



Staff Operating Expenditure for Air Traffic Control

Prepared for NERL

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Project Team

Richard Hern

George Anstey

James Grayburn

Marissa Li

NERA Economic Consulting
Marble Arch House, 66 Seymour Street
London W1H 5BT
United Kingdom
Tel: 44 20 7659 8500 Fax: 44 20 7659 8501
www.nera.com

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Executive Summary

Cost-assessment in regulated industries often relies on comparative benchmarking of cost lines or total costs across similar companies. At Reference Period 2, CAA decided not to use comparative benchmarking, because it believed that comparator ANSPs inefficient and would not therefore provide any insights into the efficiency of NERL.¹ Instead it relied on a job-matching exercise undertaken by independent consultant, IDS, which benchmarked NERL's wages against wages of similar jobs in the wider economy. For RP3, NERL asked NERA to test the hypothesis that pay for the negotiated grades subject to collective bargaining were in line with market benchmarks.

In this paper, we set out an alternative approach of constructing wage equations to estimate the market compensation level for NERL staff, which builds on IDS's work at RP2. Wage equations have a long academic heritage and a history of application in regulation and policy. In particular, our approach has merits over and above IDS's work at RP2 in benchmarking NERL pay, because:

- We control for variables other than simple job roles that affect compensation in the general economy, such as location, age, experience and education. We also use these equations to estimate the additional compensation paid to workers in the general economy falling within specific Standard Occupational Classification (SOCs); and
- We use a publicly-available database published by the Office for National Statistics (ONS), the Labour Force Survey (LFS), which provides us with over 60,000 observations of pay with over 800 variables of detailed demographic data. Both the CAA and NERL may fully interrogate the data we relied upon and our approach is therefore more transparent than IDS's work at RP2 based on its proprietary data.

Any difference between our prediction and NERL's actual wages necessarily includes both any cost inefficiency (or outperformance) by NERL and inaccuracies in the construction of the benchmark itself. We do not attempt to identify a single "right" answer in our analysis: Our resulting wage equations provide a range of compensation benchmarks for NERL staff under different sets of assumptions and can only go so far towards explaining NERL's wages as the quality of the data and comparators they include.

NERL's staff undertakes highly specific and frequently highly trained jobs requiring skills which pay a premium over wages in the general economy. The wider economy does not employ staff to undertake the precise jobs of most NERL staff. Accordingly, the LFS dataset does not contain compensation information for all of the specific occupations undertaken by NERL employees.² Our preferred models attempt to control for the activities undertaken by different categories of employees. We undertake a process of job-matching using detailed job

¹ NERL is the sole ANSP operating in UK en route airspace.

² The LFS database does contain compensation information for air traffic controllers. However, this is not strictly data on NERL's ATCOs (who work on en route service), as it also includes compensation data on those air traffic controllers who are employed by airports directly or privately-owned air traffic control service companies and work in less complex airspace. Moreover, NERL's employees are likely to dominate the sample and therefore are not a useful point of comparison for NERL.

descriptions for NERL staff with those set out in the publicly-available ONS methodology statements. This process of job-matching is necessarily somewhat subjective and accordingly we have selected a series of detailed SOCs which are related to jobs within NERL based on the information available.

Even within the narrowest available, fourth-level SOCs, wages vary widely across individuals. Our models including detailed SOCs typically explain around 60 per cent of the variation in wages (as captured by the adjusted R-squared³ statistic). This figure compares well with many wage equations in the literature. The remaining 40 per cent of variation in wages is not explained by our models and reflects omitted explanatory variables which determine any individual's wages. Many of these omitted variables are likely to be impossible to observe or obtain data on in practice. Inclusion of these omitted variables may account for any remaining differences between actual and modelled wages at NERL.

In any case, our modelling suggests that NERL's staff wages are broadly in line with market benchmarks. As can be seen in Figure 1.1 to Figure 1.6, our preferred models, which attempt to control for similar job descriptions, include results which exceed NERL's pay levels for most categories of staff:

- ATCO pay (approximately half of NERL's total pay bill) is **within** the range of benchmark levels. Our preferred models predict 89-105% of ATCO pay;
- ATSA pay is **above** our benchmark levels. Our preferred models predict 61-74% of ATSA pay. In practice, the difficulty of finding suitable benchmark professions to reflect the wide-ranging nature of roles within ATSA means that our models may underestimate ATSA's actual pay;
- ATCE pay is **within** the range of our benchmark levels. Our preferred models predict 85-102% of ATCE pay;
- MSG pay is **slightly above** our benchmark levels. Our preferred models predict 81-98% of MSG pay;
- STAR pay is **within** the range of our benchmark levels. Our preferred models predict 88-104% of STAR pay; and
- For NERL staff subject to collective wage settlements as a whole, pay is **within** the range of our benchmark levels. Our preferred models predict 87-101% of overall NERL pay.

Of all the categories, only ATSA pay is materially higher than our models would suggest on average. The difference between our modelled and actual pay for ATSAs that we identified is likely to reflect the difficulty we had in finding appropriate comparators for ATSAs, who conduct a mix of technical and specialist support functions. Moreover, the results we present for each model are central estimates for each model and take no account of the uncertainty surrounding that central estimate. Each wage benchmark for NERL would be subject to a confidence interval, many of which may overlap with NERL's existing wages.

³ The proportion of the variance in the dependent variable that is explained by the explanatory variables, between 0 and 1.

Given that any econometric model is limited to the factors included within it, regulators internationally typically assess extra-model adjustments (“special factors”) in addition to the results of any econometric analysis. In particular, our model may understate the minimum compensation that NERL could offer based on market benchmarks for at least the following reasons:

- The illiquid market for ATCOs which may prompt difficulties and long lead times in external recruitment;
- The highly unionised workforce at NERL (c.78 per cent⁴ across NERL and c.99 per cent for ATCOs) combined with the high social cost of strike action;
- The rigorous recruitment and training process NERL staff have to go through; and
- The additional pay for antisocial hours not factored into our model.

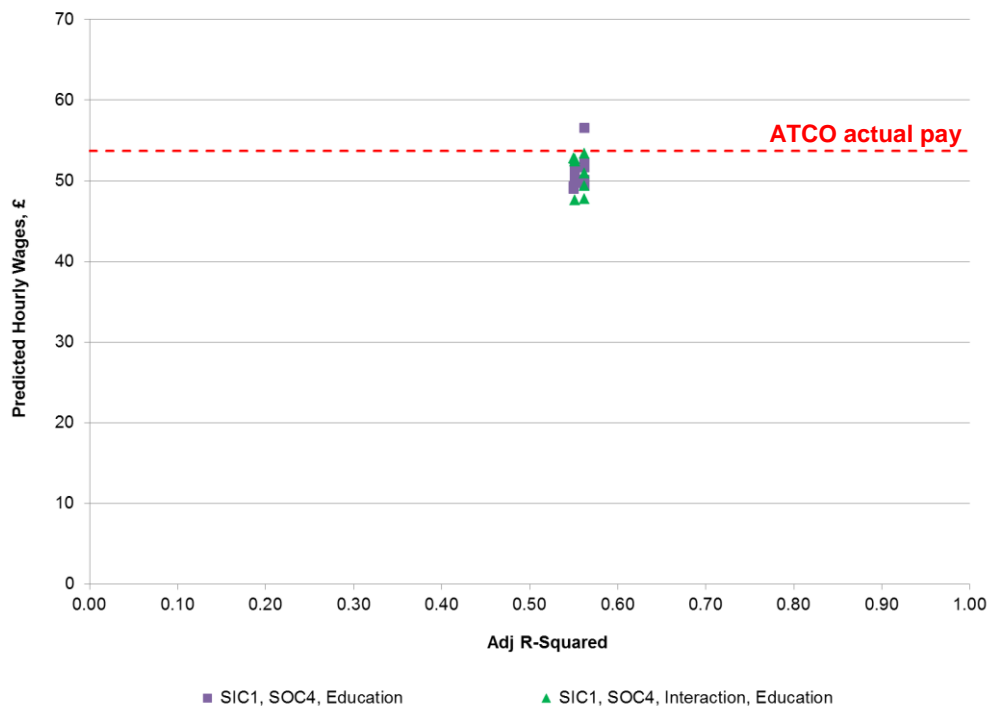
In addition to failing to account for special factors that drive NERL’s pay, our market benchmarks may understate the full compensation of comparator professions where they understate the bonuses they received.⁵

We do not model the impact of adjusting for these factors quantitatively. However, they all point to understatement of the market benchmark for NERL’s wages. Therefore, in combination with the close approximation to NERL’s pay levels we find using our wage equations, our analysis provides the CAA with the basis for concluding that NERL’s pay for negotiated grades is broadly in line with market rates.

⁴ Estimates of union membership based on NERL assumptions of c.99% for ATCOs and c.71-74% for ATSAs, ATCEs, MSGs and STARs.

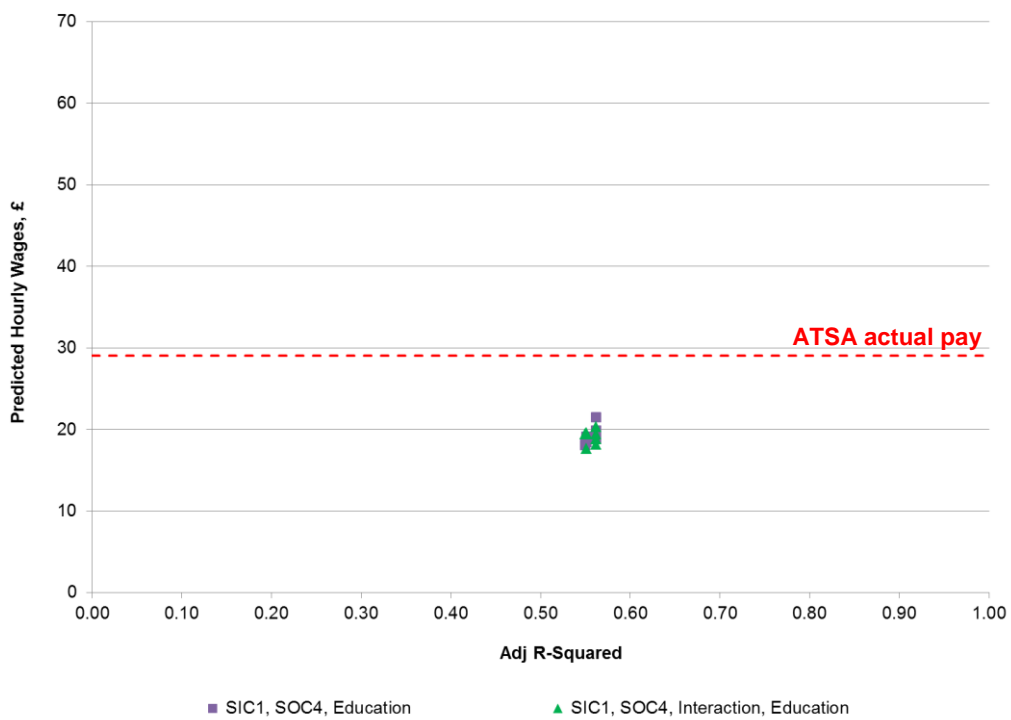
⁵ We benchmark NERL pay, including bonuses and overtime, for each financial year against pay in the general economy in the fourth quarter of the calendar year (e.g. we compare pay at NERL in financial year ending March 2016 against pay in the general economy in Q4 2016). Our models rely on pay in the fourth quarter for benchmark professions because explanatory variables related to unionisation are not available for other quarters. Analysis conducted by the ONS suggests that this may understate pay in the economy as a whole, although the extent of any understatement differs between datasets and will differ between sectors (see discussion in Appendix E below).

Figure 1.1
ATCO Predicted Wages Compared to ATCO Actual Wage for Our Preferred Models



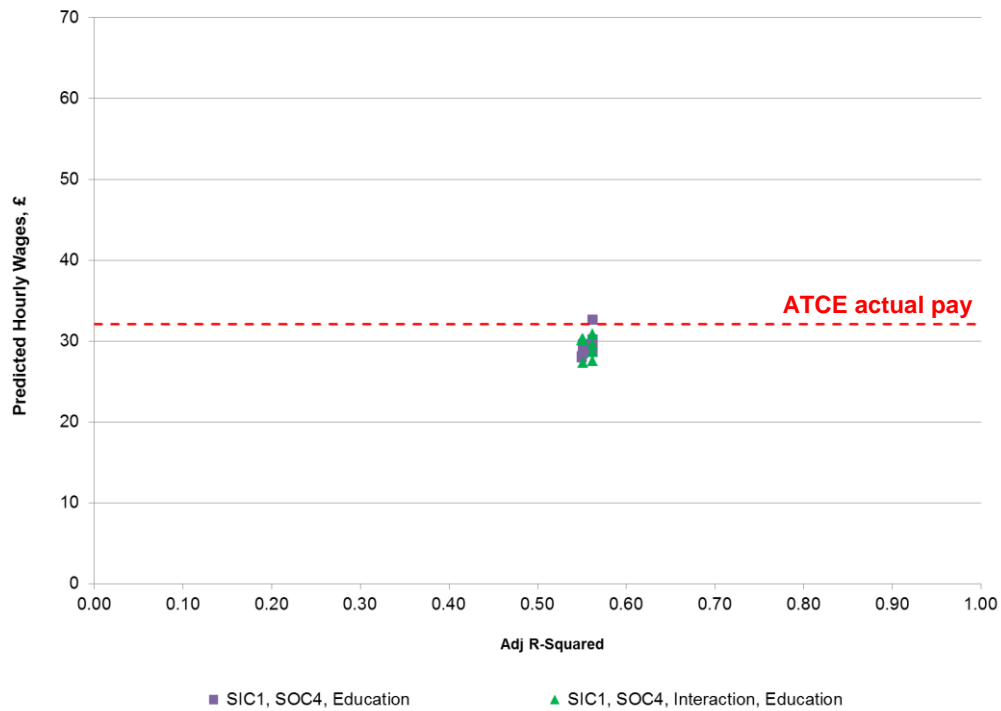
Source: NERA analysis

Figure 1.2
ATSA Predicted Wages Compared to ATSA Actual Wage for Our Preferred Models



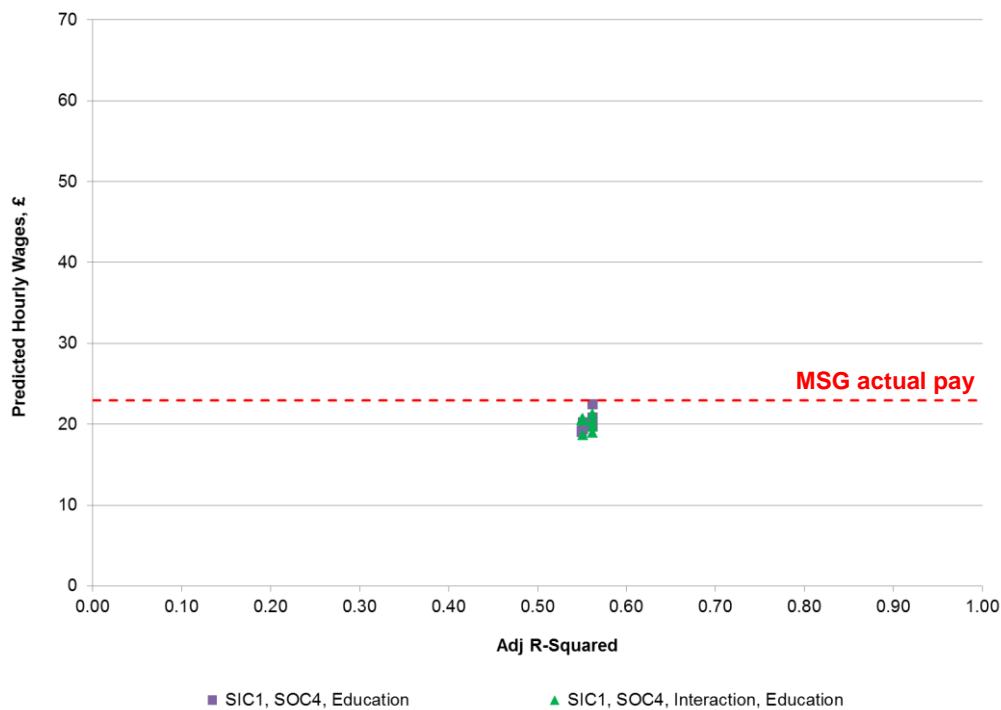
Source: NERA analysis

Figure 1.3
ATCE Predicted Wages Compared to ATCE Actual Wage for Our Preferred Models



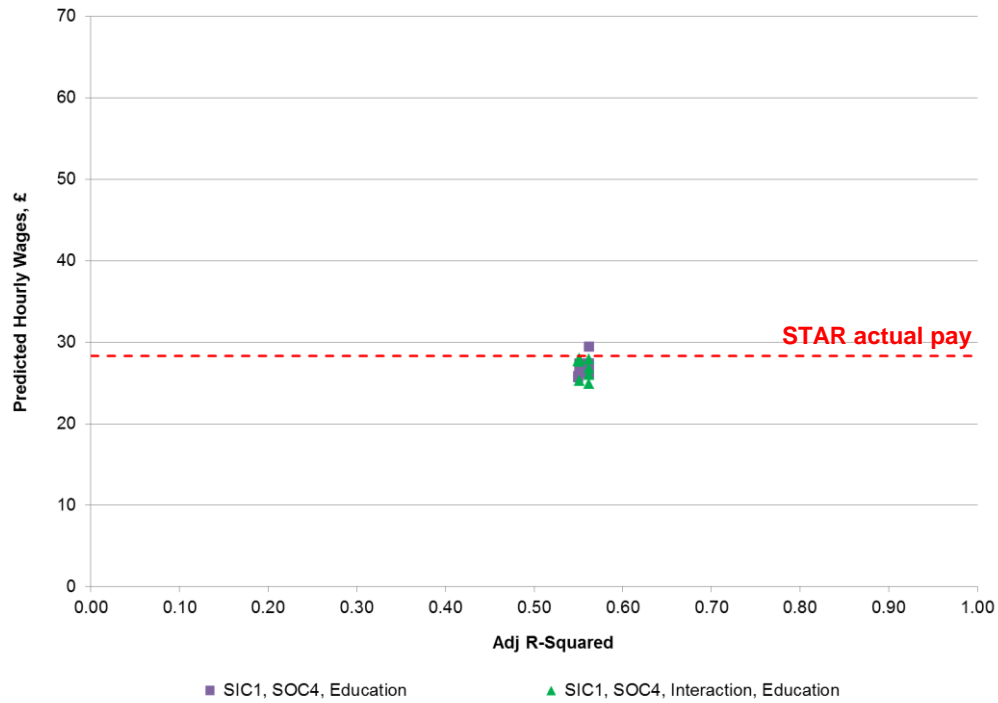
Source: NERA analysis

Figure 1.4
MSG Predicted Wages Compared to MSG Actual Wage for Our Preferred Models



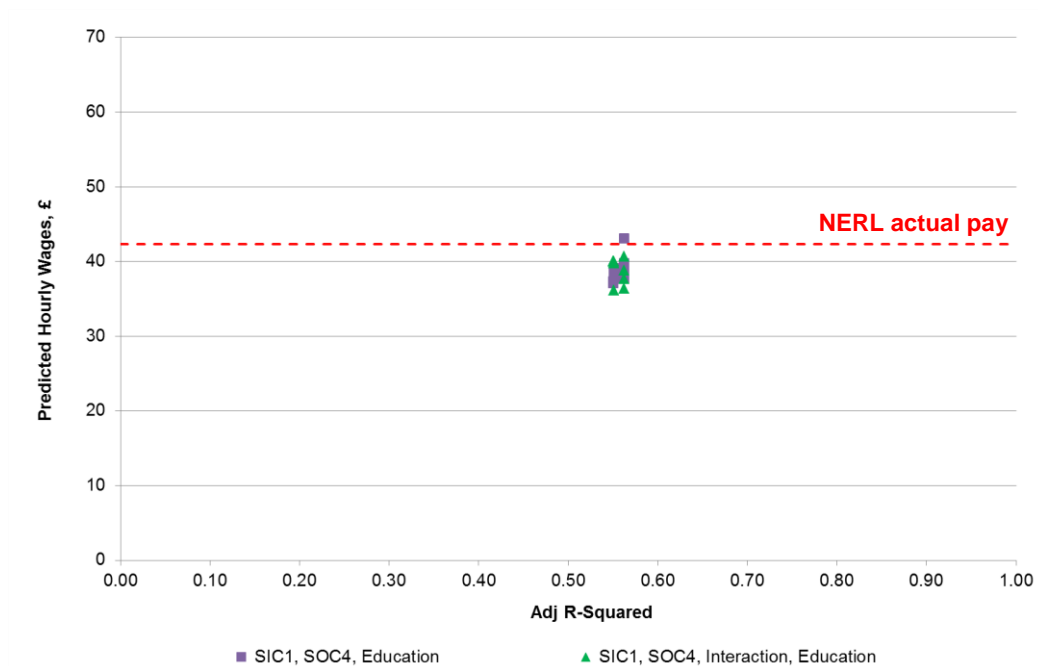
Source: NERA analysis

Figure 1.5
STAR Predicted Wages Compared to STAR Actual Wage for Our Preferred Models



Source: NERA analysis

Figure 1.6
NERL Predicted Wages Compared to NERL Actual Wage for Our Preferred Models



Source: NERA analysis

1. Introduction

NERL commissioned NERA to test the hypothesis that NERL's staff wages are in line with market benchmarks. In particular, our analysis focussed only on negotiated grades subject to collective bargaining, namely ATCO, ATSA, ATCE, MSG and STAR.

The rest of the report is structured as follows:

- Chapter 2 summarises CAA's approach to benchmarking NERL's staff opex at RP2 and outlines our alternative wage equations approach at RP3;
- Chapter 3 sets out the process we take to estimate wage equations;
- Chapter 4 presents and discusses the results of our wage equations;
- Chapter 5 sets out our analysis of "special factors", which are omitted from our wage equations, but which also drive wages; and
- The appendices present details of our analysis.

2. Wage Equations Measure Market Pay Bottom-Up

This chapter provides an overview of the approach taken by the CAA to estimating the efficiency of NERL's staff opex at RP2 and explains our proposed alternative approach of relying on wage equations. This chapter proceeds as follows:

- Chapter 2.1 summarises CAA's decision to rely on bottom-up benchmarking at RP2 to assess the efficiency of NERL's staff opex;
- Chapter 2.2 describes the job-matching method adopted by IDS, CAA's independent consultants, to measure the efficiency of staff opex;
- Chapter 2.3 describes our proposed alternative approach of using wage equations and how it builds on IDS's job-matching method; and
- Chapter 2.4 outlines the high-level steps involved in assessing NERL's staff opex efficiency using wage equations.

Our approach of relying on wage equations goes one step further than IDS's job-matching exercise at RP2 and provides a more objective benchmark against which to assess NERL's staff opex bottom-up.

2.1. CAA's Commissioned IDS to Carry out Bottom-Up Assessment of NERL's Staff Opex

In addition to any bottom-up scrutiny of expenditure, most cost-assessment in the regulated industries relies on comparative benchmarking of cost lines or total costs across similar companies. Ofgem and Ofwat, for instance, rely on statistical benchmarking models which aim to draw conclusions on the efficient level of costs for regulated electricity, gas and water networks based on their outputs.⁶ In assessing the costs of local energy networks and water companies, Ofgem and Ofwat benefit from a sample of multiple companies all operating within their jurisdiction (14 Distribution Network Operators and even more water companies). Although not used to date for the purpose of setting allowances in Great Britain, regulators internationally have used pan-European benchmarking analysis to determine companies' price controls where insufficient data points have been available. For instance, the Autoriteit Consument et Markt in the Netherlands (ACM) and the Bundesnetzagentur in Germany (BNetzA) have both applied pan-European benchmarking methods to assess the efficiency of domestic electricity transmission businesses for which the sample was too small to develop a purely national benchmark.

NERL is the sole ANSP operating within UK en route airspace. Accordingly, CAA would have to rely on international comparators to construct any meaningful statistical benchmarking analysis using similar businesses. However, CAA decided against using

⁶ Ofgem (2014). "*RIO-ED1: Final determinations for the slow-track electricity distribution companies. Business plan expenditure assessment*".

Ofgem (2012). "*RIO-GD1: Final Proposals – Overview*".

