



UNIVERSITY OF LEEDS

Transport's impact on Unemployment – Phase 2 Report

Final Report

April 2025

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ABSTRACT

TAG provides guidance on inclusion of benefits of increased labour supply, and from shifting employment to more/less productive locations. It does **not** currently provide guidance on monetising benefits from a transport induced reduction in unemployment.

Addressing this gap in TAG is the aim of this project, with the research objectives being:

- Develop and propose a framework for assessing and monetising the impacts of transport investments on unemployment.
- Provide advice on updating TAG to support application of these methods.
- Identification of further research to support further iterations of the guidance.

In motivating the first objective we present empirical and theoretical evidence from the literature which shows that by affecting commuting costs and housing & work locations, transport policies can address spatial mismatch, permanently lowering equilibrium rate of unemployment and in doing so can create additional social value.

To address this objective, we propose a framework to estimate the social value of reducing unemployment drawing on work from Johansson and Kriström (2022). This framework is parameterised based on changes in benefits and incomes arising from the transition from unemployment to employment for different categories of family units facing different participation tax rates under different income level assumptions.

We further propose a framework for modelling of employment and unemployment (where not already undertaken through supplementary economic modelling) based on the work of Norman et al (2017) who estimate the relationship between changes in employment and accessibility from Swedish data. We find the interrelationship between labour supply and unemployment requires both to be modelled simultaneously.

We demonstrate the valuation framework through application to an existing dependent development based appraisal of Newhaven Port Access Road. We demonstrate the modelling framework using an existing dataset from a modelling of the wider impacts of the Trans-Pennine Route Upgrade. We further apply the valuation framework to the modelled changes in employment and unemployment for the Trans-Pennine case study.

Both case studies demonstrate that changes in unemployment are important sources of benefit to the appraisal, and that consideration for how best to capture these benefits in TAG is worthwhile.

Based on the valuation and modelling frameworks and case study applications we address the second objective. Our advice is that the employment TAG unit, TAG A2-3, would need updating in relation to the additionality of employment increases, terminology, definition of the counterfactuals, and modelling and valuation approaches. For now we suggest changes in wording for existing TAG guidance to provide scope for inclusion of further employment impacts.

In addressing the final objective, for the longer term we outline further research which would be required to provide a consistent framework for valuation of changes in employment and for estimation of unemployment impacts.

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1 INTRODUCTION

1.1 Background to the project

Permanent changes in unemployment in a mature, high-income economy like the UK require a reduction in the equilibrium rate of unemployment. This could arise through reductions in spatial mismatch between workers and employment. Commuting costs are part of this. Transport policy itself directly impacts on commuting costs whether by changes in infrastructure or changes in fares or taxes. It also acts indirectly by stimulating land use changes. Dependent developments, where a housing or office development is contingent on a transport project, can bring homes and jobs closer to each other. These transport policies are similar to those that are expected to change labour supply. Changes in unemployment would therefore occur simultaneously with labour supply changes.

TAG provides guidance on the inclusion of the benefits of increasing labour supply, and from shifting employment to more productive locations. It does not, however, provide guidance on monetising benefits from a reduction in unemployment that can arise due to an improvement in transport connectivity. To do so three essential steps are required: measuring the impact of transport interventions on net additional economic activity and employment; measuring the share of changes in employment taken by changes in unemployment; and valuing the net social benefit of changes in unemployment.

1.2 Research objectives

Filling this gap in TAG is the focus of this project, with the research objectives of being to:

1. Develop and propose a robust, proportionate and practical framework for assessing and monetising the impacts of transport investments on various kinds of unemployment to strengthen the transport appraisal process outlined in TAG.
2. Provide advice on developing updated Transport Analysis Guidance (TAG) to support users on the practical and proportionate application of these methods.
3. Understand what type of analysis would be helpful in furthering the Department's understanding of the impact of transport on unemployment.

1.3 The Unemployed in Great Britain

Between May and July 2024 unemployment in Great Britain was 1.44 million and the unemployment rate 4.1%.¹ The unemployed only form a subset of those not in employment. Others not in employment include students, those looking after the family or home, those who are sick, retired people, those who are discouraged from working². These are the economically inactive. In total 9.3 million people aged between 16 and 64 were economically

¹ Source: ONS unemployment statistics:

<https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/unemployment>

² Discouraged workers are those who do not look for work as they consider they are no suitable jobs available.

inactive over this period, of whom 1.8 million (19.7%) want a job.³ These people are prevented from working for a variety of reasons: studies (21.3%), caring responsibilities (19.8%), temporary or long-term sickness (39.4%), discouraged (0.9%) or another reason (18.6%)⁴.

Looking specifically at the unemployed, drawing from the Census 2021 we can see that they are quite a diverse group (see Table 1-1). They are all ages, though almost half are under the age of 34 years old. Almost a quarter of them are 24 years or younger, so we might expect a large proportion of those to be living with family.⁵ Reflective of their age, most of them are not living in a couple, though around a third are. Finally, and these data are only available for the household reference person in the Census (not all unemployed), we can see that 27% of household reference persons own their home. The other 73% live in some form of rented accommodation or live rent free.⁶

Looking at their skill (qualification) levels we can see that they are of all skill levels and reflect the general skill levels in the economy, though there is a bias in the unemployed towards the lower skill levels. For example of those in employment on Census day 9% had no qualifications, whilst 16% of the unemployed had no qualifications. This is similar for those with Level 1 qualifications, but is reversed for those with Level 4 qualifications.

The unemployed are entitled to benefits both unemployment benefits and low-income/low-income benefits. However, benefit entitlement is means tested and dependent on housing tenure. As we can see from the table, the large proportion of young people who are unemployed would imply that a significant number of the unemployed may be living rent free with family and would therefore not be entitled to any housing benefits. Homeowners are also not entitled to housing benefit. The large proportion of the unemployed who have a partner may also have benefits reduced should their partner be working. Thus, we would expect a large diversity of benefit levels being received by the unemployed. This is significant when we come to consider the net social benefit of a change in unemployment induced by a change in accessibility.

³ Source: ONS Table INAC01: Economic inactivity: People aged 16 to 64 by reasons for inactivity (seasonally adjusted).

<https://www.ons.gov.uk/employmentandlabourmarket/peoplenotinwork/economicinactivity/datasets/economicinactivitybyreasonseasonallyadjustedinac01sa>

⁴ Other reasons include people who: (i) are waiting the results of a job application, (ii) have not yet started looking for work, (iii) do not need or want employment, (iv) have given an uncategorised reason for being economically inactive, or (v) have not given a reason for being economically inactive.

⁵ The Census 2021 indicates that 28% of those under 24 years old lived at home with parents <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/bulletins/familiesandhouseholds/2021>

⁶ We are not able to create a table identifying households with an unemployed adult and dependent children using the data analysis Census portal. This would require a request to the ONS. Similarly we could not identify unemployed 24 years or younger who live in a household with related working adults (e.g. as part of family).

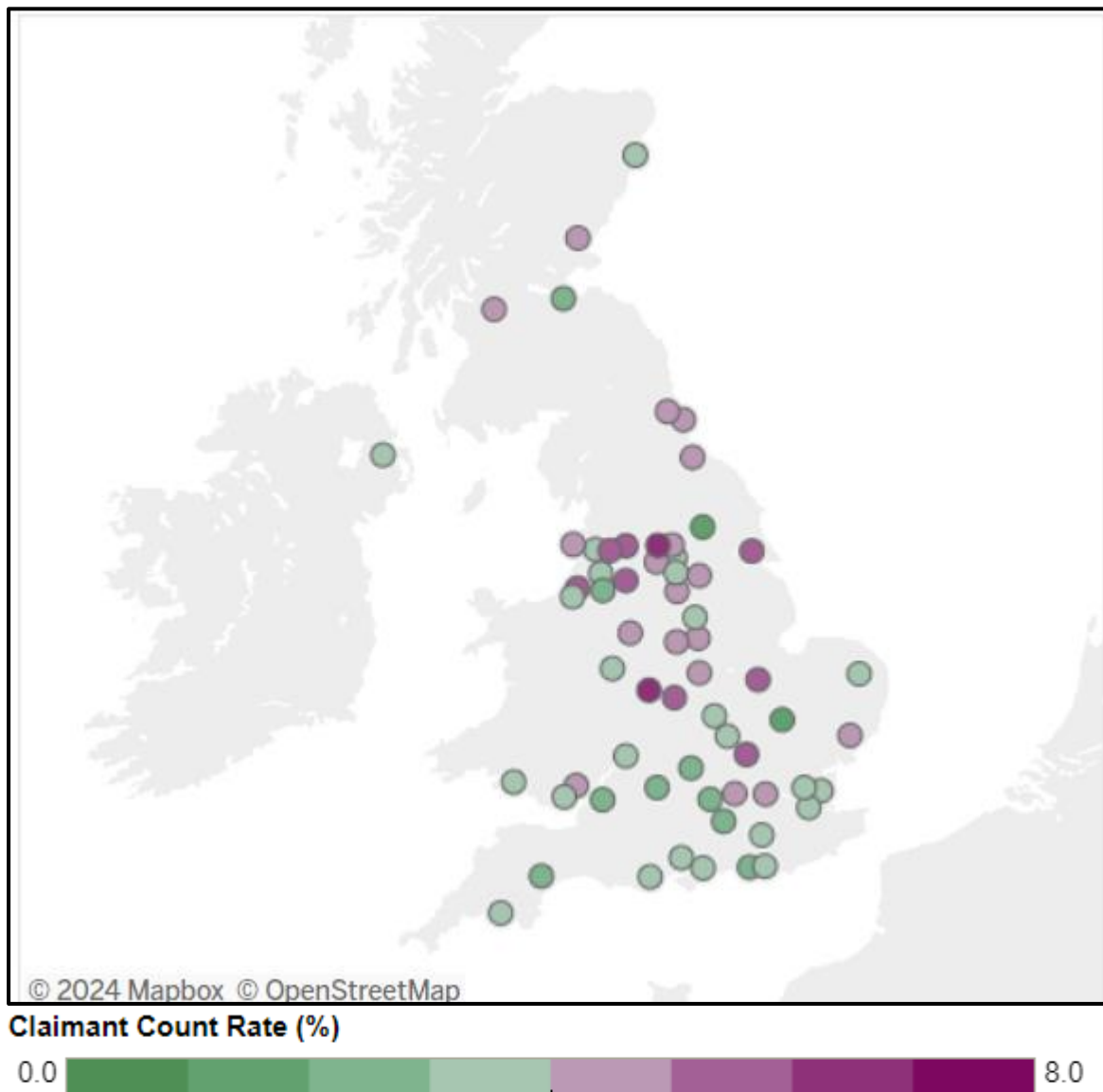
Table 1-1: Demographics of the unemployed

	Count	Proportion	Notes
Unemployed (excluding full-time students)	1,376,371		
Age			
16 yrs to 24 yrs old (inclusive)	333,399	24%	(comparison is 8% of those in employment)
16 yrs to 34 yrs old (inclusive)	662,743	48%	(comparison is 32% of those in employment)
Living arrangements			
Living in a couple	443,972	32%	
Not living in a couple and 34 yrs and younger	522,944	38%	
Not living in a couple and 35 yrs or older	360,811	26%	
Highest qualification			
No qualifications	214,858	16%	(comparison is 9% of those in employment)
Level 1 and entry level qualifications (1 to 4 GCSEs, etc.)	196,273	14%	(comparison is 9% of those in employment)
Level 2 (5 or more GCSEs, etc.)	228,058	17%	(comparison is 13% of those in employment)
Level 3 (2 or more A levels, etc.)	228,479	17%	(comparison is 19% of those in employment)
Level 4 or above (degree, etc.)	414,568	30%	(comparison is 43% of those in employment)
Other (apprenticeship, etc.)	94,135	7%	(comparison is 7% of those in employment)
Housing tenure (only available for household reference person)			
Household reference persons unemployed	483,158	35%	(proportion of total unemployed)
Owns home outright or with a mortgage	131,670	27%	(proportion of household reference persons)
Rented: Social rented	188,814	39%	(proportion of household reference persons)
Private rented or lives rent free	162,674	34%	(proportion of household reference persons)
*Unemployed is seeking work or waiting to start a job obtained: available to start working within 2 weeks			
Source: (1) Census 2021 bespoke table on economic activity, living arrangements, qualifications and age			
Source: (2) Census 2021 bespoke table on Household reference Person by economic activity and housing tenure			

There is also a regional dimension to unemployment. This is most often illustrated with claimant count data, which is a measure of the number of people claiming unemployment related benefits.⁷ Higher rates of unemployment are typically found in the north of England and in parts of the Midlands (see Figure 1-1). We can also see that there is a higher proportion of low skilled in these parts of Britain.

⁷ Claimants of unemployment related benefits include those claiming Employment and Support Allowance and other incapacity benefits, and Income Support and Pension Credit. These benefits are being replaced by Universal Credit, which unemployed can also claim in addition to New Job Seekers Allowance. Claimant count data is not a full picture of unemployment, as there are a number of unemployed people who do not receive benefits, and there are a number of people who are employed but receive unemployment related benefits (e.g. income support if they are in a low paid part-time job).

Figure 1-1: Claimant count rate (September 2024).

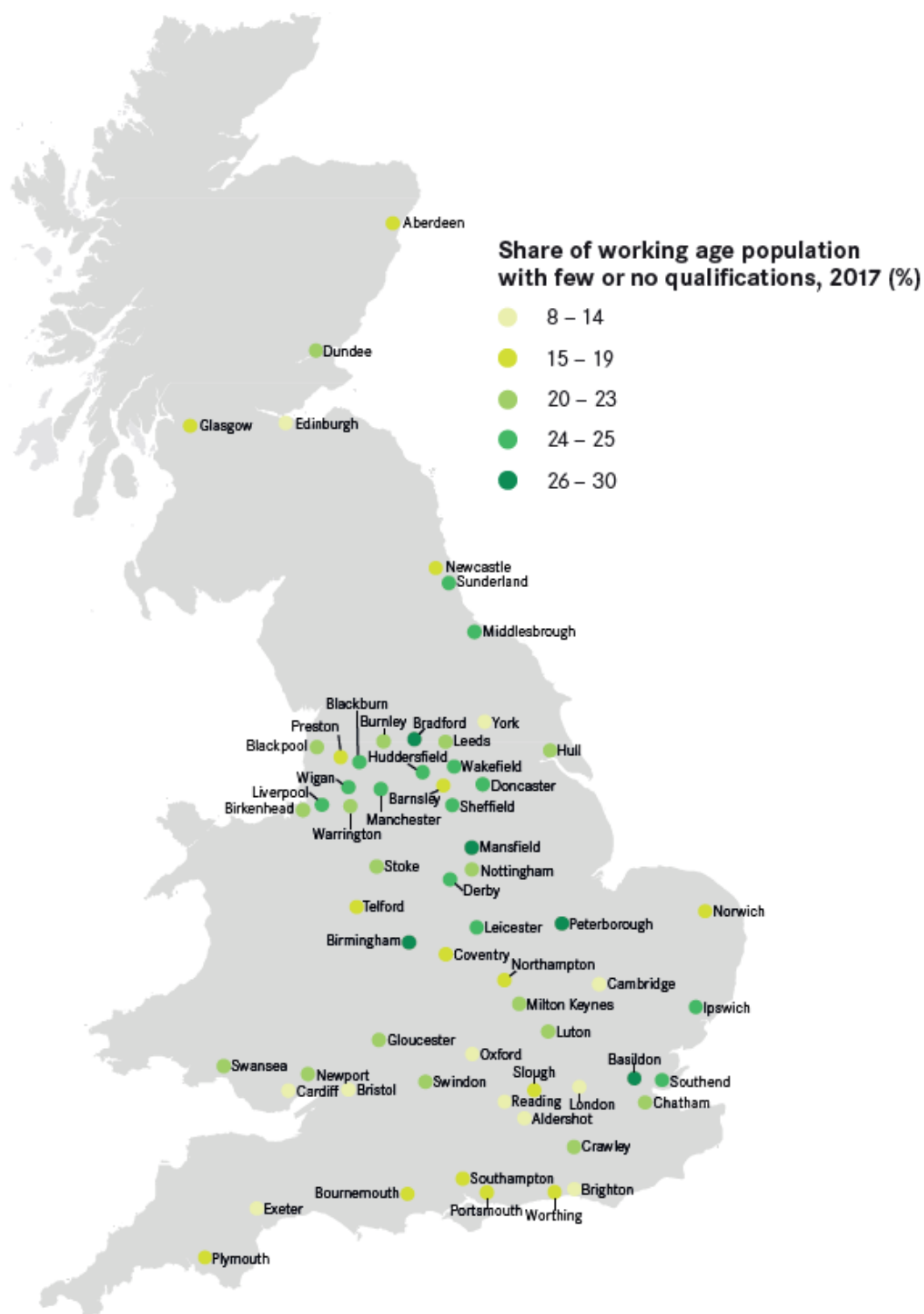


Note: Claimant count is the ratio of those claiming unemployment related benefits to the working age population.

Source: Centre for Cities unemployment tracker website:

<https://www.centreforcities.org/data/uk-unemployment-tracker/>

Figure 1-2: Share of working age population with few or no qualifications



Source: ONS, Annual Population Survey 2017

Source: Magrini (2019 Figure 3)

In summary the unemployed are really quite diverse a group. Within that diversity they tend to be younger than those in employment, on average, and be of lower skills on average. They

are also more likely to be living in rental accommodation than being a homeowner, and also more likely to be single (both of which will, to an extent, reflect their age profile).

1.4 Report Structure

Broadly speaking there are two stages to the quantification of the benefits of reducing unemployment in a cost benefit analysis. Firstly, there is the need to estimate the change in unemployment and secondly the need to value that change. Our report is structured around these stages and includes case studies and recommendations for TAG. Chapter 2 sets out the standard terminology used to describe labour market outcomes and a typology of unemployment. Chapter 3 then sets out the transmission mechanisms by which we would expect transport to impact on unemployment and reviews relevant empirical evidence. It also includes a glossary of terms. Chapter 4 presents a conceptual framework for the modelling of changes in unemployment and its valuation. These methods are then employed and illustrated in two case studies presented in Chapter 5. A summary of our findings and the implications for TAG are presented in Chapters 6 and 7. The report is accompanied by a series of appendices on modelling and valuation.

2 UNEMPLOYMENT: DEFINITIONS AND TYPOLOGY

2.1 Introduction

In modelling and valuing changes in unemployment it is important to be clear as to what labour market outcomes we are referring to, and also how transport policy links into the broader macroeconomic picture of unemployment. To this end, this chapter sets out the definitions we use and the standard typology of types of unemployment and their underlying causes.

2.2 Glossary of Labour Market Terms

There are a number of key terms related to the labour market referred to in the literature and in the policy space which we see as important to set out and clarify to avoid ambiguities in the remainder of this report. These are drawn from the ONS (2020).

Unemployed – People without a job who are 16 years and over and actively seeking work. More precisely the internationally agreed recommendation by the International Labour Organisation (ILO) is that these people have actively sought work in the last four weeks and are available to start work in the next two weeks; or are waiting to start work in the next two weeks.

Unemployment – A count of the unemployed

Unemployment rate – The headline unemployment rate is calculated by dividing the unemployment level for those aged 16 and over by the total number of economically active people aged 16 and over.

Economically active – People aged 16 and over either in employment or unemployed. Also variously referred to as the workforce (Carney, 2017), the Labour Force (ILO, 2015) and Labour Supply (TAG, 2018).

Employment – A count of the number of people aged 16 years and over who did one hour or more of paid work per week and those who had a job that they were temporarily away from (for example, because they were on holiday or off sick). It differs from the number of jobs, as one person may hold two or more jobs.

Employment rate – The headline employment count for those aged 16 to 64 divided by the population for that age group.

Labour Force participation rate – The headline labour force participation rate (economic activity rate) is the number of people in the labour force (16 to 64) divided by the population for that age group.

Economically inactive – People without a job not seeking work. More precisely, they have not actively sought work in the last 4 weeks and are not available to start work in the next two weeks. A substantial number of working age economically inactive people are not wanting employment. They may be students or responsible for household production, or they may have illnesses that prevent them from working. However, some commentators (see e.g. Centre for Cities, 2023) view part of the economically inactive as ‘hidden unemployed’. Such people would take a job if offered, but as they have ‘given up’ looking for work they do not appear in the unemployment statistics.

Inactivity rate – The headline inactivity rate is calculated by dividing the inactivity level for those aged from 16 to 64 divided by the population for that age group.

Workforce – The count of those employed and unemployed. Also known as the economically active, the labour force or labour supply.

2.3 Typology of Unemployment

2.3.1 A typology

Unemployment in the economy is interrelated with not only labour supply, but also wage growth, inflation and a number of other labour market and economy wide structural matters. This leads to concepts such as the equilibrium rate, and the non-accelerating inflation rate of unemployment. Monetary policy in part is determined by these different economic indicators. [Box 1](#) sets out these concepts and their inter-relationship in a detailed manner and is sourced from a Monetary Policy Committee inflation report (Bank of England, 2018). These interrelationships lead to important conclusions, that we will draw on later in this report, regarding how transport projects will affect unemployment. Below we summarise some of the key aspects of these concepts.

Structural unemployment. This type of unemployment is persistent and found where there are some underlying market failures, for example due to spatial or skill mismatches between workers and firms, or wages that are sticky above the market clearing rate (e.g. minimum wage) or other labour market regulations. Structural unemployment can still occur at full employment.⁸, i.e. be part of the equilibrium rate of unemployment.

Equilibrium rate of unemployment (also referred to as the **natural rate of unemployment** or **the long-term equilibrium rate of unemployment**) - “the rate at which unemployment is thought likely to settle in the long run, after all of the shocks and disturbances affecting the economy at any moment in time have dissipated” (The Bank of England 2017). “This rate is influenced by a number of structural features of the economy. Some examples include: skill levels amongst the workforce and how well they are matched with the skills required by different employers; relevant aspects of the tax and benefit system and employment legislation; how efficiently people can search for appropriate job opportunities, for example in job centres or online; and the nature of industrial relations.” (Carney, 2017).

Non-Accelerating Inflation Rate of Unemployment (NAIRU). This is the level of unemployment that is consistent with no acceleration in the inflation rate.⁹ It is a shorter term concept compared to the equilibrium rate of unemployment and can fluctuate over the course of a business cycle (Carney, 2017; Greene, 2023). The NAIRU and equilibrium rate of unemployment are different concepts. The equilibrium rate of unemployment is the minimum level of unemployment the economy can achieve given a set of structural issues (e.g. commuting costs and job search costs). The NAIRU reflects the level of unemployment below which inflation would be expected to increase rapidly. Similar structural issues affect both rates, however, they have slightly different compositions and can vary in the short term. The NAIRU reflects temporary factors such as a de-skilling of the workforce after a prolonged

⁸ The structural rate of unemployment that occurs at full employment would also be seen as the level of frictional unemployment, and is akin to the equilibrium rate of unemployment.

⁹ Unemployment levels that fall below the NAIRU would be expected to lead to a rapid increase in inflation, as the economy starts to experience resource shortages. Unemployment rates above the NAIRU .

economic shock. Such temporary effects lead to more wage pressure (and inflation) as demand recovers. This pushes NAIRU temporarily above the longer run equilibrium rate of unemployment, to which it should return (if there are no more economic shocks). The NAIRU is therefore more volatile than the longer run equilibrium rate of unemployment.

Cyclical unemployment occurs with changes in economic activity over the business cycle or as a consequence of external shocks to the economy. Cyclical unemployment is unemployment in excess of the unemployment that exists at the natural level of employment. It is also referred to as **demand deficient unemployment**.

2.3.2 The inter-relationship between the different types of unemployment

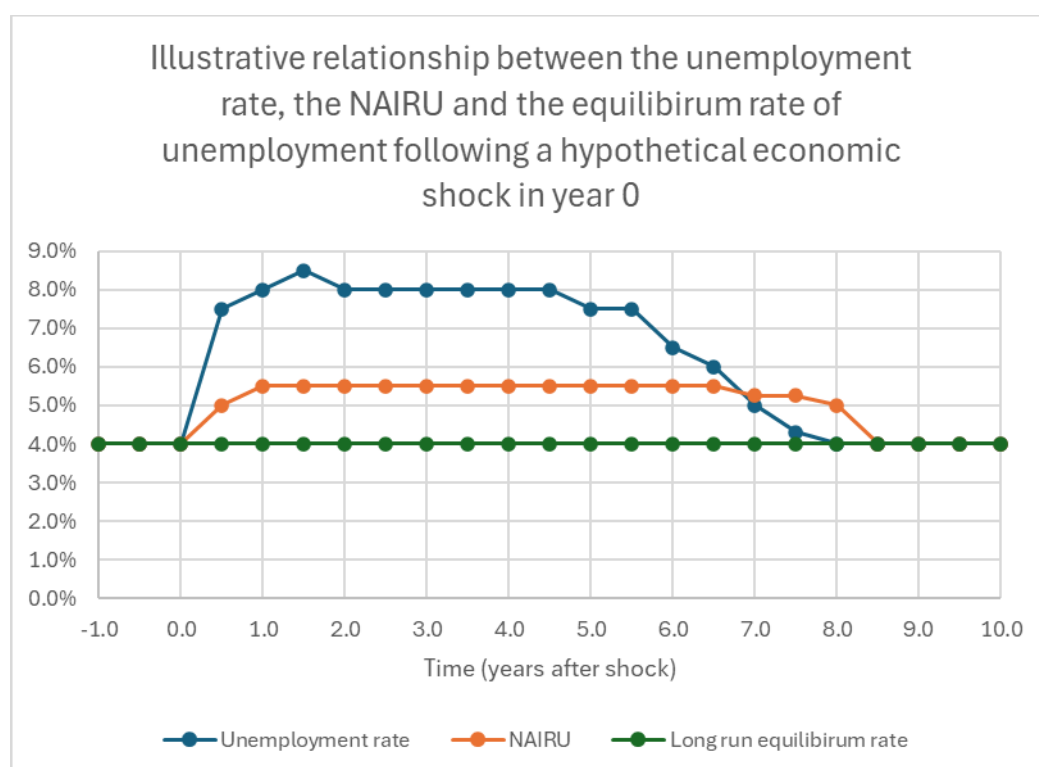
The inter-relationship between the three types of unemployment can be illustrated with the following stylised scenario. The economy has been operating in a stable efficient manner without excess demand or supply for some time and the level of unemployment is at the equilibrium rate. The NAIRU also equals the equilibrium rate in this situation. This equilibrium rate reflects structural aspects of the labour market including job search and spatial mismatches.

A negative economic shock now occurs, possibly as part of the business cycle or due to an external event, and demand reduces. This cyclical reduction in demand causes unemployment to increase. This is cyclical unemployment and causes the unemployment rate to exceed the equilibrium rate of unemployment. The downturn is prolonged and leads to a partial de-skilling of the workforce. The NAIRU therefore increases and diverges from the longer run equilibrium rate. The actual rate of unemployment remains above NAIRU. As demand recovers, the actual rate of unemployment falls towards NAIRU, and as the workforce re-trains the NAIRU in turn falls. Eventually there is no cyclical unemployment left, and in the absence of any more shocks, the economy stabilises with the unemployment rate, NAIRU and the equilibrium rate all equalling each other. This relationship is illustrated in Figure 2-1.¹⁰

Whether this is the same rate as prior to the economic shock would depend on whether similar structural issues are at play. If there has been a general de-skilling of the workforce due to unemployment it may be worse, but if government or firm sponsored re-training programmes have been very effective then it may be better. In reality of course a continuous series of shocks is likely to lead to volatility in NAIRU and continuous divergences between it and the equilibrium rate, as well as divergences between equilibrium and actual unemployment rates.

¹⁰ In the later years in the graphic the unemployment rate dips below the NAIRU which would imply inflation would be increasing.

Figure 2-1: Illustrative relationship between the unemployment rate, the NAIRU and the equilibrium rate of unemployment



Notes: This illustrative relationship between NAIRU and the unemployment rate is partially drawn from OBR analysis following the financial crisis. <https://obr.uk/box/the-equilibrium-unemployment-rate/>

February 2024's Monetary Policy Committee report by the Bank of England identifies that the medium-term unemployment rate (i.e. the NAIRU rate) is 4.5% and that the long-term equilibrium rate is just above 4% (Monetary Policy Committee (MPC), 2024). August's 2024 MPC report also gives the medium-term rate at 4.5%.

2.3.3 Implications for transport policy

An important issue to note here is that structural unemployment is a component of unemployment even at its equilibrium rate, and given the link to spatial mismatch there is potentially a role for transport policy, directly via commuting costs or indirectly via dependent developments, to permanently influence this equilibrium rate.

Further, whilst NAIRU and the equilibrium rate may be only reported as national measures, given the factors described above, there could be regional variation in these rates, particularly due to regional differences in demographics and labour market rigidities/mismatches.

Transport policy may be able to influence the speed at which the economy returns to its longer run equilibrium rate following a disturbance if, by reducing the disconnect between workers and jobs, it can speed up the job search. However, the time period over which the economy responds is relatively short in transport planning terms (approximately 6 to 8 years from Chart A in Box 1), so potentially it is only relevant to certain 'quick acting' policies such as fare reductions.

Whilst there are channels by which transport can influence the macroeconomic measures of unemployment, for evidence led appraisal we need models and empirical support to develop any guidance. The following chapters review the state of the art in this area.

Box 1: Equilibrium Rate of Unemployment

Box 4

The equilibrium rate of unemployment

The unemployment rate has fallen sharply in recent years, from 8.5% in late 2011 to 4.3% in the three months to November, its lowest level since 1975. When unemployment is low, that tends to put upward pressure on wage growth and inflation as companies need to pay more in order to recruit suitably skilled staff. And when unemployment is high, wage and inflationary pressures tend to be subdued as companies find it relatively easy to recruit and retain the right people. A key judgement for the MPC is where the 'equilibrium rate' of unemployment is — the rate consistent with meeting the inflation target in the medium term. This box explores the concept of the equilibrium unemployment rate in more detail and the evidence for where it currently lies.

What determines the equilibrium rate of unemployment?

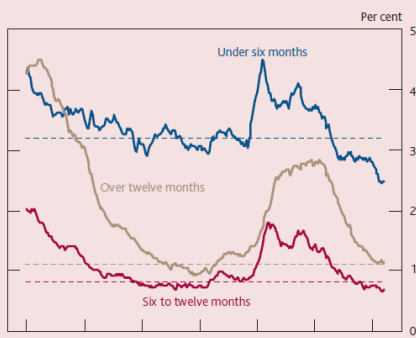
The equilibrium unemployment rate can vary over time. Over the longer term, it represents the rate of unemployment that the economy is capable of achieving sustainably over many years. This long-term rate is determined by the structural features of the economy that affect the time it takes for people to find the right jobs, for example the extent to which potential workers are a good match for the jobs companies want to fill. It will also be influenced by the tax and benefit regime, which affects the incentives for people to move between employment and unemployment. Since these factors tend to be slow-moving, the long-term equilibrium rate is usually assumed to change only slowly over time.

In the shorter term, cyclical factors, such as changes in the mix of unemployment, can also affect the unemployment rate consistent with stable wage pressures. For example, people who have been out of work for over a year tend to be less likely to find employment than those who have been out of work for a shorter period of time, and so tend to exert less downward pressure on wages and inflation.

Following the financial crisis, that shorter-term equilibrium unemployment rate probably rose as the proportion of people out of work for over a year increased sharply (**Chart A**). But that effect has largely unwound, with the proportion unemployed for over 12 months back at its pre-crisis average. That suggests that the recession was not associated with any structural rise in long-term unemployment, in contrast to previous UK experience. It also suggests that the shorter-term equilibrium unemployment rate is likely to be close to its long-term structural rate.

