	1. Summary
1. Existing case studies of road enhancements (both evaluations of DfT Local Major Projects and POPE studies) give detailed attention to the transport outcomes of road enhancements but limited consideration of their economic performance outcomes or what steps can be taken to maximise those outcomes. New case study research will be required to develop a body of evidence that helps demonstrate the economic performance impacts of individual schemes and how and why they came about. To meet the needs of stakeholders, case studies shouldseek to:
* Assess whether schemes have resulted in any changes to local economic performance, whether anticipated or not.
* Understand the mechanisms by which economic performance changes occur.
* Assess the effectiveness and efficiency of processes deployed by scheme promotors to maximise the economic impacts of schemes.
* Facilitate demonstrating and communicating evaluation results to a range of audiences.

The discussion above highlights a range of considerations for a programme of scheme level case studies. A case study specification could follow a light-touch or detailed approach:

* **Light touch case studies:** To illustrate the results of econometric analysis. While this approach would provide some indication about the types of effects that might be produced, it does not provide any analytical insight into how or why effects may have arisen.
* **Detailed analytical case studies:** In addition to the above, this approach would support an understanding of the mechanisms that result in economic performance, if any, and how these might vary by context.

To meet the needs of all stakeholders, a detailed analytical case study approach is recommended, which would comprise:

* **Case study selection:** Between 10-30 cases should be selected purposively that provide sufficient coverage of the key scheme characteristics and economic performance outcomes expected, as described in subsection 6.2.2. This selection should be supported by an initial review of the theoretical and empirical literature to understand how economic performance might vary by context.
* **Desk review and initial consultations:** A review of scheme documents, consultations with scheme promotors, and spatial analysis of the areas potentially affected should be completed to develop and/or refine the economic performance objectives of selected schemes.
* **Development of evaluation frameworks:** For each case, the ‘theory of change’ presented in Section 3 should be adapted to represent each case study scheme based on an initial desk review and possibly consultations with scheme promotors. This would serve as an organising framework for the case study. Evaluation frameworks across all schemes should be comparable and seek to measure all aspects of economic performance as far as it is useful to do so, to permit comparative analysis.This would also involve defining research questions to be addressed.
* **Review of secondary data and documentation:** Each case study should begin with a review of the available quantitative and documentary evidence to both establish the nature of changes in local economic performance in the areas affected (and how far these aligned with expectations) and characterise the local context for the project in more depth.
* **Stakeholder consultation:** At minimum, case studies should involve a consultation programme with an array of stakeholders associated with the scheme covering both the scheme promotor as well as the variety of communities that may have been affected by its delivery (e.g. businesses, developers, etc). It may be appropriate to engage 15-20 stakeholders as part of this process, depending on the key parameters of the scheme and the numbers of stakeholders involved.
* **Business surveys:** A telephone survey of firms located in the areas affected by the scheme could yield useful evidence where schemes have completed relatively recently. Surveys are recommended for those schemes that opened in the last one to three years that involved the most significant levels of public spending.
* **Comparative analysis:** Case studies could be usefully supported by the application of synthetic control group or other types of comparative methods to provide a quantitative ‘backbone’ that directly addresses the problem of attribution with statistical methods.
1. Practicalities
2. This section presents a recommended specification for a possible evaluation of road investment schemes.
	1. Activities required to support the evaluation

To support the delivery of the quantitative evaluation specified above, the DfT, Highways England and any evaluation contractor will need to complete the following practical steps to support the following:

* **Refine performance objectives** – through collection of documents and consultation with key stakeholders.
* **Identify scheme geographic locations** – again, through collection and review of documents and consultation with key stakeholders.
* **Refine the econometric framework** – through review of relevant academic and grey literature.
* **Gain appropriate data access** – by submitting a successful SRS application, gaining access to property market data and collating publically available local economic performance secondary data.
	1. Timescales for delivery
1. It is expected that the evaluation could be delivered in a nine-month period, as per the Gantt chart shown below. This suggested timescale is only provisional and evaluators should be encouraged to suggested their own timescales for delivery.
	* + - 1. Provisional EPIRE evaluation Gantt

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Task / Month** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** |
| **Inception**  |   |   |   |   |   |   |   |   |   |
| **Familiarisation**  |   |   |   |   |   |   |   |   |   |
| **Finalising evaluation plan** |   |   |   |   |   |   |   |   |   |
| **Econometric Analysis** |   |   |   |   |   |   |   |   |   |
| **Case studies** |   |   |   |   |   |   |   |   |   |
| **Triangulation, synthesis and reporting**  |   |   |   |   |   |   |   |   |   |