Ofwat (2013). "*Setting price controls for 2015-2020 – final methodology and expectations for companies' business plans*".

comparative benchmarking at Reference Period 2 (RP2), because it believed that comparator ANSPs inefficient and would not therefore provide any insights into the efficiency of NERL.

Instead, the CAA commissioned independent consultants, IDS, to carry out bottom-up assessment of NERL's staff operating costs and Capita Symonds for other operating costs and ARUP and Helios for capital expenditure.⁷ The focus of this NERA report is IDS's analysis of the efficiency of staff costs, which account for ~70%⁸ of NERL's total operating expenditure.

2.2. IDS Measured the Efficiency of Staff Opex through a Job-Matching Exercise

At a high level, IDS relied on comparisons of wages for NERL staff with reference to its assessment of pay for similarly skilled jobs in the wider economy. In other words, IDS's approach was to benchmark each individual professional group within NERL based on the wages paid to similar workers in other sectors of the economy.

As an initial step, IDS attempted to match job roles at NERL to IDS job levels, the consultant's own proprietary database. For the ATCE, STAR, MSG and HR grades, IDS was able to establish what it deemed to be the most appropriate IDS job levels in each case, using job descriptions and Hay Points⁹ provided by NERL. However, over one-third of NERL staff consisted of professional controllers, ATCOs and ATSAs, for which no clear job descriptions or Hay Points were available that would be comparable with IDS's jobs database. As a result, IDS based its assessment of the role level and commensurate pay for ATCOs and ATSAs on the pay for military ATCOs and private sector power systems engineers.

IDS then compared the pay for these roles with pay levels for similar "job contours"¹⁰ in its proprietary database on standard pay levels for the commensurate skills. IDS also attempted to adjust for the additional costs of labour in the South East for all grades at NERL, as well as labour in the energy and transport sector associated with ATCOs and ATSAs. Its final analysis consisted of a series of comparisons between the wages in its database and the wages paid to NERL staff, showing that wages including pension costs were up to 50 per cent above comparators for some grades at NERL.

⁷ IDS (2014). "Assessing the efficiency of NERL's total employment costs in RP2. A research report for the Civil Aviation Authority (CAA)".

⁸ Excluding depreciation.

⁹ Hay Points are a metric used in human resources consulting to measure the skill level of different jobs across a number of axes including problem solving, technical knowledge and accountability.

¹⁰ IDS defined job contours as "jobs that are seen to be at broadly equivalent levels as expressed internally in the organisation through similarity of grading and/or salary level. IDS (2014). "Assessing the efficiency of NERL's total employment costs in RP2. A research report for the Civil Aviation Authority (CAA)", page 56.

2.3. Our Proposed Approach using Wage Equations Builds on IDS's Work at RP2

We propose an alternative approach to benchmarking using econometric wage equations, which goes one step further than IDS's job-matching exercise at RP2. The economic literature contains a long heritage of estimating wage equations which leads to the level of staff compensation that we observe in the general economy.¹¹ Wage equations contain the factors such as qualifications, training, experience and geographic location which determine staff pay. As well as a long academic heritage, wage equations have a history in application in regulatory and policy contexts. For example, the Department for Communities and Local Government (DCLG) estimated a "labour cost adjustment" to take account of differences in wage costs between areas in order to determine local government funding.¹²

Estimating wage equations from an economy wide dataset provides us with an estimate of how wages vary given the characteristics of employees. Using that model for wages in the economy as a whole, we can then calculate the wages that NERL should pay its staff given the characteristics of NERL staff (e.g. associated with qualifications, training, experience and geographic location). The difference between NERL's predicted wage (as predicted by the wage model) and its actual wage would then include the effect of inefficient staff costs as well as any residual factors that the model does not explain.

In particular, our wage equations approach has the following merits over and above IDS's work at RP2 in benchmarking NERL pay:

- *Controls for factors other than job description that affect compensation.* Wage equations allow us to control for additional factors that may explain the pay of NERL staff to simple job roles. The inclusion of these explanatory variables means that we remove more of the wage variation caused by factors other than inefficiency from the comparison, which is an improvement on IDS's pure job-matching approach. These additional explanatory variables may include demographic characteristics (such as age), human capital (such as education, experience) and job characteristics (such as location, industry, job type/occupation); and
- *Relies on the Labour Force Survey (LFS), a large publicly-available dataset.* Whereas IDS used its own proprietary database of job levels – which not only made the job-matching process somewhat opaque, but also contained potentially a small number of relevant comparators – we rely on a large publicly-available dataset from the ONS, the Labour Force Survey (LFS), for our wage regressions. As we discuss in detail in Chapter 3.3, the LFS is a quarterly survey of over 80,000 households, capturing around 800

¹¹ For example, David Blanchflower (an academic and ex-member of the Monetary Policy Committee of the Bank of England) and Andrew Oswald estimated a wage curve for Great Britain between 1973 and 1990. In Chapter 3.1, we detail our review of near a dozen papers produced by leading economists in the field.

¹² DCLG, "Methodology Guide for the Area Cost Adjustment 2013/14". <http://webarchive.nationalarchives.gov.uk/20140505105916/http://www.local.communities.gov.uk/finance/1314/metha-cas.pdf> In particular, the DCLG ran a regression on hourly earnings excluding overtime payments against a set of variables, including the area where each individual worked and factors it controlled for. The control variables included age, gender, occupation and industry, which were derived from the ASHE dataset. The coefficients on the area variables represent the relative wage in each area, after allowing for differences that are due to the control variables.

descriptive characteristics for each respondent, including pay, age, educational qualification and occupation.

2.4. We Follow a Broad Three-Step Process in Benchmarking NERL's Wages

Our approach to benchmarking the wages that NERL pays follows the procedure set out below:

1. First, we develop and estimate a series of models for wages across the economy as a whole. We base our list of candidate models on a review of the literature on what variables drive pay and the explanatory variables available in the LFS dataset (see discussion in Chapter 3.1 below). A simple wage equation could take the following *linear* functional form:¹³

$$wage = \alpha + (\beta_1 \times age) + (\beta_2 \times union) + (\beta_3 \times job\ type) + \dots$$

Where:

- *wage* is a measure of pay (the “dependent variable”); and
- *age*, *union* and *job type* are measures of the factors that drive pay (the “explanatory variables”).

We would then estimate the above equation that best fits the LFS dataset for the economy as a whole. In other words, we estimate coefficients α and β 's in the above equation, where:

- α is the amount all workers get paid; and
 - β_1 , β_2 and β_3 are the additional amounts that a particular worker gets paid per additional year of age, if they are part of a union, or if they are in a particular job type, respectively.
2. Having estimated the above wage equations, next we input specific data on the characteristics of NERL staff into the equation (i.e. data on NERL staff's *age*, *union* and *job type*) to estimate their predicted market wage.
 3. Finally, we compare NERL staff's market wages – as predicted by the wage equations – with their actual wages. Any difference between our prediction and NERL's actual wages would reflect (a) any inefficiency as well as (b) the imperfections of the model and measurement error.¹⁴

¹³ Although, in practice, we estimate wage equations of a *log-linear* functional form (see Chapter 3.4), which is common to the economic literature.

¹⁴ In practice, no wage equation can capture all the factors that drive NERL staff's pay, such that any wage variation would be attributed to inefficient staff costs. Whilst our wage equation approach allows us to control for a wider set of explanatory variables to simple occupation (thereby reducing any wage variation caused by factors other than inefficiency), there inevitably remains a number of “special” or “omitted” factors, which have material impact on NERL's wages, but are not captured in our models. As we shall see in Chapter 4.3, our final models typically explain around 60 per cent of the variation in NERL's wages, which compares well with many wage equations in the literature. The remaining 40 per cent of variation in wages is not explained by our models and reflects omitted explanatory

3. We Estimated Wage Equations for the General Economy

This chapter describes the process we relied upon to develop and estimate a series of wage equations for the general economy in more detail. The chapter proceeds as follows:

- Chapter 3.1 summarises the approach we took to identify the key variables for our wage equations by reviewing relevant economic literature;
- Chapter 3.2 explains how we identified comparator occupations, based on ONS standard classifications, with which to benchmark roles within NERL;
- Chapter 3.3 describes the ONS dataset we relied on to estimate our wage equations for the entire economy; and
- Chapter 3.4 explains the range of wage models we estimated in assessing the efficiency of NERL's staff costs.

We developed and estimated a range of wage models for the general economy, based on clearly defined criteria for selecting the explanatory variables and comparator occupations to include in the regression, and relying on a reliable and publicly-available ONS dataset.

3.1. We Identified Key Variables for our Equations from the Economic Literature

We identified the pay variable as well as explanatory variables that determine pay from academic literature. Specifically, we reviewed near a dozen papers produced by leading economists in the field, including previous NERA collaborations with David Blanchflower, an academic and ex-member of the Monetary Policy Committee of the Bank of England. The papers we selected appeared in leading journals or were used in developing policy. They therefore provide a reliable guide to at least the opinions of policy makers or academic peer reviewers on the drivers of wages in at least the specific case in question.

The precise specifications varied slightly between jurisdictions and contexts although many variables such as age or experience and education appeared in all or the vast majority of specifications. For example, a paper estimating gender-related wage inequality in Finland may have more of a focus on gender and family-related variables than an analysis of regional pay differences.

We selected variables for our longlist to be analysed in our wage equations according to the following general criteria:

1. *Whether the variable has appeared in multiple papers.* As a starting point, we included all the variables which two or more authors have included in their wage equation estimations. This initial criterion essentially ensures that we capture all those variables that are central to a well-defined wage model. Appendix A summarises the economic literature we

variables which determine any individual's wages. Many of these omitted variables are likely to be impossible to observe or obtain data on in practice. Inclusion of these omitted variables may account for any remaining differences between actual and modelled wages at NERL.

reviewed, and in particular highlights the variables (dependent and explanatory) that each author had included in their wage equation estimation;

2. *Whether additional variable should be included or excluded based on statistical properties and/or data availability.* Many variables included in the wage equations had slightly different specifications or descriptions but essentially measured the same underlying economic properties. For instance, “potential experience” appeared in several papers – which in turn is constructed from variables “age” minus “age when completed full-time education”. Not only is not economically meaningful to include variables which are very closely related (e.g. age, experience and potential experience) it also introduces a statistical phenomenon known as multicollinearity,¹⁵ resulting in unreliable inferences from model estimation. As a result we pruned the longlist to include only a set of variables which were at least potentially jointly meaningful;¹⁶
3. *Whether we are able to collect data on the variable (or similar) from the LFS database.* As we will be relying on the LFS database to estimate the economy-wide wage equation, we also needed to ensure that the variables we include in our equations are also recorded in that database; and
4. *Whether we are likely to collect NERL-specific data on the variable.* Having estimated the economy-wide wage equation, we would then need to input specific data on the characteristics of NERL staff into the estimated model to estimate their predicted market wage. As such, we also needed to ensure that any variables we include in our wage equation in the first place are also available for NERL staff. In some cases, even if we do not have corresponding data on NERL staff for a specific variable, we can make alternative assumptions, for example, by assuming the population mean of the variable. We excluded variables relating to “significant health problems/disability” even though it featured in some of the academic papers we reviewed because this sensitive information would not have been available for NERL’s staff.

From the initial list of variables we drew from the literature in Step 1, we filtered based on Steps 2-4 to arrive at a final list of LFS variables, which we ultimately include in our wage equations.

Table 3.1 presents, for dependent and explanatory variables separately, the high-level categories of variables we have decided to include in our wage equation and the specific variables within each category that we have chosen from the LFS database. We also indicate whether the specific LFS variables are available for NERL staff. Where we do not have corresponding data on NERL staff, we note the alternative assumptions we make. We discuss specific data on NERL staff in more detail in Chapter 4.1.

¹⁵ Multicollinearity is where an explanatory variable is correlated with other explanatory variables in the model.

¹⁶ We also included additional variables based on economic rationale. For example, we included squared variables of “age” and “tenure” to capture the fact that these variables may have a quadratic rather than a linear impact on wages.

Table 3.1
List of Variables Included in Our Wage Equation

Dependent/ explanatory variable	Variable category	Specific LFS variables	Availability of data on NERL staff
Dependent	Hourly wage	Gross hourly pay	Yes – derived from pay bill and hours worked from NERL database
Explanatory	Demographic variables	e.g. age	Yes – from NERL database
	No. of children in household	No. of children in household under 2	No – LFS population mean
	Education/ Qualification	Age when completed full time education	Yes – from NERL survey
		Highest qualification	Yes – from NERL survey
	Tenure, tenure-sq	Years continuously employed	Yes – from NERL database
	Training	Job related training in the last 3 months	Yes – from NERL survey
	Occupation	1-digit SOC ¹⁷	No – see chosen comparator SOCs in Chapter 3.2
		3-digit SOC	No – see chosen comparator SOCs in Chapter 3.2
		4-digit SOC	No – see chosen comparator SOCs in Chapter 3.2
	Industry	1-digit SIC ¹⁸	N/A – within “Transportation and storage (H)” SIC
		2-digit SIC	N/A – within “Air transport (51)” SIC
	Public/private sector	Public/private sector	N/A – private sector
	Full-time/part-time	Full-time/part-time	Yes – from NERL database
	Region of work	Region of work	Yes – from NERL database
	Union status	Pay affected by union agreements	Yes – from NERL database
		Trade union membership	Yes – from NERL database
	Hours worked (per week)	Basic usual hours excluding overtime	Yes – from NERL database
Basic usual hours including overtime		Yes – from NERL database	
Firm size	Number of employees at workplace	N/A – within “500 or more” category	

Source: NERA analysis based on economic literature, LFS database and NERL data.

¹⁷ SOC stands for Standard Occupation Classification

¹⁸ SIC stands for Standard Industrial Classification

3.2. We Identified Comparator SOCs by Reviewing Job Descriptions and Applying Funnel Criteria

SOC, or the Standard Occupational Classification, is a system for classifying occupations in the UK (managed by the ONS), which groups jobs in terms of their skill level and skill content with up to 4 levels of granularity. The ONS publishes a Standard Occupational Classification description document,¹⁹ which provides job descriptions and summaries of key tasks associated with each SOC (most detailed at the 4-digit level).

We included three occupation variables – namely, 1-digit SOCs, 3-digit SOCs and 4-digit SOCs – as potential drivers of hourly pay in the general economy. The 1-digit SOC provides the broadest classification of occupations (with 9 categories), whilst the 3-digit SOC is a subset of the 1-digit SOC with more detailed categorisations, and 4-digit SOC is in turn a subset of the 3-digit SOC with even more detailed categorisations. In our analysis, we have to therefore identify corresponding 1-, 3- and 4-digit SOCs that reflect the roles of NERL staff, so that we can input them into the estimated wage equation and compute NERL’s predicted market wage.

At a high-level, we identified these comparable 1-, 3- and 4-digit SOCs by (a) reviewing job descriptions for each category of NERL staff, (b) applying our *funnel criteria* to arrive at a list of filtered SOCs and (c) deciding whether to rely on a specific SOC or the average of filtered SOCs as the most relevant comparator for NERL staff. We describe each of these steps in detail below.

3.2.1. Reviewing job descriptions of NERL staff

The first step in identifying suitable comparator SOCs for NERL staff was to understand the roles of each NERL staff category. Our analysis focussed only on negotiated grades subject to collective bargaining, namely ATCO, ATSA, ATCE, MSG and STAR.

We began by obtaining detailed job descriptions for each of the staff categories from NERL (and in the case of ATCO, from the ONS Standard Occupational Classification description document). Next, we distilled the job descriptions for each staff category into a few key skills and attributes, with the intention of capturing the specific nature of each job role. As discussed in Chapter 3.2.2 below, this step of classifying NERL job descriptions into key skills would allow us to match each category of NERL staff to relevant comparator SOCs.

We summarise the job descriptions for each staff category in Table 3.2 below, along the key skills and attributes we have assigned them. We provide detailed summaries of these by staff category in Appendix B.

¹⁹ ONS, “*Standard Occupational Classification 2010. Volume 1. Structure and description of unit groups*”

Table 3.2
Summary of NERL Staff Job Description and Key Skills/Attributes

NERL Staff Category	General Job Description	Key Skills/Attributes
ATCO (Air Traffic Control Officer)	ATCOs issue instructions, advice and information to pilots by radio to keep air traffic flying safely, efficiently and quickly. Safety plays a significant part in their role, as they are responsible for handling emergencies, unscheduled traffic and other unanticipated incidents.	<ul style="list-style-type: none"> • Emergency response/ safety critical tasks • Directing/ coordinating transport movement • Transport-specific communication • Obtaining information/ monitoring/ performing tests
ATSA (Air Traffic Service Assistant)	<p>Watch Supervisor (WAS)/ Deputy Watch Supervisor (DWAS): responsible for providing optimal operational support staff service (including safety, service delivery and training) in both Ops rooms, whilst ensuring alignment to business direction.</p> <p>Flight Information Service Officer (FISO): required to undertake any of the required duties of a FISO (A) and ATSA 4, as well as maintaining or gaining additional Operational Support Skills, as determined by the operational requirement.</p> <p>ATSA Sector Assistant (Prestwick/ Swanwick): working as a member operational support staff and provide services in support of safe, orderly and expeditious delivery of ATC function in both Ops rooms.</p>	<ul style="list-style-type: none"> • Developing strategy (ATSA 4 and above) • Leadership/ advice (ATSA 4 and above) • Secretarial/clerical duties (ATSA 3 and below) • Human resources/ training • Health and safety
ATCE (Air Traffic Control Engineer)	<p>Service Design & Transition (SD&T): focus on designing and building new technology.</p> <p>Service Operations (SO): focus on maintaining and working on current systems.</p> <p>In both cases, technicians are at the lower end of the scale (ATCE 4 and 5).</p>	<ul style="list-style-type: none"> • Programme/ system design • Software • Technician • Project planner/ management
MSG (Managerial Support Grades)	<p>MSGs comprise a range of jobs across the business, including non-management roles in professional and business support areas, e.g. finance, HR, admin/support, communications, environment, and non-operational roles at the Swanwick and Prestwick centres.</p> <p>Moreover the range of roles includes senior professionals with relevant professional qualifications and continuous professional development obligations.</p>	<ul style="list-style-type: none"> • Finance • Administrative/ support • Human resources/ communications
STAR (Scientific Technical & Research)	STARs manage, plan, execute, and report on assigned scientific/ technical/ analytical tasks within the business areas of strategic importance, including Operational Analysis, Human Factors, Validation, SESAR, Business Reporting or Division of Safety.	<ul style="list-style-type: none"> • Applying scientific/ technical/ analytical methodologies to improve business performance • Communication/ presentation/ report writing • Commercial/ regulatory knowledge

Source: NERA analysis based on job description from NERL and ONS “Standard Occupational Classification” description document.

3.2.2. Applying funnel criteria to arrive at a filtered list of SOCs

Having assessed the job descriptions of each NERL staff category and distilled them into key skills, we selected 1-, 3- and 4-digit SOCs based on the following funnel process:

1. As an initial high-level filter, we eliminated seemingly irrelevant 1-digit SOCs based on comparison of SOC titles and general descriptions (from the ONS Standard Occupational Classification description document) with job descriptions of NERL staff;
2. Next, within the 1-digit SOCs, we selected related professions in the lower level SOCs – all the way down to 4-digit SOCs – based on whether these SOCs closely matched the specific nature of the each NERL job category. We drew on the general job descriptions and summaries of key skills from the ONS Standard Occupational Classification description document to assess the lower level SOCs; and
3. Lastly, having arrived at a set of 4-digit SOCs that could be relevant comparators, we took a few additional steps to account for the *trade-off* associated with the granularity of these SOCs; that is, more granular SOCs may be less reliable indicators of more closely-related professions. In other words, a narrowly-defined 4-digit SOC may be a more relevant comparator for NERL, but may be a less reliable measure due to higher measurement error in the ONS dataset.²⁰ In some cases, it may be worth sacrificing some relevance for greater reliability and in other cases vice versa. We applied the following criteria for addressing this trade-off:
 - We kept any 4-digit SOCs relating to transport, irrespective of reliability. We deemed it was more important for a SOC to be transport-specific (which is consistent with the nature of the industry that NERL operates in) than reliable;
 - If all 4-digit SOCs were relevant, then we used the corresponding higher level 3-digit SOC, irrespective of reliability;
 - In the case that not all the 4-digit SOCs were relevant:
 - If the 4-digit SOCs were reliable, then we used the individual 4-digit SOCs;
 - If the majority of 4-digit SOCs were relevant and were “unreliable” (in relation to the small sample size at this level), then we used the higher level 3-digit SOCs; and
 - If less than a majority of 4-digit SOCs were relevant and were unreliable, then we excluded the 3-digit and 4-digit SOCs altogether.

We present detailed SOC funnels for each category of NERL staff in Appendix B, culminating in a filtered list of related SOCs as shown in Table 3.3 below. We also provide

²⁰ We deem a SOC to be reliable if its mean hourly wage estimate from ASHE has a coefficient of variation (CV) of $\leq 10\%$. The CV is the ratio of the standard error of an estimate to the estimate itself and is expressed as a percentage. The smaller the coefficient of variation the greater the accuracy of the estimate. The true value is likely to lie within \pm twice the CV. For example, for an estimate of £50 with a CV of 10%, we would expect the true population average to be within the range £40 to £60.

the job descriptions associated with the filtered list of SOCs from the ONS Standard Occupational Classification description document in Appendix D.

Table 3.3
Filtered List of Comparator SOCs Based on Funnel Criteria

NERL Staff Category	Filtered List of SOCs
ATCO	Medical practitioners (2211) Fire service officers (watch manager and below) (3313) Aircraft pilots and flight engineers (3512) Ship and hovercraft officers (3513) Energy plant operatives (8124) Train and tram drivers (8231) Marine and waterways transport operatives (8232) Air transport operatives (8233) Rail transport operatives (8234)
ATSA	Administrative occupations: Records (413) Administrative occupations: Office managers and supervisors (416) Secretarial and related occupations (421) Human resources and industrial relations officers (3562) Health and safety officers (3567)
ATCE	Mechanical engineers (2122) Electrical engineers (2123) Electronics engineers (2124) Design and development engineers (2126) IT specialist managers (2133) IT project and programme managers (2134) IT business analysts, architects and system designers (2135) Programmers and software development professionals (2136) Quality control and planning engineers (2461) Electrical and electronics technicians (3112) Engineering technicians (3113)
MSG	Administrative occupations: Finance (412) Office managers and supervisors (416) Financial and accounting technicians (3537) Financial accounts managers (3538) Human resources and industrial relations officers (3562)
STAR	Research and development managers (215) IT business analysts, architects and system designers (2135) Programmers and software development professionals (2136) Management consultants and business analysts (2423) Business and financial project management professionals (2424) Health and safety officers (3567)

Source: NERA analysis based on SOC description from ONS "Standard Occupational Classification" description document.

3.2.3. Final selection of comparator SOCs

As a final step, we assessed whether it was more appropriate to rely on a specific SOC or the average of the SOCs from our filtered list (above) as the most relevant comparator for NERL staff. Some categories of NERL staff may be so highly-specialised and niche that there is really only one relevant SOC among our filtered list of SOCs that is clearly preferred over the rest. On the other hand, it could be that other categories of NERL staff may cover a much

broader range of functions and professions, such that all the SOC's in our filtered list are relevant and should therefore be included as an average measure.

Table 3.4 below presents our final selection of comparator SOC's for each NERL staff category, specifying whether we applied a specific SOC or the average of filtered SOC's, and our justification for doing so.

Table 3.4
Final Selection of Comparator SOC's

NERL Staff Category	Specific SOC or Average of SOC's	Justification
ATCO	Specific SOC - Aircraft pilots and flight engineers (3512)	ATCOs have highly specialised and niche roles that are not easily transferable with professions outside of air traffic control. "Aircraft pilots and flight engineers" is the most relevant comparator, because it shares many of the key skills and attributes necessary in ATCOs' line of work. IDS also considered Aircraft Pilots and Flight Engineers at RP2. We therefore assume this specific SOC for ATCOs.
ATSA	Average of filtered SOC's	ATSAs cover a broad spectrum of roles that are relatively transferable between professions, including management, support, secretarial, human resources and health and safety. We therefore assume an average of the 5 related SOC's for ATSAs.
ATCE	Average of filtered SOC's	ATCEs cover a broad range of engineering professions, including system design, software, project management and technician that require mechanical, electrical, electronics and software/IT skills. We therefore assume an average of the 11 related SOC's for ATCEs.
MSG	Average of filtered SOC's	MSGs span a broad range of roles including finance, HR, admin/support, communications, environment, and non-operational roles at the Swanwick and Prestwick centres. We therefore assume an average of the 5 related SOC's for MSGs.
STAR	Average of filtered SOC's	STARs have skills that are relatively transferable between occupations, including scientific/ technical/ analytical abilities and experience with communication/presentation/report writing. We therefore assume an average of the 6 related SOC's for STARs.