Chart A Long-term unemployment has fallen back to its past average rate

Unemployment rates by duration^(a)



Sources: ONS and Bank calculations.

(a) The number of people unemployed in each duration category, divided by the economically active population. Rolling three-month measures. Dashed lines are averages from 2002 to 2007.

Equilibrium unemployment and wage growth

The equilibrium unemployment rate is unobservable and so difficult to estimate with precision. One way of assessing its level, however, is to make use of the relationship between unemployment and wages. After accounting for factors other than unemployment that are likely to be influencing wage growth — for example growth in productivity — it is possible to infer what the rate of equilibrium unemployment would need to be in order to be consistent with current wage growth.

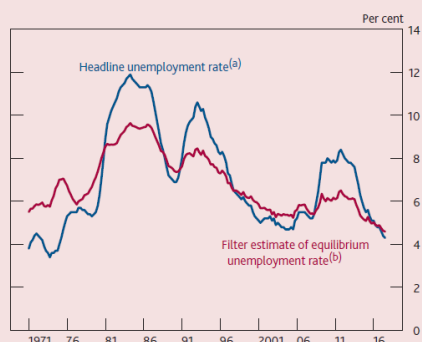
In February 2017, the MPC lowered its estimate of the long-term equilibrium rate from 5% to 4½%, following a period when wage growth had been below its projections over successive quarters. A lower equilibrium rate helped explain those forecast errors. Over the past year, annual pay growth has remained subdued (Section 4). Although that partly reflects continued weakness in productivity growth, including that stemming from recent shifts in the composition of employment growth, it would, all else equal, be consistent with a long-run equilibrium unemployment rate somewhat below 4½%.

A more formal way of using the relationship between unemployment and wages to estimate the equilibrium rate is to use statistical filtering techniques.⁽¹⁾ These techniques impose an assumption about the relationship between unemployment and wage growth, for example that it is linear. The estimated equilibrium rate is then allowed to vary over time in order to capture persistent structural changes in the labour market. **Chart B** shows that the equilibrium unemployment rate estimated using one such statistical filter has fallen since 2010. Although there is considerable

(1) For more details, see Berry, S, Corder, M, Duffy, C, Hackworth, C and Speigner, B (2015), 'Trends in UK labour supply', *Bank of England Quarterly Bulletin*, 2015 Q4.

Box 1 (contd): Equilibrium Rate of Unemployment (contd)

Chart B Estimated equilibrium unemployment from a filter model has fallen a little further over the past year
Unemployment and estimated shorter-term equilibrium rate from a statistical filtering model



Sources: ONS and Bank calculations.

- (a) Three-month measure.
(b) The filter model used produces an estimate of shorter-term equilibrium unemployment consistent with stable wage growth. The relationship between wage growth and unemployment is assumed to be linear. The sample period is 1971 Q1 to 2017 Q3. The error bands around this estimate are wide.

uncertainty around these statistical estimates, over the past year they suggest that the equilibrium rate has fallen very slightly further and remained close to the headline unemployment rate.

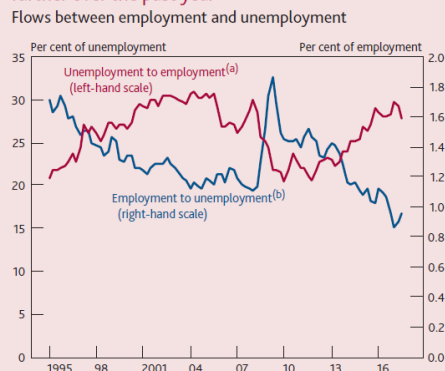
The structural determinants of equilibrium unemployment

Another way to estimate the level of equilibrium unemployment is to examine the structural features of the economy that determine the time it takes people to find the right jobs. When the efficiency with which employees are matched to new job vacancies improves, or when the rate at which existing jobs are destroyed falls, then, for a given level of labour demand, the long-run equilibrium unemployment rate will fall.

One factor likely to have improved the efficiency with which employees are matched to job vacancies is a rise in the average educational attainment of the workforce. More highly skilled workers are likely to be better-suited on average to the jobs on offer. In addition, technological progress — for example the increasing use of online vacancy sites — is likely to have improved job matching by reducing the cost to companies of advertising vacancies and to workers of searching for new jobs. Despite these developments, however, the rate at which the unemployed move into employment — which depends in part on the efficiency of job matching — remains no higher than prior to the crisis (**Chart C**).

The rate at which jobs are destroyed is also likely to have been affected by structural changes. Increased flexibility within the labour market may have meant that employment contracts can be adjusted more easily, such that firms are able to reduce

Chart C The job destruction rate has fallen slightly further over the past year
Flows between employment and unemployment



Sources: ONS and Bank calculations.

- (a) Number of people who reported having moved to employment from unemployment in the past three months. Seasonally adjusted by Bank staff. Two-quarter moving average.
(b) Number of people who reported having moved from employment to unemployment in the past three months. Seasonally adjusted by Bank staff. Two-quarter moving average.

employee hours to lower levels for a period without making their workers redundant. This will tend to lower the equilibrium unemployment rate, although it may also lead to periods of 'underemployment' of those in work if hours are reduced below the level of those that employees wish to work.

Last year, the MPC judged that such structural changes had reduced the job destruction rate and hence the rate of equilibrium unemployment. Since then, the job destruction rate has fallen slightly further (**Chart C**), largely due to a fall in the number of people moving from temporary work into unemployment. Should these developments persist, they would suggest that the equilibrium unemployment rate is lower than previously thought.

Conclusion

Taking all the evidence together, the MPC judges that the long-term equilibrium rate of unemployment is slightly lower than judged a year ago, at around 4¼%. That is broadly in line with the headline rate of unemployment. Taken together with other evidence (Section 3.1), overall slack within the economy is likely to be very small at just under ¼% of GDP.

Source: Bank of England (2018 p22-23)

3 HOW TRANSPORT PROJECTS AFFECT UNEMPLOYMENT

3.1 Introduction

In this chapter we introduce the microeconomic mechanisms that provide the theoretical justification for transport policy affecting both labour supply and unemployment. They also lead to conclusions that labour supply and unemployment should be modelled simultaneously. We then review the empirical evidence on how transport interventions have affected unemployment. This empirical review provides some insights into how changes in unemployment could be modelled in an ex-ante appraisal.

3.2 Commuting costs, job search costs and the equilibrium rate of unemployment

The equilibrium rate of unemployment is the long run market clearing unemployment rate that accounts for underlying structural issues in the economy such as job search costs including some spatial mismatch.¹¹ The existence of search costs effectively pushes the labour supply curve upwards (the red lines in Figure 3-1). This then gives rise to a labour supply of L_S^0 , of which L_D^0 are in employment and U^0 are unemployed, i.e. the economically active in the economy.

If we presume that commuting costs form part of the labour supply curve (we will return to this below), then a reduction in commuting costs will lower the labour supply curve. As spatial mismatch/job search costs are also a function of proximity (Manning, 2003, Manning and Petrongolo, 2017, Marinescu and Rathelot, 2018) then we would simultaneously also expect a reduction in job search costs. The result is that both labour supply expands (i.e. the number of those in the workforce/economically active increases) and unemployment reduces. With reference to Figure 3-1:

- Labour supply increases by ΔL_S (i.e. the difference between L_S^1 and L_S^0)
- Unemployment reduces from U^0 to U^1 ($\Delta U = U^1 - U^0$)
- With an expanding labour supply and a reduction in unemployment the long run rate of unemployment would also reduce. This can be seen as with $U^0 > U^1$ and $L_S^1 > L_S^0$ then $U^0/L_S^0 > U^1/L_S^1$.
- Employment increases from L_D^0 to L_D^1 . The change in employment can also be expressed as a change in labour supply and unemployment: $\Delta L_D = \Delta L_S - \Delta U$
- The change in unemployment can be expressed as the difference between the change in labour supply and the change in employment (which is also the change in labour demand). That is $\Delta U = \Delta L_S - \Delta L_D$.

If job search costs did not change as a consequence of the transport project, that is the gap between $Supply^0$ $Supply^1$ remains unchanged, then unemployment would not change (in this

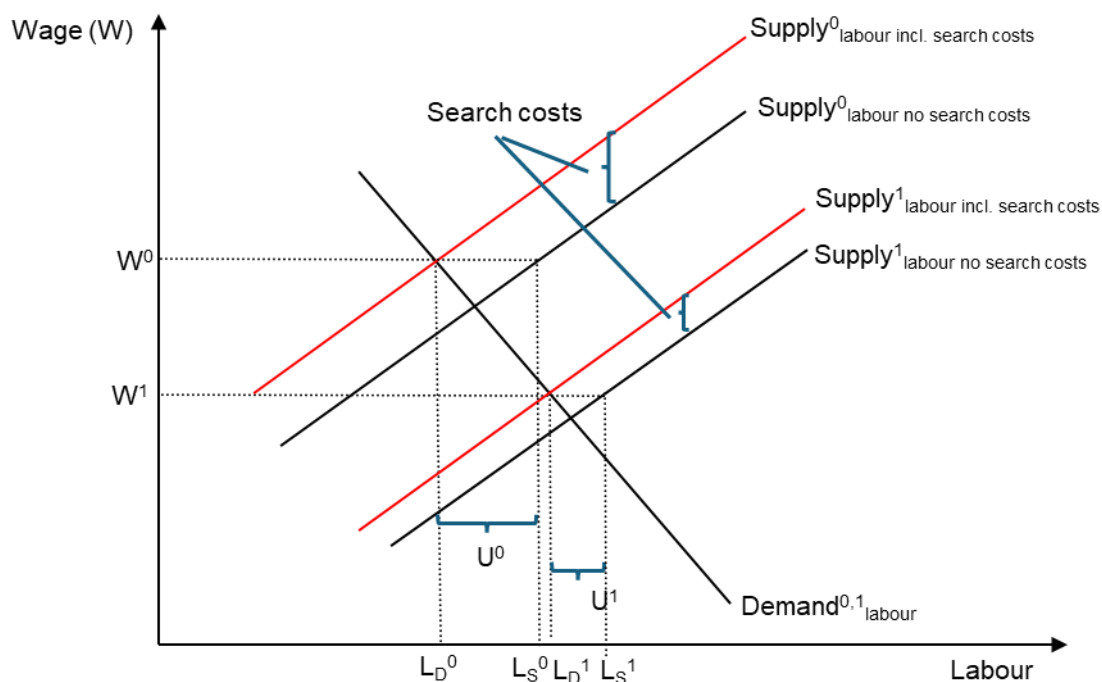
¹¹ Job search costs is a catch all phrase used to describe the time and money costs associated with searching for employment. These include the time and money costs of obtaining information, as well as applying for a job, and preparing for, and travelling to and attending an interview.

model with linear labour supply curves), but the long run equilibrium rate of unemployment would still fall. This is because even though $U^0 = U^1$, there is an increase in labour supply (i.e. $L_S^1 > L_S^0$) and $U^0/L_S^0 > U^1/L_S^1$.¹² Of course if there is no change in the count of the unemployed then there is no benefit to be included in the appraisal from reducing unemployment.

This example also illustrates that it is not sufficient for the project to decrease commuting costs, but it requires a change in job search frictions (spatial mismatch). In this case we see both occurring simultaneously as reduced commuting costs reduce the costs of job search (and therefore spatial mismatch). Thus we see that changes in labour supply (arising from commuting cost reductions) and changes in unemployment both occur at the same time.

Our case study on the Trans-Pennine Upgrade employs a methodology based around this mechanism for reducing unemployment (and expanding labour supply).

Figure 3-1: Commuting costs and unemployment arising from spatial mismatch



Implications for labour supply and unemployment modelling

The above argument rests on the presumption that workers are fully compensated for their commute via a wage premium. This is the model embodied in the TAG A2-3 labour supply model (Department for Transport, 2018). There are alternative models to this which imply full compensation for the commute via house prices, such as the classic Alonso-Muth-Mills monocentric urban model, for which extensive evidence of house price gradients in cities is taken as supporting. For cities or regions with multiple employment centres the theoretical models would predict compensation via a mixture of wage premiums and land rent reductions (Moses, 1962), and this has been shown to occur in reality (Timothy and Wheaton, 2001). Furthermore, in labour markets that experience search frictions there will only be partial

¹² Here as labour supply (the workforce) expands and the count of unemployment stays the same then one interpretation is that all those entering the workforce find employment. However, these are net changes and the dynamics may differ. For example, some of those now making themselves available for work might become temporarily unemployed until they find work, whilst more than $U_0 - U_1$ of those who were unemployed find work. All we know is that labour supply increases, employment increases and unemployment stays the same.

compensation for the commute, and there is a growing body of evidence that partial compensation is prevalent in developed economies particularly for women (Manning, 2003, Laird, 2008, Mulalic et al., 2014, Jacob et al., 2019, Le Barbanchon et al., 2021, Farré et al., 2023).

The implication of these different models is that there is evidential support for wage compensation for the commute, but that the responsiveness of the wage to changes in commuting costs will be dampened relative to the TAG labour supply model (which assumes a full pass through from commuting costs to the wage), particularly for certain labour market segments (women and the low skilled) and in cities. It therefore becomes an empirical matter as to how responsive labour supply is to changes in transport (accessibility) costs. There is therefore an argument for using observed elasticities to transport accessibility in labour supply modelling. Similarly, it is an empirical matter as to how responsive unemployment is to changes in transport costs, and observed elasticities would be preferred for modelling work.

3.3 Job displacement and unemployment

Transport investment is known to displace economic activity from one location to another and ex-post evidence exists showing this (Chandra and Thompson, 2000, Duranton and Turner, 2012, Dong, 2018, Baum-Snow et al., 2020, Pogonyi et al., 2021). It is therefore useful to consider the mechanisms at play during displacement, and the impact on unemployment.

Our starting position is that we have two regions A and B. These are shown in the left hand and right hand panels of Figure 3-2 respectively. The segment of the labour market shown is one of low skills that experience spatial mismatch, and for which some structural unemployment exists in both regions. This is U^{A0} and U^{B0} . Total employment across both regions in the Do Minimum counterfactual is the sum of L_D^{A0} and L_D^{B0} . The demand and supply curves have been depicted as linear, which can be seen as reasonable for marginal or small changes in regional labour markets.

Region A is the recipient of the transport investment. This investment does several things. It increases business productivity (via business and freight user benefits) which increases region A's output and its demand for labour (at all wage levels). This is shown by the outward shift in Region A's labour demand curve. The increased output and need for more space for additional capital and labour lead to land use change. The transport project itself may also be a catalyst for the land use change by opening up land for development (the Dependent Development aspect of TAG). The increased number of workplaces increases the proximity of employment (vis-a-vis the Do Minimum). This increased proximity of workplaces reduces spatial mismatch and is shown by a downward shift in the labour supply curve and a reduction in search costs.¹³ This results in an increase in employment (ΔL_D^A) in Region A from L_D^{A0} to L_D^{A1} . Unemployment reduces (ΔU^A) from U^{A0} to U^{A1} . Region A's labour supply also increases by ΔL_S^A , noting that the reduction in unemployment means that the increase in labour supply is less than the increase in employment. That is: $\Delta L_D^A > \Delta L_S^A$.

Turning to Region B. This region has not received a supply shock and therefore the labour supply remains unchanged. If we take it that Region A and B both produce goods that are perfect substitutes for a domestic market, then we would expect an expansion of output (and

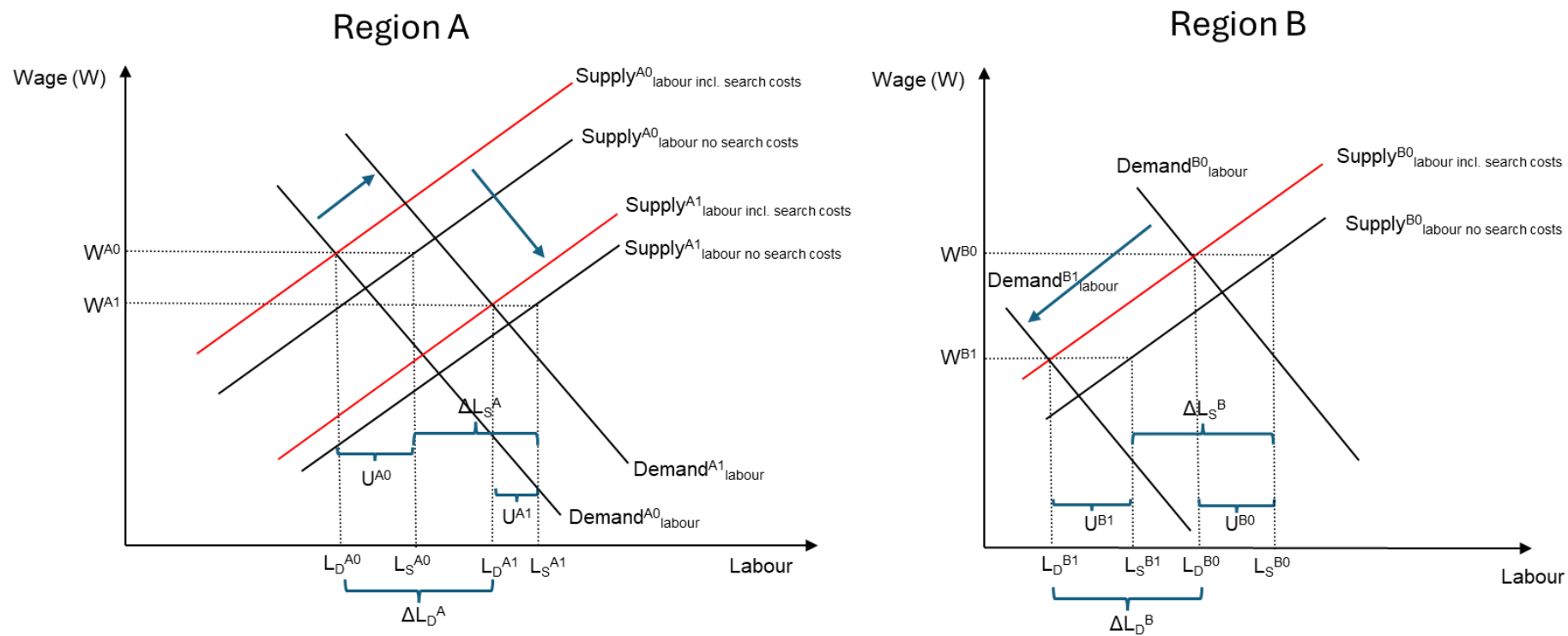
¹³ The transport intervention may also directly lower commuting costs (e.g. commuter user benefits are positive), though the land use change in isolation will increase employment proximity for the economically active. That is this mechanism holds for a transport intervention that only affects business and freight user benefits.

labour) in region A to be met by an equal and opposite contraction in output (and labour) in Region B.¹⁴ This is shown by a leftward shift in Region B's demand curve, and $\Delta L_D^A = -\Delta L_D^B$. No change in commuting costs or job search costs mean that unemployment in Region B remains unchanged. That is $U^{B0} = U^{B1}$ (and $\Delta U^B = 0$). Labour supply in Region B has contracted by the amount of labour that has been displaced (that is $\Delta L_S^B = \Delta L_D^B$).¹⁵

¹⁴ Requires a productivity in the Do Minimum to be equal between regions (as shown in the panel with $W^{A0}=W^{B0}$).

¹⁵ This would likely only occur if lost jobs in B are spread randomly across the area, whereas the new jobs in A are focused in an area where there is spatial mismatch.

Figure 3-2: Displacement and unemployment



At the economy wide level we therefore can see the following:

- Total employment has remain unchanged. That is:

$$\begin{aligned}\Delta L_D &= \Delta L_D^A + \Delta L_D^B \\ &= 0.\end{aligned}$$

- Unemployment has been reduced. That is:

$$\begin{aligned}\Delta U &= \Delta U^A + \Delta U^B \\ &= (U^{A1} - U^{A0}) + (0) \\ &= U^{A1} - U^{A0}\end{aligned}$$

- Labour supply has reduced by the amount unemployment has reduced. That is:

$$\begin{aligned}\Delta L_S &= \Delta L_S^A + \Delta L_S^B \\ &= (\Delta L_D^A + \Delta U^A) + (\Delta L_D^B + \Delta U^B) \\ &= \Delta L_D^A + \Delta U^A + (-\Delta L_D^A) + 0 \\ &= \Delta U^A \\ &= \Delta U\end{aligned}$$

Of course, these findings are dependent on the constraints imposed on the model depicted in Figure 3-2. Firstly, the reduction in unemployment in region A is dependent on the project addressing the causes of spatial mismatch, primarily by giving households better accessibility to employment. Secondly, if there are productivity differences between the regions then, as employment shifts between the regions, there will be an additional social benefit (Venables, 2007, Laird et al., 2020). Thirdly, should the changes in regional labour demand and supply be non-marginal then it would likely be the case that there could be additional gains or losses occurring. For example, unemployment in region B would increase, $U^{B1} > U^{B0}$; if the labour supply curve was concave and the change in labour demand in Region B was non-marginal. Additionally, there could also be gains if the businesses expanding in Region A exported to international (world) markets, as employment may not be fully displaced.^{16, 17}

Finally, it is also worth noting that the model itself also says nothing as to whether the changes in regional labour supply are a result of existing regional households supplying more hours, households from region B commuting into Region A, or households from Region B migrating to Region A. The exact mechanism by which regional labour supply changes could have indirect consequences for social costs and benefits. For example, if households migrate, then it would be expected that there will also be a change in household serving businesses (e.g. education and leisure services), with potential associated impacts on agglomeration and location amenity externalities.

Our Newhaven Port Access Road case study is based around displacement to a development (at Newhaven Port) that is dependent on the transport project. Key to the case study is how

¹⁶ The productivity led growth in Region A would increase wages which would further increase the supply of labour in Region B, meaning not all the increase in employment in region A is displaced from B.

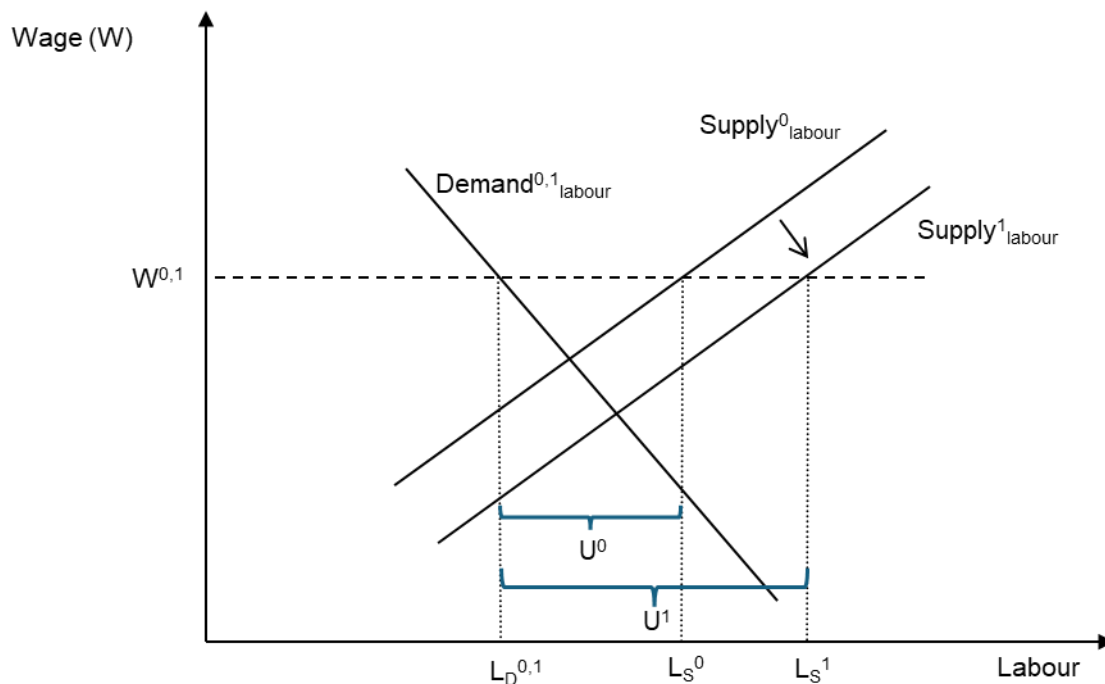
¹⁷ There would be losses elsewhere in the world, from displaced world output, but these are not of a concern to a CBA with a national perspective.

the regional displacement is modelled. In this case, with a localised development site, it is based around TAG style Dependent Development arguments. That is, there is no formal modelling of the displacement, rather a set of qualitative arguments define the counterfactuals used. However, larger projects with more dispersed regional economic growth would require more demanding analytical models to be constructed (e.g. Land Use Transport Interaction models or Spatial Computable General Equilibrium models). The exact model form and structure would depend on the economic responses that were considered relevant to the regions and the transport project but should also be proportionate to the task at hand.

3.4 Cyclical unemployment

In times of negative demand shocks when wages are, for whatever reason, sticky in a downwards direction, the labour market does not clear giving rise to unemployment. A transport project that lowers commuting costs in this situation would lead to an increase in unemployment. This is because the ΔL_S is positive but the ΔL_D is zero. This leads to the ΔU being positive. This is shown in Figure 3-3 for the simplifying situation where there are no job search costs. The lack of movement in wages results in the expansion of unemployment ($U_1 > U_0$), as the demand for labour does not change, but with lower commuting costs the supply of labour increases.

Figure 3-3: Sticky wages and a commuting cost reduction

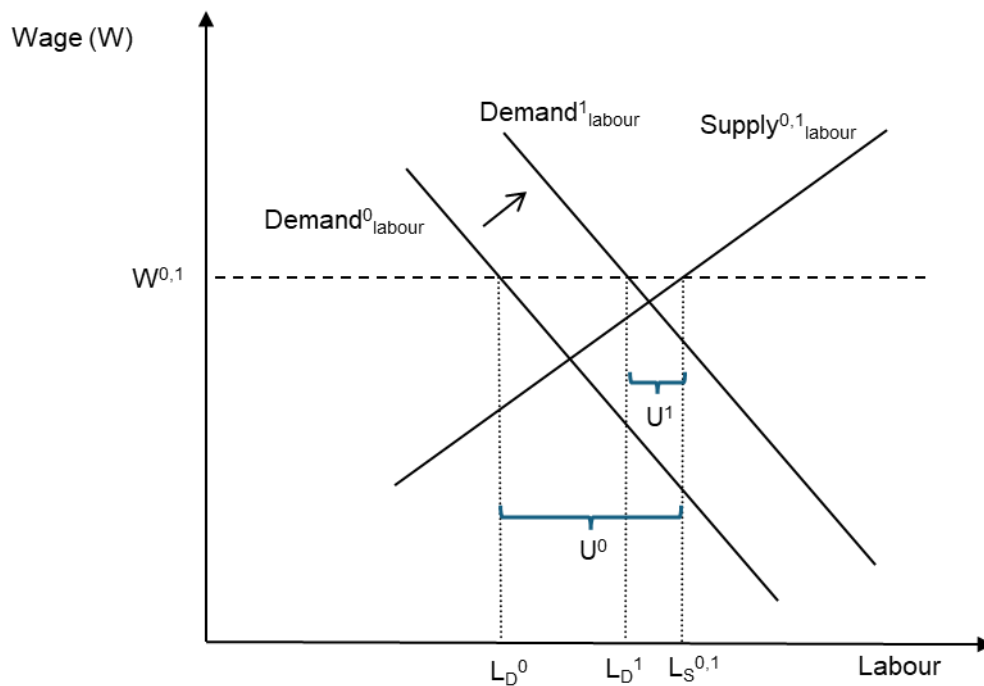


It is only with an increase in the demand for labour that unemployment would reduce (see Figure 3-4). In this instance the supply of labour is unchanged, but the demand increases. Unemployment decreases: $U_1 < U_0$. A demand increase could arise due to a government spending stimulus on construction of 'shovel ready' projects, or a transport project increasing the productivity of a region. An important aspect of cyclical unemployment is its temporary nature. In the medium-term wages will fall or workers will re-train and the unemployment rate will return to the long run equilibrium rate.

In our Newhaven Port Access Road case study we look at construction impacts of which one of the scenarios is a spending stimulus – so a scenario similar to Figure 3-4.

In the Netherlands, where wages are partially regulated, sticky wage related structural unemployment was an important contributor to the ex-ante benefits of Maglev project variants that displaced employment to the north, which reduced unemployment: and was a cost to projects that did the opposite (Elhorst and Oosterhaven, 2008). The cause of the unemployment in this instance is not demand deficiency but the regulated labour market.

Figure 3-4: Sticky wages and a labour demand increase



3.5 Evidence on changes in employment outcomes from transport projects

Transport has been associated with improved employment outcomes as it provides people with greater access to spatially dispersed job opportunities. The seminal work of Kain (1968) on the Spatial Mismatch Hypothesis argued that a major source accounting for inner-city unemployment in the US was to be found in poor access to job opportunities. Subsequent to this a large body of studies in US metropolitan areas emerged. More recently, some studies have also evaluated this relationship in EU cities (Gobillon, Selod, & Zenou, 2007; Ihlanfeldt & Sjoquist, 1998). Many of these studies are based on micro-level datasets focusing on individual labour market outcome probabilities using a measure of transport access as one of the explanatory variables. Most studies largely confirm the positive effects of transport on employment probability outcomes. Few studies present evidence on absolute changes in unemployment levels in a way which could be adopted or adapted for guidance purposes; most focus on the employment or employment rate impacts which may be conflated with

increases in labour force participation. This presents the issue of how to derive unemployment numbers and elasticities when interpreting any results.

Firstly, we address the subsection of the literature that is specifically concerned with unemployment, then we consider more broadly the employment related studies. The close relationship between changes in employment and unemployment and changes in labour supply, as introduced in section 2.2 on mechanisms, means it is worth considering this empirical work as relevant.

3.5.1.1 Job Search Models and unemployment

Norman et al. (2017) estimates the relationship between temporal changes in employment and changes in labour market accessibility in Sweden using a measure of accessibility weighted across travel modes. They present employment elasticities by different job market segments. Through the model results they derive elasticities of the employment rate to transport induced accessibility change by education and unemployment segments as shown in Table 3-1 below. They find higher elasticities for lower educated and higher unemployment areas. Their approach is presented and discussed in more detail in the Appendix as it feeds into the proposed modelling framework.

Their work has parallels with the existing TAG approach for estimating labour supply impacts — in that a reduction in commuting costs increases employment, and that some of this employment increase will be drawn from an increased labour supply and some from a reduction in unemployment. In contrast to the standard definitions outlined in section 2.1, their definition of the employment rate is non-standard, simply based on the ratio of employed to employed plus unemployed, but for the purpose of modelling this is not an issue. Based on their separate model of labour participation, it is also possible to derive labour supply participation rate elasticity which is higher than the employment rate elasticity.

Table 3-1: Employment elasticities from Norman et al (2017)

	Education level sub sample				Unemployment rate sub sample (U)		
Full sample	Primary	Secondary	Uni<4 years	Uni >4 years	U>5%	U>3.1%	U<=3.1%
0.009	0.01	0.008	0.005	0.002	0.015	0.011	0.002

Source: Norman et al. (2017)

Using measures of job matching, Marinescu and Rathelot (2017) provide some limited evidence for the existence of spatial mismatch unemployment. Using US data they find job seekers are 35 percent less likely to apply to a job 10 miles away from their zip code of residence.