1. **Source:** Ipsos MORI (2019).
	1. Resources
2. This following key resources are expected to be needed to deliver a research programme specified in the previous sections.
* **Contractor requirements:** A contractor will need to skills and capabilities in evaluation, social research, econometric methods, and transport modelling software (to develop accessibility indices as described in Section 4). They should also have access to expertise in the appraisal and evaluation of transport infrastructure projects
* **DfT and Highways England inputs:** The delivery of this programme of research will require input from the DfT and Highways England at two key stages as shown in the table below.
	+ - * 1. Inputs from DfT and Highways England

|  |  |
| --- | --- |
| **Stage** | **Project Risk** |
| **Design** | **Document and stakeholder access**: To provide access to scheme documents and those involved in the promotion and delivery of schemes.  |
| **Validating scheme and development site locations**: Reviewing and signing off scheme and development site coordinates and target locations to be used for the study.  |
| **Finalising schemes to be included in an evaluation:** Providing guidance and final sign-off on the schemes for inclusion in the quantitative and qualitative components of the evaluation, ensuring that an evaluator considers the selection considerations listed in subsections 2.4 and 6.2.2 above.  |
| **Delivery** | **Review of outputs and research materials:** To ensure that outputs and research materials are fit for purposes and sufficiently align to the evaluation aims specified above.  |
| **Review of evaluation results, conclusions and recommendations:** To provide guidance on the interpretation of evidence and the implications of the study for key stakeholders.  |
| **Provide guidance development of final outputs:** Review of final outputs to ensure that the presentation of results, conclusions and recommendations is suitable for the DfT’s needs.  |

1. **Source:** Ipsos MORI (2019).
	1. Delivery risks and mitigations
2. There are a range of risks associated with the delivery of a potential evaluation. These are suspected to relate to the development of aims and objectives, refining the evaluation design, data access, engagement with stakeholders and the development of results. This following list provides a discussion of each of these risk categories in turn and suggests mitigation strategies where possible.

Specifying aims and objectives

* **Political sensitivities:** The results of an evaluation are likely to be politically sensitive, especially if results are not positive or identify significant variance in the changes in economic performance identified across different contexts.
* **Limited engagement in evaluation from stakeholders**: Resulting in lack of buy-in to the evaluation design from scheme promoters. There may be challenges in encouraging these stakeholders to input to the design of the evaluation, resulting in reduced ‘buy-in’ to the study which in turn reduces the probability of the results being used more widely. This may be as a result of limited understanding of evaluation approaches, sensitivities (as described above) around how results will be used and time constraints. Providing opportunities for a range of stakeholders to input and review the design and results of the evaluation developed is a key mitigation.

Evaluation delivery

* **Delays in receiving, or limited access to, scheme documents or shortcomings in the documentation provided:** Documents will be a key source of information on schemes’ economic objectives and target areas and other aspects. Problems with documentation will require evaluators to engage with scheme representatives to gather such information. As discussed in Section 2, the review completed during scoping identified variation in the number of scheme documents available and the level of detail relating to scheme characteristics – for example, expected economic benefits, scheme location and anticipated development site coordinates. Early engagement with scheme promoters and other LA representatives to collect documents prior to appointing an evaluation contractor will be a key mitigation.
* **Delays in securing data access:** Confirming data sharing or access arrangements, such as securing ONS Secure Research Service project sign off, is a key risk that could cause significant delays to the completion of quantitative analysis. Arrangements relating to data access and sharing and potential issues should be raised as key points of discussion and action as part of the project management process.
* **Limited availability of key stakeholders for interviews**: Both during the design and delivery of an evaluation, limited access to stakeholders (for example, through employment changes) will reduce opportunities to understand schemes in detail, including expectations for economic performance effects and achievement of objectives. In the first instance, lists of contacts associated with case study schemes should be collated centrally by the DfT, should they need to be consulted as part of the evaluation design or delivery phases. Other scheme representatives may need to be contacted to confirm details of scheme characteristics but it is suggested that these are contacted as needed, and when all available documents and online resources have been exhausted. If required, the DfT could identify a representative for each scheme who an evaluator could use to access others through a ‘snowball’ approach. However, this issue may be insurmountable for older schemes.