Source: NERA analysis

With the exception of ATCOs, we relied on the *average* of our filtered list of SOC's as the most suitable comparator for NERL staff on the basis that from a simple comparison of job descriptions there was no objective basis for selecting on SOC over another. Staff within ATSA, ATCE, MSG and STAR grades all cover a wide range of roles and attributes that are not highly-specialised and are to an extent transferable and substitutable between related occupations. Therefore, the most relevant comparator for these staff categories would be a combination of all the related occupations identified from our funnel criteria. For example, ATCEs exhibit a broad range of capabilities (including in programme and software, system design, project management and technical), which are relevant to a number of occupations. We took the average of related SOC's in our filtered list as the representative comparator for

the ATCE group. The range of wages across the SOCs we have estimated for each staff category is very broad. For instance, average hourly pay for ATCE comparator SOCs range £16.70 to £27.60 for the most recent year 2016/17.

It is also worth noting the difficulty of finding suitable benchmark professions to reflect the diverse nature of roles within the ATSA grade, and the safety critical dimension of the ATSA role. As we can see from Table 3.2, ATSA staff covers a broad spectrum of roles including management, support, secretarial, human resources and health and safety, which made it difficult to match ATSAs job description with available SOCs.

On the other hand, ATCOs have a very niche role; they are highly trained and have highly specialised skills that are not easily transferable or substitutable with professions outside of air traffic control. For example, although we identified a number of related SOCs that capture the “safety critical” nature of ATCOs’ role (namely “Medical practitioners”, “Fire service officers” and “Energy plant operatives”), these occupations do not adequately capture the specialism of ATCOs in air traffic control activities. The occupations we selected that were related to the operation and coordination of movement of other transport vehicles employ very different skillsets and experience (namely “Ship and hovercraft officers”, “Train and tram drivers”, “Marine and waterways transport operatives” and “Rail transport operatives”). Operators of other vehicles do not have the specialism or the transferable skills required to work as an ATCO.

For this reason, we have selected the 4-digit SOC “Aircraft pilots and flight engineers” as the *most and only relevant comparator* for ATCOs.²¹ As can be seen in Table 3.5, aircraft pilots and flight engineers share many of the key skills and attributes necessary for ATCOs and also work in safety critical roles in aviation. For instance, according to the ONS Standard Occupational Classification description document, it is necessary for both ATCOs and aircraft pilots to have an understanding of air traffic control instructions – ATCOs to give instructions and pilots to comply with them. Pilots also need to maintain radio contact and understand weather conditions, same as ATCOs. Perhaps most importantly, the nature of both of these occupations requires the ability to respond to emergency and safety-critical situations – ATCOs in dealing with unanticipated incidents impacting air traffic movement, and pilots with the aircraft itself. In a similar way, flight engineers and ATCOs both have to monitor conditions and/or perform necessary tests (such as fuel consumption) as well as advising the pilot on any factors that may affect navigation or performance of the aircraft. Moreover, as discussed in Chapter 2.1, the CAA consultants at RP2, IDS, considered aircraft pilots as a benchmark comparator for ATCOs in their assessment on the efficiency of NERL pay.

²¹ The ONS does not break this SOC down further into its constituent occupations, namely “aircraft pilots” and “flight engineers”.

Table 3.5
Comparison of ATCO Key Skills and Attributes to “Aircraft Pilots and Flight Engineers” SOC

Key Skills/ Attributes	ATCO	Aircraft Pilots and Flight Engineers (3512)
Directing/ coordinating transport movement	<ul style="list-style-type: none"> directs the movement of aircraft en route to its destination and ensures minimum distances are maintained between planes gives landing instructions to pilot and monitors descent of aircraft directs movement of aircraft and motor vehicles on runways, taxiways and in parking bays 	<ul style="list-style-type: none"> directs or undertakes the operation of controls to fly aeroplanes and helicopters, complying with air traffic control and aircraft operating procedures
Transport-specific communication	<ul style="list-style-type: none"> maintains radio and/or radar or visual contact with aircraft and liaises with other air traffic controllers and control 	<ul style="list-style-type: none"> maintains radio contact and discusses weather conditions with air traffic controllers
Obtaining information/ monitoring/ performing tests	<ul style="list-style-type: none"> obtains information regarding weather conditions, navigational hazards, landing conditions, seating arrangements, loading of cargo, fuel and catering supplies calculates fuel consumption and optimum flying height, plans route and prepares flight plan for aircraft pilot 	<ul style="list-style-type: none"> monitors fuel consumption, air pressure, engine performance and other indicators during flight and advises pilot of any factors that affect the navigation or performance of the aircraft performs specified tests to determine aircraft’s stability, response to controls and overall performance studies flight plan, discusses it with flight deck crew and makes any necessary adjustments directs or undertakes routine checks on engines, instruments, control panels, cargo distribution and fuel supplies
Emergency response/ safety critical tasks	<ul style="list-style-type: none"> handles emergencies, unscheduled traffic and other unanticipated incidents 	<ul style="list-style-type: none"> directs or undertakes the operation of controls to fly aeroplanes and helicopters, complying with air traffic control and aircraft operating procedures accompanies pupil on training flights and demonstrates flying techniques

Source: NERA analysis based on SOC description from ONS “Standard Occupational Classification” description document.

3.3. We relied on a reliable, publicly-available data source

Estimating wage equations for the entire economy requires observations on pay and characteristics of individuals. For this, we relied on the Labour Force Survey (“LFS”). The LFS is a publicly-available ONS dataset consisting of data collected from a quarterly survey of over 80,000 households per quarter. Moreover, it provides over 800 descriptive variables for each respondent, including key variables of interest, such as pay, age, educational qualification and whether the worker is unionised.

Specifically, to ensure sufficient model robustness in our wage equation estimation, we relied on quarter 4 (“Q4”) data over 6 years, between 2011 and 2016. Firstly, we used Q4 data because the unionisation variable was only collected in the last quarterly survey of each year. Secondly, only around 10,000 participants provided pay data each quarter, so analysing data over a 6-year period (Q4 only) would provide us around 60,000 observations in total. This is a large dataset by econometric standards.²²

We note that there could be a potential seasonality bias in relying on Q4 LFS (rather than Q1-Q4), given the dataset is not seasonally adjusted. It could be that the pay variable – in this case hourly pay – is on average much higher (or lower) in the last quarter of the year compared to the rest of the year, in which case our wage equations of the general economy would overestimate (or underestimate) the impact of various drivers on wages, and hence the predicated wages for NERL staff. In such cases, an adjustment may be required to account for the seasonality bias.

In some datasets and for some professions the seasonality bias is substantial. For example, the ONS’s Annual Survey of Household Earnings (ASHE) dataset as a whole, average hourly pay is frequently 10 per cent higher or more in Q1 than the remainder of the year. For the LFS dataset on which we rely for our analysis, the overall bias is much smaller (as detailed in Appendix E below): we find evidence that hourly pay is on average only £0.04 (or 0.3 per cent) lower in Q4 than the average for the year across the economy as a whole. This smaller bias may reflect systematic differences in the degree of variable pay for LFS respondents or be due to misreporting under the LFS survey method. For example, respondents may not have a clear idea of variable pay at the time of completing questionnaires. Given the relatively small seasonal bias we identified for the LFS, we have not made any explicit adjustment to our modelled wages. As a result, our modelled wages may systematically understate market wages for NERL staff if they do not include the full variable pay earned by the comparator professions used.

For the purpose of the bottom-up econometric benchmarking of wages, the quarterly LFS dataset has substantial advantages over alternatives:

- *IDS’s proprietary dataset of job levels.* At RP2 CAA’s consultants, IDS, relied on its own internal database to arrive at its job role equivalence, which was non-transparent and with potentially a small number of relevant comparators for NERL staff. The quarterly LFS, on the other hand, is a large publicly-available dataset, with data on over 80,000 respondents per quarter and around 800 descriptive characteristics for each respondent. Moreover, detailed information is available in the public domain on the survey methodology and variable definitions;
- *Annual Survey of Hours and Earnings (ASHE) dataset.* The ASHE is an ONS dataset that provides information about the mean, median and distribution of hourly, weekly and annual earnings of employees across the UK as well as their paid hours worked. Earnings and hours worked can further be classified by age, region, industries (SICs) and occupations (SOCs), and further sub-divided by gender and part-time/full-time. Data is

²² Miles, J. and Shevlin, M., “*Applying Regression and Correlation: A Guide for Students and Researchers*”, page 119. They state that as a rule of thumb, there should be at least 100 observations in the sample.

collected based on PAYE data obtained from employers who fall within a 1% sample of the HMRC PAYE register. The final dataset typically covers around 180,000 jobs from around 60,000 responding businesses. In comparison to the quarterly LFS, the ASHE provides more accurate and reliable data on earnings, as it is based on PAYE data as opposed to self-reported pay by households. However, the highly aggregated nature of ASHE data means that we cannot control for more than two attributes at one time, i.e. we can only control for one aspect of pay from age, region, SICs and SOCs, and another from gender or part-time/full-time. The ASHE also provides no information on other determinants of pay (such as education, union status, tenure) that the quarterly LFS provides; and

- *LFS Five-Quarter Longitudinal dataset.* This is a derived dataset from the quarterly LFS, which retains each sample household for five consecutive quarters, with a fifth of the sample replaced each quarter. Therefore, whilst the main quarterly survey was designed to produce cross-sectional data, the longitudinal dataset allows us to follow the same individual through 5 consecutive quarters. The limitations of this longitudinal dataset, however, are that it contains a reduced number of observations (of around 6,000) as well as a reduced number of variables (of around 200 variables) for each respondent compared to the quarterly LFS. The ONS also warns of methodological problems associated with the construction of the longitudinal dataset, which could distort the data.²³

3.4. We developed and estimated a range of wage models

We estimated wage equations in a *log-linear* functional form, which was common to the economic literature we reviewed. A log-linear wage equation takes on the following general structure:

$$\ln(\text{wage}) = \alpha + (\beta_1 \times \text{age}) + (\beta_2 \times \text{union}) + (\beta_3 \times \text{job type}) + \dots^{24}$$

Where coefficients β_1 , β_2 and β_3 have the interpretation of the additional *percentage* that a particular worker gets paid per additional year of age, if they are part of a union, or if they are in a particular job type (respectively).

Specifically, we estimated the wage equations of $\ln(\text{gross hourly pay})$ on all the explanatory variables we identified in Chapters 3.1, including our selection of comparator SOCs for each NERL staff category.

In order to show the impact of different approaches on our estimated wages, we ran a range of models – 160 in total – with different model specifications. Intuitively, we are not trying to find the artificial “best model” of wages in the general economy. In econometric analysis, relying on just one particular specification is generally unwise because estimations can be sensitive to minor changes in model specification. Rather, our approach is to obtain estimates from a range of equally plausible model specifications, which is more reliable.

²³ ONS, “*User Guide. Volume 11 – LFS two-quarter and five-quarter longitudinal datasets*”, page 2.

²⁴ $\ln(\text{wage})$ is the natural log of the variable wage.

As shown in Table 3.6 below, all our models begin with the same 14 control variables. The variations in our model specifications then come from the inclusion of the following variables of interest:

- *SIC/SOC combination variables.* The main variation in our models comes from different combinations of the SIC and SOC variables. The SOC variables, in particular, are key to our wage model, because they form the benchmark occupations with which we estimate the corresponding predicted market wage for NERL’s staff. It was also necessary to include different combinations of these variables given the range of granularities of the SICs and SOCs, and the trade-offs inherent in more granular SOCs that we mentioned in Chapter 3.2. Within the SIC/SOC variation, we created additional sub-variation from combinations of other explanatory variables, which we discuss below;
- *Interaction variables.* We included the interaction of the 1-digit SIC variable with the time trend, which allows for the relationship between different industries and wages to vary through time;
- *Education variables.* We included the “Highest qualification” variable, because we believe education attainment (i.e. whether an individual has a university degree, an A-level or other qualifications) is a significant driver of wages in the general economy;
- *Unionisation variables.* We included different combinations of the two unionisation variables – “Pay affected by union agreements” and “Trade union membership” – to assess whether wage estimation would be sensitive to unionisation;
- *Time variables.* We included two time variables – a time trend and time dummies. The former allows for the possibility that movements in wages could simply be driven by the passing of time. The latter captures any year-specific effects in wages; and
- *Squared variables.* In line with the literature we reviewed in Chapter 3.1, we included squared terms of the age and tenure variables in order to capture potential quadratic (rather than linear) effects of these variables on wages. Intuitively, this allows us to account for any increasing or diminishing effect of age and tenure on wages. For instance, a positive coefficient on age and a negative coefficient on age-squared means that the individual’s age has a positive but diminishing impact on wages.

Table 3.6
Summary of Model Specifications

Control Variables	
Demographic variables, e.g. age	Full-time/part-time
No. of children in household under 2	Region of work
Age when completed full time education	Basic usual hours excluding overtime
Job related training in the last 3 months	Basic usual hours including overtime
Years continuously employed	Number of employees at workplace
Public/private sector	



SOC/SIC Variation	No. of Models
No SIC and no SOC	32
1-digit SIC and 1-digit SOC	48
2-digit SIC and 3-digit SOC	32
1-digit SIC and 4-digit SOC	48



Sub Variation 1 - Interaction	Sub Variation 2 - Education	Sub Variation 3 - Unionisation	Sub Variation 4 - Time	Sub Variation 5 - Squares
1-digit SIC interacted with time trend	With highest education	Union membership	Time trend	Squared age and tenure
1-digit SIC not interacted with time trend	Without highest education	Pay affected by union agreements		
		Both union membership and pay affected by union	Time dummies	No squared age and tenure
		No union variable		

Source: NERA analysis

For simplicity, we have categorised the 160 models into the groupings shown in Table 3.7 below. These groups are classified first by SIC/SOC combination (i.e. “SIC0, SOC0”, “SIC1, SOC1”, “SIC2, SOC3”, “SIC1, SOC4”), then by interaction of SIC variables with time trend and finally by highest education. Within each of these groupings, the remaining variation comes from the level of unionisation, time variables and squared age and tenure variables.

Table 3.7
Model Specification Groupings

Model Specification Groupings	No. of Models
SIC0, SOC0	16
SIC0, SOC0, Education	16
SIC1, SOC1	16
SIC1, SOC1, Education	16
SIC2, SOC3	16
SIC2, SOC3, Education	16
SIC1, SOC4	16
SIC1, SOC4, Education	16
SIC1, SOC1, Interaction	8
SIC1, SOC1, Interaction, Education	8
SIC1, SOC4, Interaction	8
SIC1, SOC4, Interaction, Education	8

Source: NERA analysis

4. Our Results Suggest NERL Wages are Broadly in Line with Market

This chapter presents our benchmark wages for NERL based on the wage equations we estimated from the wider economy. It proceeds as follows:

- Chapter 4.1 summarises how we applied specific data on NERL staff to our estimated wage equations to generate a benchmark wage for NERL;
- Chapter 4.2 compares the benchmark wages for NERL, for our preferred groups of models, with NERL’s actual wages; and
- Chapter 4.3 concludes.

The results from our final (or “preferred”) group of models suggest that NERL’s staff wages are broadly in line with market benchmarks. In fact, our preferred models resulted in predicted wages that exceeded NERL’s actual wage levels for most categories of staff for most categories of staff.

4.1. We Calculated NERL’s Predicted Market Wages by Inputting Specific Data on NERL Staff into Estimated Wage Equations

The wage equations we estimated and described in Chapter 3 allow us to assess the market wage that an individual would receive in the wider economy. Calculating a benchmark wage for NERL requires applying those equations to data collected about NERL’s staff.

Table 3.1 in Chapter 3.1 summarised the variables for which we required NERL-specific data. We obtained that data in the following ways:

- *Information from NERL’s internal databases.* For the majority of variables, we relied on detailed information obtained from NERL’s databases on all its employees, such as age and region of work;
- *Information from NERL staff survey.* For variables where we could not obtain relevant information from the NERL database – namely “age when completed full-time education”, “highest educational qualification” and “job related training in the last 3 months” – we relied on a survey of NERL staff. The survey covered a total of 250 employees, distributed among staff categories in roughly the same proportion as headcount figures for 2016/17;
- *Inferring NERL-specific information.* There were also some variables – namely “1- and 2-digit SICs” and “public/private sector” – which follow from employment within NERL. NERL operates in the private sector and, having assessed the SIC industry descriptions, and assumed NERL sat within the “Transportation and storage (H)” 1-digit SIC and in turn the “Air transport (51)” 2-digit SIC; and
- *Making alternative assumptions.* For variables where we did not have corresponding data on NERL staff and could not determine without additional data – namely “No. of children in household under 2” and “1-, 3- and 4-digit SOCs” – we had made alternative assumptions. Specifically, for “No. of children in household under 2”, we assumed the population mean of the LFS dataset that we used for the wage regression. In other words, we assumed that NERL staff has the same number of the children in their household

under 2 as the rest of the population. For the 1-, 3- and 4-digit SOC variables, we assumed that NERL staff reflects the range of SOCs we identified as suitable benchmark comparators in Chapter 3.2. Note in particular that for ATCOs the relevant benchmark is a specific SOC and for the rest of NERL staff the relevant benchmark is the average of all related SOC. For example, the relevant SOC for ATCOs is “Aircraft pilots and flight engineers (3512)”, whilst the relevant SOCs for MSGs are “Administrative occupations: Finance (412)”, “Office managers and supervisors (416)”, “Financial and accounting technicians (3537)”, “Financial accounts managers (3538)” and “Human resources and industrial relations officers (3562)”.

We summarise the data on NERL staff in Appendix A. As an example, Table 4.1 below summarises the distribution of NERL staff regarding the education and qualification variables, “age when completed full-time education” and “highest educational qualification” (based on survey data), as compared to the distribution of the population on average. Across all staff categories, we see that NERL staff stay in full-time education for approximately 2 to 7 years longer than the population on average, and moreover the proportion of NERL staff with degrees or equivalent is significantly higher than that for the population as a whole. All else equal, these particular characteristics of NERL staff – i.e. having higher education and qualification than the population on average – have the effect of raising NERL’s predicted market wages above that of the general economy. In other words, NERL must pay higher wages because the staff it requires tend to be more educated than the general population. NERL staff command higher wages than the general population in other professions in recognition of that education and NERL must compete with the higher wages that its staff may obtain by working elsewhere.

Moreover, as we go on to discuss in Chapter 5.3, our wage equations only rely on *observable* education variables as proxies for an individual’s ability. In practice, there are many facets to an individual’s ability and specialism that are not recorded in the data, and subsequently are not captured and compensated for by our wage equations. These facets could prove unique to NERL staff and set them apart from the rest of the population in comparison to standard educational measures alone. For instance, we understand that NERL staff – ATCOs in particular – undergo a rigorous recruitment process and several years of training to become fully licensed. There is no equivalent variable in the LFS dataset to account for multiple years of rigorous on the job training. An 18-year old out of school going through several years of training, arguably equivalent to higher education, to become licensed would have no degree qualification to show for it, which would potentially undervalue the educational ability of the individual. If we account for the additional rigorous recruitment and training process that NATS staff have to go through, then a higher proportion of NATS employees would command higher wages than the general population.

Table 4.1
NERL Staff’s Typically Have Higher Educational Qualifications than the LFS Population Mean, Which Partly Explains Higher Wages at NERL

Education/qualification variable	LFS sample mean	ATCO	ATSA	ATCE	MSG	STAR
Age completed full-time education	18.4	20.7	20.6	25.3	22.7	24.2
Highest educational qualification						
Degree or equivalent	32%	63%	44%	82%	45%	100%
Higher education	11%	7%	11%	11%	17%	0%
GCE A level or equivalent	22%	26%	30%	4%	23%	0%
GCSE grades A*-C or equivalent	21%	1%	11%	1%	6%	0%
Other qualification	8%	3%	4%	1%	6%	0%
No qualification	5%	0%	0%	0%	2%	0%
Don't know	1%	0%	0%	0%	0%	0%

Source: NERA analysis of data from NERL survey

4.2. We Compared NERL’s Predicted Market Wages with Actual Wages

Having calculated the predicted hourly wages for NERL staff, we compared these with NERL’s actual hourly wages. Using data provided by NERL, we calculated NERL staff’s actual hourly pay by first dividing the gross annual pay bill, less pensions, by the FTE headcount to obtain the annual pay per employee. We then divided this by the hours worked in a year, provided by NERL from their timesheet, to obtain NERL staff’s actual hourly wages.

Moreover, in this section we consider a 2016/17 benchmark by comparing the 2016/17 predicted wage value with the 2016/17 actual wage value for each NERL staff category. We consider 2016/17 because it is the most recent year of data we have available from both the ONS LFS and NERL.

We selected a final group of models from the original 160 models we tested as our “preferred” models. These models are a subset of the groups we described in the previous chapter in Table 3.7, namely (a) “SIC1, SOC4, Education” and (b) “SIC1, SOC4, Interaction, Education”. We chose these 2 groups of wage models as our preferred models for the following reasons:

- *Education is a key explanatory variable in the literature.* Education, in particular the highest education/qualification variable, is an important driver of pay and was included by the majority of authors we reviewed in their estimated wage equations (see Appendix

A). Moreover, the highest education variable was statistically significant²⁵ across all the wage models we estimated which included education, meaning that the estimated relationship between education and wage is not likely attributed to random chance. We therefore keep in our preferred groups of models all those models that contain education, and exclude those that do not;

- *Granular SOCs are more relevant.* As we discussed in Chapter 3.2, higher level SOCs are more relevant and may be able to explain more variation in wages. We therefore exclude from our preferred groups of models all those models that contain SOC variables that are less granular than 4-digit SOCs, leaving just “SIC1, SOC4, Education” and “SIC1, SOC4, Interaction, Education”; and
- *Selecting the final models made no systematic difference between similar specifications.* In selecting our final models, we ensured that we were not systematically over or under-estimating NERL’s pay relative to models which contained alternative but similar specifications. Our final models are therefore a representative subset of the analysis we undertook. For transparency, the results from all 160 of our models will be available on request.

Figure 4.1 to Figure 4.6 present the predicted wages for each NERL job category and NERL overall (denoted by the coloured points) relative to their actual wages (denoted by the red dotted line), for our preferred groups of wage models. These predicted wages are plotted against the “adjusted R-squared” statistic for each estimated wage equation, which measures of the goodness-of-fit²⁶ of regression models, corrected for the number of explanatory variables in the model. In general, the higher the adjusted R-squared, the more the explanatory variables in the model explain variation in the dependent variable, and so the better the model fit. However, there is no “ideal” threshold for adjusted R-squared and very high statistics close to 100 per cent may indicate “overfitting” – essentially the inclusion of irrelevant variables which have the effect of improving the model fit.

Moreover, as discussed in Chapter 3.2, for ATCOs we relied on the specific SOC comparator – namely “Aircraft pilots and flight engineers (3512)” – to derive their predicted wages, whereas for the rest of NERL staff we relied on the average of the related SOC comparators we identified from the funnel criteria. In addition, Table 4.2 summarises for each NERL staff category and NERL overall the minimum and maximum percentage of actual NERL wages predicted by our preferred models.

It is clear from Figure 4.1 to Figure 4.6 that both of our preferred groups of models – “SIC1, SOC4, Education” and “SIC1, SOC4, Interaction, Education” – are represented by a cluster of individual models, which vary by model specification. Specifically, these models reflect the sub-variations 3-5 outlined in Table 3.6, which are variations in unionisation, time and squared variables.²⁷

²⁵ At the 1% level of significance

²⁶ The proportion of the variance in the dependent variable that is explained by the explanatory variables, between 0 and 1.

²⁷ The main SIC/SOC variation and sub-variations 1 and 2 have already been covered by the high-level model groupings, i.e. “SIC1, SOC4, Education” and “SIC1, SOC4, Interaction, Education”.