Whilst their work says nothing about the potential role of transport in addressing spatial mismatch, their search and matching model predicts that relocating job seekers adjacent to jobs, would increase the number of hires by 5.3 percent. That is there would be a 5.3% reduction in the number of vacancies, with a corresponding reduction in the unemployment

count.¹⁸ They thus conclude geographic mismatch is a minor driver of aggregate unemployment, however they report considerably higher mismatch rates when focusing on job matches between seekers and vacancies within particular occupation and also educational groupings (higher mismatch rates for those with lower educational attainment). It is worth noting that using a distance decay parameter based on a UK study (Manning and Petrongolo, 2017), the mismatch doubles to about 10.8 percent.¹⁹ This could be taken to imply higher commuting costs per mile in the UK (higher petrol prices, lower car ownership) vis-a-vis the US, but could also imply a more segregated labour market with less choice.

Manning and Petrongolo (2017) use UK ward level data to model the optimal search strategies of the unemployed across space to characterize local labour markets. They estimate that labour markets are quite local as job attractiveness sharply decays with distance. Workers are also discouraged from searching in areas with strong competition from other job-seekers.

Further, a local stimulus or transport improvements are shown to have modest effects on local outcomes, as 'ripple' effects in job applications dilute their impact across a series of overlapping markets. This is evidenced in a simple ex-ante case study example of the Crossrail link between Heathrow (low unemployment) and Stratford (high unemployment). Unemployed workers living relatively close to Stratford divert some of their job search effort from their local wards towards Heathrow. Following the link, applications per job rise both in Heathrow and its close vicinity attracting more jobseekers from Stratford and surrounding areas. As a consequence, the locals to Heathrow are less likely to find jobs as they face stronger job competition from new applicants attracted by the faster transport link.

Whilst providing an interesting modelling framework which addresses interactions between proximate job markets and some simple case study evidence, it does not provide information about absolute changes in unemployment. For this reason, it is not directly applicable in a more general form for the needs of this project. Also, they do not address differences in types of jobs or workers or examine impacts in specific skill sectors.

Interestingly neither of these two papers or the Norman et al. (2017) paper feature wages as explanatory variables. Although not explained, this could be to avoid a discussion of issue of endogeneity between employment and wages.

3.5.1.2 Job Search Models and employment

This subsection focuses on the related literature on employment impacts. Matas et al. (2010) discuss the particular importance of the relationship between accessibility and employment amongst the lower skilled as being principally due to spatial mismatch in the European context — with poorer suburbs and wealthier city centres which serve as employment areas for more skilled jobs with lower skilled employment also in the suburbs (with the Paris-Ile-de France case study). A secondary reason is the lower levels of car ownership in these groups. In the UK context, Patacchini and Zenou (2005) examine job search intensity using British sub-regional aggregate data and find higher commute times and lack of car access yield less

¹⁸ That is if there are a hypothetical 1,000 vacancies then spatial mismatch (under US conditions) would contribute to 53 (5.3%) of those remaining unfilled. Should spatial mismatch be eliminated then the unemployment count would reduce by 53.

¹⁹ Thus for UK 'conditions' 108 vacancies may remain unfilled due to spatial mis-match for every 1,000 vacancies.

search intensity. However, as noted by Ihlanfeldt and Sjoquist (1998), other factors such as lack of information on job availability, discrimination and lack of skills are at least as important in affecting employment levels for inner city, low-income groups.

Studies deal with accessibility in different ways. In some studies accessibility is simply a transport measure captured by the number of public transport nodes within a particular radius (Ong and Houston (2002)) or the proximity to the nearest transport node (Holzer et al, 2003; Sanchez, 1999) or measures of route density (Rice, 2001). Other approaches look at accessibility to jobs either by mode or on average, using average commute times (Ihlanfeldt and Sjoquist, 1991; Cervero et al. 2002; Ozbay et al., 2006; Berechman and Paaswell, 2001) or numbers of jobs within a particular public transport travel time radius (Smart and Klein, 2015, Gibbons et al., 2012). More sophisticated gravity based formulations (e.g. Kawabata, 2003, Yi, 2006; Sanchez et al. 2004) account for the spatial distribution of employment with an impedance measure based on travel times or costs.

Many of the earlier studies are cross-sectional in nature which means it is more difficult to establish causality of employment outcomes (which are based on spatial variations in accessibility rather than changes). Earlier studies suffered from limitations in the underlying datasets and methodologies (Gobillon et al., 2007) and most studies typically focus on US metropolitan areas (Ihlanfeldt, 2006). Some of the mixed empirical results of earlier studies may arise from the use of different transport measures and employment outcomes, which are, thereby, difficult to compare in a meaningful and consistently measurable way.

A further limitation of many earlier studies lies in their lack of consideration of potential endogeneity between transport and employment probability outcomes: for example, car access is likely to increase people's employment probabilities, while a job also provides the means for a car, which may bias study results. There is also the issue of residential endogeneity because of the simultaneity between an individual's employment outcome and residential location decision (Glaeser, 1996). Studies that do not control for endogeneity, therefore, establish an association rather than causality between transport and employment probability outcomes. None of these studies specifically address displacement issues.

Bastiaanssen et al. (2020) reviewed the evidence base (largely US) on link between individual labour market outcomes and transport accessibility and undertook a meta-analysis. The meta models demonstrate car ownership significantly increases employment probabilities, in particular among welfare recipients. For example, the odds (of employment) ratio for employment of individuals with access to car nearly 1.8 times higher than for car less.

The overall meta-regression shows that as the mean commute times increase, the odds of employment slightly decreases; e.g. with a ten-minute increase in commute time we would expect the relative odds of employment to decrease by a factor of 0.14. Within the model, the significant negative adjustment to the log-odds ratio for commute times in the youth subgroup (aged 16–25) suggests more rapidly decreasing employment probabilities. With a ten-minute increase in commute time, the odds of employment amongst youth would decrease by a factor 0.24, which may imply that young people are more sensitive to the time and cost implications of longer commutes than other groups.

Bastiaanssen et al (2022) study uses British national employment micro datasets to assess which urban and rural areas and population groups would benefit from better public transport

services. This study computed a public transport job accessibility measure based on Census data applied to LFS data nationwide and used this to estimate individual-level employment probability models for Great Britain. The models were corrected for endogeneity by applying an instrumental variable approach. The study finds that better public transport job accessibility improves individual employment probabilities, particularly in metropolitan areas and smaller cities and towns with lower car ownership rates and in low-income neighbourhoods. For Urban Areas, public transport job accessibility changes yields an employment elasticity of 0.013. For GB as a whole there were significant parameters on accessibility for individuals in lower vehicle owning neighbourhoods, lower income areas and amongst the 25-34 age group.

3.5.2 Aggregate employment studies

There are also more aggregate studies examining link between employment and transport accessibility. Berechman and Paaswell (2001) use Census data to look at accessibility impacts in the New York Bronx area and Ozbay et al. (2006) focus on interstate travel in the New York/New Jersey metropolitan area. Berechman and Passwell (2001) find employment elasticities of (largely) PT accessibility improvements in of around 0.04. i.e. a 10% accessibility improvement increases employment by around 0.4%. Both studies effectively assume completely elastic labour demand so any increase in labour supply will increase employment. Johnson et al. (2017) find employment elasticities of PT accessibility (mainly bus) improvements in England of around 0.02.

Sanchez (1999) uses a cross section of US Census data and GIS to analyse the location and employment characteristics of workers with varying levels of accessibility to transit for the cities of Portland and Atlanta. He finds that transit access, but not always frequency, is a significant factor in determining average rates of labour participation of areas within these two cities.

3.5.3 Employment case studies addressing endogeneity

Very few aggregate studies deal with the endogeneity between transport accessibility and employment outcomes. The ideal way to establish causality is to compare employment impacts in areas which have been subject to a random natural shock or policy induced 'quasi-random' change in transport accessibility with control areas which haven't had such changes in accessibility. To this end, Gibbons et al (2012) estimate employment impacts using a panel database of employment at the ward level married to measures of road construction schemes. They deal with the issue of endogeneity by looking at the employment impact of these schemes in areas close to (10-30km), but not directly on top of these schemes, the implication being that these are incidental to the main target area of these schemes and can thus be considered as 'quasi random' in the selection of treatment areas. Their measure of accessibility is an index capturing the amount of employment reachable per unit of travel time, based on ward-to-ward travel times. They use a 'fixed effects' approach to avoid any bias arising from the correlation of unobserved time invariant area level effects with accessibility. They find a 10% improvement in accessibility leads to around a 3% increase in the number of businesses and employment up to 30km from the site, although the estimates range between zero and 10% depending on sector and specification.

Holzer et al. (2003) exploit the natural experiment of the extension of the San Francisco Bay heavy rail system which provided an exogenous increase in accessibility to employment opportunities. By surveying employers they established a higher likelihood, post intervention,

for employers close to the line to hire Hispanic (but not Black) workers from deprived neighbourhoods. This again highlights the role that public transport can play in alleviating the problems of the spatial mismatch.

3.5.4 Summary

There is a large body of evidence in the form of empirical studies which clearly point to the significance of spatial mismatch in contributing to employment outcomes. Studies point to a stronger relationship between employment and accessibility among low-educated workers than among highly educated (Norman et al. 2017, Patacchini and Zenou, 2005; Ozbay et al., 2006; Korsu and Wenglenski, 2010; Matas et al., 2010) through more acute mismatches and lack of car access. The literature also illustrates there is a role for transport interventions to partly address this mismatch (see for example Bastiaanssen et al., 2020).

Many studies are cross sectional and therefore subject to potential endogeneity bias through scheme placement, car ownership and residential relocation. Most longitudinal studies that do exist are in the form of specific area case studies.

Most studies focus on employment (rate) impacts and as such do not distinguish between employment changes through labour supply effect and reductions in unemployment. Further, some studies assume labour demand is elastic so the increase in participation feeds through directly into an increase in employment. We found little evidence of studies dealing with unemployment specifically or displacement in a systematic way. Even when models are estimated in such a way that they can yield unemployment elasticities (e.g. when they consider the binary choice between employed and unemployed rather than employed vs not employed) the rates conflate the possible impact of the labour supply effect as well.

Our finding is there is no clear framework for estimation of unemployment impacts which could be adopted directly into guidance. Further, whilst there are approaches to estimation of employment impacts which have yielded employment elasticities we have not found something that can be used off the shelf to parameterise an approach to estimation of unemployment changes. There is enough work to suggest there are viable approaches to estimation of employment impacts which could form the basis of modelling work applied to UK data which could provide suitable parameter values for use in appraisal. There is enough evidence on employment elasticities to conduct a case study using sensitivity analysis to cover a range of elasticity values provided in the literature working with a range of assumptions regarding the derivation of unemployment impacts which could be used as the basis for illustration of the valuation framework in a case study.

The Bastiaanssen et al. (2022) study shows how accessibility measures could be constructed at the UK level and applied to individual level data (but this was only done for public transport and cross-sectional models). The Norman et al. (2017) study shows that there is scope for a framework to estimate impacts of a transport induced change in accessibility controlling for changes in labour market composition. This shows potential for a case study framework and is described in more detail in section 4.2 below.

4 CONCEPTUAL FRAMEWORK

4.1 Valuation

4.1.1 The social value of reducing unemployment

In this section we draw from Johansson and Kriström (2022) (hereon J&K) to set out the social value of reducing unemployment. We use their notation for consistency. Equation 14 in J&K identifies that the social value (S) of recruiting an unemployed is the sum of the value of their output ($p\Delta x$), plus the opportunity cost of their lost leisure CV^L (noting that $CV^L < 0$), plus a wellbeing value ($CV^{q,\pi,h}$). The wellbeing value captures the willingness to pay for the combined impact on health (physical and mental), life expectancy and human capital. This is given in the equation below:

$$\Delta S = p\Delta x + CV^L + CV^{q,\pi,h} \quad (1)$$

If we take it that the value of the workers output, $p\Delta x$, is the wage (w) plus labour related overheads (*) i.e. w^* then we get:

$$\Delta S = w^* + CV^L + CV^{q,\pi,h} \quad (2)$$

For the unemployed CV^L is not observed, however, we know that for an unemployed to be recruited then the post tax wage $(1-t)w^*$ must exceed the reservation wage (w^R). t is the tax rate. That is:

$$(1-t)w^* \geq w^R \quad (3)$$

From J&K Equation 10:

$$w^R = m + m^B - CV^L \quad (4)$$

Where m is unearned income and m^B is the sum of unemployment and low-income benefits. Replacing w^R in equation (3) gives:

$$(1-t)w^* \geq m + m^B - CV^L \quad (5)$$

Re-arranging to give CV^L implies :

$$-CV^L \leq (1-t)w^* - m - m^B \quad (6)$$

If we assume that recently recruited unemployed have zero or very little unearned income then (6) becomes:

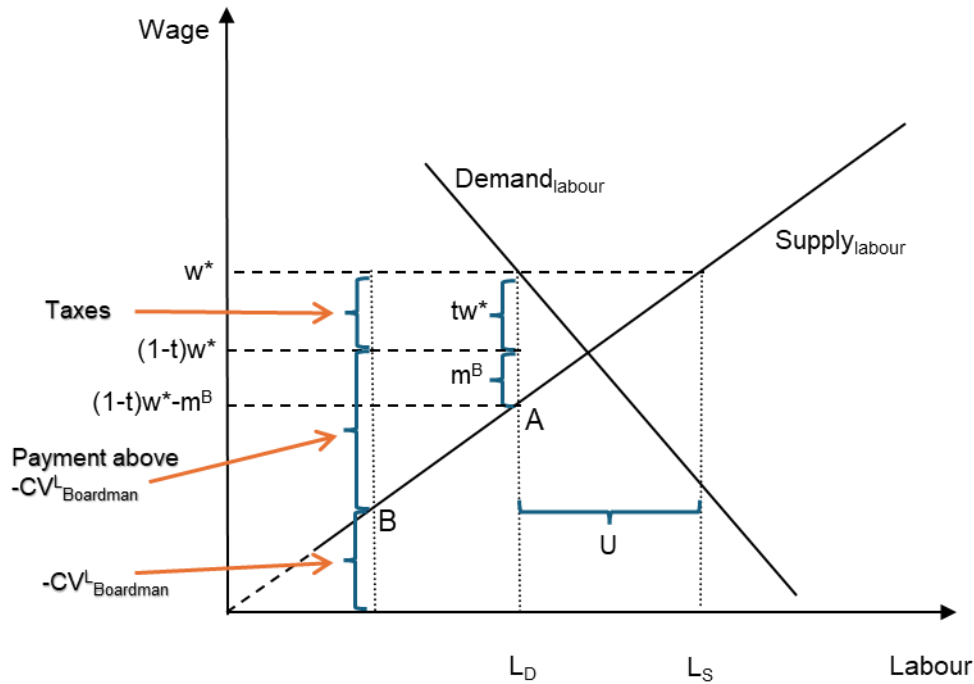
$$-CV^L \leq (1-t)w^* - m^B \quad (7)$$

The two terms on the right hand side of equation (8) are illustrated in Figure 4-1. For ease of depiction this graphic is for the simplifying case of no job search costs and sticky wages. So, at wage w^* we have an excess supply of labour of U (the unemployed). For a recently recruited unemployed we do not know where on the labour supply curve they lie. All we know is that it is somewhere between point A and the intersect of the supply curve with the y-axis. J&K suggest taking upper and lower bounds for this and sensitivity testing. They suggest an

upper bound for $-CV^L$ being at point A. They do not suggest a lower bound. Boardman et al. (2018 pp150-152 Measure E) suggest the same upper bound as J&K, but suggest a lower bound of zero. Thus, the expectation on average would be that a worker would have a $-CV^L$ half this value. This is shown as point B in Figure 4-1.

$$-CV^L_{\text{Boardman}} = 0.5 \cdot [(1-t)w^* - m^B] \quad (8)$$

Figure 4-1: Social value of reducing unemployment



Alternatively, some authors suggest adjusting the shadow wage based on the assumption that the additional workers are assumed to have reservation wages around the margin of the current employment level (Sartori et al., 2014, Riess, 2014). That is, additional employment come from those who value it the most, with an adjustment for the unemployment rate (UR) (which Riess (2014) suggest is net of search, i.e. frictional unemployment (4%)). This gives the formulation for CV^L as:

$$-CV^L_{\text{Riess}} = (1-UR) \cdot [(1-t) \cdot w^* - m^B] \quad (9)$$

Replacing $-CV^L$ in Equation (2) then gives the two following formulations for the social value of recruiting an unemployed.

$$\Delta S_{\text{Boardman}} = w^* - 0.5 \cdot [(1-t)w^* - m^B] + CV^{q,\pi,h} \quad (10)$$

$$\Delta S_{\text{Riess}} = w^* - (1-UR) \cdot [(1-t) \cdot w^* - m^B] + CV^{q,\pi,h} \quad (11)$$

The first two terms in (10) and (11) can be disaggregated into taxes and payment above $-CV^L$. This is illustrated in Figure 4-1 for the case of the Boardman $-CV^L$. For parameterisation in appraisal we express the tax and payment above $-CV^L$ (both shown in Figure 4-1) and the wellbeing benefit ($CV^{q,\pi,h}$) as a proportion of the wage (w) (rather than as a proportion of w^*). This is because the wage w is directly available from local labour market data.

In our parameterisation, for one household type, we have also factored in childcare costs (cc). Childcare costs are a wellknown barrier to joining the workforce. However, given the unemployed are actively seeking work, and are already part of the workforce, then these costs are possibly not such a barrier for the unemployed – as an unemployed person would have factored childcare into their decision when registering unemployed. Notwithstanding that, they do form part of the reservation wage, so should be added into equation (4) above. Childcare costs therefore form part of the difference between w^* and $-CV^L$ (Equation 2 above), much the same way that m^B does. Thus for example equation 10 would become:

$$\Delta S_{\text{Boardman}} = w^* - 0.5 \cdot [(1-t)w^* - m^B - cc] + CV^{q,\pi,h} \quad (12)$$

The question arises as to whether there is any additional social value for the payment of childcare to that detailed in equation 12 above. This could fall to the childcare provider as an additional surplus. The answer is that there is no additional surplus: providing we operate within a partial equilibrium framework with the labour market as the primary market. In that case, the childcare market is a secondary market, and payment by the household for childcare reflects its resource costs. The usual provisos regarding no market failures in secondary markets and small ‘general equilibrium’ effects would apply.

Some further remarks are necessary. Firstly, we have assumed that there is no change in profits for the firm as a consequence of recruiting the unemployed. This has allowed us to assume the value of workers’ output, $p\Delta x$, is the wage (w) plus labour related overheads (*) i.e. w^* in obtaining equation 2. In perfectly competitive conditions this might be viewed as reasonable. If there are any deviations from these conditions then an additional social surplus to the terms identified in (10) and (11) would need to be included. Secondly, we have assumed that unearned income is zero or small. Clearly, there are a number of the unemployed who will have considerable unearned incomes, for example partners of very well paid executives. For such people the reservation wage would be larger and the payment above $-CV^L$ commensurately larger.

Fourthly, other than childcare costs we have assumed there are no other costs associated with moving from unemployment to employment. Commuting financial costs could be seen as an additional cost, but the exact increment in costs would depend on the commute mode and distance, and also the interaction between commuting costs and housing rents. Reductions in heating costs if not at home all day would obviously be a financial benefit of working. Households may also incur other financial costs from taking employment due to reductions in ‘spare’ hours to complete household tasks such as cooking, cleaning and household maintenance, and the possible need to use paid help with such tasks. These different financial impacts of working effectively change the position of the labour supply curve, with an associated impact on the value of $-CV^L$ and the social value of employing an unemployed person. This is as in equation (12) for childcare costs. The financial costs of commuting can potentially be quite large. They are a known barrier to access work, particularly low paid work.

Finally, we note that the J&K framework considers the choice between work and leisure which is standard in the literature. In actual fact, time also has to be spent on compulsory activities such as sleeping, washing, cooking, eating, cleaning and aspects of childcare (e.g. changing nappies, etc.) (De Serpa, 1971). That is, not all of the time an unemployed person is spent in leisure, nor is all the non-work time of an employed person spent in leisure. In the J&K framework it is therefore assumed that the amount of time spent on these compulsory activities remains invariant.

4.1.2 Unit of account

The previous discussion has been in the context of an economy in which no indirect taxes exist. In most economies, and the UK is no exception, indirect taxes (T) on final goods and services are an important feature. This has important implications for the labour market analysis as there are two price bases in existence (factor and market prices) and households and firms perceive commodities in different price bases. This results in:

- The behavioural labour supply curve being in market prices. This is because workers receive a wage of $(1-t)w^*$ and buy resources r worth $(1+T)$. That is:
 $(1-t)w^* = (1+T).r$
- The behavioural labour demand curve is in factor prices. This is because the firm pays a wage w^* and uses labour to produce output which it sells at $(1+T)w^*$.

Here we are using the terms behavioural labour supply and demand curves to indicate the relationships that determine quantities of labour and wages at equilibrium in the labour market.

Thus, the two curves are in different price bases but need converting to the same price base for the cost benefit analysis. This is market prices in the UK. We therefore need to apply a factor of $(1+T)$ to w^* for the calculation of the social value of unemployment. Equations (10) and (11) above therefore become:

$$\Delta S_{\text{Boardman}} = (1+T).w^* - 0.5. [(1-t).w^* - m^B] + CV^{q,\pi,h} \quad (13)$$

$$\Delta S_{\text{Riess}} = (1+T).w^* - (1-UR). [(1-t).w^* - m^B] + CV^{q,\pi,h} \quad (14)$$

This is illustrated in Figure 4-2, with the labour demand curve in market prices shown in red. The benefit of employing an unemployed is therefore the difference between $(1+T)w^*$ and $-CV^L$. This benefit occurs as payment above $-CV^L$ to the household, employment taxes to government and indirect taxes to government.

The diagram illustrates the labor market equilibrium and the impact of a minimum wage. The vertical axis represents Wage, and the horizontal axis represents Labour. The Supply_{labour} (market prices) curve is upward-sloping, and the Demand_{labour} (market prices) curve is downward-sloping. A horizontal line at wage w^* represents the minimum wage, which is above the equilibrium wage tw^* . This creates a shortage, with labor demand L_D and labor supply L_S . The diagram shows the resulting wage structure: $(1+T)w^*$ for indirect taxes, w^* for the minimum wage, $(1-t)w^*$ for employment taxes, and $(1-t)w^*-m^B$ for the payment above $-CV^L_{Boardman}$. The shortage U is the difference between L_D and L_S . Points A and B are marked on the supply curve at the minimum wage level.

4.1.3 Parameterising the shadow wage formulation within TAG

It is also worth noting that TAG A2.3 states the tax wedge of 30% is “based on average tax revenue from income tax, NICs, corporation tax and mixed income”, whilst the 40% wedge is based on “estimated tax take of GDP changes from increase labour market participation. This incorporates average income effects of new workers, operating surplus and lost

²¹ TAG A2-3 states the tax wedge of 30% is “based on average tax revenue from income tax, NICs, corporation tax and mixed income”, whilst the 40% wedge is based on “Estimated tax take of GDP changes from increase labour market participation. This incorporates average income effects of new workers, operating surplus and lost unemployment benefits.”. Ercolani et al. appear to ignore the comments on corporation tax and operating surplus in their review. They benchmark the tax

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unemployment benefits.”. Ercolani et al. appear to ignore the comments on corporation tax and operating surplus in their review. They benchmark the tax wedges only against taxes and benefits that are directly related to labour including income related benefits. We agree with Ercolani et al. that the correct taxes and benefits to benchmark against are those associated with labour and income related benefits. The references in TAG to operating surpluses and corporation tax are not consistent with the social surplus equations (10) and (11).

With respect to TAG A2.3, the Ercolani et al. Review, and with our interest in unemployment, the m^B term should also include unemployment benefits in addition to Universal Credit. In the UK, unemployment benefits are now called New Style Job Seekers Allowance²² and can be claimed for a maximum 182 days (approximately 6 months). They vary depending on National Insurance contributions, but are currently worth up to £84.20 per week.

Given these differences between the TAG parameters and the parameters required to value reducing unemployment it will be necessary as part of the case studies (and for the development of future TAG guidance) to develop a set of parameters specific to unemployment.

Additionally, the wellbeing impacts, $CV^{q,\pi,h}$, could well be substantial, particularly in circumstances of mass layoffs (Haveman and Weimer, 2015). Evidence for these values would need to be drawn from the recent guidance on wellbeing issued by The Treasury (HM Treasury, 2021).

4.1.4 Wellbeing

The wellbeing value, $CV^{q,\pi,h}$, is sourced from recent work commissioned by the DfT on wellbeing, based around recent HMT guidance on the topic ((HM Treasury, 2021). This is reproduced in Table 4-1 below. The central annual value of £5,960 in 2021 prices is equivalent to £6,772 in 2024 prices and values (i.e. £564 pcm). The calculation of benefits, taxes and $-CV^L$ are undertaken in monthly values in a 2024 price base (see Appendix 2).

This aspect of the literature is relatively new and novel, and is only just being brought into policy – such as into cost benefit analysis. As such it remains a topic of ongoing research. We have not reviewed the literature and have instead just sourced the wellbeing value from Department for Transport (2024 Table 7). Reflecting the emerging status of these values, there exist a number of aspects that warrant further research within the valuing of employment space:

- The wellbeing value in HMT guidance is based on average incomes. This is certainly the case for the High value which is based on a median FTE wage of £30,673 (HM Treasury, 2021 p56). Our valuation framework is based on the wage the unemployed will receive, ie the actual social value rather than some equity value based on average wages. For low paid workers this would be substantially less than the median (as will be seen later in this report, we take a low paid worker to have an income of 67% of the median worker). With wellbeing value having an elasticity to income of 1.25 (HM Treasury, 2021 p56), this might imply a High wellbeing value 40% less than the £7,336 in the table below (so more like the Low value).

²² <https://www.gov.uk/jobseekers-allowance>

- The regression analysis that the 0.46 wellbeing effect is based on (second column in the table below), does not appear to control for the loss of leisure time. Thus the 0.46 wellbeing effect should be viewed as net of lost leisure time. That is the unemployed person is 0.46 wellbeing better off after entering employment despite losing leisure time and after having controlled for income. This would imply that the full wellbeing would be £5,960 plus -CV^L for the unemployed in question.
- Low skilled and low paid jobs which the unemployed may fill, potentially with poor job security and quality of working conditions, may have a different wellbeing effect to the 'average', ie that is potentially lower.

Table 4-1: Wellbeing from moving from unemployment to employment

Impact	Wellbeing effect (LS 0...10)	Value, £ (2021)		Tax wedge welfare gain, £ (2021)
1 worker employed (previously unemployed)	0.46	Low	4,585	
		Central	5,960	5,898
		High	7,336	

Source: Department for Transport (2024 Table 7)

TAXES AND BENEFITS

It is surprisingly challenging to identify the relevant tax rate and benefit rates for use in the equations set out in Chapter 3. They vary with familial circumstances. The actual taxes paid and benefits paid depend on:

- the wage (w) which determines the average tax rate (t). The marginal tax rate in the UK is tiered with income from 0% to 20% to 40% to 45% on earnings above the highest threshold, though there are differences between England, Wales and Scotland. The personal tax allowance is also withdrawn on earnings above £100,000. Workers also pay employee National Insurance Contributions, which again vary with income from 0% to 8% and for earnings above the highest threshold 2%. Employers pay National Insurance of 0% to 13.8%, depending on category of worker and income.
- The duration of unemployment. This is because unemployment benefits (New Style Job Seekers Allowance (JSA)) are only available for approximately six months of unemployment in the UK (182 days).²³ New Style JSA is worth £71.70 per week if aged between 18 and 24, or £90.50 if aged 25 or older.
- Child benefit at £25.60 per week for the eldest child and £16.95 for a second child.²⁴ This has a tapered withdrawal from £60,000 to a complete withdrawal at £80,000. This is net of deductions for pension contributions, etc.
- The change in low-income benefits received. This type of benefit is known as Universal Credit. It varies with household size, particularly the presence of children.

²³ <https://www.gov.uk/guidance/new-style-jobseekers-allowance>

²⁴ <https://www.gov.uk/child-benefit/what-youll-get>

It is means tested on household income so depends on partner's income and any benefits or unearned income received by anyone in the household. It also depends on outgoings such as rent and childcare payments (if in work).

Given the dependency on familial circumstances it is useful to consider who the unemployed who enter employment are. This would require some data analysis, possibly of the Labour Force Survey, of data that tracks workers and unemployed over several time periods. This would identify the characteristics of those unemployed who enter employment. This is beyond the scope of this work. Instead we have used the Census 2021 to give a snapshot of the demographics of the unemployed on Census day (see Table 1-1).

The unemployed are quite a diverse group. They are all ages, though almost half are under the age of 34 years old. Almost a quarter of them are 24 years or younger, so we might expect a large proportion of those to be living with family.²⁵ These may be living rent free. Reflective of their age, most of them are not living in a couple, though around a third are. For those living in a couple, their partner's income will affect their benefit entitlement. Finally, and these data are only available for the household reference person (not all unemployed), we can see that 27% of household reference persons own their home. The other 73% live in some form of rented accommodation or live rent free.²⁶

Table 9-1 and Table 9-2 illustrate the level of benefits that could be received for different household types living in Newhaven at average and low-income wages.^{27, 28, 29} Benefits are split between Universal Credit, New Style Job Seekers Allowance, council Tax Support and Child Benefit. As some of these are low-income benefits, other than Child Benefit which is universal, some are retained after finding employment. It can also be seen that the level of benefits received is particularly sensitive to having children and whether living in rented accommodation or not. On finding employment, benefits typically go down. In one instance however, benefits increase (see Table 9-2). This is for a family which has primary school age children that need 35 hours a week of paid childcare once the parent finds employment in a low-income job.

The Participation Tax Rate (PTR) is the effective average tax rate that would be experienced by someone who is entering the labour market, pays tax and has to forgo some or all income related benefits. The right hand columns of Table 9-1 and Table 9-2 in the appendix show that for low- and average-income workers the participation tax rate varies between 12.8% and 66.5%. The variation in participation tax rates is driven by household type rather than by the income derived from the job. This can be seen from Table 9-1 and Table 9-2 where there is almost as much variation in the PTR between households for average income employment

²⁵ The Census 2021 indicates that 28% of those under 24 years old lived at home with parents <https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/families/bulletins/familiesandhouseholds/2021>

²⁶ We are not able to create a table identifying households with an unemployed adult and dependent children using the data analysis Census portal. This would require a request to the ONS. Similarly we could not identify unemployed 24 years and older who live in a household with related working adults (e.g. as part of family).

²⁷ The 2024 £34,623 average wage (2024 prices and values) is derived from the TAG wider impacts databook which gives an average wage of £24,661 in 2010 prices and 2021 values

²⁸ The OECD define lower pay workers as those earning 67% of median earnings. In the UK the ONS define low pay workers as those earning 60% of the median wage. We have used the 67% figure, which is slightly higher than the UK definition of low pay.

²⁹ An annual salary of £23,196 and a 37.5 hour week implies an hourly wage of £11.89. The National Minimum Wage from April 1st 2024 is £11.40 (for 21 year olds and older).

(17.8% to 53.8%), as there is between households for low-income employment (12.8% to 66.5%). These PTRs are much higher than both the average tax rate and the marginal tax rates. The average tax rate (in the second column in from the right hand side in Table 9-1 and Table 9-2) is 13% for low-income workers and 18% for average income workers. The marginal tax rate used in the calculation of these tables, is 28% for both tables. This is comprised of the 20% income tax on all earnings over £12,570 and 8% employee NICs on all earnings over £1,048.01 pcm.

Looking at the financial impacts (Table 9-3 and Table 9-4), the worker gains their wage net of tax and NICs. They also gain from some non-wage labour costs such as employer pension contributions. Total non-wage labour costs are estimated by the DfT to be 26.5% of the gross wage (Department for Transport, 2022 p7). They typically lose low-income and out of work benefits, and may also incur childcare costs. The cost of labour to the firm goes up, by both the salary costs and the non-wage labour costs. In a competitive market we would view the sum of the wage and non-wage labour costs as representative of the marginal product of labour, and thus the social value of what one unit of labour can produce (in factor prices). These non-wage costs include for example employer pension contributions, and employers' national insurance. The government gains from the higher income tax and national insurance receipts and lower benefit payouts. There is significant variation regarding how much the government gains by family circumstances: driven entirely by different levels of benefit that different families obtain when unemployed and employed.

