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Infrastructure@Manchester

Building the Northern Powerhouse: Cost-benefit analysis and regional development

 Graham Winch and Rehema Msulwa

Report 2 of 4

1

1

Introduction

In both the public and private sectors, the rigorous selection of the most economically viable and socially beneficial projects is central to infrastructure development. Poor selection can lead either to capital sunk in non-viable "white elephants", or to under-investment in the supply of infrastructure services which enable economic and social development. At the heart of best-practice approaches to project selection is cost-benefit analysis (CBA). This paper, the second of the Infrastructure@Manchester series, will critically evaluate current

best practice in CBA and make some recommendations on how the UK's project selection process can be improved to ensure the most viable and beneficial transformative infrastructure projects are selected. Project selection is, however, subject to inherent uncertainties because it involves forecasting a future state of the world against sunk costs, and is therefore inherently challenging.

Attracting both public and private funds to the Northern Powerhouse programme will require a broad range of objectives to be considered when designing infrastructure investment programmes. A good starting point is the Five Case Model developed by HM Treasury², which provides a clear framework for thinking through project selection. This should guide Northern Powerhouse policymakers and associated stakeholders to ask the right questions, at the right time, to reach the right results. Ultimately, adopting a robust approach to project selection and the preparation of better business case development standards is a practical action that the Northern Powerhouse can take. As stated in the UK Government's Industrial Strategy White Paper³, too narrow an assessment of costs and benefits can preclude important opportunities. As we will argue, such an assessment presently tends to follow rather than create economic growth, generating a negative chain of path dependence that ultimately widens the north-south divide. This has the potential to undermine the efforts and intended positive outcomes of the Northern Powerhouse programme, as well as the Government's ambitions to narrow the northsouth divide and rebalance the economy. A broader approach to project selection is therefore required.

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²HM Treasury (2018) The Green Book: Appraisal and Evaluation in Central Government. London, HM Treasury.

³ HM Government (2017) Industrial Strategy: Building a Britain Fit for the Future. London, Department for Business, Energy and Industrial Strategy.

⁴Winch and Msulwa (2019) Building the northern powerhouse: How do we boost transformative infrastructure investment in northern England? Infrastructure@Manchester: Alliance Manchester Business School and Barclays.

⁵The N8 Research Partnership is a collaboration of the eight most research-intensive Universities in the North of England: Durham, Lancaster, Leeds, Liverpool, Manchester, Newcastle, Sheffield and York.

In this paper we will:

- Identify the importance of the Five Case Model and review the strengths and limitations of existing approaches to project selection.
- Identify the inherent biases in our current toolkit for analysis to underpin the economic case and show how they risk widening rather than narrowing regional disparities.
- Present an overview of the work Transport for the North (TfN) has been doing in this area.
- Put forward our own recommendations:
- 1. Greater effort should be made in developing cost-benefit analysis for transformative (as opposed to enabling) infrastructure investments. This work could be commissioned by the pan-northern body recommended in paper 1⁴ while drawing on the work of TfN, the National Infrastructure Commission, and the research capabilities of the N8 universities⁵.
- 2. That new sources of data flowing from smart infrastructure need to be aggregated and analysed and so a coordinating body should be established to act as "guardian of the data".
- 3. That multi-criteria analysis approaches to infrastructure investment for the Northern Powerhouse should be analysed.
- 4. That revenue-raising powers should be granted to TfN because the transformative potential is largely between rather than within existing mayoralties and other local government areas.
- 5. That the innovative appraisal work of TfN be applied more widely to the digital and energy infrastructure areas through a pan-northern body as recommended in paper 1.

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The five case model

HM Treasury's Five Case Model⁶ provides a structured process for appraising, developing, and planning public sector strategic investment decisions across government, including infrastructure. As outlined in Table 1 below, business cases prepared according to this model consider five interdependent cases – strategic, economic, commercial, financial and management - which capture an investment's technical, financial and economic feasibility, operating concept and the structure of its risk profile. As argued in the DfT's Rebalancing Toolkit⁷, this methodology allows for all of the relevant information about a proposed investment to be compellingly set out so as to inform Government decision making.

Along with the Five Case Model, impact assessment (IA), including environmental impact assessment (EIA) is usually required for major infrastructure projects. IAs are used to support the appraisal of new or secondary legislation, or in some cases the impact of non-legislative policy change. The approach to IAs follows a similar logic to business cases. It includes the rationale for government intervention, the policy objectives and intended effects, and the costs, benefits and risks of a range of options. As such, IAs capture both the social value and distributional effects of an investment.

Drawing on all of the cases in the Five Case Model can contribute to preparing robust appraisal documents, but the extent to which each aspect is in focus will vary from proposal to proposal, depending in part on its nature and complexity. Nevertheless, it is crucial that all project appraisal reports demonstrate that proposals are aligned with the Government's policy priorities, because the Strategic Case is the reason for going ahead with an investment. It is also vital that all business cases are underpinned by a strong evidence base, with clearly presented assumptions to support decision makers in project selection.