Based on our results, we conclude the following about NERL’s predicted wages relative to their actual wages:

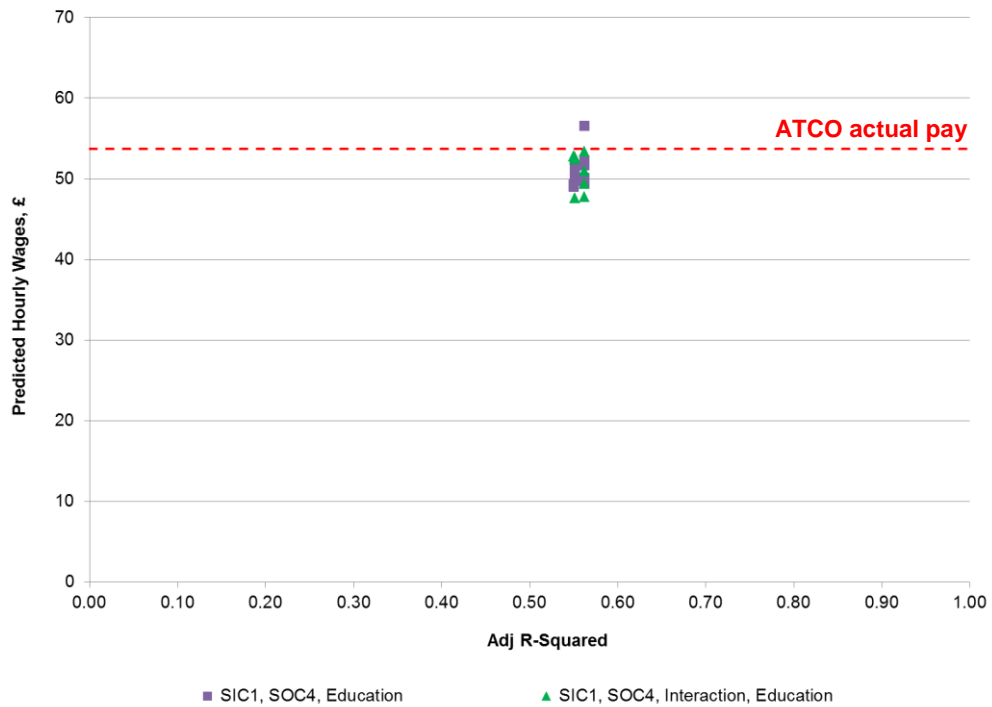
- *ATCO actual wages are **within** the range of market benchmarks.* Table 4.2 shows that our preferred models predict 89-105% of ATCO pay. Controlling for industry and occupation (by including SIC1 and SOC4 in the models) helps to explain the bulk of variation in wages for ATCOs. To a large extent, this is the result of benchmarking ATCOs against a specific SOC, namely “Aircraft pilots and flight engineers (3512)” (as described in Chapter 3.2, above). Across all the wage models we estimated which included 4-digit SOCs, the coefficient on the “Aircraft pilots and flight engineers (3512)” SOC was positive relative to the base²⁸ occupation²⁹ and was statistically significant, meaning that it has a positive impact on wages. To a lesser degree, including SIC1 in the model also explains a sizeable proportion of ATCO pay; all NERL staff fall within the “Transport and communication” industry, which exhibited positive coefficients in our models relative to the base industry³⁰;
- *ATSA actual wages are **above** the range of market benchmarks.* Unlike for ATCOs, we assumed the *average* of related SOCs as the appropriate benchmark for ATSAs and these professions are typically paid less than ATSAs and workers in the economy more generally. Overall, our preferred models predict 61-74% of ATSA pay. However, these models may underestimate ATSA’s actual pay due to difficulties in finding suitable benchmark professions that reflect the wide-ranging nature of roles within the ATSA grade;
- *ATCE actual wages are **within** the range of market benchmarks,* where we assumed the *average* of related SOCs as the appropriate benchmark for ATCEs. Our preferred models predict 85-102% of ATCE pay;
- *MSG actual wages are **slightly above** the range of market benchmarks,* where we assumed the *average* of related SOCs as the appropriate benchmark for MSGs. Our preferred models predict 81-98% of MSG pay;
- *STAR actual wages are **within** the range of market benchmarks,* where we assumed the *average* of related SOCs as the appropriate benchmark for STARS. Our preferred models predict 88-104% of STAR pay; and
- *Overall NERL staff’s actual wages are **within** the range of market benchmarks.* For NERL as a whole, we calculated the predicted wages as a weighted average of the predicted wages for individual NERL groups, weighted by the share of total pay bill of each group. Our preferred models predict 87-101% of overall NERL pay.

²⁸ A base category is always assigned to a categorical explanatory variable. This is an arbitrary category which is omitted from the regression, and forms the base against which the other categories are compared.

²⁹ The base SOC was “Chief executives and senior officials (1115)” in our models. In particular, the coefficient on “Aircraft pilots and flight engineers (3512)” was positive relative to the base SOC when virtually no other occupation was.

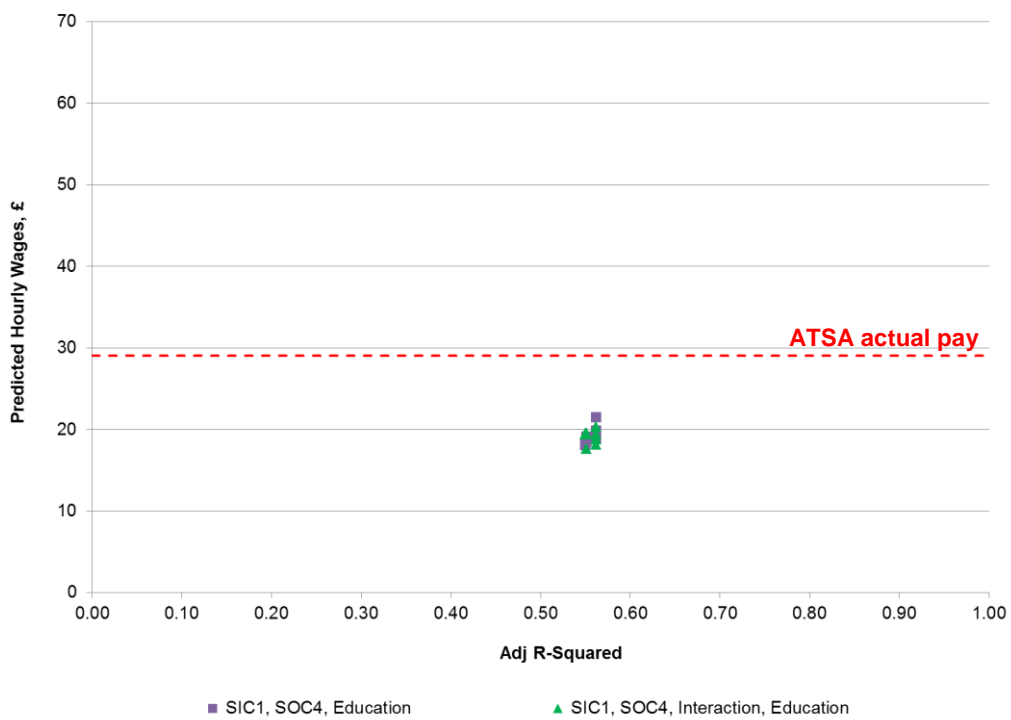
³⁰ The base SIC was “Agriculture, forestry and fishing”.

Figure 4.1
ATCO Predicted Wages Compared to ATCO Actual Wage for Our Preferred Models



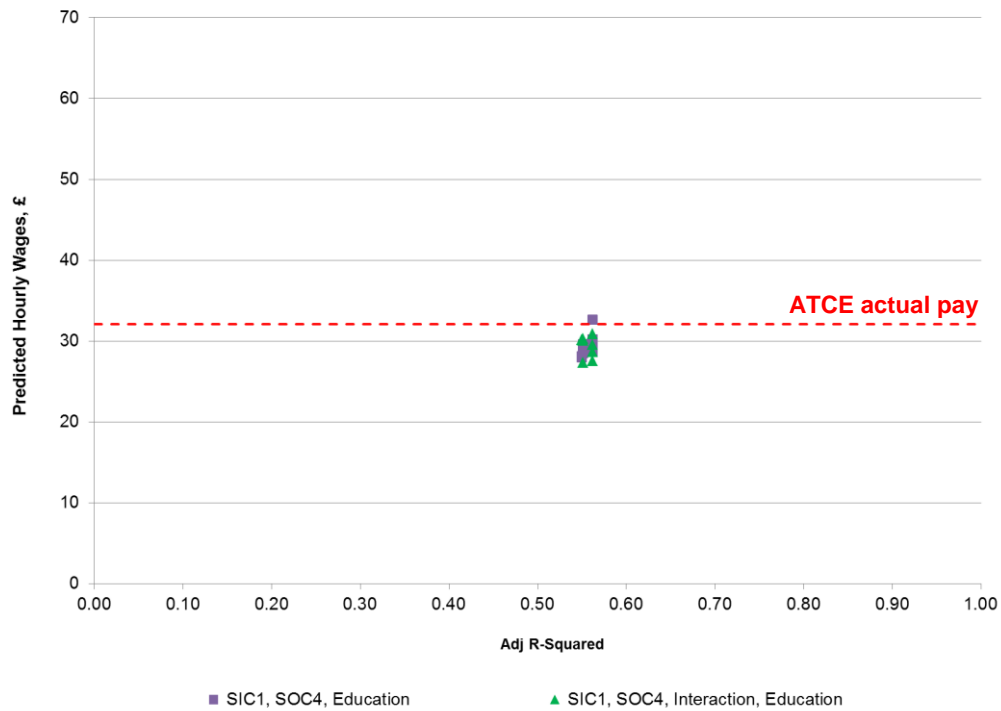
Source: NERA analysis

Figure 4.2
ATSA Predicted Wages Compared to ATSA Actual Wage for Our Preferred Models



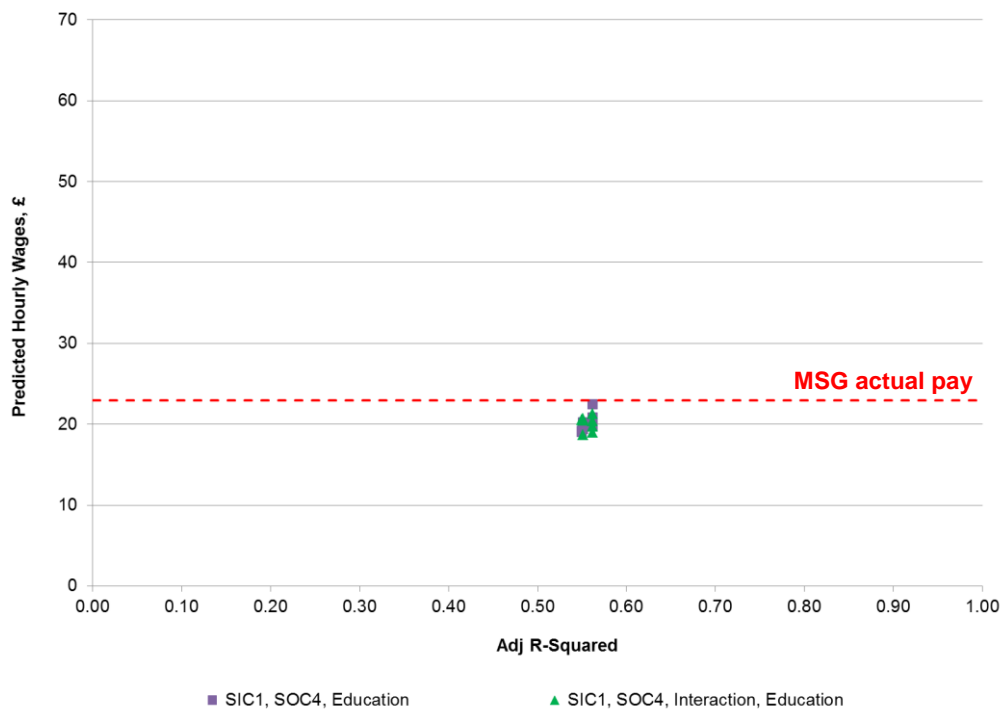
Source: NERA analysis

Figure 4.3
ATCE Predicted Wages Compared to ATCE Actual Wage for Our Preferred Models



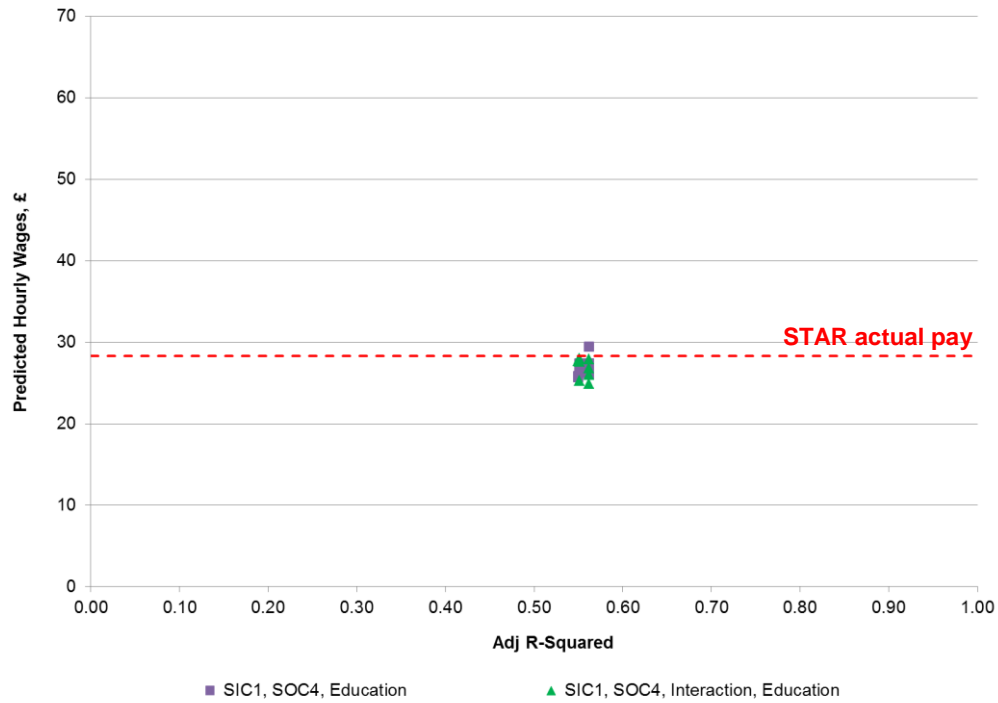
Source: NERA analysis

Figure 4.4
MSG Predicted Wages Compared to MSG Actual Wage for Our Preferred Models



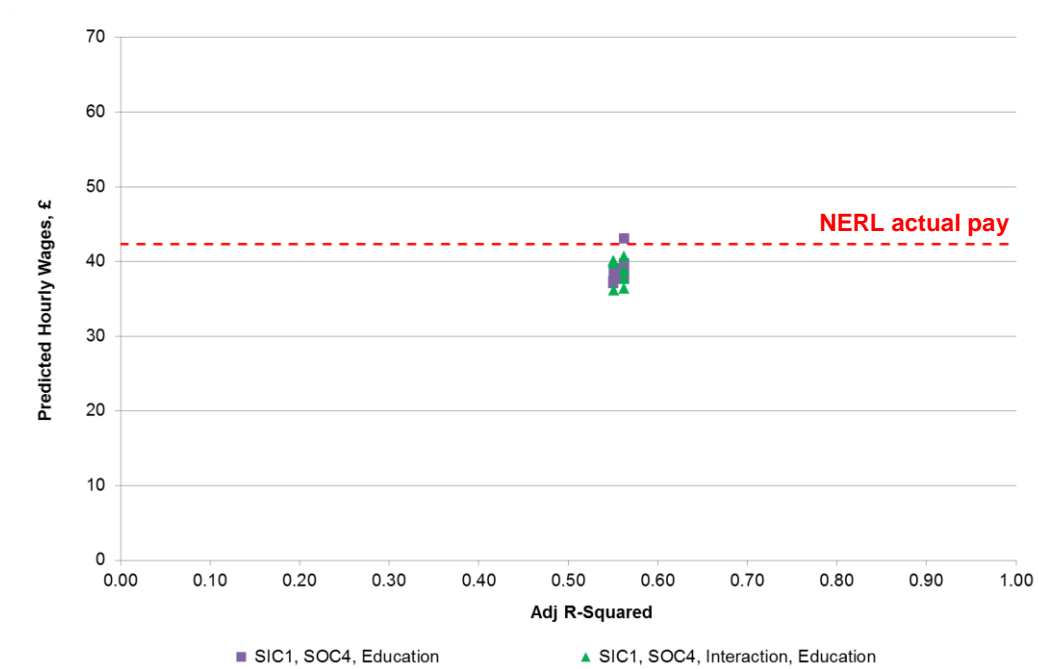
Source: NERA analysis

Figure 4.5
STAR Predicted Wages Compared to STAR Actual Wage for Our Preferred Models



Source: NERA analysis

Figure 4.6
NERL Predicted Wages Compared to NERL Actual Wage for Our Preferred Models



Source: NERA analysis

Table 4.2
Percentage of Actual NERL Wages Predicted by Our Preferred Models

	ATCO	ATSA	ATCE	MSG	STAR	NERL
Min Predicted	89%	61%	85%	81%	88%	85%
Max Predicted	105%	74%	102%	98%	104%	102%

Source: NERA analysis

4.3. Conclusion

NERL's staff undertake highly specific, frequently highly-trained jobs requiring skills which pay a premium over average wages in the general economy. Our preferred models attempt to control for the activities that NERL's staff undertake, obtained by a process of job-matching using detailed job descriptions for NERL staff with those set out in the ONS methodology statements. This process of job matching requires detailed review of the tasks undertaken and comparative analysis of job descriptions in a manner that is necessarily somewhat subjective.

Even within highly specific fourth-level SOCs, wages vary widely across individual staff members. In terms of model fit, our models including detailed SOCs typically explain around 60 per cent of the variation in wages (as captured by the adjusted R-squared³¹ figure). This figure compares well with many wage equations in the literature. The remaining 40 per cent represents omitted explanatory variables from our analysis. Those omitted variables, likely unobservable, if included could well explain the difference between NERL's actual wages and our estimated wages, which we find is much smaller than 40 per cent.³² It is not therefore realistic to anticipate that any econometric analysis would exactly and uniquely explain NERL's total wage levels.

However, our modelling suggests that at NERL's staff wages are broadly in line with market benchmarks. Our preferred models, which attempt to control for similar job descriptions, include results which exceed NERL's wage levels for most categories of staff.

³¹ The proportion of the variance in the dependent variable that is explained by the explanatory variables, between 0 and 1.

³² Intuitively, if the unexplained variation was 40 per cent but we were already predicting 90 per cent of NERL's level of actual wages, then by adding omitted variables we could possibly close the gap. On the other hand, if the unexplained variation were 1 per cent but we were predicting only 60 per cent of the level of actual wages, by adding omitted variables we could not possibly close the gap – there is only 1 per cent more to explain after all.

5. Our Results Omit “Special Factors” Which Also Drive Wages

Our alternative bottom-up approach using wage equations represents a significant improvement upon IDS’s simple job-matching method at RP2. In particular, the wage equations approach allows us to control for a wider set of explanatory variables to simple occupation, thereby reducing any wage variation caused by factors other than inefficiency (i.e. omitted variables).

In practice, however, no wage equation can capture all the factors that drive an individual’s pay. Even our current wage models do not account for all the factors that drive NERL staff’s wages. There may be a number of “special” or “omitted” factors – which have material impact on NERL’s wages – but are not captured in the current models. A post-modelling consideration of these special factors may be necessary, and if material then an adjustment may be required.

An analysis of special factors invariably accompanies econometric benchmarking assessments used in regulatory processes. Ofgem and Ofwat, for instance, consider special cost factors in addition to cost benchmarking models in their electricity, gas and water price control reviews as a way of adjusting the modelled costs for factors not captured in the modelling.³³

In the case of NERL’s pay and the wage equations we estimated – and based on discussions with NERL – we believe that at a minimum, the following special factors appear relevant, and therefore a post-modelling adjustment should be made to NERL’s wages:

- *Non-liquid market for specialist staff.* Our wage models did not consider the liquidity of the market for NERL staff on pay. In practice, the market for ATCOs and ATSAs is not very liquid, with difficulties and long lead times in external recruitment. In order to support high retention of existing ATCOs and ATSAs, NERL must justifiably pay them a higher wage;
- *Highly unionised industry.* Our wage equations control for union influence through “trade union membership” and “pay affected by union agreements”. However, union influence implies more than simple union participation and penetration rates. In practice, union influence is stronger at NERL than many other workplaces due to the disruptive effect and cost associated with strikes;
- *Impact of education and training.* Our wage equations relied on education and recent job-related training as proxies for the ability and specialism (respectively) of the individual. In practice, the ability and specialism of NERL staff are better captured by the rigorous recruitment and training process they have to go through, which is not compensated for by our wage equations; and

³³ Ofgem (2014). “*RIIO-ED1: Final determinations for the slow-track electricity distribution companies. Business plan expenditure assessment*”.

Ofgem (2012). “*RIIO-GD1: Final Proposals – Overview*”.

Ofwat (2013). “*Setting price controls for 2015-2020 – final methodology and expectations for companies’ business plans*”.

- *Pay for inconvenience and shift patterns.* Our wage equations did not take into account the impact of shift work on pay. In practice, compared to most professional jobs which offer regular working hours, NERL staff work shifts, including night shifts, and may justifiably demand a premium for their unusual working hours.

We discuss and present evidence in support of each of these special factors in the following sections.

5.1. Non-Liquid Market for ATCOs

Our wage models did not account for the liquidity of the market for NERL staff on pay. Liquidity of a market refers to the ease with which an asset can be bought or sold without having undue impact on prices. In the context of the job market, a liquid market implies that it is relatively quick and easy to match suitable candidates with employment.

In practice, the market for specialist NERL staff – particularly ATCOs and ATSAs – is not very liquid. We understand from NERL that:

- It can be difficult to recruit qualified ATCOs and ATSAs externally. In particular, the global growth in air traffic is driving demand for skilled air traffic controllers and assistants, such that there is excess ANSPs competing for limited skilled staff; and
- Even if NERL is able to find suitable qualified candidates there are long lead times before they can begin work operationally, as they undertake additional education and training to be familiar with the NERL ATM systems.

For instance, NERL shared one case with us in which NERL had advertised externally to recruit ATCOs in the summer of 2016 to help ease a shortfall in supply. Whilst NERL successfully recruited one ATCO who had previously worked for NERL, it took that ATCO c.12 months to regain an operational licence. NERL also interviewed 12 ATCOs who held a valid Approach rating. NERL made offers to 2 of the 12 candidates, but estimate that it will take c.18-21 months for those candidates to become operationally valid. Although systematic evidence suitable for quantifying the impact of an illiquid labour market is not available, this anecdote evidence illustrates the difficulties and lead times in the hiring process for ATCOs.

Given the non-liquid market for specialist staff, and in particular the difficulties associated with the external recruitment process, NERL trains almost all their operational staff ab initio and must therefore set wages at a level that supports high retention of staff. Of course, we also recognise that once ATCOs are fully trained, there are more limited opportunities for them to go elsewhere (i.e. ATCOs essentially become “captive” employees), which work in the opposite direction to depress wages. However, the latter effect would be unlikely to dominate given the high degree of unionisation at NERL.

5.2. Highly Unionised Industry

Our wage equations control for union influence through the inclusion of explanatory variables “trade union membership” and “pay affected by union agreements”. However, union influence implies more than simple union participation and penetration rates. Two trade unions, for instance, could have the same membership rates, but have very different

union strength and bargaining powers – and therefore very different abilities to attain desired improvements to employment conditions – owing to additional relevant factors.

In the case of NERL, one factor in explaining why NERL may have stronger union influence than other workplaces can be attributed to the disruptive effect of any strike action it may take.

An air traffic control strike would result in severe disruptions, including flight cancellations and delays, affecting flights travelling in and out of the airspace as well as flights traveling across the airspace. Moreover, strikes have a knock-on effect. The impact would not only be limited to the state where the strike occurs, but also in neighbouring states, as the strike forces flights to take alternative routes to avoid the affected airspace, which in turn cause spill-over disruptions in adjacent airspaces.

In addition, unlike other unionised sectors (which also have the potential to undertake industrial action) the impact of ATC strikes can be felt before and after the official strike day/s, as flights may have to be cancelled proactively in advance and accumulated delays may spill over to the next day. According to Airlines for Europe (A4E), between 2010 and 2016 there have been a total of 117 separate ATC strikes in the EU, culminating in 217 days of strikes and 278 days of disruption.³⁵ The overall impact of these strikes has cost €12bn to the EU economy.³⁶

The disruptive and costly impact of industrial strike action may help justify the high degree of union influence at NERL, giving union members more bargaining power when it comes to pay negotiations. Indeed, NERL ATC has not had a strike in recent decades..