The tax wedge³⁰, the tax take (income tax, plus employers' and employees' NICs) as a proportion of total labour costs (the gross salary plus all non-wage labour costs to the firm) varies between 21% (for low-income workers) and 28% for average income workers (right hand column of Table 9-3 and Table 9-4).

THE VALUE OF LEISURE AND THE SOCIAL BENEFIT OF REDUCING UNEMPLOYMENT

Following the framework set out above we can derive the social value of reducing unemployment for different wages (and therefore taxation and benefit levels) using both the Boardman and Riess methods: see Table 9-5, Table 9-7, Table 9-9 and Table 9-11 in the Appendix for an example using Newhaven data. Column J gives the $-CV^L$ for an average unemployed worker using the Boardman method in Table 9-5 and Table 9-9; Table 9-7 and Table 9-11 for Riess. The social benefit of bringing this worker into employment (Column M) is the difference between this and the marginal product of their labour (column I) plus the wellbeing value (column L).

In Tables 9-6, 9-8, 9-10 and 9-12 this benefit is separated into changes in consumer (household) surplus, government surplus and producer surplus plus wellbeing benefits. These surpluses are also expressed as a proportion of the gross wage (w).

Here we can see significant differences between the Boardman and Riess methods, with Riess giving a value approximately half the Boardman value as a proportion of the gross wage. We can also see differences by income, with lower incomes generally, but not always, having

³⁰ We use the OECD definition of the tax wedge: the difference between the gross wage to the employee and the wage net of taxes and social insurance taxes. <https://www.oecd.org/en/data/indicators/tax-wedge.html>.

surpluses that are a larger proportion of gross wages *ceteris paribus*. However, in absolute terms the surpluses are always larger for the higher incomes. Interestingly, the balance of whom the surplus accrues to varies with income. At the lower incomes the surplus has a higher proportion accruing to the worker as payment above $-CV^L$ and wellbeing, and less to government as taxes. This is driven by two factors: firstly, that the wellbeing value used is the same in absolute terms for low and high income workers, and secondly, lower income workers pay less tax.

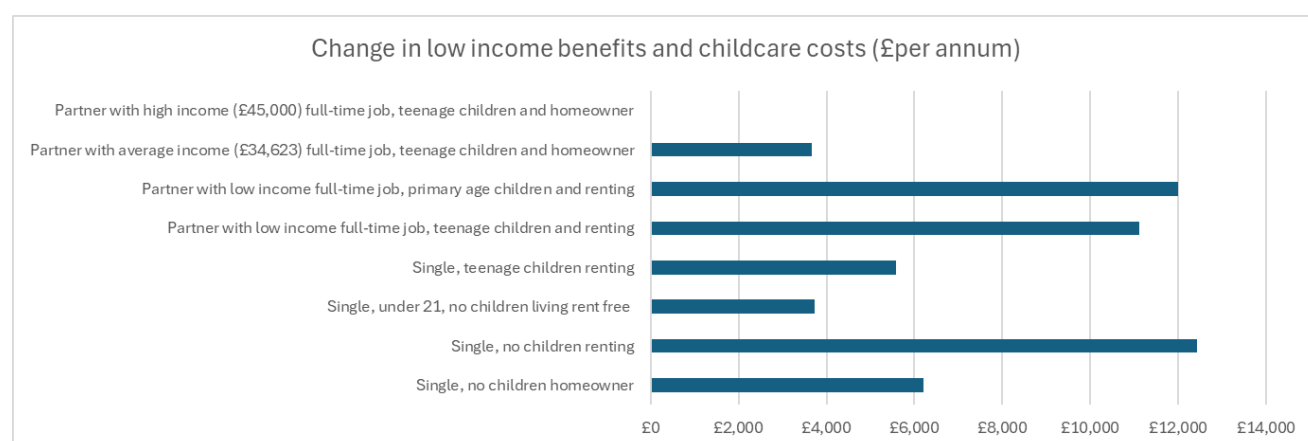
One final observation is that with the Riess method the social value is driven by tax and wellbeing, with only a small contribution from workers being paid above their $-CV^L$. With the Boardman method there is a substantial contribution to the social value from workers being paid above their $-CV^L$.

DISTRIBUTIVE IMPACTS

The nature of unemployment in a welfare state means that substantial transfers occur between households and government. The government and households both gain from an unemployed person becoming employed, with government typically gaining more than households financially. However, these transfers vary significantly by household type. Thus in a distributive sense we get differences between households, as some households gain or lose more benefits, and we also get different impacts between households (consumers) and government.

Firstly, we see that there can be substantial changes in low-income benefits plus childcare costs between household types (Figure 4-3). These vary between £0 and just over £12,000. Broadly speaking, those who get the largest benefit reduction are those who are renting and have a partner in employment. It's worth noting that those who are single and in a low paid job will typically still receive low-income benefits, thus their benefit reduction is not as great as might be expected (see the household type: single, teenage children and renting).

Figure 4-3: Change in low-income benefits per annum (low-income, unemployed > 6 months)

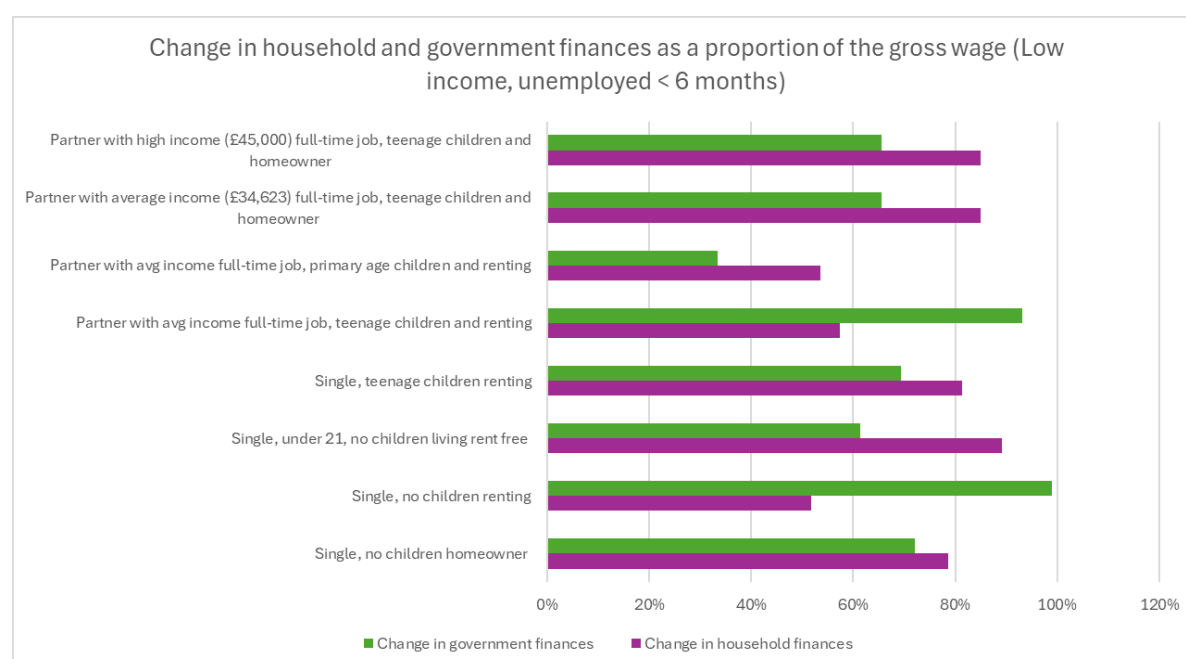


Source: Own work using benefits calculator: www.entitledto.co.uk, based on housing in Newhaven

If we now look at how household finances change (see Figure 4-4), again we can see substantial variations. For the same low paid job, household finances may increase by between 50% and 90% of the gross wage. The households that gain the most financially are

those who lose the least benefits: the homeowners with partners who work and those who live rent free. The change in government finances also varies significantly with household type, varying between about 35% and almost 100% of the gross wage. Here the opposite situation occurs, in that the government's fiscal position improves the most where the low-income benefit reduction is the greatest. The government gets the least financial gain for the household type which has increased childcare costs, as in this situation the household benefits increase.

Figure 4-4: Change in household and government finances as a proportion of the gross wage (low-income, unemployed < 6 months)



We now turn to how the respective surpluses of households (consumers), government and producers change. We separate the household (consumers) benefits into a change in consumer surplus and wellbeing. The change in consumer surplus is the difference between the post-tax wage net of change in benefits plus childcare costs minus the loss of leisure time, $-CV^L$. The government surplus is just the financial change in the government's position. Producer surplus is zero. This is because, as introduced earlier, we have taken the markets to be competitive with workers being paid the value of their output.

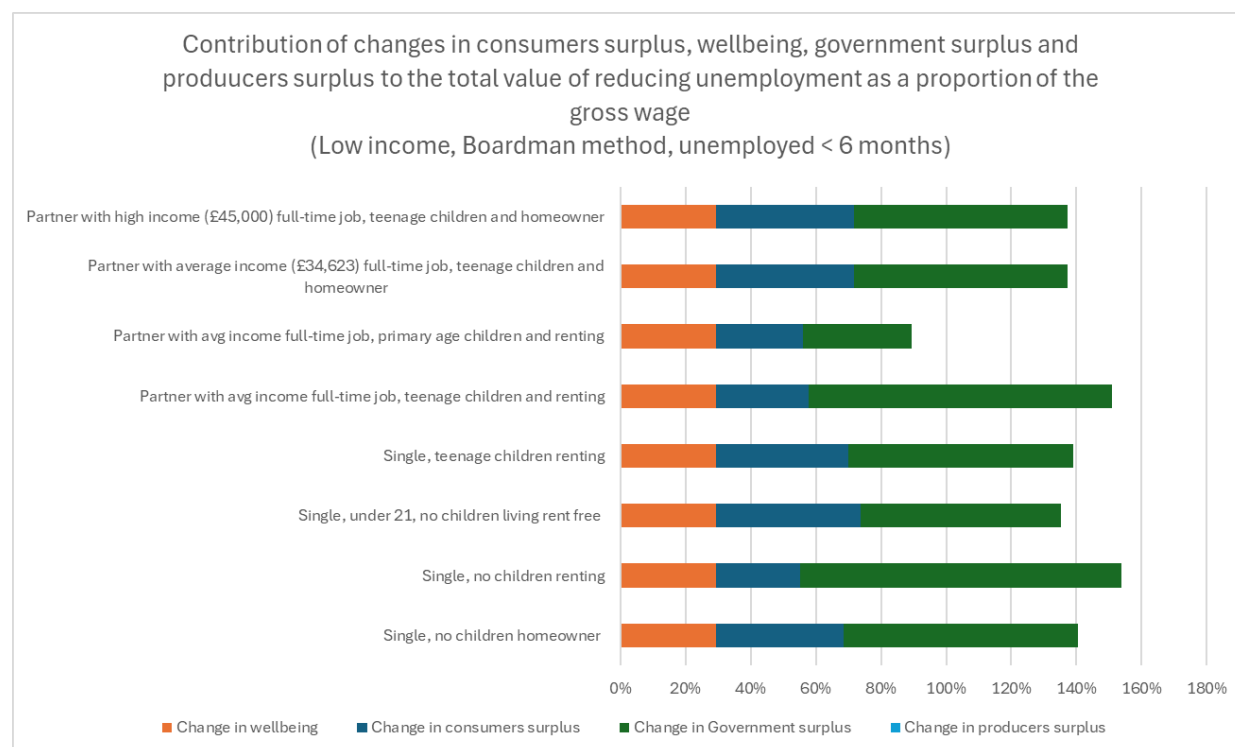
As can be seen from Figure 4-5, there is once again substantial variation in the surpluses experienced by the different economic agents depending on household type. Wellbeing benefits contribute a fixed amount to every household at 29% of the gross wage. Consumer surplus varies between just over 25% of the wage to 45% of the gross wage.³¹ Government surplus in contrast varies over a much larger range between 33% and 99% of the gross wage, although excluding the household type with young children in childcare would reduce the

³¹ This range increases to just over 50% of the wage for those unemployed greater than 6 months.

range from just over 60% to 99% of the gross wage. Producer surplus (that is the surplus experienced by employers) by definition is always zero.

Overall, this gives a net social surplus of reducing unemployment between 89% and 154% of the gross wage. However, excluding the household type with young children in childcare would reduce the range from just over 120% of the gross range to 154% of the gross wage.

Figure 4-5: Contribution to the social value of reducing unemployment from changes in consumer surplus, wellbeing, government surplus and producer surplus (low-income, unemployed < 6 months)



AN EXAMPLE HOUSEHOLD FOR THE CASE STUDIES

To calculate the social value of reducing unemployment we ideally want to know the proportion of households from each demographic in Figure 4-5 (and others not shown) that are taken out of unemployment. We do not know that. We therefore need to choose an arbitrary household type for use in the case studies.

In doing that we know, that just over half the unemployed are 35 years and older, and two thirds are single (see Table 1-1), We also know that two thirds of household reference people in the Census who are unemployed live in rented accommodation. We can therefore imagine that a 'typical' unemployed person is over 35 years, single and living in rented accommodation. We do not have information about whether they have children or not. However, as only 3 million households were lone parent families and approximately 9 million households are single person households³², then we might suppose that they do not have children. In our family profiles we have four household types which have a single adult. Of these, the family type 'single adult, with no children living in rented accommodation' best fits this description.

³²

Drawing from the second family type in Table 9-5 to Table 9-12 in the Appendix, the social value of reducing unemployment as a proportion of the gross wage for this household type is shown in Table 4-2. These values vary with the wage of the job the unemployed person obtains, and the method used to value $-CV^L$. We use these values in the case studies.

It is of interest to compare these values for creating employment for an unemployed person with the values associated with increasing labour supply. The latter is valued at 0.4 (or 40%) of a low skilled wage in TAG³³. Here we can see the value of taking someone out of unemployment and into a low wage job is either 129% (Riess method) or 154% (Boardman method). That is between three and four times greater than the value of increasing labour supply.

Table 4-2: Social Value of Unemployment as a proportion of the gross wage to the employee (for a single adult, with no children and renting in Newhaven)

		Social value as a proportion of gross wage to employee					Change in finances as a proportion of the gross wage:	
		Total	Contribution from:					
			Change in consumers surplus (the unemployed)	Change in the unemployed wellbeing	Change in government surplus	Change in producers surplus	Households	Government
Average wage	Boardman method for -CV ^L	139%	31%	20%	88%	0%	63%	88%
	Riess method for -CV ^L	109%	1%	20%	88%	0%	63%	88%
Low wage	Boardman method for -CV ^L	154%	26%	29%	99%	0%	52%	99%
	Riess method for -CV ^L	129%	1%	29%	99%	0%	52%	99%
Notes: Proportions for single adult with no children and renting								

Notes: Proportions for single adult with no children and renting

4.2 Modelling Framework

4.2.1 Predicting permanent changes in employment & unemployment from commuting cost changes

The premise of the permanent changes in employment and unemployment is the expectation that by affecting commuting costs and housing locations, transport policies will reduce spatial mismatch, thereby permanently lowering the equilibrium rate of unemployment. This framework is not about the speed of elimination of cyclical demand deficient unemployment.

The aim of the modelling framework is to produce estimates of net changes in unemployment, summed up from the estimation of spatially disaggregated changes following a transport intervention.

Whilst the end point is a measure of unemployment change, most of the modelling literature focuses on employment based impacts. So, one starting point is to estimate the employment impact, which would include both changes in labour supply and reductions in unemployment. From this, certain assumptions would be made as to the balance of the contribution to employment from the two sources, which is clearly key. This could be derived from bespoke modelling work focusing on employment and labour supply responses separately as with the Norman et al. (2017) approach.

³³ TAG uses a 0.69 proportion of median wages to derive a low productivity wage for a new entrant to the workforce.

Generalising from the Norman et al. (2017) approach, we below illustrate the form of a framework which could be used as the basis for estimation of employment rate changes. The work focuses on employment rate changes from improved accessibility from changes in labour force composition separated out from transport induced accessibility changes. The latter impact is the one of interest and represents a ‘fixed land use’ employment effect occurring through transport addressing the localised structural spatial mismatch issue for incumbent workers. In some ways this is analogous to the level 2 static agglomeration TAG measure in that it is based on a fixed land use (employment) assumption. Clearly this is not addressing that element of any impact on unemployment from transport induced land use change and displacement effects to/from outside the transport impacted zone. As such the underlying elasticities will be sensitive to the level of aggregation of zones, with displacement within zones not recognised as land use change. To some extent displacement is controlled for through the labour force composition-based accessibility change measure (however, it does not address endogeneity between labour force composition and transport change).

The Norman et al. (2017) paper only presents employment elasticities. However, they present a labour force participation model in the appendix which was estimated using the same set of independent variables. This allows the derivation of an aggregate labour supply elasticity from the parameters in this model, which we found to be 0.022.

Following Norman et al. (2017), we present an approach which could be used to predict unemployment change following a transport intervention, i.e. the Do Something (DS) vs Do Minimum (DM). We use participation rate elasticities in conjunction with employment rate elasticities to separate out employment changes into labour supply and unemployment changes; i.e. any increase in employment will come from a combination of a reduction in unemployment or an increase in labour supply (assuming some proportion of any labour supply change is employed).

Firstly, the accessibility function is defined as:

$$EA_i^{S,K} = \sum_j (GC_{ij}^{S,K})^{-\alpha} * EMP_j^{DM,K} \quad (15)$$

where:

$EA_i^{S,K}$ = Employment accessibility in zone i , scenario S (either DM or DS) in job market K (e.g. with markets potentially segregated such as by skill level, gender, unemployment level)

EMP_j = Workplace based employment in zone (e.g. LAD) j in the DM

GC_{ij} = Commute trips weighted (average) generalised cost of travel between zone i and j

α = Distance decay parameter.

The DS labour force participation rate (PR) is derived from pivoting around the existing rate based on the accessibility change from the DM to the DS scenario and the participation rate elasticity:

$$PR_i^{DS,K} = PR_i^{DM,K} * \left(\frac{EA_i^{DS,K}}{EA_i^{DM,K}} \right)^{P^K} \quad (16)$$

As noted above, the overall Norman participation rate elasticity, p , was computed to be 0.022.

The DS labour supply is then derived based on the population level POP and the new participation rate.

$$LS_i^{DS,K} = POP_i^{DM} * PR_i^{DS,K} \quad (17)$$

The employment rate change also pivots around the existing rate based on the accessibility change from the DM to the DS scenario:

$$ER_i^{DS,K} = ER_i^{DM,K} * \left(\frac{EA_i^{DS,K}}{EA_i^{DM,K}} \right)^{\epsilon^K} \quad (18)$$

where ϵ^K is the employment rate elasticity in job market K , as estimated in Norman et al. (2017), reported to be 0.011 in aggregate.

The next step is to apply the DS employment rate (18) to the DS labour supply level (17) to derive DS employment level:

$$EMP_i^{DS,K} = ER_i^{DS,K} * LS_i^{DS,K} \quad (19)$$

The DS unemployment level is the difference between the DS labour supply level and the DS employment level:

$$UNEMP_i^{DS,K} = LS_i^{DS,K} - EMP_i^{DS,K} \quad (20)$$

At one extreme, if the employment increase is purely driven by a change in labour supply, unemployment would be unchanged even though the unemployment rate would fall.

The final step is to sum the zonal changes in employment and unemployment to derive a net figure for change within the different job markets:

$$\Delta UNEMP^K = \sum_j (UNEMP_i^{DM,K} - UNEMP_i^{DS,K}) \quad (21)$$

$$\Delta EMP^K = \sum_j (EMP_i^{DM,K} - EMP_i^{DS,K}) \quad (22)$$

Whilst a more pragmatic approach could be to use unemployment level elasticities to estimate changes in unemployment directly, such elasticities are not available in a ready to use form in the literature.

4.2.2 Unemployment from productivity impacts and dependent developments

Transport led productivity impacts can lead to a rise in real wages if the regional labour markets are elastic. The argument for this goes as follows: employers' business trip costs and freight costs are costs of doing business. Transport improvements increase productivity and reduce these costs. This lowers prices and increases output. With the increased output demanded, then more labour is demanded by firms. If the regional labour market supply curve is upward sloping this will lead to an increase in real wages.³⁴

This in itself, however, is not sufficient to reduce regional unemployment. This is because the productivity effect on employment is not a labour supply effect. Unemployment itself is determined by structural issues, that is issues that affect the supply of labour. The transport project needs to address these for unemployment to alter. Thus, changes in employers' business trip costs and freight costs are not a sufficient condition for changing unemployment.

However, if the productivity improvement occurs in an area with spatial mismatch and firms re-locate to that region to take advantage of the increased productivity, then effectively jobs are being taken to the unemployed (see Figure 3-2).

In terms of forecasting changes in unemployment this there are two scenarios as we see it. Firstly, there is the dependent development scenario as detailed in TAG A2.2 (Department for Transport, 2020). Here a transport project opens up a pocket of land for development. This is the NPAR case study that we consider later. Here modelling should follow TAG A2.2.

The second scenario is where employment growth is dispersed (e.g. throughout a city centre as a result of a major rail project). Here, modelling changes in land use and unemployment will require an SEM. The SEM would need to consider the mechanism of spatial mismatch and how jobs are matched to households.

³⁴ As a consequence there will be some crowding out of the employment growth compared to a situation where the regional labour market supply curve was perfectly elastic.

5 CASE STUDIES

5.1 Newhaven Port Access Road

5.1.1 Description

This section provides an uncritical but accurate description of this project's employment impact study. Drawing from the Business Case for the Newhaven Port Access Road (NPAR) Phase 1A (WSP, 2018), the NPAR is a section of approximately 650m of single carriageway that continues from Phase 1 (the pink line in Figure 5-2). It crosses the Mill Creek canal and the Newhaven-Seaford railway branch line on a 122m long bridge. It gives direct access to the coast, East Quay and development land around that. The road now exists opening in October 2020, though the connection into the port was not opened until February 2022. See Figure 5-1 and Figure 5-2 for an image of the road during construction and a map of its alignment alongside the development sites.



Source: <https://www.skeye-pano.com/Q1829-Newhaven/tour.html>

Figure 5-1: Newhaven Port Access Road Phase 1A on completion in October 2020 (East Quay on the left hand side, with the road alignment along the bottom and right hand side, and Newhaven Town Centre at the top of the picture). Image distorted due to panoramic view.

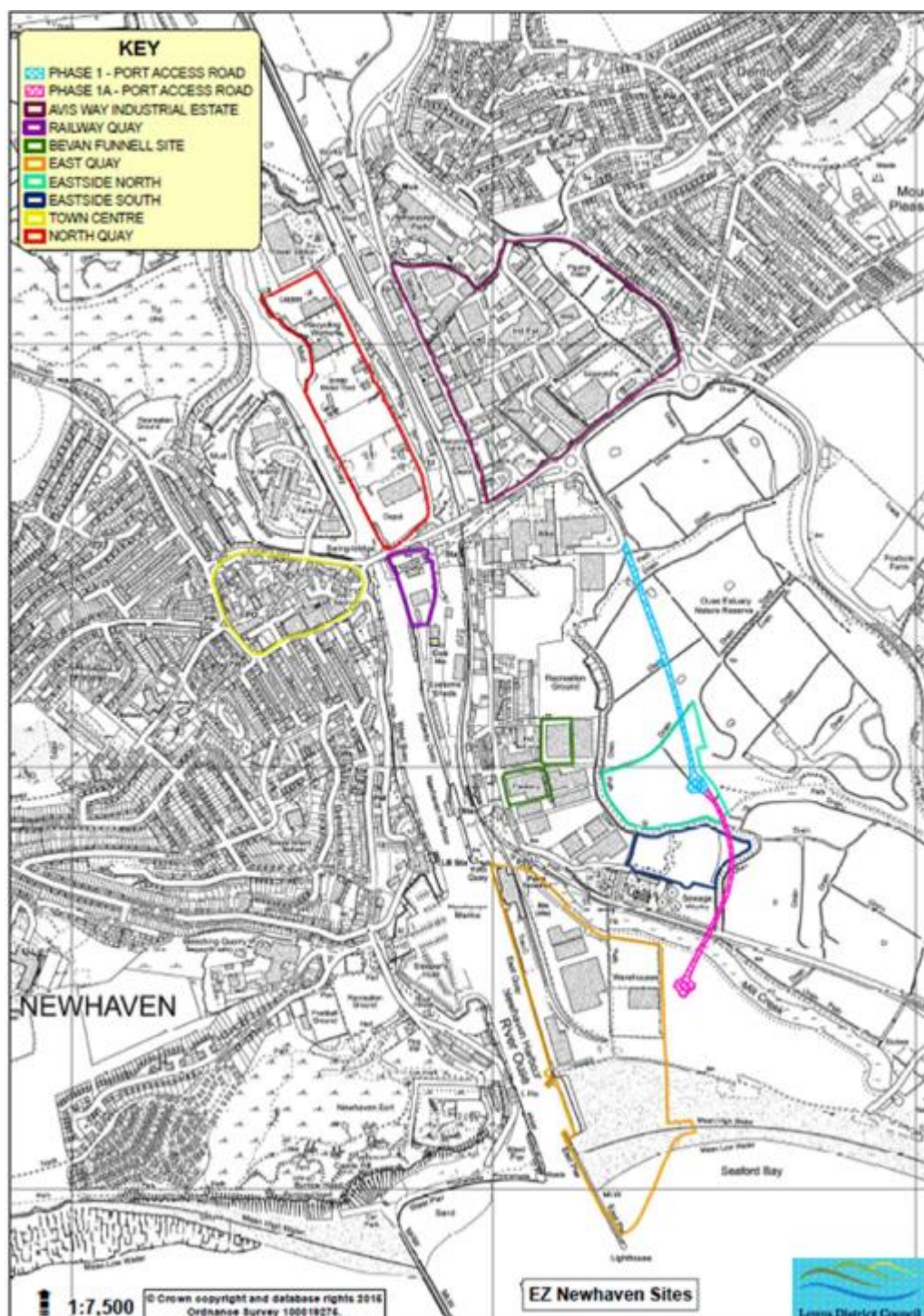


Figure 5-2: Newhaven Port Access Road Phases 1 and 1A and Development Sites on the Existing Quays

The NPAR is a relatively small piece of infrastructure, but from an economic perspective is interesting as it has a series of unlocking effects around the port and the development of Newhaven town centre and the broader Greater Brighton City Region.

The Newhaven Port itself stretches a short way up the River Ouse with some quays immediately opposite the town centre, and to the north of the town centre. Access to North Quay is via a swing bridge which when open impacts on travel to/from and within the town centre. Access to the existing quays is also through constrained streets in residential areas,

and there are limits to how many more HGVs can utilise these streets. Furthermore, the lack of development land in Newhaven and the surrounding area is constraining development. By providing direct access to East Quay, the NPAR not only provides a bypass of the residential streets, but also will act as a trigger for investment in East Quay, including a deep water berthing facility. This will then permit the re-location of port related activity from Railway and North Quays to East Quay. Railway and North Quays would then be available for mixed use development or light industrial development. Land in the vicinity of East Quay is also available for development.

The Newhaven economy is characterised by low and medium skilled activities³⁵ located in manufacturing and transport related activities. The Business Case argues that employment growth will be centred around marine related advanced manufacturing. There is also an expectation of mixed use and higher value business activities on the vacated quay sites close to the town centre.

The two best positioned priority sectors that the Employment Zone around the port could seek to attract in the short to medium-term are environmental technology and services, and advanced engineering. Both these sectors build on existing local strengths and relate to the spatial pattern of employment in the wider area. Both sectors will potentially overlap with the marine sector (e.g. marine related manufacturing and offshore energy provision), building on existing strengths and infrastructure assets, notably the port. Of these, advanced engineering is likely to generate the greatest employment opportunities.

Opportunities in the creative and digital sector is considered to be dependent on the extent to which Newhaven can be effectively integrated into the Greater Brighton City Region - which the NPAR will contribute towards through enhanced connectivity with the strategic road network.

Manufacturing is a major employer in Newhaven and, despite recent job losses, the presence of high-tech manufacturing and evidence of growing manufacturing sub-sectors are likely to provide shorter term opportunities for growth. This is related to the advanced engineering sector, where Newhaven may become an attractive location for investment as pressure for land increases in other parts of the region.

Newhaven is also well placed to benefit from investment in environmental technologies, however the scale of employment in this sector may be lower. Besides manufacturing, the current employment profile of Newhaven is dominated by low density uses and the Enterprise Zone provides an opportunity to attract and retain more job- rich and higher value employment activities to the town.

Source: NPAR Business Case (WSP, 2018, p23)

³⁵ Source: Newhaven Economic Profile (Coast to Capital LEP, 2017 p6). There is no formal definition of low and medium skilled in it. Classically we think of low skilled as qualification levels 0 and 1, and SOC codes 7, 8 and 9. Though this can sometimes be referred to as 'lower' skilled. We have not seen a definition of medium skilled.

The 2018 Business Case (see Appendix for a summary) identifies that the total number of additional jobs created at all the development sites and in the associated supply chain and local economy (direct, indirect and induced jobs) is 1,193, of which 456 FTE jobs are dependent on the NPAR. A comparison between unemployment rates in Newhaven and the South East region indicate that if unemployment in Newhaven returned to the regional average level as a consequence of all the new development in Newhaven, then there would be 71 people less unemployed as a consequence of the NPAR.

5.1.1.1 The Do Minimum and Do Something counterfactuals

We create a new economic appraisal of this dependent development, whilst using 2018 wages and the unemployment levels from when the business case was undertaken. To do this we need to define the Do Minimum and Do Something counterfactuals. Such counterfactuals are critical in any appraisal. The Do Minimum counterfactual needs to reflect where people will be living and working in the absence of the NPAR. It also needs to set out the labour market conditions, particularly that of unemployment. The Do Something counterfactual is similar but describes the situation with the project. A crucial requirement of appraisal guidance and practice is clarity on whether the perspective of the appraisal is UK plc or regional/sub-regional. The Green Book and TAG both permit placed based local/regional analysis.

The economic narrative to the project is one in which there will be significant population and housing growth in Newhaven and Lewes District. In the absence of the project, workers would need to out-commute from Newhaven to find work. There is also a lack of development land in Lewes District, and even limitations within the Greater Brighton City region. The Business Case also identifies that businesses interested in the development sites are primarily relocating from other premises, either within the region or from outside the region. They are looking to expand, but generally the businesses that have shown interest in the development sites are primarily relocating.

Our view therefore is that the 'additional' employment at the development sites is best seen as '**displacement**': that is, in the absence of the project we expect the 456 additional new jobs including the 71 dependent on the NPAR to be located elsewhere.³⁶ HCA guidance (see Table 5-1) show very high displacement rates at the region and UK level, and there is nothing here that suggests Newhaven and its associated region would differ.

³⁶ There remains a difficulty if there is insufficient development sites available at a UK level, for all economic activity to occur elsewhere. Some argue that this is sometimes the case.

Table 5-1: Displacement estimates from UK additionality guidance

Intervention type	Within City Challenge	Immediately adjoining area	District	County	Region	UK
Development	17%	21%	38%	71%	89%	91%
Housing	10%	19%	38%	84%	100%	100%
Training and Education	8%	17%	31%	77%	78%	80%
Business support	8%	19%	31%	49%	75%	75%
Source: DETR (2000) Final Evaluation City Challenge						
Note: Displacement/substitution in the case of training and education only applies to jobs created through training as opposed to qualifications gained.						