For the Northern Powerhouse, the challenge ahead is to develop business cases which demonstrate that projects located in northern England are good strategic propositions for the UK as a whole. And also, that they are affordable through life and represent Value for Money. This is especially important given the pressure on the public purse considering the ever-growing demand for public services across the country. Business cases should be prepared with an understanding that entities beyond the Government also seek to allocate their resources efficiently. Therefore, a robust approach to project planning and preparation is encouraged to inspire confidence in investors and the government so that they support infrastructure projects in the region. To that end, the Northern Powerhouse can look to improving project preparation, increasing the quality of data available to investors and developing more robust appraisal standards. Such an ambition requires an organisation to lead, and the case study shows how TfN has been doing just that.

1. Strategic case	Addresses the question <i>why</i> the project is being done and the fit of the investment with the strategy of the owner organisation. This forms the Project Mission.
2. Economic case	Addresses the question <i>which</i> options deliver the strategic case while providing acceptable Value for Money. No project should go ahead if there is not a supportive Economic Case, but this is a necessary rather than sufficient condition.
3. Commercial case	Addresses the question <i>can</i> the project be done in terms of the capabilities of the suppliers to deliver the strategic case and can a credible commercial deal be struck with those suppliers.
4. Financial case	Addresses the question <i>whether</i> the project is viable by identifying sources of finance and affordable funding streams to repay that finance and support the asset through life.
5. Management case	Addresses the question of <i>how</i> the project is to be done including the capabilities of the owner organisation for project governance and benefits realisation.

Table 1. The Five Case Model

⁶ HM Treasury & Welsh Government (2018) Guide to Developing the Project Business Case; Guide to Developing the Programme Business Case. London HM Treasury.

⁷ A toolkit designed to help authors of strategic cases assess how a programme or project fits with the objective of spreading growth across the country. For more details see: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/669043/ supplementary-guidance-rebalancing-toolkit.pdf

Cost benefit analysis and its limitations

This leadership includes interrogating existing project selection methods, such as cost-benefit analysis, and proposing more effective approaches. CBA underpins the Economic Case at the analytical heart of a business case developed using the Five Case Model. It is used to determine if a scheme represents the optimal use of resources to achieve the intended outcomes and involves the use of a number of indicators including Net Present Value (NPV) and the Internal Rate of Return (IRR) that assist in deciding between schemes. In the UK, the core appraisal technique is the measurement of user-benefit, calculated as a welfare measure for the country as a whole in present value, and often expressed, relative to costs, as the benefit-cost ratio (BCR).

The aim of CBA is to identify the effects of a project and then to express the resulting changes of social benefit in monetary units. An investment is socially desirable only if the combined monetary value of the changes in benefit is higher than the investment costs (monetised and non-monetised) of the intervention. If an investment meets this criterion it is said to be economically efficient and to represent Value for Money. Thus, the higher the BCR (i.e. monetised benefits relative to monetised costs suitably discounted over time) the better and, generally, the more likely that public funding can be justified for the intervention.

The monetary valuations used for CBA are based on a welldeveloped economic theory of valuation. This theory is based on the willingness to pay of the potential 'winners' for the benefits they will receive as a result of the option, and the willingness of potential 'losers' to accept compensation for the losses they will incur. To that end, the "consumer surplus" which underpins many BCR valuations is calculated as the difference between the maximum price that consumers are willing to pay and the market price. Similarly, the "producer surplus" is calculated as the difference between the minimum price that producers are willing to sell items for and the market price. A project's effect on social welfare is then measured using the so-called surplus criteria: consumer surplus and producer surplus plus changes in external impacts (e.g. environmental) and government impacts (e.g. tax revenue).

⁸ A. Venables, J.J. Laird, & H.G. Overman (2014). Transport investment and economic performance: Implications for project appraisal. Paper commissioned by UK Department for Transport.

⁹ S. Dietz & C. Hepburn (2013) Benefit-cost analysis of non-marginal climate and energy projects. Energy Economics. 40: 61-71.

¹⁰ See paper 1 for the definitions of "enabling" and "transformative".

CBA has great attractions as a tool for guiding policy: it considers the gains and losses to all members of the society on whose behalf the CBA is being undertaken; the model relies on the identification, evaluation and comparison of alternatives including different scales for the alternatives; and by valuing impacts in terms of a single, familiar measurement scale – money – it can guide decision making in principle. Moreover, with sufficient training and easy-tofollow guidance, CBA is easy for planners to use.

CBA has also drawn much criticism as a toolkit because it relies on narrowly defined definitions of efficiency⁸. There are two main issues here. The first is that the economic theory of valuation is based on marginal analysis – that is to say, it calculates the incremental costs and benefits of investment at the margin of existing levels of activity⁹. While this is technically adequate for enabling infrastructure investments to relieve "pinch points" and to release areas for further development, it has significant limitations for the appraisal of transformative (non-marginal) infrastructure investments¹⁰. This is because of the difficulty marginal analysis has with coping with more systemic effects such as agglomeration discussed in section 4.2 below.