5.3. Impact of Education and Training

Our wage equations relied on education variables (i.e. “age when completed full time education” and “highest qualification”) as proxies for the *ability* of the individual – a factor which is not directly observed in the data. Likewise, we relied on the training variable “job related training in the last 3 months” as a proxy for the *specialism* of NERL staff.

In practice, there are many facets to an individual’s *ability* and *specialism* that are not recorded in the data, and subsequently are not captured and compensated for by our wage equations. These facets could prove unique to NERL staff and set them apart from the rest of the population.³⁷ For instance, we understand from NERL that ATCOs in particular are highly skilled and highly specialised individuals, but that these dimensions may not be best captured by educational attainment or our crude training metric alone, as we discuss in turn.

³⁵ A4E. Link: <https://a4e.eu/air-traffic-control-strikes-have-cost-e12-billion-to-the-eu-economy-in-seven-years/>

³⁶ Although we understand that a joint study by the Air Traffic Controllers European Unions Coordination (ATCEUC) and the European Transport Workers’ Federation (ETF) sought to debunk some of A4E’s conclusions. Link: <http://www.etf-europe.org/files/extranet/-/75/47110/Study%20on%20efficiency%20capacity%20and%20growth%20in%20European%20aviation.pdf>

³⁷ NATS website: <https://nats.aero/blog/2016/08/infographic-becoming-an-air-traffic-controller-2/>

Consider education first. In the field of air traffic control, having a university degree does not qualify a possible candidate as possessing the necessary skills and abilities required to become an ATCO. Rather, being an ATCO requires a unique set of qualities, which is best captured via the demanding recruitment process potential candidates have to go through. The recruitment process for ATCOs is a highly rigorous process, which is used to identify the most suitable candidates for the job. It has a focus on “sifting” potential candidates based on a series of online assessments, computer assessments and interviews:

- *Stage 1: Initial Online Assessments.* These are generic psychometric tests, such as numerical, verbal and non-verbal reasoning, used to determine whether the applicants have the basic knowledge and skills;
- *Stage 2: Computer Assessments.* These are deeper assessments into whether applicants have the necessary cognitive skill that are essential for air traffic controllers. Assessments at this stage include the FEAST test (designed by EUROCONTROL), which is used to assess the applicants abilities in decision-making, logical reasoning, visual perception, attention, multi-tasking and spatial orientation. In addition, applicants have to complete case studies on ATC planning (FEAST DART) and a test that identifies personality traits; and
- *Stage 3: Interviews.* Applicants undergo a series of competency interviews and scenarios tests.

As we can see from Table 5.1 below, the success rate of applicants who make it past the interview stage is extremely low. Out of an average of 3,300 applicants, only 20 make it past the interview stage; that is 0.6% of applicants. Moreover, we understand from NERL that the rigour of the recruitment process places successful candidates at the upper end of people who have degrees in the general population.

Table 5.1
ATCO Validation Process and Success Rate of Applicants

Stage	Successful Applicants at Each Stage
Total no. of applicants	3,300
Stage 1: Initial online assessment	3,300
Stage 2: Computer assessment	1,700
Stage 3: Interview	120
Stage 4: Training	20
No. of applicants validated	15

Source: NERL infographic “Becoming an air traffic controller”.

Next, consider training. Once successful candidates are through the interview stage, they have to undertake a long and detailed training process (Stage 4) to gain specialisation in the area of air traffic controller and to become fully licenced air traffic controllers. This aspect again is not recorded or compensated for by our wage equations.

As part of the training process, applicants have to take a combination of college and on-the-job training. This includes 9 to 12 months of initial training to obtain the Student ATC License, which is followed by 12 to 21 months of unit training to obtain the full ATC Licence. NERL has also collaborated with Kingston University to allow students an option of achieving an Honours Degree in Aviation Studies and a Student ATC Licence in 3 years of

full time study, or a Foundation Degree in Air Traffic Management in 2 years of full time study. As shown in Table 5.1, only 15 applicants are successfully validated as ATCs after the training stage; that is 0.5% of total applicants. Even after obtaining their licence, ATCOs undergo continual training and assessment to refresh their knowledge and understanding and to sharpen their intellectual and practical capabilities.

The rigour and length of these training programmes reflect the safety-critical nature of ATCOs’ role. Indeed, few occupations in the general population require this degree of training and specialism, which places ATCOs in the upper end of the general population in terms of this characteristic.

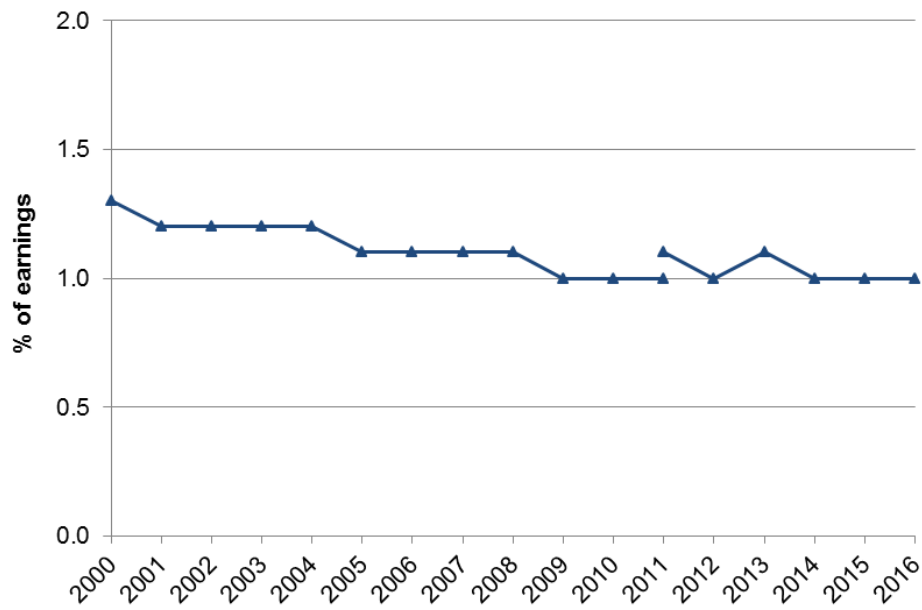
5.4. Pay for Inconvenience and Shift Patterns

Our wage equations did not explicitly take into account the impact of shift work (i.e. working non-regular hours, such as weekends or nights) on pay. In practice, whilst employees in most professional jobs work regular hours, NERL staff (ATCOs and ATSAs in particular) tend to work shifts, and may justifiably demand a premium for their unusual working hours.

According to the ONS, the shift premium for all full-time employees in the UK has remained consistently around 1.0-1.1% in recent years, as shown in Figure 5.1 below. However, this figure captures only the average shift premium in the general economy. In practice, shift premiums could differ depending on the type of profession (and also the nature of the shift work). For example, the average shift premium could be distorted by the presence of lower-skilled jobs in the general economy. Given that lower-skilled occupations tend to command lower premiums for inconvenient working hours, the average shift premium could be underestimating the premiums for higher-skilled occupations within NERL. We are not able to obtain the breakdown of shift premiums by occupation in the public domain, and so do not know where exactly in the distribution of shift premiums NERL staff sit.

However, whilst we do not explicitly control for shift work in our wage equations, we do control for it implicitly where we benchmark NERL jobs against comparator occupations which may also involve some shift work. For instance, by benchmarking ATCOs against “Aircraft pilots and flight engineers” – who also happen to work shifts – we implicitly pick up the impact of shift work on ATCO pay.

Figure 5.1
Shift Premium as a Proportion of Mean Full-Time Gross Weekly Earnings (2000-2016)



Source: ONS "ASHE 1997 to 2017 selected estimates"

Appendix A. Review of Economic Literature

Paper	Country	Time Period	Dependent variables			Explanatory variables															
						Individual demographics						Human capital characteristics									
			Log hourly pay	Log weekly pay	Log annual pay	Age	Age-sq	Gender	Marital Status	Ethnicity	Immigrant	Mother tongue	Significant health problems/disability	Years of education	Years of education - sq	Education field	(Highest) Qualification	(Potential) Experience	(Potential) Experience-sq	Years at current job (tenure)	Years at current job (tenure) - sq
NERA (2010)	UK	2006-2009Q3	Yes			Yes	Yes	Yes		Yes						Yes			Yes		
Blanchflower and Oswald (1994)	UK	1973-1990		Yes				Yes	Yes	Yes						Yes	Yes	Yes			
Maczulskij (2013)	FIN	1990-2004			Yes			Yes	Yes				Yes		Yes		Yes	Yes	Yes	Yes	
Oaxaca (1973)	US	1967	Yes					Yes	Yes	Yes		Yes	Yes			Yes	Yes				
Hartog and Oosterbeek (1993)	NL	1983	Yes					Yes	Yes				Yes			Yes	Yes	Yes			Yes
Mueller (1998)	CA	1990	Yes			Yes		Yes	Yes	Yes	Yes	Yes			Yes			Yes			
Nandi and Nicoletti (2014)	UK	2005	Yes									Yes			Yes	Yes	Yes				Yes
Olsen and Walby (2004)	UK	2001-2002	Yes			Yes		Yes	Yes	Yes		Yes	Yes					Yes			Yes

Paper	Explanatory variables ctd.																											
	Job characteristics											Household/family characteristics					Other											
	Industry	Occupation	Public sector/ private sector	Part-time/ full-time	Temporary job	Region of work	Years of full-time employment	Years of part-time employment	Years of past unemployment	Basic total hours/ hours worked	Firm size/ no. of employees	Union membership	Time travelling to work	Job level	Job-related pension	Years out for child/family care	Gender segregation in occupation	Region of residence	No. of children in household	No. of siblings	Father's occupation	Education of father	Education of mother	Household head	Household income	Size of urban area of residence	Year	Personality traits
NERA (2010)	Yes					Yes			Yes																		Yes	
Blanchflower and Oswald (1994)	Yes			Yes		Yes																					Yes	
Maczulskij (2013)	Yes		Yes			Yes												Yes									Yes	
Oaxaca (1973)	Yes	Yes		Yes		Yes					Yes							Yes							Yes			
Hartog and Oosterbeek (1993)									Yes				Yes						Yes	Yes	Yes	Yes	Yes					
Mueller (1998)		Yes	Yes	Yes						Yes	Yes			Yes				Yes						Yes				
Nandi and Nicoletti (2014)		Yes	Yes	Yes	Yes	Yes		Yes		Yes																	Yes	
Olsen and Walby (2004)	Yes		Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes			Yes	Yes		Yes						Yes				

Appendix B. Detailed Summary of Job Descriptions of NERL Staff and Relevant SOC

ATCO

SOC	Comparator	General Description	Key Skills/Attributes	Emergency response/safety critical tasks	Directing/coordinating transport movement	Transport-specific communication	Obtaining information/monitoring/performing tests
ATCO	ATCO	Air traffic controllers prepare flight plans, authorise flight departures and arrivals and maintain radio, radar and/or visual contact with aircraft to ensure the safe movement of air traffic.	<ul style="list-style-type: none"> - maintains radio and/or radar or visual contact with aircraft and liaises with other air traffic controllers and control centres to direct aircraft in and out of controlled airspace and into holding areas ready for landing; - directs the movement of aircraft en route to its destination and ensures minimum distances are maintained between planes; - gives landing instructions to pilot and monitors descent of aircraft; - directs movement of aircraft and motor vehicles on runways, taxiways and in parking bays; - obtains information regarding weather conditions, navigational hazards, landing conditions, seating arrangements, loading of cargo, fuel and catering supplies; - calculates fuel consumption and optimum flying height, plans route and prepares flight plan for aircraft pilot; - discusses operational requirements with pilot, issues duty schedules for flight deck and cabin crews, maintains records of flight progress and authorises flight departure; - handles emergencies, unscheduled traffic and other unanticipated incidents. 	<ul style="list-style-type: none"> - handles emergencies, unscheduled traffic and other unanticipated incidents. 	<ul style="list-style-type: none"> - directs the movement of aircraft en route to its destination and ensures minimum distances are maintained between planes; - gives landing instructions to pilot and monitors descent of aircraft; - directs movement of aircraft and motor vehicles on runways, taxiways and in parking bays; 	<ul style="list-style-type: none"> - maintains radio and/or radar or visual contact with aircraft and liaises with other air traffic controllers and control 	<ul style="list-style-type: none"> - obtains information regarding weather conditions, navigational hazards, landing conditions, seating arrangements, loading of cargo, fuel and catering supplies; - calculates fuel consumption and optimum flying height, plans route and prepares flight plan for aircraft pilot;
2211	Medical practitioners	Medical practitioners diagnose mental and physical injuries, disorders and diseases, prescribe and give treatment, recommend preventative action, and conduct medical education and research activities. They may specialise in particular areas of modern medicine or work in general practice and, where necessary, refer the patient to a specialist.	<ul style="list-style-type: none"> - examines patient, arranges for any necessary x-rays or other tests and interprets results; - diagnoses condition and prescribes and/or administers appropriate treatment/surgery; - administers medical tests and inoculations against communicable diseases; - supervises patient's progress and advises on diet, exercise and other preventative action; - refers patient to specialist where necessary and liaises with specialist; - prepares and delivers lectures, undertakes research, and conducts and participates in clinical trials; - supervises the implementation of care and treatment plans by other healthcare providers. 	<ul style="list-style-type: none"> - examines patient, arranges for any necessary x-rays or other tests and interprets results; - diagnoses condition and prescribes and/or administers appropriate treatment/surgery; - administers medical tests and inoculations against communicable diseases; 	<ul style="list-style-type: none"> - refers patient to specialist where necessary and liaises with specialist; - supervises the implementation of care and treatment plans by other healthcare providers. 	<ul style="list-style-type: none"> - prepares and delivers lectures, undertakes research, and conducts and participates in clinical trials; 	<ul style="list-style-type: none"> - examines patient, arranges for any necessary x-rays or other tests and interprets results; - diagnoses condition and prescribes and/or administers appropriate treatment/surgery; - supervises patient's progress and advises on diet, exercise and other preventative action;

3313	Fire service officers (watch manager and below)	Workers in this unit group co-ordinate and participate in fire fighting activities, provide emergency services in the event of accidents or bomb alerts, and advise on fire prevention.	<ul style="list-style-type: none"> - inspects premises to identify potential fire hazards and to check that fire fighting equipment is available and in working order and that statutory fire safety regulations are met; - arranges fire drills and tests alarm systems and equipment; - travels to fire or other emergency by vehicle and locates water mains if necessary; - operates hose pipes, ladders, chemical, foam, gas or powder fire extinguishing appliances; - rescues people or animals trapped by fire and administers first aid; - removes goods from fire damaged premises, clears excess water, makes safe any structural hazards and takes any other necessary steps to reduce damage to property; - attends and deals with bomb alerts and accidents involving spillage of hazardous substances; - advises on fire safety measures in new buildings; - supervises a watch. 	<ul style="list-style-type: none"> - attends and deals with bomb alerts and accidents involving spillage of hazardous substances; - operates hose pipes, ladders, chemical, foam, gas or powder fire extinguishing appliances; - rescues people or animals trapped by fire and administers first aid; 	<ul style="list-style-type: none"> - travels to fire or other emergency by vehicle and locates water mains if necessary; 		<ul style="list-style-type: none"> - arranges fire drills and tests alarm systems and equipment; - inspects premises to identify potential fire hazards and to check that fire fighting equipment is available and in working order and that statutory fire safety regulations are met;
3512	Aircraft pilots and flight engineers	Aircraft flight deck officers check, regulate, adjust and test engines and other equipment prior to take-off, navigate and pilot aircraft and give flying lessons.	<ul style="list-style-type: none"> - studies flight plan, discusses it with flight deck crew and makes any necessary adjustments; - directs or undertakes routine checks on engines, instruments, control panels, cargo distribution and fuel supplies; - directs or undertakes the operation of controls to fly aeroplanes and helicopters, complying with air traffic control and aircraft operating procedures; - monitors fuel consumption, air pressure, engine performance and other indicators during flight and advises pilot of any factors that affect the navigation or performance of the aircraft; - maintains radio contact and discusses weather conditions with air traffic controllers; - performs specified tests to determine aircraft's stability, response to controls and overall performance; - accompanies pupil on training flights and demonstrates flying techniques. 	<ul style="list-style-type: none"> - directs or undertakes the operation of controls to fly aeroplanes and helicopters, complying with air traffic control and aircraft operating procedures; - accompanies pupil on training flights and demonstrates flying techniques. 	<ul style="list-style-type: none"> - directs or undertakes the operation of controls to fly aeroplanes and helicopters, complying with air traffic control and aircraft operating procedures; 	<ul style="list-style-type: none"> - maintains radio contact and discusses weather conditions with air traffic controllers; 	<ul style="list-style-type: none"> - monitors fuel consumption, air pressure, engine performance and other indicators during flight and advises pilot of any factors that affect the navigation or performance of the aircraft; - performs specified tests to determine aircraft's stability, response to controls and overall performance; - studies flight plan, discusses it with flight deck crew and makes any necessary adjustments; - directs or undertakes routine checks on engines, instruments, control panels, cargo distribution and fuel supplies;
3513	Ship and hovercraft officers	Ship and hovercraft officers command and navigate ships and other craft, co-ordinate the activities of officers and deck and engine room ratings, operate and maintain communications equipment on board ship and undertake minor repairs to engines, boilers and other mechanical and electrical equipment.	<ul style="list-style-type: none"> - allocates duties to ship's officers and co-ordinates and directs the activities of deck and engine room ratings; - directs or undertakes the operation of controls to inflate air cushions, run engines and propel and steer ships, hovercraft and other vessels; - locates the position of vessel using electronic and other navigational aids such as charts and compasses and advises on navigation where appropriate; - monitors the operation of engines, generators and other mechanical and electrical equipment and undertakes any necessary minor repairs; - maintains radio contact with other vessels and coast stations; - prepares watch keeping rota and maintains a look-out for other vessels or obstacles; - maintains log of vessel's progress, weather conditions, conduct of crew, etc. 	<ul style="list-style-type: none"> - prepares watch keeping rota and maintains a look-out for other vessels or obstacles; 	<ul style="list-style-type: none"> - directs or undertakes the operation of controls to inflate air cushions, run engines and propel and steer ships, hovercraft and other vessels; - locates the position of vessel using electronic and other navigational aids such as charts and compasses and advises on navigation where appropriate; - allocates duties to ship's officers and co-ordinates and directs the activities of deck and engine room ratings; 	<ul style="list-style-type: none"> - maintains radio contact with other vessels and coast stations; 	<ul style="list-style-type: none"> - monitors the operation of engines, generators and other mechanical and electrical equipment and undertakes any necessary minor repairs; - prepares watch keeping rota and maintains a look-out for other vessels or obstacles; - maintains log of vessel's progress, weather conditions, conduct of crew, etc.

8124	Energy plant operatives	Job holders in this unit group operate boilers to produce hot water or steam and attend and operate compressors, turbines, electrical substations, switchboards and auxiliary plant and machinery to fuel nuclear reactors, drive blowers and pumps, electricity generators and other equipment.	<ul style="list-style-type: none"> - determines job requirements from switchboard attendant or operating instructions; - opens valves and operates controls to regulate the flow of fuel to boiler or generating equipment; - operates remote control panel to load fuel and remove discharged fuel elements from nuclear reactors; - adjusts controls to maintain correct running speed of turbine or generator and monitors temperature and pressure controls on boilers; - records instrument readings periodically and shuts down turbine/generator or boiler as demand decreases; - carries out minor maintenance tasks and prescribed tests and reports any faults. 	<ul style="list-style-type: none"> - operates remote control panel to load fuel and remove discharged fuel elements from nuclear reactors; 			<ul style="list-style-type: none"> - carries out minor maintenance tasks and prescribed tests and reports any faults.
8231	Train and tram drivers	Job holders in this unit group drive diesel, diesel-electric, electric and steam locomotives that transport passengers and goods on surface and underground railways, and transport passengers in trams.	<ul style="list-style-type: none"> - checks controls, gauges, brakes and lights before start of journey and studies route, timetable and track information; - checks safety equipment, regulates the heating of passenger compartments and records engine defects or unusual incidents on the journey; - starts train or tram when directed and operates controls to regulate speed; - watches for track hazards, observes signals and temperature, pressure and other gauges; - stops as directed to allow passengers to embark/ disembark; - makes scheduled stops for the loading and unloading of freight and coupling/uncoupling of carriages and tubs; - maintains radio contact with control centre; - may make passenger announcements and controls automatic doors; - may check travel passes, collect fares and deal with passenger queries. 	<ul style="list-style-type: none"> - checks safety equipment, regulates the heating of passenger compartments and records engine defects or unusual incidents on the journey; - watches for track hazards, observes signals and temperature, pressure and other gauges; 	<ul style="list-style-type: none"> - starts train or tram when directed and operates controls to regulate speed; 	<ul style="list-style-type: none"> - maintains radio contact with control centre; 	<ul style="list-style-type: none"> - checks controls, gauges, brakes and lights before start of journey and studies route, timetable and track information;
8232	Marine and waterways transport operatives	Marine and waterways transport operatives supervise and carry out a variety of deck duties and operate and maintain engines, boilers and mechanical equipment on board ships, boats and other marine vessels.	<ul style="list-style-type: none"> - ensures that necessary fuel supplies are on board and inspects engine, boilers and other mechanisms for correct functioning; - removes and repairs or replaces damaged or worn parts of plant and machinery and ensures that engine and plant machinery are well lubricated; - stows cargo, assists passengers to embark and disembark, watches for hazards and moors or casts off mooring ropes as required; - steers ship, under the supervision of a duty officer, checks navigational aids and keeps bridge, wheel and chartroom clean and tidy; - performs other deck duties, including servicing and maintaining deck gear and rigging, splicing wire and fibre ropes, greasing winches and derricks, opening up and battening down hatches, securing gangways and ladders and lowering and raising lifeboats. 	<ul style="list-style-type: none"> - stows cargo, assists passengers to embark and disembark, watches for hazards and moors or casts off mooring ropes as required; 	<ul style="list-style-type: none"> - steers ship, under the supervision of a duty officer, checks navigational aids and keeps bridge, wheel and chartroom clean and tidy; 		<ul style="list-style-type: none"> - ensures that necessary fuel supplies are on board and inspects engine, boilers and other mechanisms for correct functioning; - removes and repairs or replaces damaged or worn parts of plant and machinery and ensures that engine and plant machinery are well lubricated;

8233	Air transport operatives	Air transport operatives refuel, load and unload aircraft, direct the movement of aircraft at airports, and position gangways or staircases to allow passengers to board and disembark aircraft.	<ul style="list-style-type: none"> - refuels aircraft from mobile tankers; - directs the ground movement of aircraft at airports; - loads and unloads conveyor belts to transport luggage between terminal buildings and aircraft, monitors conveyor belts and clears any blockages; - loads aircraft with luggage, in-flight meals, refreshments and other items; - operates retractable gangway or positions mobile staircases to enable passengers and crew to board and disembark aircraft. 		- directs the ground movement of aircraft at airports;		
8234	Rail transport operatives	Rail transport operatives assist drivers in the operation of passenger and goods trains, drive locomotive engines in coal mines, guide wagons and coaches in marshalling yards and sidings to make up trains, operate signals and points to control the movement of rail traffic, and monitor the operation of surface and underground railways.	<ul style="list-style-type: none"> - provides crews for breakdown trains, allocates relief and replacement crews as necessary, keeps crews informed of any line repairs or restrictions, and checks train running times for punctuality; - examines schedules and decides priority of movement of trains, monitors movement of trains and issues instructions to drivers, signal operatives and level crossing keepers; - operates signals and opens and closes barriers at level crossings as required; - examines shunting instructions, uncouples wagons and coaches, guides movement of carriages using manual points and wagon breaks, links-up carriages, ensures security of couplings and reconnects brake and heating systems; - assists drivers in the operation of diesel, diesel-electric, electric and steam locomotives; - checks loading of tubs and carriages, and informs driver of load distribution and any special features of route. 	<ul style="list-style-type: none"> - examines shunting instructions, uncouples wagons and coaches, guides movement of carriages using manual points and wagon breaks, links-up carriages, ensures security of couplings and reconnects brake and heating systems; 	<ul style="list-style-type: none"> - provides crews for breakdown trains, allocates relief and replacement crews as necessary, keeps crews informed of any line repairs or restrictions, and checks train running times for punctuality; - examines schedules and decides priority of movement of trains, monitors movement of trains and issues instructions to drivers, signal operatives and level crossing keepers; - operates signals and opens and closes barriers at level crossings as required; - assists drivers in the operation of diesel, diesel-electric, electric and steam locomotives; 		<ul style="list-style-type: none"> - examines shunting instructions, uncouples wagons and coaches, guides movement of carriages using manual points and wagon breaks, links-up carriages, ensures security of couplings and reconnects brake and heating systems; - checks loading of tubs and carriages, and informs driver of load distribution and any special features of route.