In contrast, the Business Case implies substantial additionality from the developments in the employment zone with 456 net additional jobs and £183 million additional GVA (NPV). We see the economic impact set out in the Business Case as being against a counterfactual in which limited development is permitted elsewhere (we also test this scenario as a comparator). In our 'preferred' Do Minimum counterfactual there will be employment somewhere, just not in Lewes District. For appraisal of a project in the context of a growing population, a judgement is therefore required regarding the availability of development sites regionally and at a UK level for the relevant trades and industries that the unlocking facilitates. The dependent jobs would only be net additional if insufficient development sites were available at the UK level to meet population and employment growth. Some argue that this is sometimes the case, and TAG permits such benefits to be included in the appraisal via its Dependent Development aspect.

The next question is what impact the displaced economic activity has on the unemployment rate in Newhaven and surrounding areas, and over what duration. Here the economic context is important:

The employment rate for Newhaven (63.9%) is similar to that of Lewes District (63.6%) but slightly lower than the Coast to Capital rate (65.2%) and self-employment in Newhaven is lower than the surrounding areas by up to 6%. The unemployment rate for Newhaven (6.3%) is higher than both Lewes District (4.8%) and Coast to Capital (5%), as is the long-term unemployment rate.

There were 4,850 jobs in Newhaven in 2014, this has fallen 4.1% since 2009, which is a larger fall than the 0.6% decline in Lewes District and against the wider trend of the Coast to Capital region where the number of jobs grew 3.8% over the same period. In 2013 and 2014 there has been higher than average jobs growth in Newhaven however, although it has not returned to 2009 levels.

Source: Newhaven Economic Profile (Coast to Capital LEP, 2017).

Looking at these data through our unemployment lens, a reasonable argument is that following the 2008/9 recession, the Coast to Capital region (Brighton City and surrounds) have returned to the long run rate of unemployment, but despite 8 to 9 years passing, the Newhaven unemployment rate has remained stubbornly high. We could therefore interpret this to imply

the local long run rate of unemployment is likely to have shifted upwards. Spatial mismatch arguments therefore apply.

The NPAR addresses spatial mismatch, not by taking workers to jobs, but by taking jobs to workers. In the Do Something counterfactual, the Business Case suggests that the unemployment rate in Newhaven could return to the regional unemployment rate. This would require a reduction of 185 in the number of unemployed in Newhaven. This seems reasonable, as the employment zone, including the jobs associated with the NPAR is expected to create 1,193 additional jobs in Newhaven. That is, 15.5% of the additional jobs will be filled by the unemployed, which is justifiable on the basis that a lot of the jobs created will be low or medium skilled, and therefore at the skill level we might associate with spatial mismatch.

The NPAR contribution to this reduction in unemployment is 71 (38% of the additional jobs in the employment zone are attributable to the NPAR) (see Table 10-2 in the Appendix). Construction related employment might also be expected to reduce unemployment, amongst the low skilled.³⁷

The next question is whether the reduction in unemployment in Newhaven in the Do Something counterfactual is permanent or just temporary. Firstly, we are interpreting the economic data to imply a permanent shift in the long run equilibrium unemployment rate in Newhaven in the Do Minimum counterfactual. That is, a high unemployment rate above the long run equilibrium rate will persist throughout the 60 year appraisal period, though we sensitivity test this to twenty and six years.

In the Do Something counterfactual the Business Case has taken the view that the unemployment reduction will be temporary, lasting 10 years. This it seems is based on evidence related to generic direct government assistance to businesses to create jobs. Such businesses may fail and average job length for jobs created in such a manner is taken to be 10 years. In our view that is not appropriate here, and the unemployment reduction should be seen as permanent. This is because the NPAR is facilitating business development, by providing infrastructure and facilities. If one business fails then another business will still be able to take advantage of the infrastructure and facilities.

Construction related employment would be seen as a temporary demand side effect. These employment impacts would only be included if the construction work was expected to start imminently before the economy returns to a long run equilibrium rate, and importantly would only apply to those construction workers drawn from the locally unemployed part of the labour force. Additionally, construction impacts would only be seen as net additional if the government funding for the project was not displaced from another project. This might occur if government was looking to add a stimulus to the economy by bringing forward planned construction projects. There are an estimated 88 FTE construction jobs in each of two years of construction in the NPAR. If 25% of these are low skilled then 22 jobs could be drawn from the unemployed. Using displacement and leakage factors from the NPAR Business Case this reduces to 14 jobs that could be drawn from the low skilled unemployed in the Newhaven/Lewes District.

³⁷ The Business Case did not include any analysis on construction, but an earlier model supplied by DfT identified 143 FTE years of employment would be required to construct the NPAR and development sites. The impact on unemployment of construction was not analysed.

The question then arises as to where this economic activity is displaced from and, importantly, whether it causes unemployment from where it is displaced. There is no analysis on this in the Business Case. Three scenarios are possible with displacement of jobs from elsewhere in the UK to Newhaven/Lewes District. These are illustrated in Table 5-2.³⁸

Table 5-2: NPAR Do Something Counterfactuals

		Do Something Counterfactuals		
		Scenario 1	Scenario 2	Scenario 3
		Jobs displaced, but unemployment is not.	Jobs and unemployment are displaced	GB economy is supply constrained
Newhaven /Lewes District	Δemployment	456	456	456
	Δunemployment	-71	-71	-71
	Δlabour force (economic activity)	385	385	385
Elsewhere in GB	Δemployment	-456	-456	0
	Δunemployment	0	71	0
	Δlabour force (economic activity)	-456	-385	0
Net impact on GB	Δemployment	0	0	456
	Δunemployment	-71	0	-71
	Δlabour force (economic activity)	-71	0	385

For scenario 1 (unemployment is not displaced), there would need to be supporting economic arguments that competitor economies (particularly those in the South East region) have strong economies broadly operating at the long run equilibrium rate of unemployment. Such an argument could be advanced in the context of South East England which currently has an unemployment rate of 3.7%. In which case one would expect that the displaced jobs will not have any significant impact on unemployment elsewhere in the region, as it would be workers marginal to the labour force who would drop out. Having said that there some towns on the south coast (similar to Newhaven) which have structural weaknesses (e.g. Hastings, which is the 13th most deprived town in England³⁹). The Business Case does not specifically address competition between neighbouring marine related economies on the south coast of England. It should do. For us to be confident that unemployment would not increase in these local economies, the economic analysis would need to demonstrate that the businesses that would re-locate to Newhaven are either: (1) not in direct competition with businesses in these neighbouring towns, or; (2) these neighbouring towns are operating at the long run rate of unemployment.

In the absence of such analysis, one would need to assume unemployment is also displaced (Scenario 2). The 2018 Business Case only provides partial evidence on it. It identifies that there would be expansion of existing export/import orientated businesses relating to minerals and aggregate at Newhaven, but it does not specify if these are importers (with likely domestic competition) or exporters (without domestic competition). Some of the 'new' businesses that are interested in moving to Newhaven are identified as green technology and marine related manufacturing businesses. These businesses would likely be serving a national/European

³⁸ With respect to the 2018 Business Case, it appears that the Strategic Dimension arguments are based around Scenario 3, but the Economic Dimension arguments are based around Scenario 1.

³⁹ <https://www.hastingstowndeal.co.uk/our-challenges-and-ambitions>

market too, and not competing directly with other businesses located in and serving Hastings and other neighbouring deprived towns, though potentially they could currently be based in one of them. The 2018 Business Case also does not discuss regional economic issues other than in Brighton and Lewes District, so says nothing about the economic conditions in 2018 in Hastings or other south coast towns. Currently though (2024) the unemployment rate in Hastings is 4%. Thus, there are some arguments supporting Scenario 1 (no displacement of unemployment), but for a full Business Case these would need to be developed.

Contrasting to that is a third scenario closely aligned with Dependent Development guidance (Department for Transport, 2020), that there are a set of particular circumstances at the local and regional level that mean the economy is fully supply constrained and the only manner in which the Newhaven Port developments can be fully realised is through the construction of the NPAR. In this scenario there is no reduction in employment elsewhere, and there is a net increase in economic activity of 385 at the GB level. To support full additionality (Scenario 3) then evidence and arguments along the lines of those set out in the TAG Dependent Development guidance would need to be advocated in a Business Case.

5.1.2 The social value of reducing unemployment in the NPAR

In calculating the social value of reducing unemployment, we have to be mindful of displacement impacts outside the Newhaven/Lewes District and the relevant distributive impacts on government and workers. We get positive benefits from employing unemployed workers which accrue to the worker and the government, but we also get losses in the rest of the UK. Low income benefits gains/losses received by the previously unemployed net out if employment/unemployment is displaced all things being equal (e.g. equal productivity/income between the jobs created/destroyed).

In scenario 1, workers marginal to the labour force drop out of it elsewhere in the UK, and given the labour tax market failure, this causes a societal loss equivalent to the tax revenue previously paid. This nets out the government gain in Scenario 1. Thus, the full societal gain is:

$$\begin{aligned} \text{Social benefit} &= \text{Social cost of reducing workforce by 456 jobs elsewhere in the UK} \\ &+ \text{Social benefit of increasing the workforce in Lewes District by 385} \\ &+ \text{Social benefit of reducing unemployment in Lewes District by 71} \quad (23) \end{aligned}$$

Assuming equivalent wages for the displaced jobs between rest of UK and Lewes District then the net impact of the first two items is the social cost of reducing the workforce by 71 jobs elsewhere in the UK. Equation 12 therefore becomes:

$$\begin{aligned} \text{Societal benefit} &= \text{Societal cost of reducing workforce by 71 jobs elsewhere in the UK} \\ &+ \text{Societal benefit of reducing unemployment in Lewes District by 71} \quad (24) \end{aligned}$$

For Scenario 2, where unemployment is displaced, the equivalent benefit can be calculated as:

$$\begin{aligned}
\text{Social benefit} &= \text{Social cost of reducing workforce by 385 jobs elsewhere in the UK} \\
&+ \text{Social cost of increasing unemployment by 71 elsewhere in the UK} \\
&+ \text{Social benefit of increasing the workforce in Lewes District by 385} \\
&+ \text{Social benefit of reducing unemployment in Lewes District by 71} \quad (25)
\end{aligned}$$

Assuming equivalent wages and jobs between the jobs displaced between the rest of UK and Lewes District then the net impact of these two items is zero. The benefits of job creation and reducing unemployment in Newhaven are completely offset by the costs of losing employment and creating unemployment elsewhere in the UK.

For Scenario 3, where all the jobs in Lewes District are additional, the social benefit can be calculated as:

$$\begin{aligned}
\text{Social benefit} &= \text{Social benefit of increasing the workforce in the UK by 385} \\
&+ \text{Social benefit of reducing unemployment in the UK by 71} \quad (26)
\end{aligned}$$

The social benefit (cost) of increasing (reducing) the workforce at the UK level is calculated using the TAG labour supply methodology. That is:

$$\text{Social benefit of changing labour supply} = 0.4 * 0.69 * \text{average wages} \quad (27)$$

where: 0.4 is the tax wedge factor (also including an allowance for low-income benefits)

0.69 reflects the difference in productivity between average workers and those marginal to the workforce⁴⁰

average wages are sourced from the TAG databook.

Table 5-3 presents values for the 60 year PV. For Scenario 1 these give 60 year PV values of between £20.9 million and £40.1 million. This social surplus is the net of the loss of tax revenue on the 71 workers that leave the workforce, and the benefit of reducing unemployment by 71. There is also a transfer of income between workers and government. Previously unemployed workers lose benefits, and government reduces its outlay. This income transfer would have implications in a sophisticated distributional analysis along the lines recommended in the Green Book. It also has implications for the government's fiscal position. The PVC of the project is £18.4 million by comparison.

If the unemployed are low-income, the benefits are smaller than if they are average income. This primarily arises from the manner that the welfare benefit from reducing unemployment is correlated with the wage received. In our calculation there is also a lump sum wellbeing

⁴⁰ For Lewes District 0.69* average wages (£34,623) is £23,890. For a 48 week year and 37.5 hour week this gives an hourly rate of £13.27. The national minimum wage for 21 year olds and over is £11.44. In comparison we have used a value of two thirds of average income for our low paid workers, which is very similar (£23,196).

component taken to be independent of income. The difference in total benefit between low and average income workers is also exacerbated by the manner that the cost of the jobs 'destroyed' has been calculated using TAG, which effectively assumes the destroyed jobs are low-income, but the benefits for creating an average wage job uses average wages. Thus it is not a like for like displacement of jobs. This would suggest that if using TAG to value displaced jobs, then we should only focus on low-income workers.

The jobs being created by the NPAR are expected to reflect those in the local economy, which is predominantly low and medium skilled. Thus one might think that the average wage rate may be appropriate. However, we would expect only the low skilled to experience significant spatial mismatch issues. Thus we might expect that it will be low skilled jobs that will be filled by the unemployed. This would suggest that the £20.9 million (Riess -CV^L) and £27.3 million (Boardman -CV^L) figures may be more believable for Scenario 1. As mentioned, these lower figures would also be consistent with the treatment of labour supply in TAG as predominately low paid.

For Scenario 2 there are no benefits, as all employment and unemployment impacts are fully displaced. For Scenario 3 the benefits are very large, as not only does unemployment decrease, but we also get an increase in labour supply: the latter being valued using TAG. This gives a benefit range of between £103 and £123 million.

In terms of choosing between the Riess and Boardman approaches to valuing the -CV^L, the Riess approach assumes that workers who have a low reservation wage will already have found employment, as they will search harder. However, if unemployment is a random shock experienced by workers then there is no reason to believe that those who are unemployed have an -CV^L close to that of the marginal worker. This would suggest that the Boardman values may have some merit. Thus, of the benefit values presented in Table 5-3 we would prefer the £27.3 million figure for Scenario 1 and the £111.4 million figure for Scenario 3. If however for equity reasons a standardised income measure was deemed appropriate then the value based on average wages would be appropriate. This is £41.1 million for Scenario 1 and £123 million for Scenario 3.⁴¹ The benefits in Scenario 2 are always zero.

Finally, it might be questionable as to whether a high unemployment rate will persist for 60 years in the Do Minimum. If we instead assume that the Do Minimum unemployment rate returns abruptly to the long run equilibrium rate after 20 years or 6 years these benefits reduce significantly. If high unemployment persists for 20 years they reduce to just under 40% of the 60 year benefit (see Table 5-4), but they almost completely disappear, reducing to less than 10% of the benefits if the high unemployment in the Do Minimum only persists for six years (see Table 5-5).

We can therefore see that assumptions about the -CV^L of unemployed workers, the wages unemployed workers will obtain and how long the unemployment will persist in the counterfactual have significant impacts on the overall level of benefits.

⁴¹ It should be noted that these figures have been calculated in a manner that differs significantly from those presented in the Business Case. The Business Case figure was based on average GDP/worker (not wages for low skilled workers), a 10 year job lifetime, rather than a permanent reduction in unemployment and a tax wedge factor of 0.4 rather than a value reflecting the full social value of taking someone out of unemployment.

Table 5-3: NPAR social value of unemployment reduction under different -CV^L and wage assumptions (60 year PV 2010 prices and values, £Million)

			Value of net changes in economic activity at the UK level	Reduction in net unemployment at UK level	Total Benefit
Scenario 1: 456 jobs are displaced to the study area. Displaced employment leaves the workforce. 456 new jobs in study area. Net reduction in unemployment of 71, and no change in net employment.	Average wage for unemployed worker	Boardman -CV ^L	-£12.748	£53.878	£41.130
		Riess -CV ^L	-£12.748	£42.295	£29.547
	Low wage for unemployed worker	Boardman -CV ^L	-£12.748	£40.022	£27.274
		Riess -CV ^L	-£12.748	£33.614	£20.866
Scenario 2: 456 jobs are displaced to the study area. 385 of the displaced leave the workforce, 71 become unemployed. In the study 385 people join the workforce plus a reduction of 71 unemployed.	Average wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
	Low wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
Scenario 3: 456 jobs in the study area are additional at the UK level. Unemployment reduced by 71, and economic activity increases by 385.	Average wage for unemployed worker	Boardman -CV ^L	£69.126	£53.878	£123.004
		Riess -CV ^L	£69.126	£42.295	£111.421
	Low wage for unemployed worker	Boardman -CV ^L	£69.126	£40.022	£109.148
		Riess -CV ^L	£69.126	£33.614	£102.740

Notes: (1) £M 60 year PV 2010 prices and values; (2) Low wages are 67% of average wages; (3) For comparison the 60 year PV of total wages of 71 workers earning average wages is £38M, and earning low wages is £26M

Table 5-4: NPAR unemployment reduction limited to twenty years from appraisal year - social value of unemployment reduction under different -CV^L and wage assumptions (60 year PV 2010 prices and values, £Million)

			Value of net changes in economic activity at the UK level	Reduction in net unemployment at UK level	Total Benefit
Scenario 1: 456 jobs are displaced to the study area. Displaced employment leaves the workforce. 456 new jobs in study area. Net reduction in unemployment of 71, and no change in net employment.	Average wage for unemployed worker	Boardman -CV ^L	-£4.974	£21.023	£16.049
		Riess -CV ^L	-£4.974	£16.504	£11.529
	Low wage for unemployed worker	Boardman -CV ^L	-£4.974	£15.617	£10.642
		Riess -CV ^L	-£4.974	£13.116	£8.142
Scenario 2: 456 jobs are displaced to the study area. 385 of the displaced leave the workforce, 71 become unemployed. In the study 385 people join the workforce plus a reduction of 71 unemployed.	Average wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
	Low wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
Scenario 3: 456 jobs in the study area are additional at the UK level. Unemployment reduced by 71, and economic activity increases by 385.	Average wage for unemployed worker	Boardman -CV ^L	£26.973	£21.023	£47.996
		Riess -CV ^L	£26.973	£16.504	£43.477
	Low wage for unemployed worker	Boardman -CV ^L	£26.973	£15.617	£42.590
		Riess -CV ^L	£26.973	£13.116	£40.089

Notes: (1) £M 60 year PV 2010 prices and values; (2) Low wages are 67% of average wages; (3) For comparison the 60 year PV of total wages of 71 workers earning average wages is £38M, and earning low wages is £26M

Table 5-5: NPAR unemployment reduction limited to six years from appraisal year - social value of unemployment reduction under different -CV^L and wage assumptions (60 year PV 2010 prices and values, £Million)

			Value of net changes in economic activity at the UK level	Reduction in net unemployment at UK level	Total Benefit
Scenario 1: 456 jobs are displaced to the study area. Displaced employment leaves the workforce. 456 new jobs in study area. Net reduction in unemployment of 71, and no change in net employment.	Average wage for unemployed worker	Boardman -CV ^L	-£1.097	£4.636	£3.539
		Riess -CV ^L	-£1.097	£3.639	£2.543
	Low wage for unemployed worker	Boardman -CV ^L	-£1.097	£3.444	£2.347
		Riess -CV ^L	-£1.097	£2.892	£1.796
Scenario 2: 456 jobs are displaced to the study area. 385 of the displaced leave the workforce, 71 become unemployed. In the study 385 people join the workforce plus a reduction of 71 unemployed.	Average wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
	Low wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
		Riess -CV ^L	£0.000	£0.000	£0.000
Scenario 3: 456 jobs in the study area are additional at the UK level. Unemployment reduced by 71, and economic activity increases by 385.	Average wage for unemployed worker	Boardman -CV ^L	£5.948	£4.636	£10.585
		Riess -CV ^L	£5.948	£3.639	£9.588
	Low wage for unemployed worker	Boardman -CV ^L	£5.948	£3.444	£9.392
		Riess -CV ^L	£5.948	£2.892	£8.841

Notes: (1) £M 60 year PV 2010 prices and values; (2) Low wages are 67% of average wages;

Turning to the matter of the benefits of using unemployed workers during the construction, we can see that these are minimal (see Table 5-6). Even if the construction employment is net additional at the UK level (equivalent to Scenario 3), the benefits would not exceed £0.5 million compared to a PVC (construction cost) of £18.5 million. These low values are primarily due to the short term duration of the construction period and the small size of the project. For construction benefits to be net additional at the UK level, very strong arguments supporting why government spending is not displaced would need to be advanced. These would most likely be associated with a spending stimuli during a significant economic downturn and associated upsurge in unemployment (depicted in the last set of rows of Table 5-6). For the vast majority, if not all, of the typical expenditure by the DfT on capital projects, construction jobs would not only be taken to be temporary, but also to be displaced (depicted in the first set of rows of Table 5-6). If unemployment is also displaced there would be no benefits (see the middle set of rows of Table 5-6).

In a classical cost benefit analysis, the benefit of using unemployed workers for construction lowers the social cost of construction. This would lower the PVC in a classical CBA. In the UK the PVC is defined as the discounted financial cost to the transport budget, so the benefit of using unemployed workers for construction would not appear in it. Instead, this benefit would need to be added to the PVB, alongside the benefit of bringing other unemployed workers into employment.

Table 5-6: NPAR social value of construction related unemployment reduction under different -CV^L and wage assumptions (60 year PV 2010 prices and values, £Million)

				Value of net changes in economic activity at the UK level	Reduction in net unemployment at UK level	Total Benefit
Construction displaces construction elsewhere.	Construction employment is displaced, with net reduction in unemployment (akin to Scenario 1)	Average wage for unemployed worker	Boardman -CV ^L	-£0.154	£0.650	£0.496
			Riess -CV ^L	-£0.154	£0.511	£0.357
		Low wage for unemployed worker	Boardman -CV ^L	-£0.154	£0.483	£0.329
			Riess -CV ^L	-£0.154	£0.406	£0.252
	Construction employment is displaced, with no net reduction in unemployment (akin to Scenario 2)	Average wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
			Riess -CV ^L	£0.000	£0.000	£0.000
		Low wage for unemployed worker	Boardman -CV ^L	£0.000	£0.000	£0.000
			Riess -CV ^L	£0.000	£0.000	£0.000
Spending stimuli. Construction spending creates temporary new jobs for low skilled construction workers. These positions are filled by the unemployed. Medium and high skilled construction jobs are displaced from other parts of the economy (akin to Scenario 3).		Average wage for unemployed worker	Boardman -CV ^L	£0.000	£0.650	£0.650
			Riess -CV ^L	£0.000	£0.511	£0.511
		Low wage for unemployed worker	Boardman -CV ^L	£0.000	£0.483	£0.483
			Riess -CV ^L	£0.000	£0.406	£0.406

Notes: (1) £M 60 year PV 2010 prices and values; (2) Low wages are 67% of average wages;

5.2 Trans-Pennine Route Upgrade

5.2.1 Description

The Transpennine route is a 76-mile-long rail link in the north of England, which connects Manchester and York via Huddersfield and Leeds. It is the most direct rail link between Manchester and Leeds, as well as connecting smaller towns and commuter areas such as Huddersfield.

The Transpennine Route Upgrade (TRU) is a multi-billion pound long-term railway infrastructure investment aiming to improve connectivity and support economic growth in the North. The Transpennine Route Upgrade Programme (the Programme) plans for eventual full electrification of the route, additional track capacity (including for freight) in some sections, digital signalling and station upgrades.

The dataset that forms the basis of this case study is from an implementation of the WITA software tool to examine the scale of wider economic benefits of the investment. Whilst WITA covers the level 2 benefits from Agglomeration, Imperfect Competition and Labour Supply effects, it does not provide estimates or valuations of unemployment impacts.

This case study seeks to adapt the WITA based inputs and outputs in order to implement the approach to estimating the value of unemployment reductions associated with the investment in line with the methodological approach outlined in Chapter 4 which follows the work of Norman et al (2017) (see also Appendix 1). This focuses on estimation of changes in employment (and implicitly unemployment) from improvements in transport-based accessibility. Their paper discusses transport as a mechanism to address the spatial mismatch

element of unemployment. As discussed earlier in this document, these reductions in structural unemployment are likely to be more prevalent amongst lower skilled workers who are less mobile.

5.2.2 Application

There are several steps to the application of the data to estimate the value of associated unemployment impacts from the TRU in line with the approach outlined in section 4.2.

- Use journey time and trip data from DM (Reference) and DS scenarios to estimate average generalised costs.
- Use the average journey time and cost data in conjunction with employment data to construct accessibility functions for the DM and DS scenarios (*equation 15*).
- Apply changes in accessibility to Norman participation rate elasticity of 0.022 to estimate new **participation level** in DS (*equation 16*)
- Apply changes in accessibility to Norman employment rate elasticity of 0.011 to estimate DS **employment rate** (*equation 18*)
- Apply employment rate to new participation level to derive DS **employment level** (*equation 19*)
- Take difference between DS participation and employment level as DS **unemployment level** (*equation 20*)
- **Labour supply effect** is employment change (*equation 19*) net of unemployment reduction (*equation 20*)
- Value the changes in unemployment level and labour supply in line with the conceptual framework for valuation presented in chapter 4

In line with the spatial aggregation used in WITA, all the analysis is carried out at the Local Authority District (2015) level with a project year of 2030 in 2010 prices. Rather than a full appraisal, we have focused on year 2030 and compare the relativities of employment impacts with user benefits (cost and full detailed appraisal information was not available in the WITA data). Unlike the Newhaven case, the approach taken here only addresses supply side employment impacts from enhanced transport accessibility, not any impacts from the construction of the scheme itself.

This piece of work is intended to be largely illustrative of the approach that could be used. To be viable in an appraisal context, accessibility function parameters, employment elasticities and unemployment elasticities would have to be calibrated rather than adopted/adapted from elsewhere as was required for this application.

This approach requires the following data outlined in Table 5-7.

Table 5-7: Data sources used in unemployment estimation of TRU case study.

Data	Source	Spatial level	Comments
Journey time, fares and trip matrices for 2030 DM and DS	WITA	LAD (2015)	Generalised cost was calculated based on values of time used in WITA model, grown to 2030 using predicted growth path from the data. Both these sets of figures are taken from the TAG data handbook. Car fuel cost derived from a simple ppm of £0.15.
Commuting trip mode share data	2011 Census travel to work	LAD (2011/15)	2021 TTW data not available for same LAD classification and probably not indicative of current post COVID travel patterns Certain discrepancies regarding some LAD classification with respect to 2015 version resolved manually (e.g. replication of London and Westminster mode splits)
Employment data for 2030	WITA	LAD (2015)	Use 2030 employment data at the LAD level as used in WITA
Parameters for distance impedance in accessibility function	Norman et al. (2017)	Aggregate	Norman et al (2017) use exponential functional form for ED. Instead, we used TAG compliant power-based ED function with a range of distance decay elasticities.
Parameters for employment elasticity	Norman et al. (2017)	Aggregate	Figure of 0.009 not clearly derivable from paper so used 0.011 figure from log-log functional form.
Employment, unemployment and labour supply splits –	Labour Force Survey Employment data, 2022-23 from NOMISWEB	LAD	
Average workplace based earnings	TAG Wider impacts dataset 2024	LAD	Gross wage data from ASHE (DfT, 2024) https://assets.publishing.service.gov.uk/media/6658886f16cf36f4d63ebc55/tag-wider-impacts-dataset-2024.xlsm

5.2.2.1 Journey time and trip data calculation

Journey time and PT trip matrices were provided from WITA input data for 2030 DM and DS.

The construction of an average generalised journey time across modes requires a modal weighting to cover business and commuting travel for car and public transport. This was not available in the provided WITA data (public transport trips were estimated but not car). Trip weightings were instead derived from 2011 Census travel to work (TTW) data. Car data is unchanged between DS and DM and distance/times do not vary between business and commute.

Whilst this was performed for all 380*380 LAD combinations we illustrate the approach below with the example of Leeds to Manchester. Here the Census TTW data gave a mode split (PT vs Car) of 0.235.

On average, from the WITA data we found business trips to be 26% the volume of commuting trips for PT. For car, business trips were assumed to 24% the volume of commuting trips (from the supplied input data). We used fixed weights for DM and DS. The journey time and trip data for this flow are shown below in Table 5-8.

Table 5-8: Average Generalised Cost calculations (2010 £)

	PT				Car		All modes	
	Commute		Business		Commute	Business		
	DM	DS	DM	DS	DM/DS		DM GC	DS GC
Distance	43.80	43.74	45.00	44.89	55.31			
Time	92.98	84.23	99.15	90.37	67.73			
Generalised Cost (£)	32.1	30.31	85.81	79.35	21.78	41.89		
Trips (Annual)	843,786	981,899	361,102	418,915	-			
Census weight	0.235		-		0.765			
Adjusted weight (sums to 1)	0.189		0.049		0.614	0.147		
Weighted GC							29.84	29.19

5.2.2.2 Accessibility changes

In order to construct accessibility functions for the DM and DS scenarios (equation 12), average journey generalised cost figures were used in conjunction with employment data.

In the Norman paper, the distance decay parameter α is set at -0.028 , as estimated in their supporting transport demand model. Their use of negative exponential function meant the scale of proportional changes in ATEM were governed by the units used for the impedance measure and given our underlying costs and employment levels were different, their distance decay parameter was not transferrable as it was calibrated to their data. Instead, we used a power form for the accessibility function with sensitivity tests for the distance decay parameter between -0.5 and -1.25 .

The largest changes in accessibility are found for Kirklees (7.6%) and for Leeds (3.6%). It is worth noting Kirklees includes Huddersfield, which is around 40 miles from Manchester and 15 miles from Leeds and lies between the two large cities on the Transpennine line.

5.2.2.3 Deriving the changes in unemployment.

Presented below in Table 5-9 are the accessibility measures for West Yorkshire and Greater Manchester LADs and the results of the employment and unemployment estimations using the central scenario. In total the NPR results in an extra 411 jobs of which 123 represent a reduction in unemployment. The remaining 288 represent the labour supply effect. Given the elasticity figure applied from Norman was across the whole job market, no adjustments are made to the calculations to take into account the low skilled labour market which might be disproportionately affected by improvements in accessibility improvements due to spatial mismatch. No adjustment is made based on the underlying unemployment rate in an area – it has been established that spatial mismatch can be an issue and apparent even when unemployment is at the natural rate, although it might be more concentrated at higher rates of unemployment.

Table 5-9: TRU Indicative case study results (central scenario: $\rho=-1$, 2031 opening year)

LAD	ATEM DS	ATEM DM	Proportional change	Employment increase	Unemployment reduction	Labour supply increase
Bradford	152,352	152,439	1.000572	8	2	6
Calderdale	161,573	161,637	1.000397	3	1	2
Kirklees	158,915	160,116	1.007559	83	25	58
Leeds	156,049	156,606	1.003567	95	28	67
Wakefield	175,151	175,220	1.00039	4	1	3
Bolton	182,270	182,720	1.002466	19	6	13
Bury	195,841	195,841	1	0	0	0
Manchester	162,463	162,540	1.000477	10	3	7
Oldham	181,597	181,677	1.000441	3	1	2
Rochdale	185,584	185,395	0.998983	-5	-2	-4
Salford	203,037	203,008	0.999859	-1	0	-1
Stockport	178,990	179,067	1.000428	4	1	2
Tameside	175,796	176,811	1.005773	30	9	21
Trafford	191,610	191,857	1.00129	11	3	8
Wigan	184,238	184,343	1.000569	4	1	3
ALL GB LADS TOTAL (380)				411	123	288

Table 5-10: TRU Case study valuation results summary (2031 opening year)

Sensitivity test - distance decay		Unemployment reduction	Labour Supply increase	Employment increase
$\rho = -1$	Jobs	123	288	411
	Value (£M)	3.23	2.42	5.65
$\rho = -0.5$	Jobs	53	124	177
	Value (£M)	1.40	1.04	2.44
$\rho = -1.25$	Jobs	164	385	549
	Value (£M)	4.31	3.23	7.54

5.2.2.4 Value the changes in unemployment and employment

For the results shown in

Table 5-10 we have shadow priced all unemployed – the parameters from Norman are aggregate across the labour market, but we assume that the reduction in unemployment stems from those lower skilled suffering from spatial mismatch related unemployment (to the extent

it is addressed through the TRU upgrade). The premise of the Norman elasticities are that the employment increases represent additional jobs which are not displaced from elsewhere.