The second is that it tends to favour higher-income groups and regions. This distributional issue arises because by definition, willingness-to-pay and willingness-to-accept will be partly dependent on incomes. Those on higher incomes are often willing to pay more for a unit of benefit than someone on a lower income; therefore, income can influence the absolute level of benefit. A reliance on CBA can therefore lead to a potentially negative cycle being created whereby investments actually widen the gap between high-income and low-income areas. For example¹¹, consider a two-sector economy with a high income urban sector and a low income rural sector as follows. Imagine two projects, one in each sector, each with identical physical output in terms of hours of time saving. The project in the high income area would have the highest IRR, as the users of it are willing to pay more for the benefits they receive. Consequently, if the two projects were mutually exclusive (e.g. as a consequence of budget restrictions, such as in the present case of HM Treasury) the project in the high income area would attract the investment because it displayed better Value for Money in the CBA. Such an investment, however, would widen any income gap by further increasing economic growth in the high income area. A negative cycle is thereby created and the use of CBA widens regional disparities in growth.

This effect is further intensified if we consider that faster growing regions will be able to pay back an equivalent investment within a shorter period of time, further tipping the bias of CBA towards a more economically dynamic region. This dynamism is then further reinforced through the growth effects of the multiplier investment itself. Thus, if we rely on best practice CBA, there is a risk of further widening economic disparities rather than closing them. It is for this reason that we argue that CBA tends to follow rather than create economic growth. We conclude that new approaches are required for the appraisal of the transformative projects that the Northern Powerhouse intends to undertake.

There is, of course, a realisation of these issues in government. The Green Book acknowledges the limitations of CBA for transformative projects. The National Infrastructure Commission (NIC)¹² is intent on supporting the identification and development of improved appraisal methodologies that:

> capture system-wide effects, rather than simply the marginal impact of individual projects;

improve the treatment of uncertainty too often a single number is presented which does not reflect the range of possible outcomes, and;

ensure the process of appraisal does not become overly precise and focused on a preferred option at too early a stage.

As such, the NIC has engaged with a range of experts and interested stakeholders over the past year to better understand the limitations of existing methods and assess where improvements could be made. In this spirit, below we consider potential improvements in the section that follows.

Addressing the limitations of cost-benefit analysis

Regional disparities

For the Northern Powerhouse to be successful, it is necessary to avoid the potential negative cycle arising through regional disparities whereby high-income areas, yielding high project returns, attract investment and potentially crowd out investment in low income areas (as highlighted above).

Such investments would further increase income in the southeast, thereby widening the income gap between regions, which is counter to the Government's ambition to bridge the northsouth divide and rebalance the economy. One way to mitigate this effect is through the use of distributional weights which counteract inequalities in the income distribution without making the calculation of benefits and costs by all income groups irrelevant. Distributional weights¹³ are factors that increase the monetary value of benefits or costs that accrue to lower income individuals or households. They are based on the principle that the value of an additional pound of income may be higher for a low-income recipient than a high-income recipient and thus the social value differs from simple additionality due to who gains or loses. Distributional weights can be used as part of a distributional analysis where this is understood to be the case.

In practice, the use of distributional weighting is challenging. This is due to uncertainty in the assumptions relating to the groups between whom redistribution is measured and the related uncertainty associated with estimating distributional weights. Nevertheless, the Green Book argues that weighting is important to assess the differential impact of new interventions. For devolved administrations with differences in existing policies, for example, it is necessary to include, as far as possible, an assessment of the effects of an intervention on other areas affected by the proposal.

A full distributive weighting approach to appraisal can also be very ambitious because of the various ways in which benefits can feed into final impacts. In the context of transport benefits, for example, the final incidence of benefits from transport projects depends on the relevant supply and demand elasticities in the relevant markets. These are often unknown and require explicit or implicit assumptions¹⁴. As such, the following can be expected in the context of a typical transport project:

¹¹ Institute for Transport Studies (2003) Distribution of Benefits and Impacts on Poor People. Part of Toolkit for the Economic Evaluation of World Bank Transport Projects. If TS, University of Leeds.

¹² National Infrastructure Commission (2018) National Infrastructure Assessment. NIC.

¹³HM Treasury (2018) The Green Book: Appraisal and Evaluation in Central Government. HM Treasury

¹⁴ A project may in fact cause a displacement of poor people with no land rights and increased land values and rents for the rich landowners.

- High cost of determining local values of time for every scheme appraisal and the cost of obtaining the necessary data on the pattern of usage by worker types, income and social group;
- Potential for bias in appraisals where entirely locally determined values of time were used;
- Difficulty in defining the final incidence of costs and benefits to income and social groups; and in defining an agreed set of social weights.

The Northern Powerhouse now has an opportunity to accompany value for money assessments based on national welfare impacts with assessments of regional, sub-national and local impacts and distributional effects. The Green Book makes provision for such analysis for interventions with subnational or regional distributional effects (e.g. those that involve redistribution of welfare to different parts of the UK). This allows appraisal to move beyond assessing projects based on their relative UK-wide social value and makes a stronger case for regional and sub-national perspectives.

Given the difficulties associated with distributional analysis, however, it is imperative that related results are presented transparently. For example, if distributional weights are used to adjust estimated costs or benefits depending on which groups in society they fall on, the analysis with weights should be presented alongside the analysis without weights. To account for the uncertainties, sensitivity analysis is also recommended as it may be useful to estimate switching values i.e. the distributional weights required to change the preferred option. This provides an estimate of the robustness of the results based on the weights used.