Development of evaluation findings, conclusions and recommendations

* **Data quality and completeness:** When engaging with scheme representatives, data collection may not be complete or not of a high quality. This could be because research participant responses suffer from recall bias issues or a loss of institutional memory through changes in personnel.This can be mitigated by ensuring that any data analysis considers the extent of possible biases during the data triangulation process.
* **Evaluation results are not sufficiently clear:** It may be the case that the evaluation does not produce evidence to prove or disprove the economic effects of investments in the road network. This makes the development of clear conclusions and recommendations challenging for an evaluator and limits the opportunities to make use of the evidence to support decisions making. The review has suggested, however, that sample sizes are likely to be sufficient such that this can be considered a low risk.

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1. The Maryland Scientific Methods Scale (SMS) is a commonly used measure of robustness, where Level I represents basic descriptive analysis with no attempt to control for differences across treated and untreated groups and Level V represents a randomised control trial (RCT). More information available at: <https://whatworksgrowth.org/resources/the-scientific-maryland-scale/>. Date accessed: Aug 19. [↑](#footnote-ref-2)
2. These schemes were only identified by the study team once a more detailed second stage review had been completed. It may be beneficial to exclude these schemes from a potential evaluation given that journey time and reliability improvements were a secondary concern. [↑](#footnote-ref-3)
3. URL: <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>. Date accessed: Nov 2018. [↑](#footnote-ref-4)
4. Firm impacts resulting from decreased generalised travel costs represent a departure from current Transport Appraisal Guidance (TAG) guidance, which does not consider wider economic impacts arising directly from reduced generalised journey travel costs unless they relate to a specific market failure. [↑](#footnote-ref-5)
5. Though without additional housing, this may merely place pressure on rents and/or house prices, potentially forcing lower income residents elsewhere. [↑](#footnote-ref-6)
6. URL: <https://voaratinglists.blob.core.windows.net/html/rlidata.htm>, accessed (October 2018). [↑](#footnote-ref-7)
7. For examples of subscription software, see SATURN or VISSUM. For examples of free software, see SUMO or stplnr. [↑](#footnote-ref-8)
8. ‘Evaluating Productivity Impacts of Transport,’ Department for Transport, April 2009 [↑](#footnote-ref-9)
9. See ‘The Causal Effects of an Industrial Policy,’ CEP Discussion Paper No. 1113, Criscuolo, Martin, Overman, and Van Reenen, 2012 [↑](#footnote-ref-10)
10. URL: <https://www.gov.uk/government/publications/hmrc-data-catalogue>. [↑](#footnote-ref-11)
11. More information is available at <https://www.gov.uk/government/collections/road-freight-domestic-and-international-statistics>. Date accessed: Oct 2018. [↑](#footnote-ref-12)
12. The DfT Road Freight Statistics team highlighted that, because of the way survey data is processed, it is not possible to distinguish between respondents that provided responses using postcodes or place names. [↑](#footnote-ref-13)
13. URL: <https://www.gov.uk/government/statistics/work-and-pensions-longitudinal-study>. Date accessed: Jan 2019. [↑](#footnote-ref-14)
14. For example, see MHCLG (2018). Dwelling Stock Estimates: 2017, England. Statistical Release, available at: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/710382/Dwelling_Stock_Estimates_2017_England.pdf>. Date accessed: Jan 19. [↑](#footnote-ref-15)
15. Homes England publish its own data on homes funded by its schemes from 2017 onwards, available at: <https://www.gov.uk/government/statistics?departments%5B%5D=homes-england>. Date accessed: Jan 19. [↑](#footnote-ref-16)
16. As part of its OS Address Base Plus product. [↑](#footnote-ref-17)
17. A contractor should be aware that the dataset only records changes in land use, i.e. if a piece of land has not had its use changed, it will not appear in the dataset. [↑](#footnote-ref-18)
18. MHCLG (2018). Land Use Change Statistics in England: 2016-17. Planning Statistical Release, available at: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/712316/Land_use_change_statistics_England_2016-17.pdf>. Date accessed: Jan 19. [↑](#footnote-ref-19)
19. URL: <http://www.costar.co.uk/>, accessed 03/12/18. [↑](#footnote-ref-20)
20. URL: <http://www.2010.voa.gov.uk/rli/en/basic/find>, accessed 03/12/18. [↑](#footnote-ref-21)