To value the extra employed based on labour supply increase, we use the TAG tax wedge of 40% applied to average wage per LAD (in 2031 at 2010 prices) adjusted to less productive labour market entrants (wage multiplied by 0.69). Focusing on the central scenario results, this gave a value of £2.42M (market prices) for the central scenario in the opening year. This represents the labour supply effect.

For valuing the additional unemployment reductions separately we again assume low-income workers, but additionally include the social surplus for workers now receiving wage above their -CV^L in addition to the tax wedge. For this we use the social value uplift proportion figure of 154% from Table 4-2 (based on the Boardman approach) applied to the low-income adjusted average wage per LAD as before for each of the workers estimated to have been removed from unemployment. This represented an additional £3.23M (market prices) for the opening year of 2031 on top of the other level 2 wider benefits.

In total, the value of the employment increases sum to £5.65M for the opening year. Application of the Riess approach⁴² (social value proportion of 129%) would reduce the value of unemployment impacts by around 20% (to £2.7M) in the central scenario.

If however for equity reasons a standardised income measure was deemed appropriate then the value based on average wages would be appropriate applied to a wedge of 139% from Table 4-2 giving a total benefit (of reduction in unemployment) of £4.35M PA (£3.40M if applying the Riess approach).

The agglomeration impacts predicted from WITA were around £12M per year (in 2010 prices). The value of the employment impacts estimated here are lower in magnitude to the agglomeration benefits (measuring about a quarter of agglomeration benefits in the central scenario). Unemployment change is about 40% of the labour supply increase, (around a third of the total change in employment). The value of the unemployment reduction is approximately 30% higher than the estimated labour supply effect. User benefits or costs were not available as comparators.

5.2.2.5 Comment on the results

What we have presented here in section 5.2 is an attempt to provide an illustrative case study employing a potential approach to estimation of unemployment impacts through transport induced reductions in spatial mismatch. Whilst we believe there is potential in the approach, the main takeaway is that the state of the art is not robust and that to use this approach in earnest would probably require better estimates of:

- accessibility change including an accurately specified accessibility function and a calibrated distance decay parameter.
- employment and labour supply elasticities in a UK based context of inter-urban rail

⁴² We use the unemployment rates associated with Table 5-4 (i.e. Newhaven) for this estimate. They are likely similar to those in the Trans-Pennine corridor and are therefore illustrative.

The example case study for the TRU was not ideal for a number of reasons. We only had the WITA data to work with, which was missing mode share for car and missing the user benefit and cost information. We were unable to use the Norman accessibility function and distance decay parameter to estimate unemployment changes. There were also issues with some of the travel time and trip data not being available for certain flows from the modelling.

Also, we recognise application of such an approach requires a clear understanding and articulation of the context of the transport scheme - whether the drivers of employment change amongst lower skilled are relevant for a project such as this providing inter-regional, longer distance commuting benefits are debatable. There are broader questions about the type of employment that TRU would facilitate – who are the types of workers affected by rail improvements, and would these workers be suffering from spatial mismatch or be existing workers shifting jobs?

Arguably, rail connectivity may not directly benefit low skilled workers (due to the cost of rail travel), however low skilled workers may still benefit. For example, there may be labour market repercussions (the ripple-effect discussed in Manning and Petrongolo (2017)) which open up more opportunities for low skilled workers not directly affected by the accessibility improvements. These opportunities are created by existing workers taking a new job now accessible by rail, thereby vacating their existing job. Furthermore, the business growth opportunities provided by TRU may create both high and low skilled jobs. The low skilled jobs may be closer to the unemployed and therefore reduce spatial mismatch. The latter is a similar argument to that used in the NPAR of taking jobs to the unemployed, rather than taking the unemployed to the jobs.

Implicitly in our valuation approach, we are assuming that workers coming out of employment are low skilled workers, i.e. are better placed to access jobs in a way which addresses spatial mismatch. The Centre for Cities report (Magrini, 2019 Figure 2) on economic outcomes for low skilled people in cities highlights that the two towns and cities that gain the most from the TRU have a share of low skilled jobs in excess of this (Huddersfield (Kirklees) has between 33 and 41% of jobs as low skilled, and Leeds has 21 to 25%). This suggests some defence for these unemployment reduction figures, in that the existing industrial structure would suggest a large proportion of the new jobs would be low skilled.

It is hard to judge the scale of these results without a calibrated distance decay parameter and accompanying cost or user benefit figures which were not available in the WITA data we had. These standard appraisal outputs along with a TAG compliant figure for labour supply impacts would really be required as a litmus test for assessing the scale and to some extent the plausibility of our results. Anecdotally from a handful of other appraisals to hand, agglomeration impacts are markedly larger than labour supply impacts although it could be that the agglomeration figures for such an inter-urban scheme might be low in comparison to an urban scheme.

Our approach to valuing the labour supply effect estimates the change in employment in a fundamentally different way to that in TAG. If an approach to estimating unemployment impacts is adopted in some form, this would require a reconsideration of existing labour supply impacts guidance.

Also, the approach is essentially fixed land use – the accessibility function used as the basis for the employment estimation filters out changes in composition of the labour market. Such a large scale project as this would lead to change in labour market composition and a redistribution of economic activity.

6 IMPLICATIONS FOR TAG GUIDANCE

6.1 Additionality of changes in employment

In this first section we consider the language used in TAGA2-3 and how consistent it is with other aspects of appraisal guidance.

The overarching guidance on cost benefit analysis for the government sector is provided by the Green Book (HM Treasury, 2022). This guidance has changed over the years in terms of its advice regarding the additionality of employment from government policy interventions, and its wording on the topic appears carefully nuanced. It acknowledges that government spending can have macroeconomic impacts:

Interventions which increase human capital, job-search activity or provide better access to jobs can have positive labour supply and macroeconomic effects. Provided they can be supported by clear, objective evidence labour supply effects can be included in appraisal.

HM Treasury (2022 paragraph 6.4)

However, it considers that these macroeconomic impacts will not be statistically significant between project variants.⁴³ Therefore they would not normally feature in the cost benefit analysis (paragraph 6.5).⁴⁴

Broadly speaking, the thrust of the 2022 Green Book is that macroeconomic impacts can occur, but the onus is on the analyst to demonstrate that they are defensible and statistically significant. In the absence of such supporting evidence there would be a need to assume 100% displacement.

TAG A2.3 currently takes a firmer stance than the Green Book. It details a set of circumstances in which employment impacts may occur. Primarily this is one of changing labour supply, or in exceptional circumstances and for a temporary period only, whilst the labour market adjusts back to a long run equilibrium. All other employment impacts would be viewed as displaced. This is in fact in line with the Green Book as it was in 2018 when TAG A2-3 was drafted. In line with the current Green Book, some macroeconomic impacts are permissible in an appraisal in addition to labour supply, providing they improve the supply side of the economy (e.g. increasing productivity).

Thus, for example a transport project that gives rise to real wage increases via increased agglomeration (productivity) would be expected to have some labour supply (and employment) impacts. Increased agglomeration could arise through both reduced transport costs, but also through displacement of economic activity to dense locations (e.g. increased densification around city centre stations). Of course real wage increases may lead to reductions in employment, if the segment of the labour market affected has a backward

⁴³ The place based impact analysis guidance in the Green Book, and in particular the What Works multipliers, relate to the analysis and reporting of local impacts. No guidance or opinion is offered on their additionality.

⁴⁴ TAG and VfM guidance is interested in both comparisons between project alternatives, but also in the absolute value for money of a project. Understanding macroeconomic impacts could be relevant with regard to the latter.

bending labour supply curve.⁴⁵ The implication is that it would only be through appropriate analytical modelling, as with Spatial Computable General Equilibrium models or alternative modelling methods, that increases in employment at a national level could be justifiably included in an appraisal.

In the absence of any supporting analysis, we take the view that the assumption of 100% displacement should be adopted – as in the current version of the guidance. This remains defensible as the default in that previous guidance by HCA shows high anticipated regional and UK level displacement rates (see Table 5-1). It is also consistent with some ex-post transport impact analysis that shows very high levels of displacement. For example, Pogonyi et al. (2021) found that all the new economic activity within walking distance around the Jubilee Line Extension (JLE) stations had been displaced, with those areas within 2km, but further than walking distance away experiencing a significant negative impact.

To conclude, the text in TAG A2-3 should be softened to permit changes in employment beyond just changes in labour supply from reduced commuting costs. Such additionality would need to be supported not only by conceptual arguments regarding productivity driven real wage increases but also by appropriate analytical modelling.

6.2 TAG and Unemployment

TAG A2-3 mentions unemployment in two places. The first is in the context of an economy that is operating below full employment (paragraph 2.2.8) and the second is in Box 1 in relation to market failures in the labour market.

The text for both needs updating to be consistent with the typology presented in Chapter 2⁴⁶, and the manner that transport investment can reduce spatial mismatch. Primarily there is a need to identify that there is a long run rate of unemployment, which is structural in its origin. This long run rate of unemployment may have regional variations, reflecting structural differences in regional labour markets. One of the sources of that structural unemployment is spatial mismatch. Transport can therefore lower the long run rate of unemployment by increasing accessibility to employment and reducing spatial mismatch. This can occur via two mechanisms: reducing commuting and job search costs and displacing employment into locations of unemployment (subject to what happens in the areas where employment is displaced from).

TAG should also identify the following:

- When labour markets are functioning well and unemployment is at the long run equilibrium level, unemployment levels will likely remain unchanged by the project unless the project acts on the supply side labour market factors such as job search costs including spatial mismatch.
- The strong inter-relationship between reducing unemployment and job accessibility implies we expect there to be labour supply impacts alongside the unemployment

⁴⁵ The HS2 Phase 2 S-CGE model predicted a reduction in labour supply following an increase in real wages (i.e. a backward bending labour supply curve).

⁴⁶ TAGA2-3 refers to frictional unemployment, a term we avoid in our typology, as it implies a rate of unemployment that cannot be lowered by government policy such as transport investment. We refer to the long run rate of unemployment, NAIRU and cyclical unemployment.

impacts. Joint modelling of both ideally should occur, and the proportion of the additional employment which is drawn from the unemployed pool should be evidenced and discussed.

- Reductions in spatial mismatch are likely to only impact on low skilled workers. Skilled workers are typically well paid and mobile. They would usually be expected to be in employment, and if unemployed this would only be transitory. A project would therefore just displace skilled workers from one job to another. Thus, the change in unemployment of skilled workers will in the main be zero. It is the low skilled who will be experiencing spatial mismatch and benefit from improved transport connectivity. Projections of reduced levels of unemployment should therefore reflect the number of low skilled jobs that will be created, as it is these workers who experience the most spatial mismatch.
- For dependent development type analysis or for changing land uses where employment is displaced, the cost benefit analysis for displaced jobs needs to consider the cost of destroying a job alongside the benefit of creating a job by reducing unemployment. Thus, it is important to also project changes in unemployment in the regions which lose employment.
- Related to this there is also the need to be mindful that pure proximity to unemployment of new jobs is not a guarantor of improvements in labour market outcomes, if the jobs are not suitable for the unemployed. For example, Gibbons et al. (2021) examined the impact of the £8.2billion Single Regeneration Budget fund in England. This fund subsidised the building of business floor space in deprived neighbourhoods. They found that, whilst creating jobs in these neighbourhoods, it did little to improve the employment outcomes of local residents, so local unemployment was largely unaffected. That is the 'new' workers commuted in from outside the neighbourhood.

Persistence of unemployment is important to the appraisal, as it reflects underlying structural problems, which transport can address. If unemployment is not persistent, for example cyclical unemployment (also known as demand deficient unemployment), then the benefits of reducing it will only be short-lived. Our tests on the NPAR case study indicate that any benefits from reducing such temporary unemployment are small.

This could be case dependent, but would imply that unless there is a widespread demand stimulus programme during a period of cyclical unemployment (e.g. one or both of increased spending on construction, or large scale subsidisation of public transport) then cyclical unemployment should be ignored from a transport appraisal perspective. Further research exploring this issue could be warranted, to better understand if the specific circumstances where it may have significance.

A final point is that the impact on unemployment may differ by type of transport project. As car ownership varies systematically with income, the unemployed may have limited access to vehicles. Thus, public transport projects, providing fares are affordable, may better address spatial mismatch via the commuting mechanism. Of course road projects, as in the NPAR case study, could address spatial mismatch via dependent developments.

6.3 Parameterisation of the shadow price of unemployment in TAG

The framework for shadow pricing unemployment is well understood. We found that presenting the shadow price as a proportion of wages worked well in the appraisals conducted (the case studies). This approach would be worthwhile adopting in TAG. It is also informative to disaggregate these proportions between the different components of the shadow price: payment above $-CV^L$, taxes and wellbeing. This is helpful from a distributional perspective as taxes fall to government, but payment above $-CV^L$, and wellbeing fall to the worker. Related to this distributional aspect a financial analysis would show significant transfers between workers (who lose low-income benefits) and government who gain not only additional tax revenue but also a reduced social security bill.

TAG will need to identify how to value reducing unemployment when it arises as a consequence of displacement. This is due to the interaction between unemployment, labour supply and move to more/less productive jobs. The interaction can be illustrated drawing from the NPAR Scenario 1 analysis. Here:

$$\begin{aligned} \text{Social benefit} &= \text{Social cost of reducing workforce by 456 jobs elsewhere in the UK} \\ &+ \text{Social benefit of increasing the workforce in Lewes District by 385} \\ &+ \text{Social benefit of reducing unemployment in Lewes District by 71} \end{aligned}$$

Assuming equivalent wages for the displaced jobs between rest of UK and Lewes District (i.e. no costs/benefits from M2MLPJ) then the net impact of the first two items is the social cost of reducing the workforce by 71 jobs elsewhere in the UK. The equation therefore becomes:

$$\begin{aligned} \text{Societal benefit} &= \text{Societal cost of reducing workforce by 71 jobs elsewhere in the UK} \\ &+ \text{Societal benefit of reducing unemployment in Lewes District by 71} \end{aligned}$$

This example also highlights the need for consistency between the unemployment, labour supply and M2MLPJ parameters, something any future research on parameterisation should look to achieve. It's worth noting that potential inconsistencies between the labour supply and M2MLPJ 'tax wedge' parameters have previously been identified (Laird et al., 2020).

Despite the framework for shadow pricing unemployment being well understood it is not straightforward to derive parameters for it. Primarily this is due to the complexities of unemployment and low-income benefits and their dependency on housing tenure, family structure and alternative income sources. Taxes paid also vary with the wages of the job the unemployed takes. Additionally, there is a need to know whether there is any systematic variation in the attributes of the unemployed who are recruited into employment (i.e. do they come from a particular segment of the unemployed or just generally reflect the profile of the unemployed). It is these people that we need to shadow price.

Before parameters for valuing unemployment in TAG can be recommended it is therefore necessary to undertake research on:

- The characteristics of the unemployed who enter employment into low skilled jobs. It is such unemployed people that will experience more significant spatial mismatch.

The characteristics of particular relevance are those factors that affect receipt of low-income benefits as well as the wages received once in employment;

- The financial values of benefits received by the unemployed. This research has made a start in this direction.
- The interrelationship (if any) between the labour supply parameters and the unemployment parameters⁴⁷.

We also found there to be considerable variability in the benefits from reducing unemployment depending on the method used to value the lost leisure time (-CV^L). We tested two variants; one we termed Boardman and the other Riess. In terms of choosing between the Riess and Boardman approaches to valuing the -CV^L, the Riess approach assumes that workers who have a low reservation wage will already have found employment, as they will search harder. However, if unemployment is a random shock experienced by workers then there is no reason to believe that those who are unemployed have an -CV^L close to that of the marginal worker. This would suggest that the Boardman values may have more merit, and we would lean to implementing that approach.

The wellbeing values used in the valuation of unemployment in TAG should be consistent with those used elsewhere in TAG and with HMT guidance. At the moment these are recommended to be income neutral. Our preferred valuations for the shadow cost of labour reflect the actual shadow costs, so reflect the wages received by the previously unemployed. Our view is that such people will be low skilled and therefore will have lower than average wages. There is therefore a discrepancy between the treatment of income between the benefit components. This should be noted in the TAG guidance.

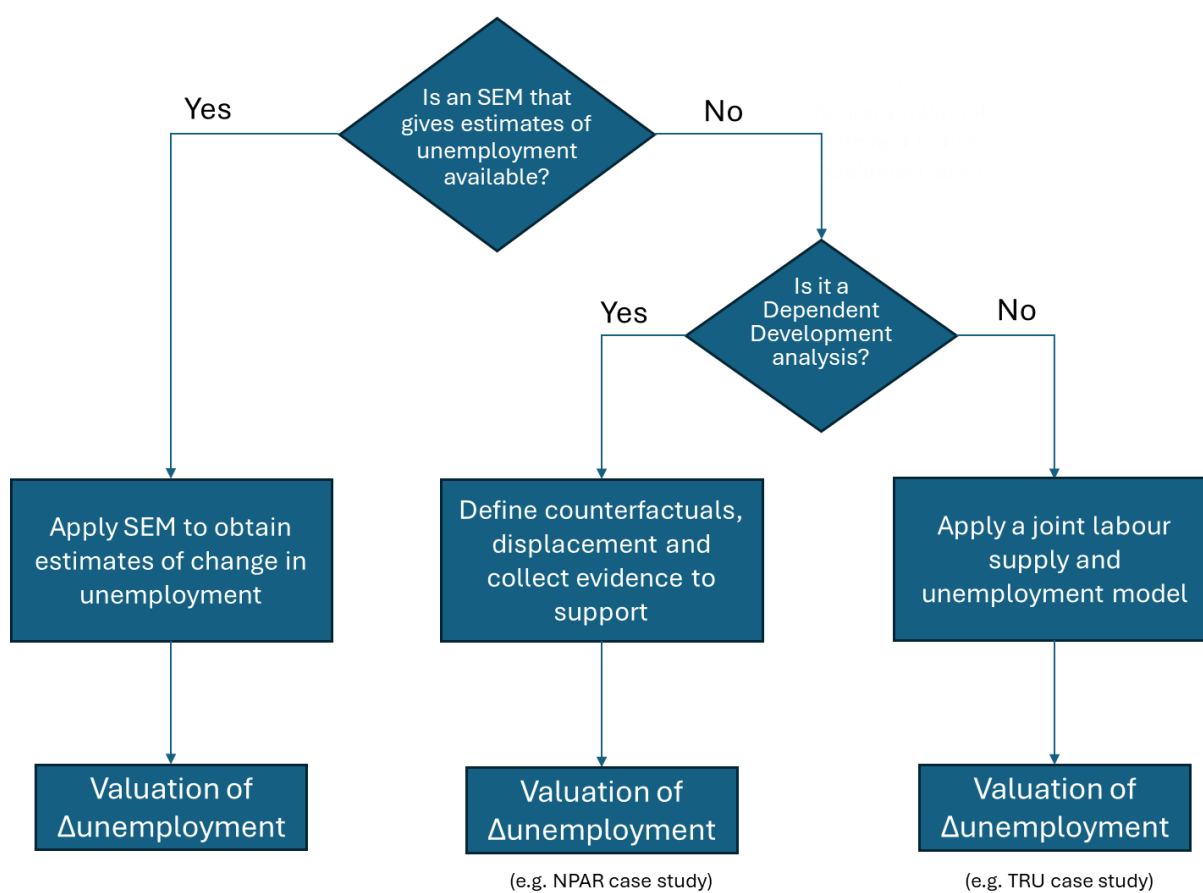
6.4 Modelling and counterfactuals

Our case studies identify that how the modelling is undertaken and the counterfactuals are defined are critical to determining the level of benefits that are projected. This section of the TAG guidance will therefore be critical.

The first point is that without appropriate analytical modelling or evidence, and in line with the proposed updates to TAG discussed above, it would be assumed that there is 100% displacement of employment. Analytical modelling could include the use of SEMs, or suitable and well evidenced analysis of dependent developments. A joint labour supply and unemployment model would also be creating additionality. These three analytical options are illustrated below in Figure 6-1. It is the two right hand side options that we applied in our case studies. The NPAR was a dependent development case study, whilst the TRU was an application of a joint labour supply and unemployment model. Even if there is no net increase in employment at the national level (i.e. no net additionality), there may still be a reduction in unemployment.

⁴⁷ This will include for example the wages of those entering the labour market (labour supply) or coming out of unemployment. Additionally, noting that the labour supply parameters are old (Ercolani et al., 2024), and Laird et al. (2020) identified inconsistencies between the labour supply parameters and the M2MLPJ parameters (again related to the treatment of the productivity of workers for jobs that are displaced).

Figure 6-1: Unemployment modelling choices



Source: Own work

SEM MODELLING

With respect to modelling with an SEM, it will be hard for TAG to provide guidance, as there are many different types of SEM. A clear justification of the modelling approach with respect to economic theory, the interrelation with labour supply and move to more productive jobs will be needed. Cross referencing to the TAG SEM guidance would also be needed.

DEPENDENT DEVELOPMENT

TAG will need to be very clear in its guidance regarding the counterfactuals. As in our NPAR case study substantial additionality occurs in a dependent development scenario in which all development is constrained, but government intervention permits it to then to go ahead. Guidance on counterfactual definition will need to be particularly clear for such dependent developments. Our view is that the starting position should be zero benefits, so 100% displacement of employment and unemployment, unless evidence suggesting otherwise is available.

The guidance would therefore need to refer to:

- The requirement for tests on dependency, probably via a cross reference to the TAG A2-2 guidance on induced investment
- A baseline analysis of unemployment within the study area,

- Demonstration of the persistence of unemployment over more than the ‘usual’ period of adjustment following negative shock in order to justify underlying rates above the national long run rate of unemployment. For example, the NPAR case study was showing persistently high unemployment over a 10-year period. The current national long run rate of equilibrium can be sourced from the latest MPC publication (e.g. Monetary Policy Committee (MPC) (2024)).

As mentioned, the starting position should be zero benefits, so 100% displacement of both employment and unemployment. This is Scenario 2 of the NPAR case study. For a reduction in unemployment to be additional (that is the Scenario 1 of the NPAR analysis) the TAG guidance would need to require evidence that areas from which employment will be displaced exhibit the long run rate of unemployment. As discussed in the NPAR case study, identification of such areas would need to include:

- Analysis of whether the businesses dependent on the project are importers (competing domestically) or are exporters (competing in world markets);
- Analysis of where competitor businesses are based (or alternatively where the development would locate otherwise);
- Analysis of unemployment rates in any identified locations.

For full additionality, including that of labour supply, akin to Scenario 3 of the NPAR analysis, the additionality guidance in TAG A2-2 would need to be followed. That is, some analysis that demonstrates no development (in the region) could go ahead in the absence of a government intervention. The TAG A2.2 guidance may also need strengthening as it is mainly associated with housing developments where planning consent can be a limiting factor. Economic growth is likely to be less limited by planning consent. Of course, planning consent is needed for large scale development, such as business parks, but economic growth will often include incremental expansion of existing businesses, or some change in use of an existing building (e.g. redevelopment of old mills for office space). Thus, the additionality test in A2.2 for full dependency by businesses on a transport project should be more stringent than that for housing. In this scenario there are both benefits from increasing labour supply and reducing unemployment. In the NPAR case study the benefits from increasing labour supply were very large, and we would usually expect them to be larger than the benefits from reducing unemployment.⁴⁸

JOINT LABOUR SUPPLY AND UNEMPLOYMENT MODEL

As discussed in several places earlier in this report, changes in labour supply will occur simultaneously with changes in unemployment. This is because the driver to unemployment is a change in job accessibility, which also drives changes in labour supply. Thus, it is necessary to jointly estimate labour supply and unemployment impacts for any unemployment projections to avoid double counting or inconsistency.

⁴⁸ There is more benefit per new job from reducing unemployment, than increasing labour supply, but there is a larger increase in labour supply than in reducing unemployment. Ancillary unreported analysis associated with the TRU case study identified approximately 15% of any increase in employment arose from a reduction in unemployment, and 85% arose from an increase in labour supply.

The Norman et al. model of labour supply and unemployment (see Appendix 1) appealed as it disentangles the effects of changes in land use from changes in accessibility. The model therefore gives an estimate of a change in unemployment based on supply side cost reductions under fixed land use. The model controls for the impact of changes in the spatial distribution of employment through a separate accessibility function although such changes are assumed to be exogenous to any transport intervention. The model thus does not address transport induced displacement.

If implemented into TAG we would envisage that this joint labour supply and unemployment model would supersede the existing labour supply model, otherwise there would be inconsistencies within TAG. The model does not rely on the assumption of elastic labour demand which underpins TAG approach to labour supply.

Consideration would have to be given to the context of any application: for example, in the NPR case study there was a concern whether an inter-urban rail project would be relevant to addressing spatial mismatch. Even in such situations there could potentially be ripple effects in local labour markets where skilled jobs have been displaced, as discussed in Manning and Petrongolo (2017). Further case study specific background evidence may be required to support the use of such an approach.

We experienced a number of difficulties in applying the Norman et al. model given its aggregate nature, the functional form of the accessibility function and shortcomings with some of the supporting descriptive statistics. Further, we did not have supporting level 1 and 2 analysis to compare the degree of additionality. Nonetheless, we feel we have demonstrated the principle of the approach and the potential capability of the technique. To be incorporated into TAG, a significant research effort would be needed that would estimate a joint labour supply and unemployment model to GB data (detailed further in 7.2).

7 CONCLUSION

7.1 Discussion and summary

The primary objective of this work is to propose and develop a robust, proportionate and practical framework for assessing and monetising the impacts of transport investments on various kinds of unemployment.

TAG already provides guidance on the inclusion of the benefits of increasing labour supply and from shifting employment to more (or less) productive locations. The key driving mechanism at play in this work is reduction in spatial mismatch. This may come about via changes in accessibility or, in cases of dependent development via induced effects on the availability and productivity of land.

A key requirement is to distinguish additionality from displaced economic activity. For appraisal at the national level (i.e. using TAG) this means net additionality at the national level versus redistribution within it.

Because of the long gestation period involved, transport investment is unlikely to have a robust and predictable impact on cyclical unemployment. An exception might be fast response policies such as public transport fares policy.

Meeting the objective set out above involves three essential steps: measuring the impact of transport interventions on net additional economic activity and employment; measuring the share of changes in employment taken by changes in unemployment; valuing the net social benefit of changes in unemployment.

The key driver of supply side induced employment change is changes in commuting costs. This presumes that the wage compensates workers for the generalised cost of their commuting as in TAG. Whether there is full or only partial wage compensation depends on spatial and social conditions. So, the strength of the empirical evidence on relevant elasticities is important. Many studies are reviewed in Chapter 3.

Most studies focus on employment effects and do not distinguish the sources of labour for additional employment. There is no clear framework for estimation of unemployment impacts which could be adopted directly into practice. In the case studies we describe two methods which could be developed further.

While the economic principles for valuing the net social benefits of reducing unemployment via supply side interventions are well-defined, we find that operationalising this with numbers is surprisingly challenging for three reasons. The first is the high level of variation of marginal tax/benefit rates according to family and housing status. The second is the need to decide whether newly employed are drawn from people at the margin of employment (Riess) or are paid a significant wage premium above their reservation wage (Boardman). Thirdly there is the question of adding a well-being component for the non-monetary value to the individual of being employed. Table 4.2 shows the range of results for just one demographic category.

Two case study applications were developed, very different in nature and scale. The NPAR is a medium sized project which is dependent development in nature. Therefore, an approach based on bespoke evidence and professional judgement is appropriate. Stronger evidence on

the characteristics of the induced economic activity, in this case the marine sector, and the likelihood of additionality, is desirable. Using this type of approach, estimating the proportion of net additional employment drawn from unemployment is bound to be challenging.

The second case study – based on a Trans-Pennine upgrade scenario – illustrates a large intervention of an increasing accessibility kind. Whilst it is limited in the sense of requiring a number of assumptions to operationalise and difficulty comparing the scale of unemployment impacts relative to other benefits, it serves as a useful application of the proposed methodology to model transport induced reductions in spatial mismatch unemployment in line with Norman et al (2017). This approach offers the possibility of development into guidance following further research.

Both case studies demonstrate that changes in unemployment are important sources of benefit to the appraisal, and that consideration for how best to capture these benefits in TAG is worthwhile.

Our overall recommendations are that the employment TAG unit, TAG A2-3, would need updating in several areas to offer guidance on the appraisal of changes in unemployment. The areas identified for updates are in relation to the additionality of employment increases, the terminology used to refer to unemployment, the definition of the counterfactuals, the modelling approaches to be adopted (including the evidence required to justify dependent development approaches) and valuation of reducing unemployment.

For now, we suggest changes in wording for existing TAG guidance to provide scope for inclusion of further employment impacts. In the longer term, further research is required to provide a consistent framework for valuation of changes in employment and for estimation of unemployment impacts developing on the approaches demonstrated through the case studies.

In writing this report, we have often returned to the point that although the specific application under investigation is to the transport sector, the principles apply to all applications of the Green Book, most obviously the skills agenda and planning and infrastructure decisions for energy, water, telecoms etc with expected downstream impacts on employment and unemployment. We would therefore encourage DfT to engage with HMT and other Green Book using Departments to seek wider views about how best to take this important topic forward.

7.2 Further research

Further research is necessary to implement this. There are two strands of research necessary on the valuation and modelling sides.

7.2.1 Valuation

Research is needed to permit a valuation of the shadow price of unemployment. This will require a deeper understanding of who are the unemployed entering employment and the profile of their incomes and benefits.

On the valuation side there is also a need to consider whether more consistency between the labour supply parameters and the move to more (or less) productive jobs parameters are needed. Specifically:

- The characteristics of the unemployed who enter employment into low skilled jobs. It is such unemployed people that will experience more significant spatial mismatch. The characteristics of particular relevance are those factors that affect receipt of low-income benefits as well as the wages received once in employment. This could use the Understanding Society dataset – a household longitudinal survey;
- The financial values of benefits received by the unemployed. This research has made a start in this direction.
- The interrelationship (if any) between the labour supply parameters in TAG, such as the tax wedge, and the unemployment parameters.

7.2.2 Modelling

Secondly, there is a need to develop a joint labour supply and unemployment model for applications without supporting SEMs or dependent development analysis. Our view is that a model similar to that developed by Norman et al. (2017) would be a suitable approach. However, as noted, it cannot be applied as it stands. We suggest a UK version of the model is developed based on further supporting research along the following lines.

1. Experimentation with different decay functions. Norman et al (2007) used a negative exponential accessibility function which meant the scale of proportional changes in ATEM were governed by the units used, the underlying level of costs and employment levels. As such their distance decay parameter was not transferrable. We recommend testing different approaches, including a power based function. A distance decay parameter could potentially be used from the DfT's National Transport Model in a similar fashion to the Norman approach's use of the Swedish national model.
2. Separate labour supply and employment models need to be estimated to provide the respective elasticities, as with the Norman approach. Whilst this could be modelled mirroring the Norman approach with aggregated (LAD level) data on transport and economic variables of interest, their model did not address endogeneity between transport and employment. Consideration should be given to addressing such endogeneity, e.g. through use of instrumental variables and whether distance decay could be parameterised.
3. Better still would be to estimate disaggregate micro data based logit models of individual's labour supply and employment probabilities using datasets such as the Labour Force Survey. Panel based datasets such as Understanding Society could be chained for a longer time series to control for individual level fixed effects. Consideration should be given to the potential for a spatial dimension to the modelling.
4. Elasticity responses should reflect local conditions such as the unemployment rate (N.B. when using a logit functional form, the elasticity is proportional to the level).