Wider impacts

Significant investment in physical assets has the potential to have geographically extensive system effects captured in the term "agglomeration" that arise through the close location of businesses and people as shown in Figure 1. These can include access to more productive jobs, benefits from dynamic clustering, increased private investment, enhanced product market competition, and the generation and flow of ideas¹⁵. These all lead to changes in the structure of the economy. Moreover, agglomeration can have strategic enabling effects on future developments and on the future flexibility of affected organisations or industries as well as on other infrastructure service providers. While these effects are most intense in cities, those cities in turn benefit the surrounding towns that have good access to the city centres¹⁶ and revitalise the retail offer in those centres¹⁷.

Infrastructure investments can have positive labour supply and macroeconomic effects through an increase in human capital, job-search activity or the provision of better access to jobs, all of which can contribute to the growth of assets over time. As such, HM Treasury suggests that where productivity benefits can be objectively demonstrated, they should be considered as part of appraisal in the calculation of UK costs and benefits. Furthermore, long-term planning and high interdependence levels need to be taken into account at the long-listing stage and when selecting the optimum project short-list. Support for this approach is suggested in the Industrial Strategy White Paper¹⁸ which recognises that well-targeted investment can be transformative, particularly when implemented as part of a wider programme of interventions to address the unique circumstances of each area.

The current best practice for the appraisal of transformative infrastructure investments is insufficient to capture their complex interactions with each other and the economy. Substantial system effects, which can affect the viability of investments, are hidden by current project selection methods. For example, the Green Book recommends that multiplier effects (i.e. the additional economic activities which result from supplying the labour and equipment to build the infrastructure) are not to be included in estimates of social value because they are generally already accounted for at a macro level by aggregate decisions nationally to spend at a particular level. Moreover, if multiplier effects do occur it is usually not possible to reliably observe or measure

differences between individual programmes and options between projects. By contrast, we can suggest that given the level of spare capacity within the region, increasing investment in the Northern Powerhouse will be less inflationary than in the south east. In other words, the multiplier effect will work in varying ways in different regions around the UK, and should therefore not be ignored but regionally weighted for its inflationary effects.

More generally, current appraisal methods are limited because most analyses are made against a static development environment, disregarding all potential parallel and future developments and the opportunities and constraints these create. Doing so ignores the temporal nature of investments, which may increase benefits or unlock future developments. As a result, this can favour investment in places where development has already happened and overlook the transformative longer-term benefits that infrastructure can bring to areas such as the Northern Powerhouse looking to realise their economic potential.

A robust account of the various impacts of applomeration at the regional level is crucial for a robust appraisal of projects in the Northern Powerhouse given that its policy agenda is driven by the principle of benefiting from scale. By investing in spatially connective infrastructure such as railways, roads and telecommunications, the Northern Powerhouse programme aspires to increase scale and create a single economy across the north of England to rival other city regions internationally¹⁹. This connective infrastructure has the potential to induce agglomeration economies, which have a positive impact on growth.

Investing in connectivity in the Northern Powerhouse can boost the regionalised production of goods and services, increasing competition and reducing market deadweight loss due to imperfect competition and a spatial monopoly. Firms benefit from 'external scale economies' in large concentrations of economic activity by (i) sharing infrastructure and information; (ii) matching production requirements such as skills and premises, and (iii) learning about new techniques, products and services through 'knowledge spillovers' and a cross-fertilisation of ideas. This in turn increases the scope for interactions to foster creativity, innovation, collaboration, competitiveness and accelerated growth.

¹⁵ E.L. Glaeser (2010) Agglomeration Economics. Chicago, University of Chicago Press.

¹⁶ P. Swinney, R. McDonald & L. Ramuni (2018) Talk of the Town: The Economic Links between Cities and Towns. London, Centre for Cities. ¹⁷ R. McDonald & P. Swinney (2019) City Centres: Past, Present and Future Their Evolving Role in the National Economy. London, Centre for Cities. ¹⁸ HM Government (2017) Industrial Strategy: Building a Britain Fit for the Future. London, Department for Business, Energy and Industrial Strategy. ¹⁹ North (2014) One North A Proposition for an Interconnected North

Sharing Ability to share inputs, supply chains and infrastructure Learning Ability to exchange ideas and information ('knowledge spillovers')

Figure 1: The Benefits of Agglomeration²⁰

At present there is no consensus about which economic variables, estimation methods, types of data and spatial units should be used to measure the effects of agglomeration because of its complexity and feedback effects, and also because some factors may be outweighed by others. More sophisticated modelling techniques will therefore be required going forward. An example of this is the research currently

²⁰ P. Swinney. (2016) Building the Northern Powerhouse: Lessons from the Rhine-Ruhr and Randstad. London, Centre for Cities. ²¹Forster (2018) Land Value Modelling to inform Northern Powerhouse Rail Case. TransportXtra.



underway at the Institute of Transport Studies at the University of Leeds²¹, which aims to develop a regional model that captures both accessibility and place quality for policy and strategy purposes. Ahead of such developments coming to fruition, it is vital that appraisal reports are supported by sufficient good quality, robust and objective research and evidence, for example on previous similar interventions.

Complementary methodologies

While CBA is used as a way to fully consider the long-term economic, environmental and social implications of infrastructure investments, a number of complementary methodologies are available to help government decide which project solutions are best value for money. Two decision-support techniques which are based primarily on monetary valuation of the impacts of options include cost-effectiveness analysis, and input-output analysis. Each of these prioritisation methodologies has advantages and challenges but offers alternative evaluation methods from CBA.