ATSA

SOC	Comparator	General Description	Key Skills/Attributes	Developing strategy	Leadership/advice	Secretarial/clerical duties	Human resources/training	Health and safety
ATC T&S/ ATSA 4	Watch Supervisor (WAS)/ Deputy Watch Supervisor (DWAS)	<p>WAS is responsible for providing an optimal Operational Support Staff service within the AC and TC operations through direct leadership of the Operational Management Teams. Define the future Support Staff requirements for the Swanwick Operations rooms whilst ensuring its alignment to business direction.</p> <p>The DWAS, alongside the WAS, is accountable for the provision of the ATSA operational service and to assist with the management of both Ops rooms to optimise safety, service delivery and training. The DWAS will be required to deputise for the WAS, when required operationally, and act as part of a cohesive watch management team.</p>	<ul style="list-style-type: none"> - Provide Proactive leadership of operational Support Staff. Ensure high quality service provision through performance management and a constant focus on safety, service and value. - Accountable for the effective rostering and tactical deployment of ATSAs in AC, TC and FPRS through service-focused rosters, annual leave planning and training/development programmes that delivers optimum operational resourcing. - Accountable for the provision of on-the-job training for operational Support Staff, ensuring training needs are met across both Ops rooms. Manage the effective use and development of the Support Staff AOPA Scheme. - Responsible for ensuring the Support Staff business objectives and section budget are met and that opportunities to fully optimise efficiency and cost effectiveness are considered and implemented - Accountable for the provision of expert advice to the Operational Supervisor in the event of a NAS/NAS Link failure. Direct and manage the consequential Support Staff activity so that the impact of a failure is minimised. - Responsible for engagement of PCS in operational Support Staff strategy and Support Staff Industrial Relations across the Operations, ensuring Working Together principles are followed. Provide expert knowledge and leadership in all PCS negotiations linked to operational support staff. - Define future Support Staff requirements that meet Swanwick service, performance, cost and efficiency requirements. Work with key stake holders across the business to ensure, where possible, alignment and efficiencies. - Develop, maintain and disseminate all relevant data, systems and supporting documentation, ensuring that users and recipients understand usage and application. - Manage the safe and effective operation of the FIS and FPRS in service of optimum service delivery. - Review, analyse and progress operational safety issues filed by Support Staff so that safety performance is improved and lessons-learned are captured. 	<ul style="list-style-type: none"> - Responsible for ensuring the Support Staff business objectives and section budget are met and that opportunities to fully optimise efficiency and cost effectiveness are considered and implemented - Define future Support Staff requirements that meet Swanwick service, performance, cost and efficiency requirements. Work with key stake holders across the business to ensure, where possible, alignment and efficiencies. - Develop, maintain and disseminate all relevant data, systems and supporting documentation, ensuring that users and recipients understand usage and application. 	<ul style="list-style-type: none"> - Provide Proactive leadership of operational Support Staff. Ensure high quality service provision through performance management and a constant focus on safety, service and value. - Accountable for the provision of expert advice to the Operational Supervisor in the event of a NAS/NAS Link failure. Direct and manage the consequential Support Staff activity so that the impact of a failure is minimised. - Responsible for engagement of PCS in operational Support Staff strategy and Support Staff Industrial Relations across the Operations, ensuring Working Together principles are followed. Provide expert knowledge and leadership in all PCS negotiations linked to operational support staff. - Develop, maintain and disseminate all relevant data, systems and supporting documentation, ensuring that users and recipients understand usage and application. 		<ul style="list-style-type: none"> - Accountable for the effective rostering and tactical deployment of ATSAs in AC, TC and FPRS through service-focused rosters, annual leave planning and training/development programmes that delivers optimum operational resourcing. - Accountable for the provision of on-the-job training for operational Support Staff, ensuring training needs are met across both Ops rooms. Manage the effective use and development of the Support Staff AOPA Scheme. 	<ul style="list-style-type: none"> - Manage the safe and effective operation of the FIS and FPRS in service of optimum service delivery. - Review, analyse and progress operational safety issues filed by Support Staff so that safety performance is improved and lessons-learned are captured.
ATSA 4	Flight Information Service Officer (FISO)	<p>The jobholder may be required to undertake any of the required duties of a FISO (A) and ATSA 4, as well as maintaining or gaining additional Operational Support Skills, as determined by the operational requirement.</p>	<ul style="list-style-type: none"> - Provide a Flight Information Service (Area) necessary for the safe and efficient conduct of flight to aircraft operating outside CAS within the London FIR. - Undertake additional ATSA 4 tasks as required. - Carry out training where appropriate and as necessary once a competency is held. - Provide expert advice to non-operational and project areas on FISO related matters. - Carry out SIS editing and desk duties. - Obtain/Maintain a sector validation as required or determined by the Operational requirement. 		<ul style="list-style-type: none"> - Provide expert advice to non-operational and project areas on FISO related matters. 	<ul style="list-style-type: none"> - Carry out SIS editing and desk duties. 		
ATSA 2/3	ATSA Sector Assistant (Prestwick)	<p>Working as a member of a watch of operational support staff, provide services in support of the delivery of the ATC function in the Prestwick Centre Operation.</p>	<ul style="list-style-type: none"> - Provide support in an ATSA functional role to ensure the business and customer expectations in the PC Operations are met. - Ensure a constant focus on safety exists through delivery of day to day tasks. - Provide feedback as required within ATSA forums. - Support delivery of the ATSA cross training plan by providing training as directed by the ATSA Team Leader. - Achieve or maintain relevant skills within the PC Operation in line with the agreed structure for ATSA 3 operational positions. 			<ul style="list-style-type: none"> - Provide feedback as required within ATSA forums. 	<ul style="list-style-type: none"> - Support delivery of the ATSA cross training plan by providing training as directed by the ATSA Team Leader. - Achieve or maintain relevant skills within the PC Operation in line with the agreed structure for ATSA 3 operational positions. 	<ul style="list-style-type: none"> - Ensure a constant focus on safety exists through delivery of day to day tasks.

ATSA 2	ATSA Sector Assistant (Swanwick)	To act as an Air Traffic Services Assistant in the Swanwick Operation in accordance with MATS 2 and other associated documentation. Will act as an integral part of the operational team contributing to the provision of a safe, orderly and expeditious air traffic control service	<ul style="list-style-type: none"> - Processing flight data and flight progress strips within the Swanwick Operations Room. - Inputting flight data and other information, as appropriate, in the AC and TC operations rooms. - Handling telephone calls from adjacent Units, passing ATC clearances when instructed to do so. - Liaising closely with other ATSA's, T&P ATCOs and members of the ATCO supervisor team. - Providing on the job training to new ATSA staff. 			<ul style="list-style-type: none"> - Processing flight data and flight progress strips within the Swanwick Operations Room. - Inputting flight data and other information, as appropriate, in the AC and TC operations rooms. - Handling telephone calls from adjacent Units, passing ATC clearances when instructed to do so. 	- Providing job training to new ATSA staff	
413	Administrative occupations: records	Workers in this minor group create, maintain, update and file correspondence, data, documents and information held both in hard copy and electronically for storage, reference purposes and despatch.	Includes the following 4-digit SOCs: 4131 RECORDS CLERKS AND ASSISTANTS 4132 PENSIONS AND INSURANCE CLERKS AND ASSISTANTS 4133 STOCK CONTROL CLERKS AND ASSISTANTS 4134 TRANSPORT AND DISTRIBUTION CLERKS AND ASSISTANTS 4135 LIBRARY CLERKS AND ASSISTANTS 4138 HUMAN RESOURCES ADMINISTRATIVE OCCUPATIONS			- create, maintain, update and file correspondence, data, documents and information held both in hard copy and electronically for storage, reference purposes and despatch.		
416	Administrative occupations: Office managers and supervisors	Workers in this minor group coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.	Includes the following 4-digit SOCs: 4161 OFFICE MANAGERS 4162 OFFICE SUPERVISORS			- coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.		
421	Secretarial and related occupations	Workers in this minor group provide dictation services, type, edit and print documents, perform general clerical and organisational duties in support of management or other workers, and receive and direct clients and visitors to commercial, government and other establishments.	Includes the following 4-digit SOCs: 4211 MEDICAL SECRETARIES 4212 LEGAL SECRETARIES 4213 SCHOOL SECRETARIES 4214 COMPANY SECRETARIES 4215 PERSONAL ASSISTANTS AND OTHER SECRETARIES 4216 RECEPTIONISTS 4217 TYPISTS AND RELATED KEYBOARD OCCUPATIONS			- provide dictation services, type, edit and print documents, perform general clerical and organisational duties in support of management or other workers, and receive and direct clients and visitors to commercial, government and other establishments.		

3562	Human resources and industrial relations officers	Human resources and industrial relations officers conduct research and advise on recruitment, training, staff appraisal and industrial relations policies and assist specialist managers with negotiations on behalf of a commercial enterprise, trade union or other organisation.	<ul style="list-style-type: none"> - undertakes research into pay differentials, productivity and efficiency bonuses and other payments; - develops and recommends personnel and industrial relations policies, assists with their implementation and drafts staff handbooks; - assists with negotiations between management and employees or trades unions concerning pay and conditions of employment; - interviews candidates for jobs; - advises on training and recruitment, negotiating procedures, salary agreements and other personnel and industrial relations issues; - deals with grievance and disciplinary procedures, and with staff welfare and counselling provision. 	<ul style="list-style-type: none"> - develops and recommends personnel and industrial relations policies, assists with their implementation and drafts staff handbooks; 	<ul style="list-style-type: none"> - assists with negotiations between management and employees or trades unions concerning pay and conditions of employment; - advises on training and recruitment, negotiating procedures, salary agreements and other personnel and industrial relations issues; - deals with grievance and disciplinary procedures, and with staff welfare and counselling provision. 		<ul style="list-style-type: none"> - undertakes research into pay differentials, productivity and efficiency bonuses and other payments; - develops and recommends personnel and industrial relations policies, assists with their implementation and drafts staff handbooks; - assists with negotiations between management and employees or trades unions concerning pay and conditions of employment; - interviews candidates for jobs; - advises on training and recruitment, negotiating procedures, salary agreements and other personnel and industrial relations issues; - deals with grievance and disciplinary procedures, and with staff welfare and counselling provision. 	
3567	Health and safety officers	Health and safety officers counsel employees to ensure and promote health and safety in the workplace and co-ordinate accident prevention and health and safety measures within an establishment or organisation.	<ul style="list-style-type: none"> - inspects workplace areas to ensure compliance with health and safety legislation; - helps to develop effective health and safety policies and procedures and carries out risk assessments; - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - compiles statistics on accidents and injuries, analyses their causes and makes recommendations to management accordingly; - maintains contact with those off work due to illness; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation. 	<ul style="list-style-type: none"> - helps to develop effective health and safety policies and procedures and carries out risk assessments; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation. 	<ul style="list-style-type: none"> - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation. 			<ul style="list-style-type: none"> - inspects workplace areas to ensure compliance with health and safety legislation; - helps to develop effective health and safety policies and procedures and carries out risk assessments; - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - compiles statistics on accidents and injuries, analyses their causes and makes recommendations to management accordingly; - maintains contact with those off work due to illness; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation.

ATCE

SOC	Comparator	General	Key Skills/Attributes	Programmes/system design	Software	Technician	Project planner/management
ATCE	Service Design and Transition (SD&T)	<p>SD&T are focussed on designing and building new technology.</p> <p>There are more higher grades in the SD&T team as this focusses on engineering design etc. Technicians are at the lower end of the scale, ATCE 4 and 5, more of a range in the other categories.</p>	<ul style="list-style-type: none"> - Manage delegated tasks and work-packages associated with new and existing Systems to meet cost and timescale objectives including the management of allocated resources (people and equipment). - Generate and evolve technical specifications and system design documents necessary to implement tasks and work packages and maintain an awareness of the costs against estimates. - Assist in the production and maintenance of safety cases for the life cycle of Infrastructure systems demonstrating that safety standards and requirements have been met. - Undertake related technical studies or specialised consultancy as required to produce formal reports in response to internal or external requests. - Implement NATS Asset Management and Operations Engineering procedures to monitor and record the performance of operational systems in respect of integrity and reliability. Investigate any abnormal performance, recommend appropriate remedial action if necessary and identify the need for orderly replacement of ageing systems. - Provide technical support for the restoration and configuration of systems to maintain operational service. 	<ul style="list-style-type: none"> - Generate and evolve technical specifications and system design documents necessary to implement tasks and work packages and maintain an awareness of the costs against estimates. - Assist in the production and maintenance of safety cases for the life cycle of Infrastructure systems demonstrating that safety standards and requirements have been met. - Undertake related technical studies or specialised consultancy as required to produce formal reports in response to internal or external requests. - Implement NATS Asset Management and Operations Engineering procedures to monitor and record the performance of operational systems in respect of integrity and reliability. - Investigate any abnormal performance, recommend appropriate remedial action if necessary and identify the need for orderly replacement of ageing systems. 		<ul style="list-style-type: none"> - Provide technical support for the restoration and configuration of systems to maintain operational service. 	<ul style="list-style-type: none"> - Manage delegated tasks and work-packages associated with new and existing Systems to meet cost and timescale objectives including the management of allocated resources (people and equipment).
ATCE	Service Operations (SO)	<p>In broad terms SO is the team maintaining and working on our current systems.</p> <p>Technicians are at the lower end of the scale, ATCE 4 and 5, more of a range in the other categories.</p>	<ul style="list-style-type: none"> - Plans, conducts, and coordinates software development activities. - Designs, develops, documents, tests, and debugs software that contains logical and mathematical solutions to business/mission problems or questions in computer language for solutions by means of data processing equipment. - Applies the appropriate standards, processes, procedures, and tools throughout the development life cycle. - Applies knowledge of computer hardware and software, subject matter to be programmed in business/mission applications, information processing techniques used, and information gathered from system users to develop software. - Corrects program errors, prepares operating instructions, compiles documentation of program development, and analyzes system capabilities to resolve questions of program intent, output requirements, input data acquisition, programming techniques, and controls. - Ensures software standards are met. 		<ul style="list-style-type: none"> - Designs, develops, documents, tests, and debugs software that contains logical and mathematical solutions to business/mission problems or questions in computer language for solutions by means of data processing equipment. - Applies the appropriate standards, processes, procedures, and tools throughout the development life cycle. - Applies knowledge of computer hardware and software, subject matter to be programmed in business/mission applications, information processing techniques used, and information gathered from system users to develop software. - Corrects program errors, prepares operating instructions, compiles documentation of program development, and analyzes system capabilities to resolve questions of program intent, output requirements, input data acquisition, programming techniques, and controls. 		<ul style="list-style-type: none"> - Plans, conducts, and coordinates software development activities.

2122	Mechanical engineers	Mechanical engineers undertake research and design, direct the manufacture and manage the operation and maintenance of engines, machines, aircraft, vehicle and ships' structures, building services and other mechanical items.	<ul style="list-style-type: none"> - undertakes research and advises on energy use, materials handling, thermodynamic processes, fluid mechanics, vehicles and environmental controls; - determines materials, equipment, piping, capacities, layout of plant or system and specification for manufacture; - designs mechanical equipment, such as steam, internal combustion and other non-electrical motors for railway locomotives, road vehicles, aeroplanes and other machinery; - organises and establishes control systems to monitor operational efficiency and performance of materials and systems. 	<ul style="list-style-type: none"> - designs mechanical equipment, such as steam, internal combustion and other non-electrical motors for railway locomotives, road vehicles, aeroplanes and other machinery; - organises and establishes control systems to monitor operational efficiency and performance of materials and systems. 	<ul style="list-style-type: none"> - determines materials, equipment, piping, capacities, layout of plant or system and specification for manufacture; - ensures that equipment, operation and maintenance comply with design specifications and safety standards; 	<ul style="list-style-type: none"> - undertakes research and advises on energy use, materials handling, thermodynamic processes, fluid mechanics, vehicles and environmental controls;
2123	Electrical engineers	Electrical engineers undertake research and design, direct construction and manage the operation and maintenance of electrical equipment, power stations, building control systems and other electrical products and systems.	<ul style="list-style-type: none"> - supervises, controls and monitors the operation of electrical generation, transmission and distribution systems; - determines and specifies manufacturing methods of electrical systems; - ensures that manufacture, operation and maintenance comply with design specifications and contractual arrangements; - organises and establishes control systems to monitor the performance and safety of electrical assemblies and systems. 	<ul style="list-style-type: none"> - organises and establishes control systems to monitor the performance and safety of electrical assemblies and systems. 	<ul style="list-style-type: none"> - determines and specifies manufacturing methods of electrical systems; - ensures that manufacture, operation and maintenance comply with design specifications and contractual arrangements; 	<ul style="list-style-type: none"> - supervises, controls and monitors the operation of electrical generation, transmission and distribution systems;
2124	Electronics engineers	Electronics engineers undertake research and design, direct construction and manage the operation and maintenance of electronic motors, communications systems, microwave systems, and other electronic equipment.	<ul style="list-style-type: none"> - undertakes research and advises on all aspects of telecommunications equipment, radar, telemetry and remote control systems, data processing equipment, microwaves and other electronic equipment; - determines and specifies appropriate production and/or installation methods and quality and safety standards; - organises and establishes control systems to monitor performance and evaluate designs; - tests, diagnoses faults and undertakes repair of electronic equipment. 	<ul style="list-style-type: none"> - organises and establishes control systems to monitor performance and evaluate designs; 	<ul style="list-style-type: none"> - determines and specifies appropriate production and/or installation methods and quality and safety standards; - tests, diagnoses faults and undertakes repair of electronic equipment. 	<ul style="list-style-type: none"> - undertakes research and advises on all aspects of telecommunications equipment, radar, telemetry and remote control systems, data processing equipment, microwaves and other electronic equipment;
2126	Design and development engineers	Design and development engineers conceive engineering designs from product ideas or requirements in mechanical, electrical and electronic engineering.	<ul style="list-style-type: none"> - assesses product requirements, including costs, manufacturing feasibility and market requirements; - prepares working designs for steam, aero, turbine, marine and electrical engines, mechanical instruments, aircraft and missile structures, vehicle and ship structures, plant and machinery equipment, domestic electrical appliances, building systems and services, and electronic computing and telecommunications equipment; - arranges construction and testing of model or prototype and modifies design if necessary; - produces final design information for use in preparation of layouts, parts lists, etc.; - prepares specifications for materials and other components. 	<ul style="list-style-type: none"> - prepares working designs for steam, aero, turbine, marine and electrical engines, mechanical instruments, aircraft and missile structures, vehicle and ship structures, plant and machinery equipment, domestic electrical appliances, building systems and services, and electronic computing and telecommunications equipment; - arranges construction and testing of model or prototype and modifies design if necessary; - produces final design information for use in preparation of layouts, parts lists, etc.; 	<ul style="list-style-type: none"> - assesses product requirements, including costs, manufacturing feasibility and market requirements; - prepares specifications for materials and other components. 	<ul style="list-style-type: none"> - arranges construction and testing of model or prototype and modifies design if necessary;

2133	IT specialist managers	IT specialist managers plan, organise, manage and coordinate the provision of specialist IT services and functions in an organisation.	<ul style="list-style-type: none"> - plans, coordinates and manages the organisation's IT provision or a specialist area of IT activity; - liaises with users, senior staff and internal/external clients to clarify IT requirements and development needs; - takes responsibility for managing the development of a specialist aspect of IT provision such as user support, network operations, service delivery or quality control; - supervises the technical team and coordinates training; - plans and monitors work and maintenance schedules to ensure agreed service levels are achieved; - reports on IT activities to senior management. 		<ul style="list-style-type: none"> - takes responsibility for managing the development of a specialist aspect of IT provision such as user support, network operations, service delivery or quality control; 		<ul style="list-style-type: none"> - plans, coordinates and manages the organisation's IT provision or a specialist area of IT activity; - liaises with users, senior staff and internal/external clients to clarify IT requirements and development needs; - takes responsibility for managing the development of a specialist aspect of IT provision such as user support, network operations, service delivery or quality control; - supervises the technical team and coordinates training; - plans and monitors work and maintenance schedules to ensure agreed service levels are achieved; - reports on IT activities to senior management.
2134	IT project and programme managers	Jobholders in this unit group manage, coordinate and technically supervise specific IT projects and programmes of a discrete duration and/or budget.	<ul style="list-style-type: none"> - works with client or senior management to establish and clarify the aims, objectives and requirements of the IT project or programme; - plans the stages of the project or programme, reviews actions and amends plans as necessary; - coordinates and supervises the activities of the project/programme team; - manages third party contributions to the programme or project; - monitors progress including project/programme budget, timescale and quality; - coordinates and oversees implementation of the project or programme; - reports on project or programme to senior management and/or client. 				<ul style="list-style-type: none"> - works with client or senior management to establish and clarify the aims, objectives and requirements of the IT project or programme; - plans the stages of the project or programme, reviews actions and amends plans as necessary; - coordinates and supervises the activities of the project/programme team; - manages third party contributions to the programme or project; - monitors progress including project/programme budget, timescale and quality; - coordinates and oversees implementation of the project or programme; - reports on project or programme to senior management and/or client.
2135	IT business analysts, architects and systems designers	Workers in this unit group provide advice on the effective utilisation of IT and design IT systems in order to meet the business objectives or to enhance the business effectiveness of the organisation.	<ul style="list-style-type: none"> - liaises with internal/external clients in order to analyse business procedure, clarify clients' requirements and to define the scope of existing software, hardware and network provision; - undertakes feasibility studies for major IT developments incorporating costs and benefits, and presents proposals to clients; - communicates the impact of emerging technologies to clients and advises upon the potential introduction of such technology; - provides advice and assistance in the procurement, provision, delivery, installation, maintenance and use of IT systems and their environments; - examines existing business models and flows of data and designs functional specifications and test plans for new systems in order to meet clients' needs; - researches, analyses, evaluates and monitors network infrastructure and performance; - works closely with clients to implement new systems. 	<ul style="list-style-type: none"> - examines existing business models and flows of data and designs functional specifications and test plans for new systems in order to meet clients' needs; - works closely with clients to implement new systems. 	<ul style="list-style-type: none"> - liaises with internal/external clients in order to analyse business procedure, clarify clients' requirements and to define the scope of existing software, hardware and network provision; 	<ul style="list-style-type: none"> - researches, analyses, evaluates and monitors network infrastructure and performance; 	

2136	Programmers and software development professionals	<p>Programmers and software development professionals design, develop, test, implement and maintain software systems in order to meet the specifications and business objectives of the information system; they also design and develop specialist software e.g. for computer games.</p>	<ul style="list-style-type: none"> - examines existing software and determines requirements for new/modified systems in the light of business needs; - undertakes feasibility study to design software solutions; - writes and codes individual programs according to specifications; - develops user interfaces; - tests and corrects software programs; - writes code for specialist programming for computer games, (for example, artificial intelligence, 3D engine development); - implements and evaluates the software; - plans and maintains database structures; - writes operational documentation and provides subsequent support and training for users. 		<ul style="list-style-type: none"> - examines existing software and determines requirements for new/modified systems in the light of business needs; - undertakes feasibility study to design software solutions; - writes and codes individual programs according to specifications; - develops user interfaces; - tests and corrects software programs; - writes code for specialist programming for computer games, (for example, artificial intelligence, 3D engine development); - implements and evaluates the software; - plans and maintains database structures; - writes operational documentation and provides subsequent support and training for users. 		
2461	Quality control and planning engineers	<p>Quality control and planning engineers plan production schedules, work sequences, and manufacturing and processing procedures to ensure accuracy, quality and reliability.</p>	<ul style="list-style-type: none"> - devises inspection, testing and evaluation methods for bought-in materials, components, semi-finished and finished products; - ensures accuracy of machines, jigs, fixtures, gauges and other manufacturing and testing equipment; - prepares work flow charts for individual departments and compiles detailed instructions on processes, work methods and quality and safety standards for workers; - analyses plans, drawings, specifications and safety, quality, accuracy, reliability and contractual requirements; - prepares plan of sequence of operations and completion dates for each phase of production or processing; - oversees effective implementation of adopted processes, schedules and procedures. 				<ul style="list-style-type: none"> - devises inspection, testing and evaluation methods for bought-in materials, components, semi-finished and finished products; - ensures accuracy of machines, jigs, fixtures, gauges and other manufacturing and testing equipment; - prepares work flow charts for individual departments and compiles detailed instructions on processes, work methods and quality and safety standards for workers; - analyses plans, drawings, specifications and safety, quality, accuracy, reliability and contractual requirements; - prepares plan of sequence of operations and completion dates for each phase of production or processing; - oversees effective implementation of adopted processes, schedules and procedures.