8 APPENDIX 1: DETAILED DESCRIPTION OF NORMAN ET AL. (2017)

Norman et al. (2017) estimate the relationship between temporal changes in unemployment and changes in labour market accessibility in Sweden. The work offers a potentially useful framework for analysis of employment impacts along with some elasticities which could be applied to the case study work. We have identified it as interesting in a number of ways:

- In line with TAG guidance on agglomeration impacts the study uses more accurate measure of accessibility weighted across travel modes.
- It applies a temporal approach to examine how changes in accessibility cause changes in employment.
- The work focuses on employment effect from improved accessibility from changes in composition separated out from transport induced accessibility changes. This fixed land use employment (although they don't refer to it as such) effect occurs through transport addressing the localised structural spatial mismatch issue and does not require the calculation of displacement.
- Presents employment elasticities by different job market segments.
- Improves on earlier literature such as Berechman and Paaswell (2001) and Ozbay et al. (2006) who effectively assume completely elastic labour demand so any increase in labour supply will increase employment.

In line with the literature studied here and the conceptual framework, their working hypothesis is that there is a spatial mismatch between supply and demand for labour in some locations due to 'sticky geography' which is a form of structural unemployment'; i.e. workers are effectively too slow to move to job opportunities. This has the implication that "unemployment would decrease at the national level as the transport system improves to allow longer commutes".

They describe two mechanisms underpinning link between transport and unemployment. Firstly, a reduction in commuting costs reduces reservation wages and increases job search area. Secondly, higher accessibility improves matching as it reduces search costs. The impact of better accessibility on reservation wages and search costs is more relevant for low-educated workers who have lower wages more likely below reservation wage.

In order to estimate their model they use a 'pseudo-panel' approach to regress temporal changes in employment on local accessibility at the municipality level in Sweden. Within each of the 288 municipality they identify 144 socio-economic segments based on age, gender, country of birth and educational level providing a sample of 41,760 'representative workers'.

There were 288 municipalities in Sweden during the time period. For each municipality there are 144 socio-economic segments, defined with respect to age (six segments), male/female (two segments), country of birth (three segments), and educational level (four segments). In total, there are thus 41,760 segments, which can be interpreted as representative workers, for which the employment rate is observed in years 1 and 3. They estimate a logistic regression model of the employment rate using a mixture of labour market data and gravity weighted accessibility measures based on generalised commute costs from transport model data. The model includes socio economic variables to control for sorting effects (Combes et al., 2008).

For preparation of the independent variables, they decompose accessibility change into 2 parts: accessibility change due to changes in transport system and accessibility changes due to changes in jobs (which may be endogenous). As the employment rate may be influenced by a change in the number of jobs unrelated to improvements in the transport system so this can be controlled for by isolating the accessibility change from transport investment. They further argue that accessibility change due to changes in the transport system is exogenous because transport investments are exogenous from changes in the labour market conditions, providing some evidence to suggest this is the case in Sweden. They use a deeper lag for changes in accessibility. The transport-based accessibility change uses a deeper lag than the employment-based change as it is argued transport-based accessibility changes take time to impact on employment.

The model doesn't reveal absolute changes in employment, unemployment or the rate. The employment rate (which is estimated as the ratio of employment to unemployed + employed) and the associated elasticity will be affected not just by previously unemployed finding work but by changes in labour supply – indeed the numbers of unemployed could potentially stay the same even with an increase in employment if it is offset by an increase in labour supply. Unemployment elasticities can be derived from the employment impacts but require assumptions about labour supply changes.

8.1.1 Considerations for future modelling work

Derivation of unemployment changes would have to be applied based on separate modelling of changes in employment and labour force participation models or assumptions possibly derived based on the labour supply estimation formula in TAG. However, given the highlighted variations in regional unemployment and rates by skill levels in this report it seems reasonable to consider whether the assumption that the labour supply effect translates directly into employment outcomes in the contexts where we might see a role for transport reducing unemployment.

An important consideration for any aggregate modelling would be the spatial scale at which the modelling is conducted, e.g. whether the data be at LSOA, Ward, Travel to Work Area or Local Authority level. Whilst the Annual Population Survey (APS) provides a large scale repeated cross sectional dataset (with a short term panel element), it is a sample-based study so may be restrictive at the smaller zonal level.

There is also the potential for disaggregate modelling along the lines of Bastiaanssen et al. (2022) combined with the application of the accessibility decomposition from Norman et al. (2017). The Annual Population Survey would again be suitable for this purpose and this could avoid some of the problems with aggregation, although the zoning of the accessibility function would still require consideration.

9 APPENDIX 2: SOCIAL VALUE OF UNEMPLOYMENT DERIVATIONS AND FACTORS

Table 9-1: Average worker (earning £34,623 per annum): Participation Tax Rates for differing family units, jobs and unemployment durations

Family unit	Employment status	Benefit entitlement (per week)					Find an avg income job (£34,623 per year)					
		Total benefits entitlement	Universal credit	New style jobseekers allowance	Council tax support	Child benefit	Benefits lost (pcm)	Income tax & NIC (pcm)	Additional childcare costs (pcm)	Total deductions (pcm)	Average tax & NIC rate	Participation tax rate
Single, no children homeowner	Unemployed < 6 months	£119.38	£0.29	£90.50	£28.59	£0.00	£517.31	£514.42	£0.00	£1,031.73	18%	35.8%
	Unemployed > 6 months	£119.38	£90.79	£0.00	£28.59	£0.00	£517.31	£514.42	£0.00	£1,031.73	18%	35.8%
	Earning £34,623	£0.00	£0.00	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, no children renting	Unemployed < 6 months	£281.85	£162.76	£90.50	£28.59	£0.00	£1,036.75	£514.42	£0.00	£1,551.17	18%	53.8%
	Unemployed > 6 months	£281.84	£253.25	£0.00	£28.59	£0.00	£1,036.71	£514.42	£0.00	£1,551.13	18%	53.8%
	Earning £34,623	£42.60	£42.60	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, under 21, no children living rent free	Unemployed < 6 months	£71.92	£0.22	£71.70	£0.00	£0.00	£311.65	£514.42	£0.00	£826.07	18%	28.6%
	Unemployed > 6 months	£71.92	£71.92	£0.00	£0.00	£0.00	£311.65	£514.42	£0.00	£826.07	18%	28.6%
	Earning £34,623	£0.00	£0.00	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, teenage children renting	Unemployed < 6 months	£452.06	£290.42	£90.50	£28.59	£42.55	£464.53	£514.42	£0.00	£978.95	18%	33.9%
	Earning £34,623	£344.86	£302.31	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with low income full-time job, teenage children and renting	Unemployed < 6 months	£396.59	£263.54	£90.50	£0.00	£42.55	£926.86	£514.42	£0.00	£1,441.28	18%	50.0%
	Unemployed > 6 months	£396.59	£354.04	£0.00	£0.00	£42.55	£926.86	£514.42	£0.00	£1,441.28	18%	50.0%
	Earning £34,623	£182.70	£140.15	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with low income full-time job, primary age children and renting	Unemployed < 6 months	£386.11	£253.06	£90.50	£0.00	£42.55	£229.71	£514.42	£1,229.83	£1,514.54	18%	52.5%
	Earning £34,623	£439.12	£396.57	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£133.05	£0.00	£90.50	£0.00	£42.55	£392.17	£514.42	£0.00	£906.59	18%	31.4%
	Unemployed > 6 months	£112.94	£70.39	£0.00	£0.00	£42.55	£305.02	£514.42	£0.00	£819.44	18%	28.4%
	Earning £34,623	£42.55	£0.00	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£133.05	£0.00	£90.50	£0.00	£42.55	£392.17	£514.42	£0.00	£906.59	18%	31.4%
	Unemployed > 6 months	£42.55	£0.00	£0.00	£0.00	£42.55	£0.00	£514.42	£0.00	£514.42	18%	17.8%
	Earning £34,623	£42.55	£0.00	£0.00	£0.00	£42.55	---	---	---	---	---	---

Notes:

Living: Newhaven, Council Tax Band B

Employment for worker and partner: 35 hours per week, £34,623 per year (equivalent to £13 per hour)

Children: none, two teenage (15yrs & 13yrs), two primary (3yrs and 5yrs)

Housing: homeowner or renting (£1,000 per month rent or mortgage)

Local Housing Allowance: £718.03 for single, £1,080.04 for family

Childcare costs: £157 per week per primary aged child if both adults are working full-time

Avg income job: £34,623 per year or £1,933 pcm; Tax £176.95 pcm, NICs £70.84 pcm; net earnings £1,685.21 pcm

Source: Own work using benefits calculator: www.entitledto.co.uk

Table 9-2: Low-income worker (earning £23,196 per annum): Participation Tax Rates for differing family units, jobs and unemployment durations

Family unit	Employment status	Benefit entitlement (per week)					Find a low income job (£23,196 per year)					
		Total benefits entitlement	Universal credit	New style jobseekers allowance	Council tax support	Child benefit	Benefits lost (pcm)	Income tax & NIC (pcm)	Additional childcare costs (pcm)	Total deductions (pcm)	Average tax & NIC rate	Participation tax rate
Single, no children homeowner	Unemployed < 6 months	£119.38	£0.29	£90.50	£28.59	£0.00	£517.31	£247.79	£0.00	£765.10	13%	39.6%
	Unemployed > 6 months	£119.38	£90.79	£0.00	£28.59	£0.00	£517.31	£247.79	£0.00	£765.10	13%	39.6%
	Earning £23,196	£0.00	£0.00	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, no children renting	Unemployed < 6 months	£281.85	£162.76	£90.50	£28.59	£0.00	£1,036.75	£247.79	£0.00	£1,284.54	13%	66.5%
	Unemployed > 6 months	£281.84	£253.25	£0.00	£28.59	£0.00	£1,036.71	£247.79	£0.00	£1,284.50	13%	66.5%
	Earning £23,196	£42.60	£42.60	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, under 21, no children living rent free	Unemployed < 6 months	£71.92	£0.22	£71.70	£0.00	£0.00	£311.65	£247.79	£0.00	£559.44	13%	28.9%
	Unemployed > 6 months	£71.92	£71.92	£0.00	£0.00	£0.00	£311.65	£247.79	£0.00	£559.44	13%	28.9%
	Earning £23,196	£0.00	£0.00	£0.00	£0.00	£0.00	---	---	---	---	---	---
Single, teenage children renting	Unemployed < 6 months	£452.06	£290.42	£90.50	£28.59	£42.55	£464.53	£247.79	£0.00	£712.32	13%	36.9%
	Earning £23,196	£344.86	£302.31	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with low income full-time job, teenage children and renting	Unemployed < 6 months	£396.59	£263.54	£90.50	£0.00	£42.55	£926.86	£247.79	£0.00	£1,174.65	13%	60.8%
	Unemployed > 6 months	£396.59	£354.04	£0.00	£0.00	£42.55	£926.86	£247.79	£0.00	£1,174.65	13%	60.8%
	Earning £23,196	£182.70	£140.15	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with low income full-time job, primary age children and renting	Unemployed < 6 months	£386.11	£253.06	£90.50	£0.00	£42.55	-£229.71	£247.79	£1,229.83	£1,247.91	13%	64.6%
	Earning £23,196	£439.12	£396.57	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£133.05	£0.00	£90.50	£0.00	£42.55	£392.17	£247.79	£0.00	£639.96	13%	33.1%
	Unemployed > 6 months	£112.94	£70.39	£0.00	£0.00	£42.55	£305.02	£247.79	£0.00	£552.81	13%	28.6%
	Earning £23,196	£42.55	£0.00	£0.00	£0.00	£42.55	---	---	---	---	---	---
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£133.05	£0.00	£90.50	£0.00	£42.55	£392.17	£247.79	£0.00	£639.96	13%	33.1%
	Unemployed > 6 months	£42.55	£0.00	£0.00	£0.00	£42.55	£0.00	£247.79	£0.00	£247.79	13%	12.8%
	Earning £23,196	£42.55	£0.00	£0.00	£0.00	£42.55	---	---	---	---	---	---

Notes:

Living: Newhaven, Council Tax Band B

Employment for worker and partner: 35 hours per week, £23,196 per year (equivalent to £13 per hour)

Children: none, two teenage (15yrs & 13yrs), two primary (3yrs and 5yrs)

Housing: homeowner or renting (£1,000 per month rent or mortgage)

Local Housing Allowance: £718.03 for single, £1,080.04 for family

Childcare costs: £157 per week per primary aged child if both adults are working full-time

Low income job: £23,196 per year or £1,933 pcm; Tax £176.95 pcm, NICs £70.84 pcm; net earnings £1,685.21 pcm

Source: Own work using benefits calculator: www.entitledto.co.uk

Table 9-3: Average income worker (£34,623): Financial impacts on employees, firms and government (pcm)

Family unit	Employment status	Employee (pcm)						Firms - Cost of labour (pcm)					Government (pcm)						Tax wedge
		Gross salary	Tax & Employee NIC	Change in benefits	Change in childcare costs	Change in non-wage income (Pensions, etc.)	Net change in income (wage and non-wage)	Gross Wage/salary	Total on-costs (26.5%: Source: TAG)	Of which Employers NIC (13.8% above £758pcm)	Other on-costs (benefits to employees)	Total cost of labour	Income tax	Employee NIC	Employers NIC	Total change in taxes	Change in benefits	Total impact on government	Tax revenue as proportion of gross wage/salar
Single, no children homeowner	Unemployed < 6 months	£2,885	-£514	-£517	£0	£471	£2,325	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£517	£1,325	28.0%
	Unemployed > 6 months	£2,885	-£514	-£517	£0	£471	£2,325	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£517	£1,325	28.0%
Single, no children renting	Unemployed < 6 months	£2,885	-£514	-£1,037	£0	£471	£1,805	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£1,037	£1,845	28.0%
	Unemployed > 6 months	£2,885	-£514	-£1,037	£0	£471	£1,805	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£1,037	£1,845	28.0%
Single, under 21, no children living rent free	Unemployed < 6 months	£2,885	-£514	-£312	£0	£471	£2,530	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£312	£1,120	28.0%
	Unemployed > 6 months	£2,885	-£514	-£312	£0	£471	£2,530	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£312	£1,120	28.0%
Single, teenage children renting	Unemployed < 6 months	£2,885	-£514	-£465	£0	£471	£2,377	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£465	£1,273	28.0%
Partner with low income full-time job, teenage children and renting	Unemployed < 6 months	£2,885	-£514	-£927	£0	£471	£1,915	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£927	£1,735	28.0%
	Unemployed > 6 months	£2,885	-£514	-£927	£0	£471	£1,915	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£927	£1,735	28.0%
Partner with low income full-time job, primary age children and renting	Unemployed < 6 months	£2,885	-£514	£230	-£1,230	£471	£1,842	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	-£230	£578	28.0%
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£2,885	-£514	-£392	£0	£471	£2,450	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£392	£1,200	28.0%
	Unemployed > 6 months	£2,885	-£514	-£305	£0	£471	£2,537	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£305	£1,113	28.0%
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£2,885	-£514	-£392	£0	£471	£2,450	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£392	£1,200	28.0%
	Unemployed > 6 months	£2,885	-£514	£0	£0	£471	£2,842	£2,885	£765	£294	£471	£3,650	£367	£147	£294	£808	£0	£808	28.0%

Notes:

Living: Newhaven, Council Tax Band B

Employment for worker and partner: 35 hours per week, £34,623 per year (equivalent to £13 per hour)

Children: none, two teenage (15yrs & 13yrs), two primary (3yrs and 5yrs)

Housing: homeowner or renting (£1,000 per month rent or mortgage)

Local Housing Allowance: £718.03 for single, £1,080.04 for family

Childcare costs: £157 per week per primary aged child if both adults are working full-time

Avg income job: £34,623 per year or £1,933 pcm; Tax £176.95 pcm, NICs £70.84 pcm; net earnings £1,685.21 pcm

Source: Own work using benefits calculator: www.entitledto.co.uk

Table 9-4: Low-income worker (£23,196): Financial impacts on employees, firms and government (pcm)

Family unit	Employment status	Employee (pcm)						Firms - Cost of labour (pcm)					Government (pcm)						Tax wedge Tax revenue as proportion of gross wage/salary to employee
		Gross salary	Tax & Employee NIC	Change in benefits	Change in childcare costs	Change in non-wage income (Pensions, etc.)	Net change in income (wage and non-wage) to employee	Gross Wage/ salary	Total on- costs (26.5%: Source: TAG)	Of which Employers NIC (13.8% above £758pcm)	Other on- costs (benefits to employees)	Total cost of labour	Income tax	Employees NIC	Employers NIC	Total change in taxes	Change in benefits	Total impact on government	
Single, no children homeowner	Unemployed < 6 months	£1,933	-£248	-£517	£0	£350	£1,518	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£517	£927	21.2%
	Unemployed > 6 months	£1,933	-£248	-£517	£0	£350	£1,518	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£517	£927	21.2%
Single, no children renting	Unemployed < 6 months	£1,933	-£248	-£1,037	£0	£350	£999	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£1,037	£1,447	21.2%
	Unemployed > 6 months	£1,933	-£248	-£1,037	£0	£350	£999	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£1,037	£1,447	21.2%
Single, under 21, no children living rent free	Unemployed < 6 months	£1,933	-£248	-£312	£0	£350	£1,724	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£312	£722	21.2%
	Unemployed > 6 months	£1,933	-£248	-£312	£0	£350	£1,724	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£312	£722	21.2%
Single, teenage children renting	Unemployed < 6 months	£1,933	-£248	-£465	£0	£350	£1,571	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£465	£874	21.2%
Partner with low income full-time job, teenage children and renting	Unemployed < 6 months	£1,933	-£248	-£927	£0	£350	£1,108	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£927	£1,337	21.2%
	Unemployed > 6 months	£1,933	-£248	-£927	£0	£350	£1,108	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£927	£1,337	21.2%
Partner with low income full-time job, primary age children and renting	Unemployed < 6 months	£1,933	-£248	£230	-£1,230	£350	£1,035	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	-£230	£180	21.2%
Partner with average income (£34,623) full- time job, teenage children and homeowner	Unemployed < 6 months	£1,933	-£248	-£392	£0	£350	£1,643	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£392	£802	21.2%
	Unemployed > 6 months	£1,933	-£248	-£305	£0	£350	£1,730	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£305	£715	21.2%
Partner with high income (£45,000) full- time job, teenage children and homeowner	Unemployed < 6 months	£1,933	-£248	-£392	£0	£350	£1,643	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£392	£802	21.2%
	Unemployed > 6 months	£1,933	-£248	£0	£0	£350	£2,035	£1,933	£512	£162	£350	£2,445	£177	£71	£162	£410	£0	£410	21.2%

Notes:

Living: Newhaven, Council Tax Band B

Employment for worker and partner: 35 hours per week, £23,196 per year (equivalent to £13 per hour)

Children: none, two teenage (15yrs & 13yrs), two primary (3yrs and 5yrs)

Housing: homeowner or renting (£1,000 per month rent or mortgage)

Local Housing Allowance: £718.03 for single, £1,080.04 for family

Childcare costs: £157 per week per primary aged child if both adults are working full-time

Low income job: £23,196 per year or £1,933 pcm; Tax £176.95 pcm, NICs £70.84 pcm; net earnings £1,685.21 pcm

Source: Own work using benefits calculator: www.entitledto.co.uk

Table 9-5: Social benefit of reducing unemployment (average income, Boardman method)

Family unit	Employment status	Benefits to worker when unemployed that are 'given up' [negative implies a benefit increase] (A)	Additional childcare costs when employed (B)	Gross wage to employee (C)	Post-tax wage to employee (D)	Non-wage benefits to employee (E)	post-tax wage (including non-wage employee benefits) (F)	Upper Bound for:		Net social value of creating employment (Boardman)								Social value as a proportion of gross wage to employee (Boardman)	
								Reservation Wage (= post tax income) (G) = (F)	-CV ⁴ (= reservation wage minus benefits) (H) = (G) - (A+B)	Value of output (=MPL*1.19) (I)	Boardman average - CV ⁴ for unemployed worker (J) = 50% x (H)	Childcare costs (K)=(B)	Wellbeing value from being employed versus unemployed (L)	Value of employing an unemployed person (M)=(I)-(J)-(K)*(L)	Of which accrues to:			Total (Q) = (L)/(C)	
															Government as additional tax (N)=(M)-(O)-(P)	Worker as a wellbeing benefit (O)=(L)	Worker as payment above opportunity costs of working (P)=(F)-(J)-(K)		
Single, no children and homeowner	Unemployed < 6 months	£517	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,325	£4,343	£1,162	£0	£564	£3,745	£1,501	£564	£1,680	130%	
	Unemployed > 6 months	£517	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,325	£4,343	£1,162	£0	£564	£3,745	£1,501	£564	£1,680	130%	
Single, no children renting	Unemployed < 6 months	£1,037	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,805	£4,343	£903	£0	£564	£4,005	£1,501	£564	£1,939	139%	
	Unemployed > 6 months	£1,037	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,805	£4,343	£903	£0	£564	£4,005	£1,501	£564	£1,939	139%	
Single, under 21, no children and living rent free	Unemployed < 6 months	£312	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,530	£4,343	£1,265	£0	£564	£3,643	£1,501	£564	£1,577	126%	
	Unemployed > 6 months	£312	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,530	£4,343	£1,265	£0	£564	£3,643	£1,501	£564	£1,577	126%	
Single, with teenage children and renting	Unemployed < 6 months	£466	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,377	£4,343	£1,189	£0	£564	£3,719	£1,501	£564	£1,653	129%	
	Unemployed > 6 months	£927	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,915	£4,343	£958	£0	£564	£3,950	£1,501	£564	£1,884	137%	
Partner with avg income full-time job, teenage children and renting	Unemployed < 6 months	£927	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,915	£4,343	£958	£0	£564	£3,950	£1,501	£564	£1,884	137%	
	Unemployed > 6 months	£927	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,915	£4,343	£958	£0	£564	£3,950	£1,501	£564	£1,884	137%	
Partner with avg income full-time job, primary age children and renting	Unemployed < 6 months	-£238	£1,230	£2,885	£2,371	£471	£2,842	£2,842	£1,842	£4,343	£921	£1,230	£564	£2,757	£1,501	£564	£991	96%	
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,450	£4,343	£1,225	£0	£564	£3,683	£1,501	£564	£1,617	128%	
	Unemployed > 6 months	£392	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,537	£4,343	£1,268	£0	£564	£3,639	£1,501	£564	£1,573	126%	
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,450	£4,343	£1,225	£0	£564	£3,683	£1,501	£564	£1,617	128%	
	Unemployed > 6 months	£0	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,842	£4,343	£1,421	£0	£564	£3,487	£1,501	£564	£1,421	121%	
Note: Average GDP/worker in Lews District		£56,583 per annum		£4,715 pcm															

Table 9-6: Social benefit of reducing unemployment disaggregated by changes in consumer, government and producer surplus plus wellbeing (average income, Boardman method)

Family unit	Gross wage to employee	Value of employing an unemployed person					Value of employing an unemployed person as percentage of gross wage					Change in Household finances		Change in Government finances	
		Total	Contribution from:				Total	Contribution from:				£	%age of wage	£	%age of wage
			Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus		Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus				
Single, no children and homeowner	£2,885	£3,745	£1,162	£564	£2,019	£0	130%	40%	20%	70%	0%	£2,325	81%	£2,019	70%
	£2,885	£3,745	£1,162	£564	£2,019	£0	130%	40%	20%	70%	0%	£2,325	81%	£2,019	70%
Single, no children renting	£2,885	£4,005	£903	£564	£2,538	£0	139%	31%	20%	88%	0%	£1,805	63%	£2,538	88%
	£2,885	£4,005	£903	£564	£2,538	£0	139%	31%	20%	88%	0%	£1,805	63%	£2,538	88%
Single, under 21, no children and living rent free	£2,885	£3,643	£1,265	£564	£1,813	£0	126%	44%	20%	63%	0%	£2,530	88%	£1,813	63%
	£2,885	£3,643	£1,265	£564	£1,813	£0	126%	44%	20%	63%	0%	£2,530	88%	£1,813	63%
Single, with teenage children and renting	£2,885	£3,719	£1,189	£564	£1,966	£0	129%	41%	20%	68%	0%	£2,377	82%	£1,966	68%
	£2,885	£3,950	£958	£564	£2,428	£0	137%	33%	20%	84%	0%	£1,915	66%	£2,428	84%
Partner with avg income full-time job, teenage children and renting	£2,885	£3,950	£958	£564	£2,428	£0	137%	33%	20%	84%	0%	£1,915	66%	£2,428	84%
	£2,885	£3,950	£958	£564	£2,428	£0	137%	33%	20%	84%	0%	£1,915	66%	£2,428	84%
Partner with avg income full-time job, primary age children and renting	£2,885	£2,757	£921	£564	£1,272	£0	96%	32%	20%	44%	0%	£1,842	64%	£1,272	44%
	£2,885	£2,757	£921	£564	£1,272	£0	96%	32%	20%	44%	0%	£1,842	64%	£1,272	44%
Partner with average income (£34,623) full-time job, teenage children and homeowner	£2,885	£3,683	£1,225	£564	£1,894	£0	128%	42%	20%	66%	0%	£2,450	85%	£1,894	66%
	£2,885	£3,639	£1,268	£564	£1,806	£0	126%	44%	20%	63%	0%	£2,537	88%	£1,806	63%
Partner with high income (£45,000) full-time job, teenage children and homeowner	£2,885	£3,683	£1,225	£564	£1,894	£0	128%	42%	20%	66%	0%	£2,450	85%	£1,894	66%
	£2,885	£3,487	£1,421	£564	£1,501	£0	121%	49%	20%	52%	0%	£2,842	98%	£1,501	52%

Table 9-7: Social benefit of reducing unemployment (average income, Riess method)

Family unit	Employment status	Benefits to worker when unemployed that are 'given up' [negative implies a benefit increase] (A)	Additional childcare costs when employed (B)	Gross wage to employee (C)	Post-tax wage to employee (D)	Non-wage benefits to employee (E)	post-tax wage (including non-wage employee benefits) (F)	Upper Bound for:		Value of output (=MPL*1.19) (I)	Riess average for unemployed worker (J) = (1-UR) x (H)	Childcare costs (K)	Net social value of creating employment (Riess)						Social value as a proportion of gross wage to employee (Riess) Total (Q) = (L)/(C)
								Reservation Wage (= post tax income) (G) = (F)	-CV ² (= reservation wage minus benefits) (H) = (G) - (A+B)				Wellbeing value from being employed versus unemployed (L)	Value of employing an unemployed person (M)=(I)-(J)-(K)+(L)	Government as additional tax (N)=(M)-(O)-(P)	Worker as a wellbeing benefit (O)=(L)	Worker as payment above opportunity costs of working (P)=(F)-(J)-(K)		
Single, no children homeowner	Unemployed < 6 months	£517	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,325	£4,343	£2,271	£0	£564	£2,637	£1,501	£564	£571	91%	
	Unemployed > 6 months	£517	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,325	£4,343	£2,271	£0	£564	£2,637	£1,501	£564	£571	91%	
Single, no children renting	Unemployed < 6 months	£1,037	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,805	£4,343	£1,764	£0	£564	£3,144	£1,501	£564	£1,078	109%	
	Unemployed > 6 months	£1,037	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,805	£4,343	£1,764	£0	£564	£3,144	£1,501	£564	£1,078	109%	
Single, under 21, no children living rent free	Unemployed < 6 months	£312	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,530	£4,343	£2,472	£0	£564	£2,436	£1,501	£564	£370	84%	
	Unemployed > 6 months	£312	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,530	£4,343	£2,472	£0	£564	£2,436	£1,501	£564	£370	84%	
Single, teenage children renting	Unemployed < 6 months	£466	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,377	£4,343	£2,323	£0	£564	£2,585	£1,501	£564	£519	90%	
Partner with avg income full-time job, teenage children and renting	Unemployed < 6 months	£927	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,915	£4,343	£1,871	£0	£564	£3,037	£1,501	£564	£971	105%	
	Unemployed > 6 months	£927	£0	£2,885	£2,371	£471	£2,842	£2,842	£1,915	£4,343	£1,871	£0	£564	£3,037	£1,501	£564	£971	105%	
Partner with avg income full-time job, primary age children and renting	Unemployed < 6 months	-£230	£1,230	£2,885	£2,371	£471	£2,842	£2,842	£1,842	£4,343	£1,799	£1,230	£564	£1,878	£1,501	£564	-£187	65%	
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,450	£4,343	£2,393	£0	£564	£2,514	£1,501	£564	£449	87%	
	Unemployed > 6 months	£305	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,537	£4,343	£2,478	£0	£564	£2,429	£1,501	£564	£363	84%	
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,450	£4,343	£2,393	£0	£564	£2,514	£1,501	£564	£449	87%	
	Unemployed > 6 months	£0	£0	£2,885	£2,371	£471	£2,842	£2,842	£2,842	£4,343	£2,776	£0	£564	£2,131	£1,501	£564	£65	74%	

Note: Newham unemployment rate is 6.3%; economy wide lone run rate is 4%; UR = 6.3%-4% = 2.3%

Note: Newhaven unemployment rate is 6.3%; economy wide long run rate is 4%; UR = 6.3%-4% = 2.3%

Table 9-8: Social benefit of reducing unemployment disaggregated by changes in consumer, government and producer surplus plus wellbeing (average income, Riess method)

Family unit	Gross wage to employee	Value of employing an unemployed person					Value of employing an unemployed person as percentage of gross wage					Change in Household finances		Change in Government finances	
		Total	Contribution from:				Total	Contribution from:				£	%age of wage	£	%age of wage
			Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus		Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus				
Single, no children homeowner	£2,885	£2,637	£53	£564	£2,019	£0	91%	2%	20%	70%	0%	£2,325	81%	£2,019	70%
	£2,885	£2,637	£53	£564	£2,019	£0	91%	2%	20%	70%	0%	£2,325	81%	£2,019	70%
Single, no children renting	£2,885	£3,144	£42	£564	£2,538	£0	109%	1%	20%	88%	0%	£1,805	63%	£2,538	88%
	£2,885	£3,144	£42	£564	£2,538	£0	109%	1%	20%	88%	0%	£1,805	63%	£2,538	88%
Single, under 21, no children living rent free	£2,885	£2,436	£58	£564	£1,813	£0	84%	2%	20%	63%	0%	£2,530	88%	£1,813	63%
	£2,885	£2,436	£58	£564	£1,813	£0	84%	2%	20%	63%	0%	£2,530	88%	£1,813	63%
Single, teenage children renting	£2,885	£2,585	£55	£564	£1,966	£0	90%	2%	20%	68%	0%	£2,377	82%	£1,966	68%
	£2,885	£2,585	£55	£564	£1,966	£0	90%	2%	20%	68%	0%	£2,377	82%	£1,966	68%
Partner with avg income full-time job, teenage children and renting	£2,885	£3,037	£44	£564	£2,428	£0	105%	2%	20%	84%	0%	£1,915	66%	£2,428	84%
	£2,885	£3,037	£44	£564	£2,428	£0	105%	2%	20%	84%	0%	£1,915	66%	£2,428	84%
Partner with avg income full-time job, primary age children and renting	£2,885	£1,878	£42	£564	£1,272	£0	65%	1%	20%	44%	0%	£1,842	64%	£1,272	44%
	£2,885	£1,878	£42	£564	£1,272	£0	65%	1%	20%	44%	0%	£1,842	64%	£1,272	44%
Partner with average income (£34,623) full-time job, teenage children and homeowner	£2,885	£2,514	£56	£564	£1,894	£0	87%	2%	20%	66%	0%	£2,450	85%	£1,894	66%
	£2,885	£2,429	£58	£564	£1,806	£0	84%	2%	20%	63%	0%	£2,537	88%	£1,806	63%
Partner with high income (£45,000) full-time job, teenage children and homeowner	£2,885	£2,514	£56	£564	£1,894	£0	87%	2%	20%	66%	0%	£2,450	85%	£1,894	66%
	£2,885	£2,131	£65	£564	£1,501	£0	74%	2%	20%	52%	0%	£2,842	98%	£1,501	52%