Cost-effectiveness analysis.

An assessment of the costs of alternative options which all achieve the same objective where costs need not be restricted to purely financial ones, and;

Cost-effectiveness is used to assess the least-cost way of achieving an objective where there are alternative options to achieving a specific objective, but where the objective is difficult to measure using monetary values. Cost effectiveness analysis typically gets around this by circumventing the critical step of converting benefits (and sometimes costs) into a single monetary unit. Instead, benefits are converted to a non-monetary common unit (e.g. number of fatal accidents avoided). This method is especially useful when the objectives of candidate projects are similar but difficult to assign a value for. However, as with CBA, it is best suited for projects with incremental benefits rather than systemic or transformational benefits.



An assessment which provides a sophisticated method to evaluate economic, social and environmental benefits of projects and to understand how the project will interact with other economic sectors.

Input-output analysis provides a sophisticated method to evaluate the economic, social and environmental benefits of projects and to understand how the project will interact with other economic sectors. It models the detailed impacts of candidate projects on different sectors using the multipliers of the input-output matrix. By quantifying the interdependencies between production and consumption among different sectors, input-output models (IOMs) are a particularly powerful tool for the study of the effects of demand-driven changes in the economy. While IOMs are appropriate for regional studies, they also have limits. These include that they do not account very well for business links and networks. Furthermore, given their initial focus on industrial economies, with an emphasis on manufacturing, IOMs do not appear effective in contemporary service driven economies. Thus, inputoutput analysis should not be used on its own, but rather to augment other analysis.

Muti criteria decision analysis

We have outlined how distributional weights are a useful way for avoiding a negative cycle being created where investments actually widen the gap between high-income and low-income areas. We have also discussed how accounting for wider impacts can capture the economic potential associated with infrastructure investments and adopting input output analysis helps to quantify interdependencies between production and consumption among different sectors. Although these tools serve as good complements for CBA, there is the additional complexity of how to handle the decision structure. In the context of a policy for narrowing the north-south divide, for example, is the decision taken to trade off the economic rate of return against a project's impact in the north (i.e. some form of regional-weighted rate of return approach)? Or is a sequential approach taken in which, within the set of projects that satisfy the economic efficiency test, those that most narrow the north-south divide are selected?

The Northern Powerhouse can adopt this approach using a Multi Criteria Analysis (MCA) framework, which establishes preferences between options by reference to an explicit set of objectives that the decision-making body has identified, and for which it has established measurable criteria to assess the extent to which the objectives have been achieved. MCA often involves combinations of some criteria which are valued in monetary terms, either by direct observation of prices if appropriate or indirectly using generally accepted techniques. However, the framework is also useful for dealing with complex values that cannot be monetised, as well as for items for which satisfactory values have not been derived, but which are nevertheless regarded as being of major importance.

The process of identifying objectives and criteria may alone provide enough information for decision-makers. However, where a level of detail broadly akin to CBA is required, MCA offers a number of ways of aggregating the data on individual criteria to provide indicators of the overall performance of options. MCA can therefore bring a degree of structure, analysis and openness to classes of decision that lie beyond the practical reach of CBA. A key feature of MCA is its emphasis on the judgement of the decision-making team, in establishing objectives and criteria, estimating relative importance weights and, to some extent, in judging the contribution of each option to each performance criterion. Its foundation, in principle, is the decision makers' own choices of objectives, criteria, weights and assessments of achieving the objectives, although 'objective' data such as observed prices can also be included. This subjectivity can be a matter of concern as can be the lack of an explicit rationale that benefits should exceed costs. Thus, in MCA, as is also the case with CBA, the 'best' option can be inconsistent with improving benefits and so doing nothing could in principle be preferable. Another limitation of MCA is that it cannot show that an action adds more to welfare than it detracts.

Ultimately, by using MCA to draw attention to impacts which are not valued, the Northern Powerhouse can reinforce the choice ordering implied by the monetary results as it may not be regarded as sufficient to change this ordering. Sometimes, however, where the difference between alternatives implied by monetary valuations is small, it may tip the balance. In either case, MCA is a useful tool for foregrounding particular objectives set out by the Northern Powerhouse.

Conclusion

As set out in the Industrial Strategy White Paper, infrastructure is one of the five foundations of productivity, yet, as demonstrated in our first paper of this series, the UK has a relatively low rate (as a proportion of GDP) of investment in infrastructure. Indeed, it is an outlier amongst developed nations in the perceived relatively low quality of its current infrastructure provision.

Within the UK, this problem is compounded by regional disparities in investment caused by technical limitations of the existing toolset compounded by – some would argue – a political bias. As we argued in Paper 1, the north of England is not particularly disadvantaged in the enabling infrastructure that supports current levels of economic activity, but it has to date completely missed out on the types of transformative infrastructure investment such as HS1, Crossrail, and Heathrow redevelopment that stimulate economic growth to higher trajectories through agglomeration and international connectivity.