3112	Electrical and electronics technicians	<p>Electrical and electronics technicians perform a variety of miscellaneous technical support functions to assist with the design, development, installation, operation and maintenance of electrical and electronic systems.</p>	<ul style="list-style-type: none"> - plans and prepares work and test schedules based on specifications and drawings; - sets up equipment, undertakes tests, takes readings, performs calculations and records and interprets data; - plans installation methods, checks completed installation for safety and controls or undertakes the initial running of the new electrical or electronic equipment or system; - diagnoses and detects faults and implements procedures to maintain efficient operation of systems and equipment; - visits and advises clients on the use and servicing of electrical and electronic systems and equipment. 			<ul style="list-style-type: none"> - plans and prepares work and test schedules based on specifications and drawings; - sets up equipment, undertakes tests, takes readings, performs calculations and records and interprets data; - plans installation methods, checks completed installation for safety and controls or undertakes the initial running of the new electrical or electronic equipment or system; - diagnoses and detects faults and implements procedures to maintain efficient operation of systems and equipment; 	
3113	Engineering technicians	<p>Engineering technicians perform a variety of technical support functions to assist engineers with the design, development, operation, installation and maintenance of engineering systems and constructions.</p>	<ul style="list-style-type: none"> - plans and prepares work and test schedules based on specifications and drawings; - sets up equipment, undertakes tests, takes readings, performs calculations and records and interprets data; - prepares estimates of materials, equipment and labour required for engineering projects; - diagnoses and detects faults and implements procedures to maintain efficient operation of systems and equipment; - inspects completed aircraft maintenance work to certify that it meets standards and the aircraft is ready for operation; - visits and advises clients on the use and servicing of mechanical and chemical engineering products and services. 			<ul style="list-style-type: none"> - plans and prepares work and test schedules based on specifications and drawings; - sets up equipment, undertakes tests, takes readings, performs calculations and records and interprets data; - prepares estimates of materials, equipment and labour required for engineering projects; - diagnoses and detects faults and implements procedures to maintain efficient operation of systems and equipment; - inspects completed aircraft maintenance work to certify that it meets standards and the aircraft is ready for operation; 	

STAR

SOC	Comparator	General Description	Key Skills/Attributes	Applying scientific/technical/analytical methodologies to improve business performance	Communication/presentation/report writing	Commercial/regulatory knowledge
STAR 1-2	STAR 1-2	STAR 1-2 lead a technical area of strategic significance to NATS, and manage, plan, execute, and report on assigned scientific/ technical/ analytical tasks within the business areas of strategic importance, including Operational Analysis, Human Factors, Validation, SESAR, Business Reporting or Division of Safety.	<p>Purpose of role:</p> <ul style="list-style-type: none"> - The purpose of the role is to be the NATS lead for a technical area of strategic significance to NATS and to manage, plan, execute, and report on assigned technical activities within that area. - proactively support the management of the overall programme of work within the business areas of Operational Analysis, Human Factors, Validation, SESAR, Business Reporting or Directorate of Safety. - provides expert scientific, technical or analytical knowledge in one of these areas, providing technical direction and leadership to project stakeholders including senior managers within NATS and stakeholders outside of NATS. This is required by NATS to improve capacity, safety, operational or business performance and delivery of the LTIP and other important programmes / activities. - leading activities for external clients, leading NATS' representation at external meetings and / or leading the strategic development of the industry. - lead the proactive driving of improvement in the relevant scientific, technical or analytical areas. <p>Expertise:</p> <ul style="list-style-type: none"> - an in-depth knowledge of the scientific, technical or analytical techniques, data and tools used in one or more of the business areas. - considered to be the NATS expert for at least one specialist subject area which is of significance to NATS such that they have credibility with senior management within NATS and are influential with external stakeholders. - an in-depth knowledge of NATS' ATM operations, NATS organisation and processes. 	<ul style="list-style-type: none"> - Excellent understanding of the nature and relevance of specialist techniques and methodologies when applied to studies and The ability to apply these to multiple customer areas. - Proficient in The use of Microsoft Windows / Office environment, or equivalent and The use of appropriate programming languages, databases, statistical packages and models. 	<ul style="list-style-type: none"> - Produces persuasive, well documented, high quality technical work which influences change inside and outside of NATS. Actively determines when work is of a sufficient standard. - Appreciates the importance of generating and applying best practice including use of the NMS. - Proven communication and presentation skills which are persuasive both within and external to NATS. - An ability to negotiate with international, senior managerial, technical, operational and non-operational staff on a wide range of technical and non-technical topics, including the ability to present clear and persuasive business cases and arguments. As a result, influences change both within and external to NATS. - In cross-functional teams including staff from outside of NATS and the UK, an ability to lead, motivate and inspire an effective team culture, by promoting team spirit, keeping others focussed and supporting colleagues. Able to communicate effectively within a multi-disciplinary environment taking into account different perspectives and able to moderate different technical viewpoints. - Uses knowledge and experience to influence decisions made by senior managers affecting change both within and external to NATS. 	<ul style="list-style-type: none"> - A breadth of knowledge and appreciation of current and likely future UK ATM operations (e.g. SESAR) and is seen as being The NATS expert in more than one area that is of significance to NATS. An in-depth understanding of The interactions between ATM operations and how work produced fits into The wider processes, including performance reporting, a good understanding of European and world-wide developments in ATM as required. Applies knowledge to be influential at a strategic level both within and external to NATS. - a broad knowledge of The NATS organisation and The department's customers, with in-depth knowledge of a number of relevant customers. a good understanding of The interactions within The organisation and how The department fits into The wider organisation. - A good understanding of NATS' commercial environment and the contribution that the job holder's work centre can make to it. Identifies opportunities for commercial gain. Leads work to take advantage of opportunities and is aware of and mitigates associated risks. Balances the needs of internal NATS customers with the opportunities for commercial growth. - A good knowledge of regulatory and legislative requirements that are applicable to the programme of work being undertaken. Anticipates and proactively manages the impact of changes that affect that work programme.
STAR 3-5	STAR 3-5	STARs manage, plan, execute, and report on assigned scientific/ technical/ analytical tasks within the business areas of strategic importance, including Operational Analysis, Human Factors, Validation, SESAR, Business Reporting or Division of Safety.	<p>Purpose of role:</p> <ul style="list-style-type: none"> - The purpose of the role is to manage, plan, execute, and report on assigned technical tasks and to proactively support the management of the overall programme of work within the business areas of Operational Analysis, Human Factors, Validation, SESAR, Business Reporting or Division of Safety. - The job holder provides expert scientific, technical or analytical knowledge in one of these areas, providing technical direction and leadership to project stakeholders. This is required by NATS to improve capacity, safety, operational or business performance and delivery of the LTIP and other important programmes/projects; it may also involve leading projects for external clients. - The job holder will also be involved in proactively driving improvement in the relevant scientific, technical or analytical areas. <p>Expertise:</p> <ul style="list-style-type: none"> - An in-depth knowledge of the scientific, technical or analytical techniques, data and tools used in one or more of the business areas, and an expert knowledge of at least one specialist subject area. - An in-depth knowledge of NATS' ATM operations, NATS organisation and processes. 	<ul style="list-style-type: none"> - Good understanding of the nature and relevance of specialist techniques and methodologies when applied to studies and the ability to apply these to multiple customer areas. - Proficient in the use of Microsoft Windows / Office environment, or equivalent and use of appropriate programming languages, databases, statistical packages and models. 	<ul style="list-style-type: none"> - Produces well documented, high quality technical work, and actively determines when work is of a sufficient standard. - Appreciation of the importance of generating and applying best practice including use of the NMS. - Proven communication and presentation skills at all levels. - An ability to negotiate with technical, operational and non-operational staff on a wide range of technical and non-technical topics, including the ability to present clear and persuasive business cases and arguments. - An ability to lead, motivate and inspire an effective team culture, by promoting team spirit, keeping others focussed and supporting colleagues. Able to communicate effectively within a multidisciplinary environment taking into account different perspectives and able to moderate different technical viewpoints. 	<ul style="list-style-type: none"> - A knowledge and appreciation of current and likely future UK ATM operations (e.g. SESAR), in depth in at least one area. A good understanding of the interactions between ATM operations and how work produced fits into the wider processes, including performance reporting. Some familiarity with European and world-wide developments in ATM as required. - A good knowledge of the NATS organisation and the department's customers, with in-depth knowledge of at least one relevant customer. A good understanding of the interactions within the organisation and how the department fits into the wider organisation.

215/ 2150	Research and development managers	Managers in this unit group plan, organise, co-ordinate and manage resources to undertake the systematic investigation necessary for the development of new, or to enhance the performance of existing, products and services.	<ul style="list-style-type: none"> - establishes product design and performance objectives in consultation with other business functions; - liaises with production departments to investigate and resolve manufacturing problems; - develops research methodology, implements and reports upon research investigations undertaken; - plans work schedules, assigns tasks and delegates responsibilities to the research and development team; - monitors the standards of scientific and technical research undertaken by the research team. 	<ul style="list-style-type: none"> - develops research methodology, implements and reports upon research investigations undertaken; - plans work schedules, assigns tasks and delegates responsibilities to the research and development team; - monitors the standards of scientific and technical research undertaken by the research team. 	<ul style="list-style-type: none"> - liaises with production departments to investigate and resolve manufacturing problems; - plans work schedules, assigns tasks and delegates responsibilities to the research and development team; - monitors the standards of scientific and technical research undertaken by the research team. 	<ul style="list-style-type: none"> - establishes product design and performance objectives in consultation with other business functions;
2135	IT business analysts, architects and systems designers	Workers in this unit group provide advice on the effective utilisation of IT and design IT systems in order to meet the business objectives or to enhance the business effectiveness of the organisation.	<ul style="list-style-type: none"> - liaises with internal/external clients in order to analyse business procedure, clarify clients' requirements and to define the scope of existing software, hardware and network provision; - undertakes feasibility studies for major IT developments incorporating costs and benefits, and presents proposals to clients; - communicates the impact of emerging technologies to clients and advises upon the potential introduction of such technology; - provides advice and assistance in the procurement, provision, delivery, installation, maintenance and use of IT systems and their environments; - examines existing business models and flows of data and designs functional specifications and test plans for new systems in order to meet clients' needs; - researches, analyses, evaluates and monitors network infrastructure and performance; - works closely with clients to implement new systems. 	<ul style="list-style-type: none"> - undertakes feasibility studies for major IT developments incorporating costs and benefits, and presents proposals to clients; - examines existing business models and flows of data and designs functional specifications and test plans for new systems in order to meet clients' needs; - researches, analyses, evaluates and monitors network infrastructure and performance; 	<ul style="list-style-type: none"> - liaises with internal/external clients in order to analyse business procedure, clarify clients' requirements and to define the scope of existing software, hardware and network provision; - communicates the impact of emerging technologies to clients and advises upon the potential introduction of such technology; - provides advice and assistance in the procurement, provision, delivery, installation, maintenance and use of IT systems and their environments; - works closely with clients to implement new systems. 	<ul style="list-style-type: none"> - communicates the impact of emerging technologies to clients and advises upon the potential introduction of such technology; - provides advice and assistance in the procurement, provision, delivery, installation, maintenance and use of IT systems and their environments;
2136	Programmers and software development professionals	Programmers and software development professionals design, develop, test, implement and maintain software systems in order to meet the specifications and business objectives of the information system; they also design and develop specialist software e.g. for computer games.	<ul style="list-style-type: none"> - examines existing software and determines requirements for new/modified systems in the light of business needs; - undertakes feasibility study to design software solutions; - writes and codes individual programs according to specifications; - develops user interfaces; - tests and corrects software programs; - writes code for specialist programming for computer games, (for example, artificial intelligence, 3D engine development); - implements and evaluates the software; - plans and maintains database structures; - writes operational documentation and provides subsequent support and training for users. 	<ul style="list-style-type: none"> - examines existing software and determines requirements for new/modified systems in the light of business needs; - undertakes feasibility study to design software solutions; - writes and codes individual programs according to specifications; - develops user interfaces; - tests and corrects software programs; - writes code for specialist programming for computer games, (for example, artificial intelligence, 3D engine development); - implements and evaluates the software; - plans and maintains database structures; 	<ul style="list-style-type: none"> - writes operational documentation and provides subsequent support and training for users. 	
2423	Management consultants and business analysts	Jobholders in this unit group advise industrial, commercial and other establishments on a variety of management and business related matters to assist in the formulation of financial and business policies in order to maximise growth or improve business performance.	<ul style="list-style-type: none"> - assesses the functions, objectives and requirements of the organisation seeking advice; - identifies problems concerned with business strategy, policy, organisation, procedures, methods and markets; - determines the appropriate method of data collection and research methodology, analyses and interprets information gained and formulates and implements recommendations and solutions; - advises governments, commercial enterprises, organisations and other clients in light of research findings; - runs workshops, and addresses seminars, conferences and the media to present results of research activity or to express professional views. 	<ul style="list-style-type: none"> - determines the appropriate method of data collection and research methodology, analyses and interprets information gained and formulates and implements recommendations and solutions; 	<ul style="list-style-type: none"> - advises governments, commercial enterprises, organisations and other clients in light of research findings; - runs workshops, and addresses seminars, conferences and the media to present results of research activity or to express professional views. 	<ul style="list-style-type: none"> - assesses the functions, objectives and requirements of the organisation seeking advice; - identifies problems concerned with business strategy, policy, organisation, procedures, methods and markets;

2424	Business and financial project management professionals	Job holders in this unit group manage and oversee major projects across all sectors of modern industry, commerce and the public sector, in areas such as e-commerce, business analysis, finance, product development, marketing, human resources.	<ul style="list-style-type: none"> - finds out what the client or company wants to achieve; - agrees timescales, costs and resources needed; - draws up a detailed plan for how to achieve each stage of the project; - selects and leads a project team; - negotiates with contractors and suppliers for materials and services; - ensures that each stage of the project is progressing on time, on budget and to the right quality standards; - reports regularly on progress to the client or to senior managers. 	<ul style="list-style-type: none"> - draws up a detailed plan for how to achieve each stage of the project; - ensures that each stage of the project is progressing on time, on budget and to the right quality standards; 	<ul style="list-style-type: none"> - finds out what the client or company wants to achieve; - agrees timescales, costs and resources needed; - selects and leads a project team; - negotiates with contractors and suppliers for materials and services; - reports regularly on progress to the client or to senior managers. 	
2425	Actuaries, economists and statisticians	Jobholders in this unit group apply theoretical principles and practical techniques to assess risk and formulate probabilistic outcomes in order to inform economic and business policy, and to analyse and interpret data used to assist in the formulation of financial, business and economic policies in order to maximise growth or improve business performance.	<ul style="list-style-type: none"> - assesses the objectives and requirements of the organisation seeking advice; - uses a variety of techniques and theoretical principles to establish probability and risk in respect of e.g. life insurance or pensions; - uses appropriate techniques and theoretical principles to determine an appropriate method of data collection and research methodology, analyse and interpret information gained and formulate recommendations on issues such as future trends, improved efficiency; - designs and manages surveys and uses statistical techniques in order to analyse and interpret the quantitative data collected; - provides economic or statistical advice to governments, commercial enterprises, organisations and other clients in light of research findings; - addresses seminars, conferences and the media to present results of research activity or to express professional views. 	<ul style="list-style-type: none"> - uses a variety of techniques and theoretical principles to establish probability and risk in respect of e.g. life insurance or pensions; - uses appropriate techniques and theoretical principles to determine an appropriate method of data collection and research methodology, analyse and interpret information gained and formulate recommendations on issues such as future trends, improved efficiency; - designs and manages surveys and uses statistical techniques in order to analyse and interpret the quantitative data collected; 	<ul style="list-style-type: none"> - provides economic or statistical advice to governments, commercial enterprises, organisations and other clients in light of research findings; - addresses seminars, conferences and the media to present results of research activity or to express professional views. 	<ul style="list-style-type: none"> - assesses the objectives and requirements of the organisation seeking advice; - provides economic or statistical advice to governments, commercial enterprises, organisations and other clients in light of research findings;
3567	Health and safety officers	Health and safety officers counsel employees to ensure and promote health and safety in the workplace and co-ordinate accident prevention and health and safety measures within an establishment or organisation.	<ul style="list-style-type: none"> - inspects workplace areas to ensure compliance with health and safety legislation; - helps to develop effective health and safety policies and procedures and carries out risk assessments; - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - compiles statistics on accidents and injuries, analyses their causes and makes recommendations to management accordingly; - maintains contact with those off work due to illness; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation. 	<ul style="list-style-type: none"> - helps to develop effective health and safety policies and procedures and carries out risk assessments; - compiles statistics on accidents and injuries, analyses their causes and makes recommendations to management accordingly; 	<ul style="list-style-type: none"> - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - maintains contact with those off work due to illness; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation. 	<ul style="list-style-type: none"> - inspects workplace areas to ensure compliance with health and safety legislation; - instructs workers in the proper use of protective clothing and safety devices and conducts routine tests on that equipment; - counsels individuals on any personal or domestic problems affecting their work; - gives talks and distributes information on accident prevention, and keeps up to date with the relevant legislation.

MSG

SOC	Comparator	General Description	Key Skills/Attributes	Finance	Administrative/support	Human resources/communications
MSG	MSG	MSG is the management support group and comprises a range of jobs across the business, including non-management roles in professional and business support areas and non-operational roles.	<p>MSGs' range of jobs include non-management roles in professional and business support areas, e.g. finance, HR, admin/support, communications, environment, and non-operational roles at the Swanwick and Prestwick centres.</p> <p>Moreover the range of roles includes senior professionals with relevant professional qualifications and continuous professional development obligations.</p>	Finance include a range of roles, including finance controller, credit controller, book-keeper, payroll officers, financial/management accountants and accounting assistants.	Admin and support staff help with the day-to-day running of the business.	HR officers develop, advise on and implement policies relating to the effective use of staff in an organisation.
412	Administrative occupations: Finance	Workers in this minor group perform administrative and other tasks in relation to credit control and debt collection, the maintenance of financial records within firms, financial transactions made with customers and the collection of payments from businesses and households.	Includes the following 4-digit SOCs: 4121 CREDIT CONTROLLERS 4122 BOOK-KEEPERS, PAYROLL MANAGERS AND WAGES CLERKS 4123 BANK AND POST OFFICE CLERKS 4124 FINANCE OFFICERS 4129 FINANCIAL ADMINISTRATIVE OCCUPATIONS N.E.C.	- perform administrative and other tasks in relation to credit control and debt collection, the maintenance of financial records within firms, financial transactions made with customers and the collection of payments from businesses and households.	- perform administrative and other tasks in relation to credit control and debt collection, the maintenance of financial records within firms, financial transactions made with customers and the collection of payments from businesses and households.	
416	Administrative occupations: Office managers and supervisors	Workers in this minor group coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.	Includes the following 4-digit SOCs: 4161 OFFICE MANAGERS 4162 OFFICE SUPERVISORS		- coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.	

3537	Financial and accounting technicians	Financial and accounting technicians work alongside accountants and other financial professionals in managing the financial affairs of organisations.	<ul style="list-style-type: none"> - maintains profit and loss accounts, budgets, cash flow forecasts and other accounting records; - produces, collates and reports financial information for managers; - liaises with clients to ensure that payments are made on time and credit limits are not exceeded; - ensures invoices and payments are correct and sent out on time; - monitors accounting systems to determine accounts are being maintained effectively and provides information on accounting practices to auditors. 	<ul style="list-style-type: none"> - maintains profit and loss accounts, budgets, cash flow forecasts and other accounting records; - produces, collates and reports financial information for managers; - liaises with clients to ensure that payments are made on time and credit limits are not exceeded; - ensures invoices and payments are correct and sent out on time; - monitors accounting systems to determine accounts are being maintained effectively and provides information on accounting practices to auditors. 		
3538	Financial accounts manager	Job holders in this unit group manage client accounts or departments within financial institutions (such as banks and insurance companies) or manage a variety of financial accounts within other organisations.	<ul style="list-style-type: none"> - develops and manages business accounts to increase sales of financial products; - takes responsibility for the efficient and effective operation of several business accounts; - manages teams handling insurance claims; - checks customers' credit rating with banks and credit reference agencies, and decides whether to offer credit; - establishes terms of credit and ensures timely payment by customer, renegotiates payment terms and initiates legal action to recover debts if necessary; - carries out and/or supervises general accounting and administrative work. 	<ul style="list-style-type: none"> - develops and manages business accounts to increase sales of financial products; - takes responsibility for the efficient and effective operation of several business accounts; - manages teams handling insurance claims; - checks customers' credit rating with banks and credit reference agencies, and decides whether to offer credit; - establishes terms of credit and ensures timely payment by customer, renegotiates payment terms and initiates legal action to recover debts if necessary; - carries out and/or supervises general accounting and administrative work. 		