Note: Newhaven unemployment rate is 6.3%; economy wide long run rate is 4%; UR = 6.3%-4% = 2.3%

Table 9-9: Social benefit of reducing unemployment (low-income, Boardman method)

Family unit	Employment status	Benefits to worker when unemployed that are 'given up' [negative implies a benefit increase] (A)	Additional childcare costs when employed (B)	Gross wage to employee (C)	Post-tax wage to employee (D)	Non-wage benefits to employee (E)	post-tax wage (including non-wage employee benefits) (F)	Upper Bound for:		Net social value of creating employment (Boardman)								Social value as a proportion of gross wage to employee (Boardman)	
								Reservation Wage (= post tax income) (G) = (F)	-CV ⁴ (= reservation wage minus benefits) (H) = (G) - (A+B)	Value of output (=MPL*1.19) (I)	Boardman average - CV ⁴ for unemployed worker (J) = 50% x (H)	Childcare costs (K)	Wellbeing value from being employed versus unemployed (L)	Value of employing an unemployed person (M)=(I)-(J)-(K)*(L)	Of which accrues to:		Total (Q) = (L)/(C)		
															Government as additional tax (N)=(M)-(O)-(P)	Worker as a wellbeing benefit (O)=(L)		Worker as payment above opportunity costs of working (P)=(F)-(J)-(K)	
Single, no children homeowner	Unemployed < 6 months	£517	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,518	£2,910	£759	£0	£564	£2,715	£875	£564	£1,276	140%	
	Unemployed > 6 months	£517	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,518	£2,910	£759	£0	£564	£2,715	£875	£564	£1,276	140%	
Single, no children renting	Unemployed < 6 months	£1,037	£0	£1,933	£1,685	£350	£2,035	£2,035	£999	£2,910	£499	£0	£564	£2,975	£875	£564	£1,536	154%	
	Unemployed > 6 months	£1,037	£0	£1,933	£1,685	£350	£2,035	£2,035	£999	£2,910	£499	£0	£564	£2,975	£875	£564	£1,536	154%	
Single, under 21, no children living rent free	Unemployed < 6 months	£312	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,724	£2,910	£862	£0	£564	£2,612	£875	£564	£1,173	135%	
	Unemployed > 6 months	£312	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,724	£2,910	£862	£0	£564	£2,612	£875	£564	£1,173	135%	
Single, teenage children renting	Unemployed < 6 months	£465	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,571	£2,910	£785	£0	£564	£2,689	£875	£564	£1,250	139%	
Partner with avg income full-time job, teenage children and renting	Unemployed < 6 months	£927	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,108	£2,910	£554	£0	£564	£2,920	£875	£564	£1,481	151%	
	Unemployed > 6 months	£927	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,108	£2,910	£554	£0	£564	£2,920	£875	£564	£1,481	151%	
Partner with avg income full-time job, primary age children and renting	Unemployed < 6 months	-£234	£1,230	£1,933	£1,685	£350	£2,035	£2,035	£1,035	£2,910	£518	£1,230	£564	£1,727	£875	£564	£288	89%	
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,643	£2,910	£822	£0	£564	£2,653	£875	£564	£1,214	137%	
	Unemployed > 6 months	£305	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,730	£2,910	£865	£0	£564	£2,609	£875	£564	£1,170	135%	
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,643	£2,910	£822	£0	£564	£2,653	£875	£564	£1,214	137%	
	Unemployed > 6 months	£0	£0	£1,933	£1,685	£350	£2,035	£2,035	£2,035	£2,910	£1,018	£0	£564	£2,457	£875	£564	£1,018	127%	

Table 9-10: Social benefit of reducing unemployment disaggregated by changes in consumer, government and producer surplus plus wellbeing (low-income, Boardman method)

Family unit	Gross wage to employee	Value of employing an unemployed person					Value of employing an unemployed person as percentage of gross wage					Change in Household finances		Change in Government finances	
		Total	Contribution from:				Total	Contribution from:				£	%age of wage	£	%age of wage
			Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus		Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus				
Single, no children homeowner	£1,933	£2,715	£759	£564	£1,392	£0	140%	39%	29%	72%	0%	£1,518	79%	£1,392	72%
	£1,933	£2,715	£759	£564	£1,392	£0	140%	39%	29%	72%	0%	£1,518	79%	£1,392	72%
Single, no children renting	£1,933	£2,975	£499	£564	£1,911	£0	154%	26%	29%	99%	0%	£999	52%	£1,911	99%
	£1,933	£2,975	£499	£564	£1,911	£0	154%	26%	29%	99%	0%	£999	52%	£1,911	99%
Single, under 21, no children living rent free	£1,933	£2,612	£862	£564	£1,186	£0	135%	45%	29%	61%	0%	£1,724	89%	£1,186	61%
	£1,933	£2,612	£862	£564	£1,186	£0	135%	45%	29%	61%	0%	£1,724	89%	£1,186	61%
Single, teenage children renting	£1,933	£2,689	£785	£564	£1,339	£0	139%	41%	29%	69%	0%	£1,571	81%	£1,339	69%
	£1,933	£2,689	£785	£564	£1,339	£0	139%	41%	29%	69%	0%	£1,571	81%	£1,339	69%
Partner with avg income full-time job, teenage children and renting	£1,933	£2,920	£554	£564	£1,801	£0	151%	29%	29%	93%	0%	£1,108	57%	£1,801	93%
	£1,933	£2,920	£554	£564	£1,801	£0	151%	29%	29%	93%	0%	£1,108	57%	£1,801	93%
Partner with avg income full-time job, primary age children and renting	£1,933	£1,727	£518	£564	£645	£0	89%	27%	29%	33%	0%	£1,035	54%	£645	33%
	£1,933	£1,727	£518	£564	£645	£0	89%	27%	29%	33%	0%	£1,035	54%	£645	33%
Partner with average income (£34,623) full-time job, teenage children and homeowner	£1,933	£2,653	£822	£564	£1,267	£0	137%	43%	29%	66%	0%	£1,643	85%	£1,267	66%
	£1,933	£2,609	£865	£564	£1,180	£0	135%	45%	29%	61%	0%	£1,730	90%	£1,180	61%
Partner with high income (£45,000) full-time job, teenage children and homeowner	£1,933	£2,653	£822	£564	£1,267	£0	137%	43%	29%	66%	0%	£1,643	85%	£1,267	66%
	£1,933	£2,457	£1,018	£564	£875	£0	127%	53%	29%	45%	0%	£2,035	105%	£875	45%

Table 9-11: Social benefit of reducing unemployment (low-income, Riess method)

Family unit	Employment status	Benefits to worker when unemployed that are 'given up' [negative implies a benefit increase] (A)	Additional childcare costs when employed (B)	Gross wage to employee (C)	Post-tax wage to employee (D)	Non-wage benefits to employee (E)	post-tax wage (including non-wage employee benefits) (F)	Upper Bound for:		Value of output (=MPL*1.19) (I)	Net social value of creating employment (Riess)										Social value as a proportion of gross wage to employee (Riess) Total (Q) = (L)/(C)
								Reservation Wage (= post tax income) (G) = (F)	-CV ² (= reservation wage minus benefits) (H) = (G) - (A+B)		Riess average for unemployed worker (J) = (1-UR) x (H)	-CV ² for child care costs (K)	Childcare costs (K)	Wellbeing value from being employed versus unemployed (L)	Value of employing an unemployed person (M)=(I)-(J)-(K)*(L)	Of which accrues to:			Worker as a payment above opportunity costs of working (P)=(F)-(J)-(K)		
																Government as additional tax (N)=(M)-(O)-(P)	Wellbeing benefit (O)=(L)	Worker as payment above opportunity costs of working (P)=(F)-(J)-(K)			
Single, no children homeowner	Unemployed < 6 months	£517	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,518	£2,910	£1,483	£0	£564	£1,991	£875	£564	£552	103%			
	Unemployed > 6 months	£517	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,518	£2,910	£1,483	£0	£564	£1,991	£875	£564	£552	103%			
Single, no children renting	Unemployed < 6 months	£1,037	£0	£1,933	£1,685	£350	£2,035	£2,035	£999	£2,910	£976	£0	£564	£2,499	£875	£564	£1,060	129%			
	Unemployed > 6 months	£1,037	£0	£1,933	£1,685	£350	£2,035	£2,035	£999	£2,910	£976	£0	£564	£2,499	£875	£564	£1,060	129%			
Single, under 21, no children living rent free	Unemployed < 6 months	£312	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,724	£2,910	£1,684	£0	£564	£1,790	£875	£564	£351	93%			
	Unemployed > 6 months	£312	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,724	£2,910	£1,684	£0	£564	£1,790	£875	£564	£351	93%			
Single, teenage children renting	Unemployed < 6 months	£469	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,571	£2,910	£1,535	£0	£564	£1,940	£875	£564	£501	100%			
Partner with avg income full-time job, teenage children and renting	Unemployed < 6 months	£927	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,108	£2,910	£1,083	£0	£564	£2,391	£875	£564	£952	124%			
	Unemployed > 6 months	£927	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,108	£2,910	£1,083	£0	£564	£2,391	£875	£564	£952	124%			
Partner with avg income full-time job, primary age children and renting	Unemployed < 6 months	-£230	£1,230	£1,933	£1,685	£350	£2,035	£2,035	£1,035	£2,910	£1,011	£1,230	£564	£1,233	£875	£564	-£206	64%			
Partner with average income (£34,623) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,643	£2,910	£1,605	£0	£564	£1,869	£875	£564	£430	97%			
	Unemployed > 6 months	£305	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,730	£2,910	£1,690	£0	£564	£1,784	£875	£564	£345	92%			
Partner with high income (£45,000) full-time job, teenage children and homeowner	Unemployed < 6 months	£392	£0	£1,933	£1,685	£350	£2,035	£2,035	£1,643	£2,910	£1,605	£0	£564	£1,869	£875	£564	£430	97%			
	Unemployed > 6 months	£0	£0	£1,933	£1,685	£350	£2,035	£2,035	£2,035	£2,910	£1,988	£0	£564	£1,486	£875	£564	£47	77%			

Note: Newhaven unemployment rate is 6.3%; economy wide lone run rate is 4% UR = 6.3%-4% = 2.3%

Note: Newhaven unemployment rate is 6.3%; economy wide long run rate is 4%; UR = 6.3%-4% = 2.3%

Table 9-12: Social benefit of reducing unemployment disaggregated by changes in consumer, government and producer surplus plus wellbeing (low-income, Riess method)

Family unit	Gross wage to employee	Value of employing an unemployed person					Value of employing an unemployed person as percentage of gross wage					Change in Household finances		Change in Government finances	
		Total	Contribution from:				Total	Contribution from:				£	%age of wage	£	%age of wage
			Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus		Change in consumers surplus	Change in wellbeing	Change in Government surplus	Change in producers surplus				
Single, no children homeowner	£1,933	£1,991	£35	£564	£1,392	£0	103%	2%	29%	72%	0%	£1,518	79%	£1,392	72%
	£1,933	£1,991	£35	£564	£1,392	£0	103%	2%	29%	72%	0%	£1,518	79%	£1,392	72%
Single, no children renting	£1,933	£2,499	£23	£564	£1,911	£0	129%	1%	29%	99%	0%	£999	52%	£1,911	99%
	£1,933	£2,499	£23	£564	£1,911	£0	129%	1%	29%	99%	0%	£999	52%	£1,911	99%
Single, under 21, no children living rent free	£1,933	£1,790	£40	£564	£1,186	£0	93%	2%	29%	61%	0%	£1,724	89%	£1,186	61%
	£1,933	£1,790	£40	£564	£1,186	£0	93%	2%	29%	61%	0%	£1,724	89%	£1,186	61%
Single, teenage children renting	£1,933	£1,940	£36	£564	£1,339	£0	100%	2%	29%	69%	0%	£1,571	81%	£1,339	69%
	£1,933	£1,940	£36	£564	£1,339	£0	100%	2%	29%	69%	0%	£1,571	81%	£1,339	69%
Partner with avg income full-time job, teenage children and renting	£1,933	£2,391	£25	£564	£1,801	£0	124%	1%	29%	93%	0%	£1,108	57%	£1,801	93%
	£1,933	£2,391	£25	£564	£1,801	£0	124%	1%	29%	93%	0%	£1,108	57%	£1,801	93%
Partner with avg income full-time job, primary age children and renting	£1,933	£1,233	£24	£564	£645	£0	64%	1%	29%	33%	0%	£1,035	54%	£645	33%
	£1,933	£1,233	£24	£564	£645	£0	64%	1%	29%	33%	0%	£1,035	54%	£645	33%
Partner with average income (£34,623) full-time job, teenage children and homeowner	£1,933	£1,869	£38	£564	£1,267	£0	97%	2%	29%	66%	0%	£1,643	85%	£1,267	66%
	£1,933	£1,784	£40	£564	£1,180	£0	92%	2%	29%	61%	0%	£1,730	90%	£1,180	61%
Partner with high income (£45,000) full-time job, teenage children and homeowner	£1,933	£1,869	£38	£564	£1,267	£0	97%	2%	29%	66%	0%	£1,643	85%	£1,267	66%
	£1,933	£1,486	£47	£564	£875	£0	77%	2%	29%	45%	0%	£2,035	105%	£875	45%

Note: Newhaven unemployment rate is 6.3%; economy wide long run rate is 4%; UR = 6.3%-4% = 2.3%

10 APPENDIX 3: THE ECONOMIC IMPACT OF THE NPAR – THE 2018 BUSINESS CASE APPROACH

The economic impact of the NPAR was estimated by estimating the number of jobs that each of the development sites in Newhaven would support, and determining how much of that could be attributed to the NPAR. The total number of jobs that could be supported was based on a calculation of floorspace, likely industrial use and expected job density per square metre (see Table 10-1).

Table 10-1: Conversion of floorspace estimates to gross employment capacity

Employment Zone Site	Floorspace (sqm GEA)	Use	Employment density (sqm/job)	Gross jobs capacity (FTE)
East Quay	9,750	B2	32	259
Avis Way	5,200	B1c/B2	47/32	116
Railway Quay	3,000	B1a/B1c	12/47	173
Bevan Funnell	10,000	B1c	47	181
Eastside North	9,000	B2/B1c	32/47	142
Eastside South	7,800	B2/B1c	32/47	158
North Quay	19,200	B2/B8	32/70	302
Town Centre	3,440	A1/D2	18/65	100
Total	67,390			1,431

Source: WSP (2018, p78)

Attribution to the NPAR was then made using judgement based on an understanding of the development constraints. The largest site, the East Quay, was considered to be 100% dependent on the road, whilst the other development sites varied between 10% (the town centre) to 30% (e.g. Railway Quay). Displacement (35%) and leakage (5%) factors were then applied, along with a 1.35 multiplier to reflect induced jobs within the local economy⁴⁹. This gives an expectation that there will be an extra 456 jobs associated with the NPAR (see Table 10-2). We discuss in the next section, our analysis, what counterfactual these are additional against.

⁴⁹ Direct jobs are those jobs directly associated with the employment site. Indirect jobs are those in the supply chain. Induced jobs are those created from serving those newly employed (e.g. in shops, cafes, and their associated supply chains).

Table 10-2: NPAR Attributed FTE Jobs

Employment Zone Site	Gross jobs	All jobs (Direct, Indirect and Induced) [multiplier of 1.35]	Leakage (jobs being taken by workers outside of Greater Brighton) (-5%)	Displacement (jobs replacing existing jobs within Greater Brighton) (-35%)	Additional jobs associated with development sites	Attribution	NPAR attributed net additional jobs impact
East Quay	259	350	-17	-116	216	100%	216
Avis Way	116	157	-8	-52	97	25%	24
Railway Quay	173	234	-12	-78	144	30%	43
Bevan Funnell	181	244	-12	-81	151	30%	45
Eastside North	142	192	-10	-64	118	25%	30
Eastside South	158	213	-11	-71	132	30%	40
North Quay	302	408	-20	-136	252	20%	50
Town Centre	100	135	-7	-45	83	10%	8
Total	1,431	1,932	-97	-642	1,193		456

Source: own working based on WSP (2018 pp78-80)

The business case considered that the full build out of these development sites (i.e. the extra 1,193 jobs associated with the sites) would reduce the unemployment rate in Newhaven to the South East of England average. This would result in a reduction in unemployment of 185. As the NPAR contributes 38% ($=456/1,193$) of the additional jobs, then a reduction in unemployment of 71 was attributed to the NPAR.

The business case reports that the present value of the welfare impact of these 71 jobs is £12.7M in 2010 prices and values. It is not absolutely clear how this has been calculated, but it has been possible to recreate it in the following manner:

- The 71 jobs that were filled by unemployed people were expected to ramp up in line with the time profile of the employment zone. Thus, not all the jobs will be created and filled until 2033, though most jobs will have been created by 2026. The time profile is provided in the business case (WSP, 2018 Table 13 p81).
- Once created each job was assumed to persist for 10 years (WSP, 2018 p80).
- Different GDP/worker data was used to reflect that some jobs would be in manufacturing and some in the general economy. The employment zone jobs were all taken to be in manufacturing, and all the unemployed were taken to find a manufacturing job. The indirect and induced jobs were taken to be in the general economy. The 2018 average GDP/worker in the general economy was £54,460 (WSP, 2018 p80). Converted to 2010 prices and 2018 values this becomes £47,548⁵⁰. The corresponding manufacturing job was estimated at approximately £67,000 GDP/worker.⁵¹
- The GDP/worker data was factored using annual GDP/capita factors contained in the 2018 TAG databook.

⁵⁰ Own calculation. This used the GDP deflator in TAG and the change in CPI.

⁵¹ The manufacturing figures have not been reported in the Business Case. The £67,000 figure has been estimated to help reproduce the final economic benefit of £12.7M. £67,000 in 2010 prices and 2018 values is approximately equivalent to £77,000 in 2018 prices and 2018 values. This is less than that report in earlier economic modelling work made available to us (£87,000 2018 prices and values), but more than the values in the TAG wider impacts databook £52,285 in 2010 prices and 2018 values).

- The welfare value of reducing unemployment was calculated by multiplying the total GDP produced per annum by each previously unemployed worker by 0.4. 0.4 is the labour supply tax wedge in TAG.

The additional £12.7M of benefit raises the BCR from 0.1 to 0.8. Thus, whilst not sufficient to take the project over the VfM threshold between poor and low, combined with other elements of the business case e.g. the strategic dimension it was sufficient for the project to be approved for construction. Our interpretation is that the induced employment impacts were critical to the decision in this case.

Table 10-3: NPAR cost benefit analysis decision criteria

	Present value £Million 2010 prices and values
PV of Benefits (Level 1 excluding wider impacts)	1.901
Present Value of Costs (PVC)	18.493
NPV	-16.592
BCR	0.1
PV of estimated welfare impacts of NPAR wider benefits	12.700
PV all benefits (including welfare impacts of NPAR wider benefits)	14.601
NPV incl. unemployment	-3.892
BCR incl. unemployment	0.8

Source: own working based on WSP (2018 p84)

11 REFERENCES

- BANK OF ENGLAND (2017), Correspondence to Chair of House of Commons Treasury Committee from Governor of Bank of England, <https://www.parliament.uk/globalassets/documents/commons-committees/treasury/Correspondence/Governor-BoE-evidence-session-Inflation-Report-24-4-17.pdf>
- BANK OF ENGLAND 2018. Inflation Report. *Inflation Reports*. London: Bank of England,.
- BASTIAANSSEN J, JOHNSON D & LUCAS K (2020) Does transport help people to gain employment? A systematic review and meta-analysis of the empirical evidence,. *Transport Reviews* 40: 607–628.
- BASTIAANSSEN J, JOHNSON D & LUCAS, K., 2022. Does better job accessibility help people gain employment? The role of public transport in Great Britain. *Urban Studies*, 59(2), pp.301-322.
- BAUM-SNOW, N., HENDERSON, J. V., TURNER, M. A., ZHANG, Q. & BRANDT, L. 2020. Does investment in national highways help or hurt hinterland city growth?. *Journal of Urban Economics*, 115, 14.
- BERECHMAN, J., & PAASWELL, R. (2001). Accessibility improvements and local employment: An empirical analysis. Bureau of Transportation Statistics.
- BOARDMAN, A. E., GREENBERG, D. H., VINING, A. R. & WEIMER, D. L. 2018. *Cost-benefit analysis: concepts and practice*, Cambridge, Cambridge University Press.
- CARNEY, M. (2017) Letter to Andrew Tyrie, Chair of the Treasury Select Committee. 24th April 2017. <https://www.parliament.uk/globalassets/documents/commons-committees/treasury/Correspondence/Governor-BoE-evidence-session-Inflation-Report-24-4-17.pdf>
- CENTRE FOR CITIES(2023) *The UK's army of hidden unemployed people*. 31st January 2023. <https://www.centreforcities.org/reader/cities-outlook-2023/the-uks-army-of-hidden-unemployed-people/>
- CERVERO R, SANDOVAL O and LANDIS J (2002) Transportation as a stimulus of welfare-to work private versus public mobility. *Journal of Planning Education and Research* 22: 50–63.
- CHANDRA, A. & THOMPSON, E. 2000. Does public infrastructure affect economic activity? Evidence from the rural interstate highway system. . *Regional Science and Urban Economics*, , 30(4), 457-490.
- COAST TO CAPITAL LEP 2017. Newhaven Economic Profile. July 2017. .
- DE SERPA, A. C. 1971. A theory of the economics of time. *The economic journal*, 81, 828-846.
- DEPARTMENT FOR TRANSPORT 2018. TAG Unit A2.3 Employment Effects. In: DEPARTMENT FOR TRANSPORT (ed.) *Transport Appraisal Guidance*. London: Department for Transport,.
- DEPARTMENT FOR TRANSPORT 2020. TAG Unit A2.2 Appraisal of Induced Investment Impacts In: DEPARTMENT FOR TRANSPORT (ed.) *Transport Appraisal Guidance*. London: Department for Transport,.
- DEPARTMENT FOR TRANSPORT 2022. TAG Unit A4.1 Social Impact Appraisal In: DEPARTMENT FOR TRANSPORT (ed.) *Transport Appraisal Guidance*. London: Department for Transport.

- DEPARTMENT FOR TRANSPORT 2024. Review of TAG Impacts through a wellbeing lens. Final Report. September 2024. London: Department for Transport,.
- DONG, X. 2018. High-speed railway and urban sectoral employment in China. *Transportation Research Part A: Policy and Practice*, 116, 603-621.
- DURANTON, G. & TURNER, M. A. 2012. Urban growth and transportation. *Review of Economic Studies*, 79(4), 1407-1440.
- ELHORST, J. P. & OOSTERHAVEN, J. 2008. Integral cost-benefit analysis of Maglev projects under market imperfections. *Journal of Transport and Land Use*, 1, 65-87.
- ERCOLANI, M. G., BROMFIELD, J. P. & SELIM, S. 2024. A review of TAG A2.3 employment parameters: labour supply elasticity and labour tax wedges. Report to the Department for Transport. February 2024. Department for Transport: University of Birmingham.
- FARRÉ, L., JOFRE-MONSENY, J. & TORRECILLAS, J. 2023. Commuting time and the gender gap in labor market participation. *Journal of Economic Geography*, 23, 847-870.
- GIBBONS, S., OVERMAN, H. & SARVIMÄKI, M. 2021. The local economic impacts of regeneration projects: Evidence from UK's single regeneration budget. *Journal of Urban Economics*, 122, 103315.
- GIBBONS, S., LYYTIKAINEN, T., OVERMAN, H., & R. SANCHIS-GUARNER. 2012. New Road Infrastructure: The Effects on Firms. SERC Discussion Paper 117. London, UK: London School of Economics
- GLAESER, E. L. (1996). Spatial effects upon employment outcomes: The case of New Jersey teenagers. Discussion paper, New England Economic Review, May/June, pp. 58–64
- GOBILLON L & SELOD H (2007) The effects of segregation and spatial mismatch on unemployment: Evidence from France. Research Unit Working Papers 0702, Laboratoire d'Economie Appliquée, INRA.
- GOBILLON, L., SELOD, H., & ZENOU, Y. (2007). The mechanisms of spatial mismatch. *Urban Studies*, 44, 2401–2427.
- GREENE, MEGAN (2023),, Are we there yet: speech by Megan Greene, <https://www.bankofengland.co.uk/speech/2023/november/megan-greene-speech-at-leeds-university>
- HAVEMAN, R. H. & WEIMER, D. L. 2015. Public policy induced changes in employment: Valuation issues for benefit-cost analysis. *Journal of Benefit-Cost Analysis*, 6, 112-153.
- HENDERSON, J. V. 1974. The Sizes and Types of Cities. *American Economic Review*, 64, 640-56.
- HOLZER, H. J., QUIGLEY, J. M., & RAPHAEL, S. (2003). Public transit and the spatial distribution of minority employment: Evidence from a natural experiment. *Journal of Policy Analysis and Management*, 22, 415–441.
- HM TREASURY 2021. Wellbeing Guidance for Appraisal: Supplementary Green Book Guidance. London: HM Treasury.
- HM TREASURY 2022. The Green Book. Central Government Guidance on Appraisal and Evaluation.
- IHLANFELDT, K. R., & SJOQUIST, D. L. (1991). The effect of job access on black and white youth employment: A cross-sectional analysis. *Urban Studies*, 28, 255–265.
- IHLANFELDT, K. (2006). A primer on spatial mismatch within urban labor markets. In R. J. Arnott, & D. P. McMillen (Eds.), *A Companion to urban economics* (pp. 404–417). Oxford: Blackwell.

- IHLANFELDT KR AND SJOQUIST DL (1998) The spatial mismatch hypothesis: A review of recent studies and their implications for welfare reform. *Housing Policy Debate* 9: 849–892.
- ILO (2015), Key Indicators of the Labour Market (2015), User Guide, https://www.ilo.org/global/statistics-and-databases/research-and-databases/kilm/WCMS_422090/lang--en/index.htm
- JACOB, N., MUNFORD, L., RICE, N. & ROBERTS, J. 2019. The disutility of commuting? The effect of gender and local labor markets. *Regional Science and Urban Economics*, 77, 264-275.
- JOHANSSON, P.-O. & KRISTRÖM, B. 2022. On the social opportunity cost of unemployment. *Journal of Economic Policy Reform*, 25, 229-239.
- JOHNSON D, ERCOLANI M AND MACKIE P (2017) Econometric analysis of the link between public transport accessibility and employment. *Transport Policy* 60: 1–9.
- KAIN JF (1968) Housing segregation, negro employment, and metropolitan decentralization. *The Quarterly Journal of Economics* 82: 175–197
- KAWABATA M (2003) Job access and employment among low-skilled autoless workers in US metropolitan areas. *Environment and Planning A* 35: 1651–1668.
- KORSU E AND WENGLANSKI S (2010) Job accessibility, residential segregation and risk of longterm unemployment in the Paris region. *Urban Studies* 47: 2279–2324.
- LAIRD, J., VENABLES, A. & JOHNSON, D. 2020. Move to More/Less Productive Jobs. report to the Department for Transport. Report dated February 2020. London: Department for Transport.
- LAIRD, J. J. 2008. *Modelling the economic impact of transport projects in sparse networks and peripheral regions*. University of Leeds.
- LE BARBANCHON, T., RATHELOT, R. & ROULET, A. 2021. Gender differences in job search: Trading off commute against wage. *The Quarterly Journal of Economics*, 136, 381-426.
- MAGRINI, E. 2019. Opportunity knocks? Economic outcomes for low-skilled people in cities. Centre for Cities.
- MANNING, A. 2003. The real thin theory: monopsony in modern labour markets. *Labour economics*, 10, 105-131.
- MANNING, A. & PETRONGOLO, B. 2017. How local are labor markets? Evidence from a spatial job search model. *American Economic Review*, 107, 2877-2907.
- MARINESCU, I. & RATHELOT, R. 2018. Mismatch unemployment and the geography of job search. *American Economic Journal: Macroeconomics*, 10, 42-70.
- MATAS A, RAYMOND JL AND ROIG JL (2010) Job accessibility and female employment probability: The cases of Barcelona and Madrid. *Urban Studies* 47: 769–787
- MONETARY POLICY COMMITTEE (MPC) 2024. Monetary Policy Report. Bank of England,.
- MOSES, L. N. Towards a theory of intra-urban wage differentials and their influence on travel patterns. Papers of the Regional Science Association, 1962. Springer, 53-63.
- MULALIC, I., VAN OMMEREN, J. N. & PILEGAARD, N. 2014. Wages and commuting: Quasi-natural experiments' evidence from firms that relocate. *The Economic Journal*, 124, 1086-1105.
- NORMAN, T., BÖRJESSON, M. AND ANDERSTIG, C., 2017. Labour market accessibility and unemployment. *Journal of Transport Economics and Policy (JTEP)*, 51(1), pp.47-73.

- ONG, P. M., & HOUSTON, D. (2002). Transit, employment and women on welfare. *Urban Geography*, 23 (4), 344–364.
- ONS (2020), A guide to labour market statistics, <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/methodologies/aguidetolabourmarketstatistics>
- OZBAY, K., OZMAN, D., & BERECHMAN, J. (2006). Modeling and analysis of the link between accessibility and employment growth. *Journal of Transportation Engineering*, 132(5), 385–393.
- PATACCHINI, E. AND ZENOU, Y., 2005. Spatial mismatch, transport mode and search decisions in England. *Journal of Urban Economics*, 58(1), pp.62-90.
- POGONYI, C. G., GRAHAM, D. J. & CARBO, J. M. 2021. Metros, agglomeration and displacement. Evidence from London. *Regional Science and Urban Economics*, 103681.
- RICE, L. (2001). Public transit and employment outcomes. Job Market Paper.
- RIESS, A.-D. 2014. Shadow Prices for the Economic Appraisal of Projects. Report prepared for the Projects Directorate of the European Investment Bank.: European Investment Bank.
- SANCHEZ, T. W. (1999). The connection between public transit and employment the cases of Portland and Atlanta. *Journal of the American Planning Association*, 65, 284–296.
- SANCHEZ T, SHEN Q AND PENG Z-R (2004) Transit mobility, jobs access and low-income labour participation in US metropolitan areas. *Urban Studies* 41: 1313–1331.
- SARTORI, D., CATALANO, G., GENCO, M., PANCOTTI, C., SIRTORI, E., VIGNETTI, S. & BO, C. 2014. Guide to cost-benefit analysis of investment projects. Economic appraisal tool for cohesion policy 2014-2020.
- SMART, M. J., & KLEIN, N. J. (2015). A longitudinal analysis of cars, transit, and employment outcomes. MNTRC Mineta National Transit Research Consortium, pp. 2–49.
- TIMOTHY, D. & WHEATON, W. C. 2001. Intra-urban wage variation, employment location, and commuting times. *Journal of Urban Economics*, 50, 338-366.
- VENABLES, A. J. 2007. Evaluating urban transport improvements: cost–benefit analysis in the presence of agglomeration and income taxation. *Journal of Transport Economics and Policy*, 41, 173-188.
- WSP 2018. Newhaven Port Access Road. Business Case. July 2018. Report to East Sussex Council.
- YI C (2006) Impact of public transit on employment status disaggregate analysis of Houston,Texas. *Transportation Research Record: Journal of the Transportation Research Board* 1986: 137–144.