We have argued that the current toolset for the analysis which underpins the economic case of the Five Case Model inherently follows rather than stimulates economic growth. It is important to realise that this is a technical bias inherent in the present best practice for the Economic Case. It can either be corrected or reinforced by political biases within the development of the Strategic Case. We recognise that capturing the full benefits of infrastructure investments is challenging. Moving beyond infrastructure investment appraisal methods designed for incremental capacity improvements in enabling infrastructure at "pinch points" will require large amounts of spatially detailed data across many factors. Moreover, when presenting results, it is important that analysts are transparent about the robustness of the underlying evidence base and the appraisal values used. Meeting this challenge calls for a multidisciplinary and collaborative approach supported by the use of a large diversity of financial, strategic and risk assessment models. It also calls for good quality data on infrastructure costs and performance as well as micro and macro level data from a variety of sources. Potential investors who see evidence of credible investment appraisal are more likely to consider financing transformative projects. Especially in the context of the Northern Powerhouse, there is a greater need for appraisal approaches that capture projects' transformational potential as it relates to economic growth and social welfare. Increasingly, infrastructure is emphasising reliability and resilience; it is moving towards electricity and away from fossil fuel dependence; towards the city regions and away from the national network; and towards a more integrated economic development approach. Hence, project appraisal will need to evolve to serve these changing needs.

Recommendations

Greater resources should be put into the development of appraisal tools and techniques for transformative infrastructure investments. The present CBA toolset available to decision-makers (in the UK, this is principally the BCR tool) who allocate resources to projects inherently favours areas with higher incomes and faster rates of economic growth. For this reason, if it is used without adjustment it will reinforce regional disparities rather than reduce them. And in so doing, it will not help realise any policy ambition that seeks to close the 'north-south divide'.

We develop from this argument five recommendations for further development:

1

Greater effort needs to be made to develop alternatives to best practice cost-benefit analysis including 1) developing more sophisticated analysis of the social and economic benefits of agglomeration; 2) developing better equity

ratings to offset the willingness to pay bias; and 3) moving beyond seeing the multiplier as an aggregate effect by taking into account regional differences in inflationary effects. This work could draw on the resources of the N8 universities as well as the advanced work currently being done by Transport for the North. This work could be commissioned by the new pan-Northern coordinating body recommended in Paper 1.

2

In doing this work, fine-grained local information is important and new data sources available from positioning infrastructure (e.g. GPS feeds) and smart ticketing and metering should be fully explored. Aggregating and analysing these data

could well be a role for the "guardians of the evidence" recommended by the Northern Powerhouse Independent Economic Review, in collaboration with Transport for the North and the NP 11 grouping.



Further work is required to evaluate the efficacy of introducing multi-criteria analysis approaches that appraise infrastructure investment against specific policy objectives. Given the shifting policy landscape towards rebalancing the economy,

value for money assessments for the development of economic infrastructure for the Northern Powerhouse could focus on maximising the impact of each pound spent to narrow the north-south divide. That is, starting with the intention to make transformative (as opposed to enabling) infrastructure investments in the north and then "triangulating" using the improved CBA approach proposed in recommendation one. This approach would provide a way to align the investment pipeline with the UK's strategic objectives and to evaluate how the pipeline would be ordered. A multi-criteria analysis approach might also make it easier to include new sources of data identified in recommendation 2 in the analysis.

4

The UK Government should also consider the feasibility of granting revenue raising powers to sub-national bodies, such as TfN, with a focus on funding transformative infrastructure which, almost by definition, crosses existing local

government boundaries and, in particular, the new mayor-led city regions in the north. The current funding environment is extremely challenging for local authorities in general and local transport funding in particular, and existing mechanisms are better suited for enabling rather than transformative infrastructure.

5

Under the auspices of the pan-Northern coordinating body recommended in Paper 1, we further recommend an investigation on how to build on the excellent work of Transport for the North presented in the case study to take a

wider view of the challenges of investment appraisal for transformative projects across transport, energy and digital and their interaction.

Case Study 1:

Transport for the North, A Transformational Growth Catalyst

A central part of the argument across this research series is the need to change the way we tackle investment appraisal for transformative infrastructure. Such changes need to be sponsored and promoted by an appropriate agency. Transport for the North is actively pursuing this agenda as a pan-Northern partnership of civic and business leaders working closely with Highways England, Network Rail, High Speed 2 (HS2) and the Department for Transport, to make the case for transformational change in transport infrastructure investment. TfN is currently building an evidence base and toolset that can reflect a detailed northern view of how changes in connectivity can lead to transformative changes in the regional economy.

TfN commissioned the Northern Powerhouse Independent Economic Review (NPIER) in 2016²² which quantified the economic benefits of improving the North's economy and now supports those aims through its Transport Analysis, Modelling and Economics (TAME) team²³. TAME supports the TfN Strategic Transport Plan²⁴, TfN Programmes such as Northern Powerhouse Rail and engages nationally with debates on best practice in transport investment appraisal²⁵. TfN is creating an Analytical Framework for the North which will promote 'one voice' for data; forecasting; and investment decisions. The 'one voice' theme is at the heart of TfN's strategy, encompassing the development of a consistent framework and dataset. Adopting 'one voice' will also allow the development of monitoring tools which will improve how the benefits of transport interventions are realised. For example, TfN will be able to monitor the impact of large investments in the Northern and Transpennine rail franchises. Ultimately, the goal is to develop a full modelling and appraisal system for transport investment business cases, and a more efficient operating model for the North's transport system.