21. Such a random process could be conceived in some form of Challenge Fund process in which funding is awarded at random to proposals that meet a required minimum standard. However, such an approach to awarding funding may not be politically or economically feasible or desirable. [↑](#footnote-ref-22)
22. Relocation of Public Sector Workers: Evaluating a Place-based Policy,’ Giulia Faggio, Spatial Economics Research Centre [↑](#footnote-ref-23)
23. The Local Economic Impacts of Regeneration Projects: Evidence from UK’s Single Regeneration Budget, Stephen Gibbons, Henry Overnman, Matti Sarvimaki, August 2017. [↑](#footnote-ref-24)
24. In the former case, it may be preferable to compute these in terms of the distance along the road network rather than the straight line distance. [↑](#footnote-ref-25)
25. The regression would take the form: $y\_{it}=α+\sum\_{j=1}^{J}β\_{j}T\_{jt}+X\_{it}γ+α^{ⅈ}+α^{t}+ε\_{it}$. In this model, y is the outcome of interest in area i in period t (mapping onto the outcomes defined in the preceding section). T is a binary indicator taking the value of 1 after the completion of the road enhancement if area i lies inside distance band j, and 0 otherwise. X is a vector of time varying controls and the model is specified with unobserved area level effects and unobserved time specific shocks affecting all areas. [↑](#footnote-ref-26)
26. New Road Infrastructure: The Effects on Firms, Stephen Gibbons, [↑](#footnote-ref-27)
27. Gibbons, S., Lyytikainen, T., Overman, H. G., & Sanchis-Guarner, R. (2012). New road infrastructure: the effects on firms. [↑](#footnote-ref-28)
28. The approach examines the relationship between changes in accessibility as a result of the transport improvement to changes in area and firm level outcomes following the completion of the scheme. The index can be defined as $A\_{jt}=\sum\_{k\ne j}^{}a(c\_{jkt})l\_{kt}$, i.e. for a firm in location j at time t, it is the weighted sum of employment in all destinations, k, that can be reached from origin, j by incurring some transport cost $c\_{jkt}$ along some specified route between j and k; an inverse weighting system is used such that the function $a\left(∙\right)=c\_{jkt}\^-1 $is decreasing in the cost of reaching k from j. [↑](#footnote-ref-29)
29. Graham, D. (2014). Causal Influence for Ex-Post Evaluation of Transport Interventions*. International Transport Forum*. OECD. [↑](#footnote-ref-30)
30. It was beyond the scope of this study to determine how many firms may have been affected by the scheme under review. However, it is expected that the number of ‘treated’ firms will be weakly correlated with the number of schemes included in an evaluation. [↑](#footnote-ref-31)
31. Gibbons et al. (2017). New Road Infrastructure: The Effects on Firms. SERC/Urban and Spatial Programme Discussion Paper. [↑](#footnote-ref-32)
32. DfT (2012). Monitoring and Evaluation Framework for Local Authority Major Schemes. *UK Department for Transport.* [↑](#footnote-ref-33)
33. Atkins & Aecom (2014). Meta evaluation of Local Major schemes final report. London. *Department for Transport.* Available at: <https://www.gov.uk/government/publications/local-major-schemes-meta-evaluation>, accessed on 29/11/18. [↑](#footnote-ref-34)
34. Although a description of expected development is provided in Section 6, this does not provide a detailed understanding of the processes employed to secure this development. [↑](#footnote-ref-35)
35. URL: <https://www.gov.uk/government/collections/post-opening-project-evaluation-pope-of-major-schemes>, accessed on 29/11/18. [↑](#footnote-ref-36)
36. Highways England (2017). How Highways England supports economic growth - Assessment of Growth Impacts. Available at: <https://www.gov.uk/guidance/highways-england-supporting-growth>. accessed on 09/01/19. [↑](#footnote-ref-37)
37. The meta-analysis considered direct economic benefits as those arising from journey time and safety benefits whereas wider economic benefits reflected those arising from local economic development in proximate locations to schemes. [↑](#footnote-ref-38)
38. Drawing on the accessibility approach discussed in Section 4. [↑](#footnote-ref-39)
39. Highways England (2016). Assessment of growth impacts. Available at: <https://bit.ly/3288zNQ>. Date accessed Jan 19. [↑](#footnote-ref-40)
40. DfT (2018). All UK major and minor port freight traffic, by port and year (direction filter) from 1965. Port0101. [↑](#footnote-ref-41)
41. Mayne, J. (2001). Addressing attribution through contribution analysis: using performance measures sensibly. Canadian journal of program evaluation, 16(1), 1-24. [↑](#footnote-ref-42)
42. Legewie, N. (2013, September). An introduction to applied data analysis with qualitative comparative analysis. In Forum Qualitative Sozialforschung/Forum: Qualitative Social Research (Vol. 14, No. 3). [↑](#footnote-ref-43)