3562	Human resources and industrial relations officers	Human resources and industrial relations officers conduct research and advise on recruitment, training, staff appraisal and industrial relations policies and assist specialist managers with negotiations on behalf of a commercial enterprise, trade union or other organisation.	<ul style="list-style-type: none"> - undertakes research into pay differentials, productivity and efficiency bonuses and other payments; - develops and recommends personnel and industrial relations policies, assists with their implementation and drafts staff handbooks; - assists with negotiations between management and employees or trades unions concerning pay and conditions of employment; - interviews candidates for jobs; - advises on training and recruitment, negotiating procedures, salary agreements and other personnel and industrial relations issues; - deals with grievance and disciplinary procedures, and with staff welfare and counselling provision. 		<ul style="list-style-type: none"> - undertakes research into pay differentials, productivity and efficiency bonuses and other payments; - develops and recommends personnel and industrial relations policies, assists with their implementation and drafts staff handbooks; - assists with negotiations between management and employees or trades unions concerning pay and conditions of employment; - interviews candidates for jobs; - advises on training and recruitment, negotiating procedures, salary agreements and other personnel and industrial relations issues; - deals with grievance and disciplinary procedures, and with staff welfare and counselling provision
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Appendix C. SOC Funnel and Filtered List of Comparator SOCs

ATCO

1-digit SOC suitable benchmarks	Code	2-digit SOC suitable benchmarks	Code	3-digit SOC suitable benchmarks	Code	Avg. growth	4-digit SOC suitable benchmarks	Code	Avg. growth
Managers, directors and senior officials	1	Science, research, engineering and technology professionals	21	Health professionals	221	-1.0%	Medical practitioners	2211	-0.1%
Professional occupations	2	Health professionals	22	Therapy professionals	222	0.6%	Psychologists	2212	0.4%
Associate professional and technical occupations	3	Teaching and educational professionals	23	Nursing and midwifery professionals	223	0.9%	Pharmacists	2213	-0.3%
Administrative and secretarial occupations	4	Business, media and public service professionals	24	Protective service occupations	331	1.1%	Ophthalmic opticians	2214	0.9%
Skilled trades occupations	5	Science and technology associate professionals	31	Transport associate professionals	351	5.4%	Dental practitioners	2215	2.0%
Caring, leisure and other service occupations	6	Health and social welfare associate professionals	32	Legal associate professionals	352	1.7%	Veterinarians	2216	0.8%
Sales and customer service occupations	7	Protective service occupations	33	Business, finance and related associate professionals	353	0.2%	Medical radiographers	2217	-0.6%
Process, plant and machine operatives	8	Culture, media and sports occupations	34	Sales, marketing and related associate professionals	354	4.3%	Podiatrists	2218	1.0%
Elementary occupations	9	Business and public service associate professionals	35	Conservation and environmental associate professionals	355	-0.1%	Health professionals n.e.c.	2219	-0.3%
		Process, plant and machine operatives	81	Public services and other associate professionals	356	1.2%	NCOs and other ranks	3311	N/A
		Transport and mobile machine drivers and operatives	82	Process operatives	811	1.0%	Police officers (sergeant and below)	3312	0.9%
				Plant and machine operatives	812	0.5%	Fire service officers (watch manager and below)	3313	1.3%
				Assemblers and routine operatives	813	2.9%	Prison service officers (below principal officer)	3314	1.2%
				Construction operatives	814	-0.9%	Police community support officers	3315	1.2%
				Road transport drivers	821	1.6%	Protective service associate professionals n.e.c.	3319	3.0%
				Mobile machine drivers and operatives	822	2.0%	Air traffic controllers	3511	4.8%
				Other drivers and transport operatives	823	3.5%	Aircraft pilots and flight engineers	3512	2.1%
							Ship and hovercraft officers	3513	3.0%
							Paper and wood machine operatives	8121	-0.2%
							Coal mine operatives	8122	-2.3%
							Quarry workers and related operatives	8123	0.4%
							Energy plant operatives	8124	1.4%
							Metal working machine operatives	8125	0.2%
							Water and sewerage plant operatives	8126	1.0%
							Printing machine assistants	8127	-0.5%
							Plant and machine operatives n.e.c.	8129	1.6%
							Train and tram drivers	8231	3.1%
							Marine and waterways transport operatives	8232	4.6%
							Air transport operatives	8233	2.0%
							Rail transport operatives	8234	1.8%
							Other drivers and transport operatives n.ec.	8239	-0.1%

ATSA

1-digit SOC suitable benchmarks	Code
Managers, directors and senior officials	1
Professional occupations	2
Associate professional and technical occupations	3
Administrative and secretarial occupations	4
Skilled trades occupations	5
Caring, leisure and other service occupations	6
Sales and customer service	7
Process, plant and machine operatives	8
Elementary occupations	9

2-digit SOC suitable benchmarks	Code
Science and technology associate professionals	31
Health and social welfare associate professionals	32
Protective service occupations	33
Culture, media and sports occupations	34
Business and public service associate professionals	35
Administrative occupations	41
Secretarial and related occupations	42

3-digit SOC suitable benchmarks	Code	Avg. growth
Transport associate professionals	351	5.4%
Legal associate professionals	352	1.7%
Business, finance and related associate professionals	353	0.2%
Sales, marketing and related associate professionals	354	4.3%
Conservation and environmental associate professionals	355	-0.1%
Public services and other associate professionals	356	1.2%
Government and related organisations	411	1.9%
Administrative occupations: Finance	412	1.4%
Administrative occupations: Records	413	1.3%
Other administrative occupations	415	2.3%
Administrative occupations: Office managers and supervisors	416	0.4%
Secretarial and related occupations	421	1.2%

4-digit SOC suitable benchmarks	Code	Avg. growth
Public services associate professionals	3561	0.6%
Human resources and industrial relations officers	3562	2.1%
Vocational and industrial trainers and instructors	3563	1.7%
Careers advisers and vocational guidance specialists	3564	-0.3%
Inspectors of standards and regulations	3565	-0.6%
Health and safety officers	3567	0.6%
Records clerks and assistants	4131	1.5%
Pensions and insurance clerks and assistants	4132	0.5%
Stock control clerks and assistants	4133	1.5%
Transport and distribution clerks and assistants	4134	1.0%
Library clerks and assistants	4135	1.3%
Human resources administrative occupations	4138	0.9%
Office managers	4161	0.3%
Office supervisors	4162	0.6%
Medical secretaries	4211	0.8%
Legal secretaries	4212	1.0%
School secretaries	4213	1.1%
Company secretaries	4214	2.7%
Personal assistants and other secretaries	4215	1.7%
Receptionists	4216	1.6%
Typists and related keyboard occupations	4217	1.8%

ATCE

1-digit SOC suitable benchmarks	Code
Managers, directors and senior officials	1
Professional occupations	2
Associate professional and technical occupations	3
Administrative and secretarial occupations	4
Skilled trades occupations	5
Caring, leisure and other service occupations	6
Sales and customer service occupations	7
Process, plant and machine operatives	8
Elementary occupations	9

2-digit SOC suitable benchmarks	Code
Science, research, engineering and technology professionals	21
Health professionals	22
Teaching and educational professionals	23
Business, media and public service professionals	24
Science and technology associate professionals	31
Health and social welfare associate professionals	32
Protective service occupations	33
Culture, media and sports occupations	34
Business and public service associate professionals	35

3-digit SOC suitable benchmarks	Code	Avg. growth
Natural and social science professionals	211	0.4%
Engineering professionals	212	1.8%
Information technology and telecommunications professionals	213	1.3%
Conservation and environment professionals	214	1.3%
Research and development managers	215	1.1%
Legal professionals	241	1.4%
Business, research and administrative professionals	242	0.6%
Architects, town planners and surveyors	243	0.6%
Welfare professionals	244	0.2%
Librarians and related professionals	245	0.9%
Quality and regulatory professionals	246	1.4%
Media professionals	247	0.2%
Science, engineering and production technicians	311	0.9%
Draughtspersons and related architectural technicians	312	1.2%
Information technology technicians	313	0.6%

4-digit SOC suitable benchmarks	Code	Avg. growth
Civil engineers	2121	1.7%
Mechanical engineers	2122	1.6%
Electrical engineers	2123	1.1%
Electronics engineers	2124	-0.2%
Design and development engineers	2126	1.9%
Production and process engineers	2127	2.4%
Engineering professionals n.e.c.	2129	1.6%
IT specialist managers	2133	1.0%
IT project and programme managers	2134	1.6%
IT business analysts, architects and system designers	2135	2.3%
Programmers and software development professionals	2136	2.0%
Web design and development professionals	2137	0.2%
IT and telecom professionals n.e.c.	2139	0.5%
Quality control and planning engineers	2461	1.6%
Quality assurance and regulatory professionals	2462	1.0%
Environmental health professionals	2463	1.0%
Laboratory technicians	3111	-0.1%
Electrical and electronics technicians	3112	1.7%
Engineering technicians	3113	1.3%
Building and civil engineering technicians	3114	1.3%
Quality assurance technicians	3115	-0.2%
Planning, process and production technicians	3116	2.3%
Science, engineering and production technicians n.e.c.	3119	1.3%

STAR

1-digit SOC suitable benchmarks	Code
Managers, directors and senior officials	1
Professional occupations	2
Associate professional and technical occupations	3
Administrative and secretarial occupations	4
Skilled trades occupations	5
Caring, leisure and other service occupations	6
Sales and customer service occupations	7
Process, plant and machine operatives	8
Elementary occupations	9

2-digit SOC suitable benchmarks	Code
Science, research, engineering and technology professionals	21
Health professionals	22
Teaching and educational professionals	23
Business, media and public service professionals	24
Science and technology associate professionals	31
Health and social welfare associate professionals	32
Protective service occupations	33
Culture, media and sports occupations	34
Business and public service associate professionals	35

3-digit SOC suitable benchmarks	Code	Avg. growth
Natural and social science professionals	211	0.4%
Engineering professionals	212	1.8%
Information technology and telecommunications professionals	213	1.3%
Conservation and environment professionals	214	1.3%
Research and development managers	215	1.1%
Legal professionals	241	1.4%
Business, research and administrative professionals	242	0.6%
Architects, town planners and surveyors	243	0.6%
Welfare professionals	244	0.2%
Librarians and related professionals	245	0.9%
Quality and regulatory professionals	246	1.4%
Media professionals	247	0.2%
Transport associate professionals	351	5.4%
Legal associate professionals	352	1.7%
Business, finance and related associate professionals	353	0.2%
Sales, marketing and related associate professionals	354	4.3%
Conservation and environmental associate professionals	355	-0.1%
Public services and other associate professionals	356	1.2%

4-digit SOC suitable benchmarks	Code	Avg. growth
IT specialist managers	2133	1.0%
IT project and programme managers	2134	1.6%
IT business analysts, architects and system designers	2135	2.3%
Programmers and software development professionals	2136	2.0%
Web design and development professionals	2137	0.2%
IT and telecom professionals n.e.c.	2139	0.5%
Research and development managers	2150	1.1%
Chartered and certified accountants	2421	0.7%
Management consultants and business analysts	2423	-0.4%
Business and financial project management professionals	2424	1.2%
Actuaries, economists and statisticians	2425	-1.1%
Business and related research professionals	2426	1.2%
Business, research and administrative professionals n.e.c.	2429	2.5%
Public services associate professionals	3561	0.6%
Human resources and industrial relations officers	3562	2.1%
Vocational and industrial trainers and instructors	3563	1.7%
Careers advisers and vocational guidance specialists	3564	-0.3%
Inspectors of standards and regulations	3565	-0.6%
Health and safety officers	3567	0.6%

MSG

1-digit SOC suitable benchmarks	Code
Managers, directors and senior officials	1
Professional occupations	2
Associate professional and technical occupations	3
Administrative and secretarial occupations	4
Skilled trades occupations	5
Caring, leisure and other service occupations	6
Sales and customer service	7
Process, plant and machine operatives	8
Elementary occupations	9

2-digit SOC suitable benchmarks	Code
Science and technology associate professionals	31
Health and social welfare associate professionals	32
Protective service occupations	33
Culture, media and sports occupations	34
Business and public service associate professionals	35
Administrative occupations	41
Secretarial and related occupations	42

3-digit SOC suitable benchmarks	Code	Avg. growth
Transport associate professionals	351	5.4%
Legal associate professionals	352	1.7%
Business, finance and related associate professionals	353	0.2%
Sales, marketing and related associate professionals	354	4.3%
Conservation and environmental associate professionals	355	-0.1%
Public services and other associate professionals	356	1.2%
Government and related organizations	411	1.9%
Administrative occupations: Finance	412	1.4%
Administrative occupations: Records	413	1.3%
Other administrative occupations	415	2.3%
Office managers and supervisors	416	0.4%

4-digit SOC suitable benchmarks	Code	Avg. growth
Estimators, valuers and assessors	3531	1.1%
Brokers	3532	3.3%
Insurance underwriters	3533	0.0%
Finance and investment analysts and advisers	3534	-0.3%
Taxation experts	3535	5.8%
Importers and exporters	3536	3.2%
Financial and accounting technicians	3537	1.7%
Financial accounts managers	3538	-0.1%
Business and related associate professionals n.e.c.	3539	0.9%
Public services associate professionals	3561	0.6%
Human resources and industrial relations officers	3562	2.1%
Vocational and industrial trainers and instructors	3563	1.7%
Careers advisers and vocational guidance specialists	3564	-0.3%
Inspectors of standards and regulations	3565	-0.6%
Health and Safety officers	3567	0.6%
Credit controllers	4121	1.7%
Book-keepers, payroll managers and wages clerks	4122	1.8%
Bank and post office clerks	4123	0.9%
Finance officers	4124	0.4%
Financial administrative occupations n.e.c.	4129	0.7%
Office managers	4161	0.3%
Office supervisors	4162	0.6%

Appendix D. Job Descriptions of Filtered List of Comparator SOC

ATCO

SOC	Comparator	General Description
2211	Medical practitioners	Medical practitioners diagnose mental and physical injuries, disorders and diseases, prescribe and give treatment, recommend preventative action, and conduct medical education and research activities. They may specialise in particular areas of modern medicine or work in general practice and, where necessary, refer the patient to a specialist.
3313	Fire service officers (watch manager and below)	Workers in this unit group co-ordinate and participate in firefighting activities, provide emergency services in the event of accidents or bomb alerts, and advise on fire prevention.
3512	Aircraft pilots and flight engineers	Aircraft flight deck officers check, regulate, adjust and test engines and other equipment prior to take-off, navigate and pilot aircraft and give flying lessons.
3513	Ship and hovercraft officers	Ship and hovercraft officers command and navigate ships and other craft, co-ordinate the activities of officers and deck and engine room ratings, operate and maintain communications equipment on board ship and undertake minor repairs to engines, boilers and other mechanical and electrical equipment.
8124	Energy plant operatives	Job holders in this unit group operate boilers to produce hot water or steam and attend and operate compressors, turbines, electrical substations, switchboards and auxiliary plant and machinery to fuel nuclear reactors, drive blowers and pumps, electricity generators and other equipment.
8231	Train and tram drivers	Job holders in this unit group drive diesel, diesel-electric, electric and steam locomotives that transport passengers and goods on surface and underground railways, and transport passengers in trams.
8232	Marine and waterways transport operatives	Marine and waterways transport operatives supervise and carry out a variety of deck duties and operate and maintain engines, boilers and mechanical equipment on board ships, boats and other marine vessels.
8233	Air transport operatives	Air transport operatives refuel, load and unload aircraft, direct the movement of aircraft at airports, and position gangways or staircases to allow passengers to board and disembark aircraft.
8234	Rail transport operatives	Rail transport operatives assist drivers in the operation of passenger and goods trains, drive locomotive engines in coal mines, guide wagons and coaches in marshalling yards and sidings to make up trains, operate signals and points to control the movement of rail traffic, and monitor the operation of surface and underground railways.

ATSA

SOC	Comparator	General Description
413	Administrative occupations: records	Workers in this minor group create, maintain, update and file correspondence, data, documents and information held both in hard copy and electronically for storage, reference purposes and despatch.
416	Administrative occupations: Office managers and supervisors	Workers in this minor group coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.
421	Secretarial and related occupations	Workers in this minor group provide dictation services, type, edit and print documents, perform general clerical and organisational duties in support of management or other workers, and receive and direct clients and visitors to commercial, government and other establishments.
3562	Human resources and industrial relations officers	Human resources and industrial relations officers conduct research and advise on recruitment, training, staff appraisal and industrial relations policies and assist specialist managers with negotiations on behalf of a commercial enterprise, trade union or other organisation.
3567	Health and safety officers	Health and safety officers counsel employees to ensure and promote health and safety in the workplace and co-ordinate accident prevention and health and safety measures within an establishment or organisation.

ATCE

SOC	Comparator	General Description
2122	Mechanical engineers	Mechanical engineers undertake research and design, direct the manufacture and manage the operation and maintenance of engines, machines, aircraft, vehicle and ships' structures, building services and other mechanical items.
2123	Electrical engineers	Electrical engineers undertake research and design, direct construction and manage the operation and maintenance of electrical equipment, power stations, building control systems and other electrical products and systems.
2124	Electronics engineers	Electronics engineers undertake research and design, direct construction and manage the operation and maintenance of electronic motors, communications systems, microwave systems, and other electronic equipment.
2126	Design and development engineers	Design and development engineers conceive engineering designs from product ideas or requirements in mechanical, electrical and electronic engineering.
2133	IT specialist managers	IT specialist managers plan, organise, manage and coordinate the provision of specialist IT services and functions in an organisation.
2134	IT project and programme managers	Jobholders in this unit group manage, coordinate and technically supervise specific IT projects and programmes of a discrete duration and/or budget.
2135	IT business analysts, architects and systems designers	Workers in this unit group provide advice on the effective utilisation of IT and design IT systems in order to meet the business objectives or to enhance the business effectiveness of the organisation.
2136	Programmers and software development professionals	Programmers and software development professionals design, develop, test, implement and maintain software systems in order to meet the specifications and business objectives of the information system; they also design and develop specialist software e.g. for computer games.
2461	Quality control and planning engineers	Quality control and planning engineers plan production schedules, work sequences, and manufacturing and processing procedures to ensure accuracy, quality and reliability.
3112	Electrical and electronics technicians	Electrical and electronics technicians perform a variety of miscellaneous technical support functions to assist with the design, development, installation, operation and maintenance of electrical and electronic systems.
3113	Engineering technicians	Engineering technicians perform a variety of technical support functions to assist engineers with the design, development, operation, installation and maintenance of engineering systems and constructions.

STAR

SOC	Comparator	General Description
215/2150	Research and development managers	Managers in this unit group plan, organise, co-ordinate and manage resources to undertake the systematic investigation necessary for the development of new, or to enhance the performance of existing, products and services.
2135	IT business analysts, architects and systems designers	Workers in this unit group provide advice on the effective utilisation of IT and design IT systems in order to meet the business objectives or to enhance the business effectiveness of the organisation.
2136	Programmers and software development professionals	Programmers and software development professionals design, develop, test, implement and maintain software systems in order to meet the specifications and business objectives of the information system; they also design and develop specialist software e.g. for computer games.
2423	Management consultants and business analysts	Jobholders in this unit group advise industrial, commercial and other establishments on a variety of management and business related matters to assist in the formulation of financial and business policies in order to maximise growth or improve business performance.
2424	Business and financial project management professionals	Job holders in this unit group manage and oversee major projects across all sectors of modern industry, commerce and the public sector, in areas such as e-commerce, business analysis, finance, product development, marketing, human resources.
2425	Actuaries, economists and statisticians	Jobholders in this unit group apply theoretical principles and practical techniques to assess risk and formulate probabilistic outcomes in order to inform economic and business policy, and to analyse and interpret data used to assist in the formulation of financial, business and economic policies in order to maximise growth or improve business performance.
3567	Health and safety officers	Health and safety officers counsel employees to ensure and promote health and safety in the workplace and co-ordinate accident prevention and health and safety measures within an establishment or organisation.

MSG

SOC	Comparator	General Description
412	Administrative occupations: Finance	Workers in this minor group perform administrative and other tasks in relation to credit control and debt collection, the maintenance of financial records within firms, financial transactions made with customers and the collection of payments from businesses and households.
416	Administrative occupations: Office managers and supervisors	Workers in this minor group coordinate the day-to-day running of offices providing the administrative services of commercial, industrial and other non-governmental organisations and public agencies, and supervise the staff within those offices.
3537	Financial and accounting technicians	Financial and accounting technicians work alongside accountants and other financial professionals in managing the financial affairs of organisations.
3538	Financial accounts manager	Job holders in this unit group manage client accounts or departments within financial institutions (such as banks and insurance companies) or manage a variety of financial accounts within other organisations.
3562	Human resources and industrial relations officers	Human resources and industrial relations officers conduct research and advise on recruitment, training, staff appraisal and industrial relations policies and assist specialist managers with negotiations on behalf of a commercial enterprise, trade union or other organisation.

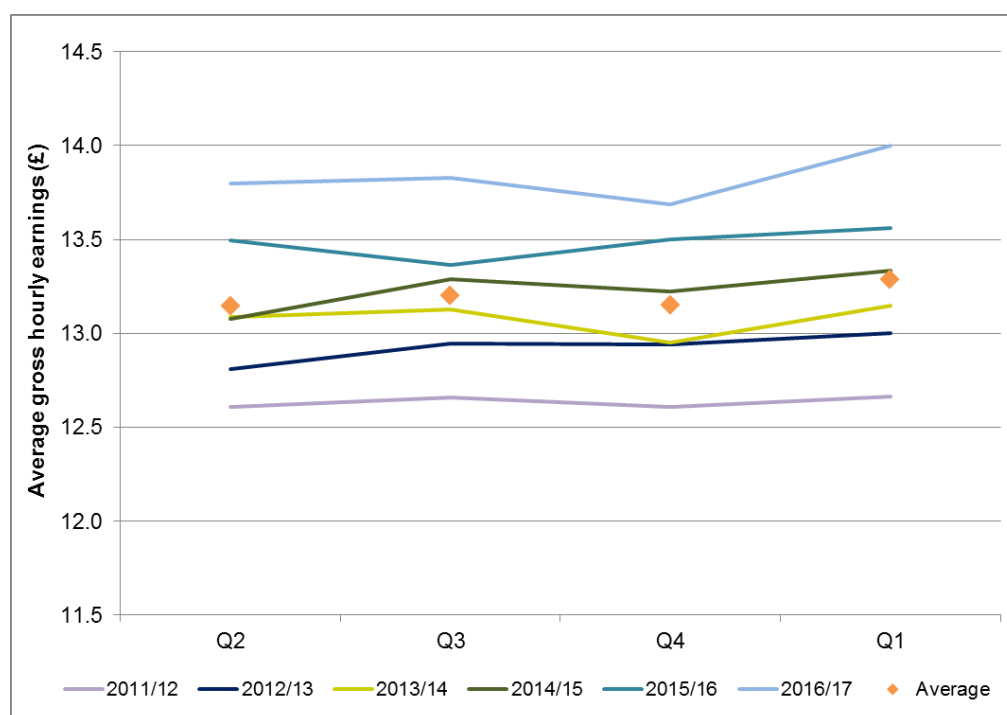
Appendix E. Seasonality in Pay

To assess the extent of seasonality on pay (if any), we present in Figure E.1 average LFS gross hourly earnings³⁸ by quarter for each year of our modelling horizon, 2011/12 to 2016/17, as shown by the coloured lines. The orange diamonds show the averages over these years for each quarter. We also present in Table E.1 the ratio of average gross hourly earnings for the quarter over the average for the year.

Our results suggest that over the period 2011/12 – 2016/17, hourly earnings in Q4 are on average slightly lower than the annual average. By contrary, employees are paid slightly more on average in Q1, reflecting the bonuses they tend to receive during this quarter.

However, we note that these differentials are relatively small and amount to employees earning on average only £0.04 per hour (or 0.3%) less in Q4 compared to the annual average. In other words, whilst using the Q4 LFS dataset in our regression would lead us to underestimate the impact of potential drivers on general economy wages and hence on NERL’s predicted wages, this effect would be very small.

Figure E.1
Average Gross Hourly Earnings by Quarter, 2011/12-2016/17



Source: EARN06: Gross weekly earnings by occupation (LFS)

³⁸ Across all employees

Table E.1
Ratio of Quarterly Hourly Earnings over Average Hourly Earnings for the Year

Quarter	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	Average
Q2	0.998	0.991	1.001	0.988	1.001	0.998	0.996
Q3	1.002	1.001	1.004	1.004	0.991	1.000	1.000
Q4	0.998	1.001	0.990	0.999	1.002	0.990	0.997
Q1	1.002	1.006	1.005	1.008	1.006	1.012	1.007

Source: NERA analysis

Appendix F. Summary of Data on NERL Staff

Variable	NERL Staff Data				
	ATCO	ATSA	ATCE	MSG	STAR
Age	42.5	45.4	46.6	42.4	36.9
Age when completed full time education	20.7	20.6	25.3	22.7	24.2
Highest educational qualification					
Degree or equivalent	63%	44%	82%	45%	100%
Higher education	7%	11%	11%	17%	0%
GCE A level or equivalent	26%	30%	4%	23%	0%
GCSE grades A*-C or equivalent	1%	11%	1%	6%	0%
Other qualification	3%	4%	1%	6%	0%
No qualification	0%	0%	0%	2%	0%
Don't know	0%	0%	0%	0%	0%
Years continuously employed	18.9	18.5	16.6	10.6	9.3
Job related training in the last 3 months					
Yes	44%	37%	49%	46%	23%
No	56%	63%	51%	54%	77%
Full-time/part-time					
Full-time	90%	91%	96%	88%	84%
Part-time	10%	9%	4%	12%	16%
Region of work					
Tyne & Wear	0%	0%	0%	0%	0%
Rest of Northern region	0%	0%	0%	0%	0%
South Yorkshire	0%	0%	0%	0%	0%
West Yorkshire	0%	0%	0%	0%	0%
Rest of Yorks & Humberside	0%	0%	0%	0%	0%
East Midlands	0%	0%	0%	0%	0%
East Anglia	0%	0%	0%	0%	0%
Central London	0%	0%	0%	0%	0%
Inner London (not central)	0%	0%	0%	1%	0%
Outer London	0%	0%	0%	0%	0%
Rest of South East	71%	79%	86%	85%	95%
South West	0%	0%	0%	0%	0%
West Midlands Metropolitan	0%	0%	0%	0%	0%
Rest of West Midlands	0%	0%	0%	0%	0%
Greater Manchester	0%	0%	0%	0%	0%
Merseyside	0%	0%	0%	0%	0%
Rest of North West	0%	0%	0%	0%	0%
Wales	0%	0%	0%	0%	0%
Strathclyde	0%	0%	0%	0%	0%
Rest of Scotland	29%	21%	13%	14%	4%
Northern Ireland	0%	0%	0%	0%	0%
Outside UK	0%	0%	0%	0%	1%
Pay affected by union agreements					
Yes	100%	100%	100%	100%	100%
No	0%	0%	0%	0%	0%
Trade union membership					
Yes	99%	71%	74%	71%	74%
No	1%	29%	26%	29%	26%
Basic usual hours excluding overtime	32.9	32.9	35.0	35.0	35.0
Basic usual hours including overtime	35.5	37.0	39.0	38.2	37.4

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NERA

ECONOMIC CONSULTING

NERA Economic Consulting
Marble Arch House, 66 Seymour Street
London W1H 5BT
United Kingdom
Tel: 44 20 7659 8500 Fax: 44 20 7659 8501
www.nera.com