TfN's work pushes the boundaries of existing appraisal methodologies designed around enabling investment and incremental change rather than the transformational investment and growth to which the North aspires. By moving beyond calculating benefits using the value of time measure, TfN also considers key factors impacting economic growth at the regional level such as transport efficiency, reliability and resilience. The tools that TfN is developing complement the norms of transport investment appraisal with models that capture market creation and market shaping.

A key issue in Northern transport appraisal is that travel in the North is constrained by a number of factors, and therefore, appraisal based on existing trends is unlikely to fully reflect the untapped potential in the North. TfN has therefore developed the Northern Transport Demand Model (NTDM), a rail market demand and revenue model which uses dynamic multi-modal simulation to estimate how changes in population and employment resulting from the economic growth envisaged by the NPIER will affect travel patterns across the North by 2050 under a range of potential futures. Moreover, modelling within the Analytical Framework is an iterative process between two key tools. The first is the Northern Economy and Land-Use Model (NELUM), a Land Use Transport Interaction (LUTI) model which shows how transformational travel markets are generated. NELUM captures re-distributed travel markets by assessing the impact of economic connectivity on population growth, GVA and increases in employment in the north. This model is key to being able to demonstrate that changes in connectivity can lead to more jobs and more growth, and make places more attractive to live. And by adding in the transformational growth scenario developed in the Independent Economic Review, TfN can show what impact interventions can have in a future transformed North.

Once generated, the transformative travel markets are then downloaded into the second tool, Northern Transport Models (NTMs). NTMs provide detailed representation, optioneering and design that complement the generated network and service capacity restraints in Northern freight, highways assignment and rail. In turn, this is reloaded into NELUM to reassess the spatial economic impact of the transport improvement. The iterative process between NELUM and the NTMs informs the Northern Investment Programme, a sequential list of strategic multimodal interventions for design, development and delivery²⁶.

By taking a more holistic, causal and dynamic 'systems' view, TfN's work reflects the insight that transport impacts much more widely on the economy, society and the environment than is currently captured in BCRs, and that scenarios and scheme variants can be adopted to support transformational infrastructure development. This approach is not unique. It has been used in London, Manchester and other cities to assess policies, as well as by major transport schemes such as HS2. But what makes the TfN approach different is the capability to model a range of interventions against different economic futures. Moreover, TfN is developing robust new tools and techniques for the North that are applicable beyond the North. To that end, it is unsurprising that TfN has already seen partners outside of the North, such as Midland Connect, Transport for London and the National Infrastructure Commission, expressing interested in what they are doing.



²⁴ Transport for the North (2019) Strategic Transport Plan. TfN. ²⁵ Transport for the North (2018) DfT Appraisal and Modelling Strategy: Transport for the North Coordinated Northern Response. TfN. ²⁶ Transport for the North (2019). Investment Program. TfN



The Relocation of Chester Bus Interchange: Paving the Way for Transformational Regeneration

The Northgate area in Chester is a substantial area of 1960s office blocks which once housed Chester City Council and other public sector agencies. The Local Government reorganisation and public agency downsizing contributed to a reduction in the number of staff needing space in the city centre, therefore leaving some of the office blocks vacant.

To stimulate the development of the City, the Council took the decision to redevelop Northgate as part of the wider redevelopment of the city centre. A major investment of £300 million was announced with a view to transform Chester's leisure and retail offer – a cross-party ambition of the council for many years. Phase 1 of The Northgate project aims to deliver a new Car Park, a new destination Market, restaurants, a new six-screen cinema plus markets and a new Public Square. Phase 2 of the scheme proposes a range of uses for the remainder of the site. Not only is the project hugely significant for the further development of Chester but, with the potential to create a significant number of new direct and indirect jobs, it is also crucial for the growth and future prosperity of the local and wider Cheshire and Warrington economy.

Ahead of the redevelopment of Northgate and other regeneration proposals, Chester's One City Plan, developed by Chester Renaissance and Cheshire West & Chester Council, proposed a review of the bus strategy for the City to ensure that there was alignment between the wider development proposals and local plans for improving public transport. Especially important was the relocation of Chester Bus Interchange, which was located right in the middle of the potential development space. Mott MacDonald was therefore appointed to produce a feasibility study, exploring options for the relocation of the interchange, and to explore bus facility provision and utility across Cheshire West and Chester more generally.

In line with DfT's WebTAG guidance on the development of Business Cases for transport investment, Mott MacDonald undertook an appraisal of a range of options, including the relocation of the interchange, its redevelopment in-situ, and the continued operation of the current interchange. Using a multi-criteria assessment framework the team determined that it was most suitable to relocate the bus interchange to Gorse Stacks, a large 300-space surface car park north of the city centre. Despite being well-used and located close to a major gateway into the city centre on the A56 Hoole Road corridor, the Gorse Stacks car park was disconnected from the city's historic core. Thus, the relocation of the bus interchange to Gorse Stacks could give momentum to the wider development of improved services for pedestrians in the area, as well as act as a catalyst for the redevelopment of Frodsham Street, and enable the development of the Northgate project.

In principle, Government, local elected representatives and council officers supported the concept of the development of a new bus interchange for Chester. However, making the case for the scheme was challenging. Although the option of relocating the bus station gave ambience, congestion and pollution benefits, the relocation was not intended to deliver journey time savings for travellers. It was, therefore, hard to communicate the benefits of the scheme through a standard benefit-cost ratio (BCR). However, by focussing on the scheme's ability to unlock the growth potential of the wider Northgate development the team were able to communicate the scheme's considerable wider economic benefits, enabling it to rise towards the top of the Local Enterprise Partnership's (LEP) priorities list. Ultimately, the project was supported by the Cheshire and Warrington LEP through a £13.5 million Local Growth Deal investment, as well as funding for public realm improvements to surrounding streets to improve connections to the city centre.

This successful outcome was largely due to the multidisciplinary approach that Mott MacDonald took to develop a transport business case that considered urban regeneration issues. The transport planning team developed the transport component of the business case in terms of bus network changes, the design of the interchange, highway modelling and air quality modelling. The economic and social development team then added the regeneration and development benefits from the relocation of the interchange, which would allow Northgate, as a major development site, to come forward. In the end, complementing the transport benefits with the employment benefits (jobs and gross value added) was sufficient to secure funding.







Appendix - Glossary

Agglomeration Economies:

The benefits that come when firms and people locate near one another together in cities and industrial clusters.

Appraisal:

The process of defining objectives, examining options and weighing up the relevant costs, benefits, risks and uncertainties before a decision is made.

Benefit Cost Ratio:

The ratio of the present value of benefits to the present value of costs. It provides a measure of the benefits relative to costs.

Consumer Surplus:

The difference between what a consumer would be willing to pay for a good or service and what that consumer actually has to pay. Added to producer surplus, it provides a measure of the total economic benefit of a transaction.

Cost Benefit Analysis: A method of reaching economic decisions by comparing the costs of doing something with its benefits.

Elasticity:

A measure of the responsiveness of one variable to changes in another. Price Elasticity measures how much the quantity of demand of a good, or supply for it, changes if its price changes. If the percentage change in quantity is more than the percentage change in price, the good is price elastic; if it is less, the good is inelastic. Income elasticity of demand measures how the quantity demanded changes when income increases.

Distributional Effects:

The differing impacts across people affected by an initiative.

Distributional Weights:

Factors that increase the monetary value of benefits or costs that accrue to lower income individuals or households. They are based on the principle that the value of an additional pound of income may be higher for a lowincome recipient than a high-income recipient.

Efficiency:

An efficient activity maximises output for a given input, or minimises input for a given output and, in so doing, pays due regard to appropriate quality.

Environment Impact Assessment:

A process of evaluating the likely environmental impacts of a proposed project or development, taking into account inter-related socio-economic, cultural and humanhealth impacts, both beneficial and adverse.

Impact Assessment:

A means of measuring the effectiveness of organisational activities and judging the significance of changes brought about by those activities.

Internal Rate of Return:

The interest rate at which the net present value of all the cash flows (both positive and negative) from a project or investment equal zero

Multi Criteria Decision Analysis:

A technique for dealing with complex un-monetisable values. It can be employed, in certain circumstances, at the long-listing stage to consider un-monetisable trade-offs.

Multiplier Effect:

Shorthand for the way in which a change or new injection in spending produces an even larger change in final income.

Net Present Value:

A generic term for the sum of a stream of future values (that are already in real prices) that have been discounted to bring them to today's value.

Path Dependence:

The tendency of institutions or technologies to become committed to develop in certain ways as a result of their structural properties or their beliefs and values.

Producer Surplus:

The difference between what a supplier is paid for a good or service and what it costs to supply. Added to consumer surplus, it provides a measure of the total economic benefit of a transaction.

Sensitivity Analysis:

Involves exploring the sensitivity of expected outcomes of an intervention to potential changes in key input variables. It can be used to test the impact of changes in assumptions and should be clearly presented in the results of appraisal.

Social Cost Benefit analysis:

Quantifies in monetary terms all effects on UK social welfare. Costs to society are given a negative value and benefits to society a positive value. Costs to the public sector are counted as a social welfare cost.

Social Value:

The net measure of total welfare resulting from an option or intervention. Alternatively, it is the sum of total benefits and total costs of an intervention, including private and social costs and benefits

Transformative Infrastructure:

Long-lived infrastructure assets engineered and constructed to increase the potential productivity growth rate above the current trajectory.

Uncertainty:

A Situation where the current state of knowledge is such that (1) the order or nature of things is unknown, (2) the consequences, extent, or magnitude of circumstances, conditions, or events is unpredictable, and (3) credible probabilities to possible outcomes cannot be assigned.

Value for Money:

Good value for money is the optimal use of resources to achieve the intended outcomes. 'Optimal' means 'the most desirable possible given expressed or implied restrictions or constraints'. Value for money is not about achieving the lowest initial price.

White elephant:

An investment that is unprofitable and is likely to remain unprofitable partly given the high cost of operating and maintaining it.

Willingness to Accept:

A technique for the inference of value of a non-marketed good or service from the amount that respondents to a survey are willing to accept to give up a good or service.

Willingness to Pay:

A technique for the inference of value of a non-marketed good or service from statements of the amount that respondents to an expertly designed survey are willing to pay to acquire a good or service.



