Dental Working Hours

2012/13 and 2013/14 Motivation and Earnings Analysis Experimental Statistics

Published 1 June 2017

In their 41st report, the Review Body on Doctors' and Dentists' Remuneration (DDRB) expressed a desire to explore whether there is evidence of a link between dentists' motivation and reward.

In response to that request, additional questions relating to motivation and morale were added to the biennial Dental Working Patterns Survey which was undertaken in the spring of 2014.

Initial findings relating to the motivation and morale of dentists were published in 2015. This final instalment of the 2012/13 and 2013/14 release of the Dental Working Hours series of reports explores the relationship between motivation and morale of self-employed primary care dentists and their taxable income.

Analysis was conducted for six distinct groups of dentists (Principal and Associate dentists in England & Wales[1], Scotland and Northern Ireland) based on their survey responses which were linked to self-assessment tax return data held at Her Majesty's Revenue and Customs (HMRC).

Key findings

- For dentists in England & Wales, there are a number of factors that affect how they feel about their pay and whether they consider it to be fair. These factors include overall working patterns such weekly hours, amount of NHS/private work undertaken and weeks of annual leave as well as remuneration.
- Findings for Principals in England & Wales and Northern Ireland suggest an association between higher pay and higher motivation levels. However, this relationship is smaller than may have been expected, and Principals in Scotland and Associate dentists in all four countries show no such relationship.
- In 2013/14 there appeared to be a relationship between higher pay and lower morale for Associate dentists in England & Wales and Scotland.

1. For the sake of simplicity of prose in this front sheet, Providing-Performer and Performer Only dentists in England & Wales are referred to as Principals and Associates, respectively, matching nomenclature for dentists in the other countries.

Author: GP and Dental Pay Team, NHS Digital
Responsible Statistician: Helen Lewis

www.digital.nhs.uk
enquiries@nhsdigital.nhs.uk

Contents

This is an Experimental Statistics publication

This document is published by NHS Digital, part of the Government Statistical Service

Experimental statistics are official statistics which are published in order to involve users and stakeholders in their development and as a means to build in quality at an early stage. It is important that users understand that limitations may apply to the interpretation of these data. More details are given in the report.

All official statistics should comply with the UK Statistics Authority's Code of Practice for Official Statistics which promotes the production and dissemination of official statistics that inform decision making.

Find out more about the Code of Practice for Official Statistics at www.statisticsauthority.gov.uk/assessment/code-of-practice

Find out more about Experimental Statistics at www.statisticsauthority.gov.uk/wp-content/uploads/2016/11/Guidance-on-Experimental-Statistics.pdf

ISBN 978-1-78734-022-0

This report may be of interest to members of remuneration boards and policy officials.

Introduction

The analysis in this report is based on individuals' answers to the Dental Working Patterns (DWP) Survey covering 2012/13 and 2013/14 and their tax return data for the same years. The analysis primarily concentrates on 2013/14 results for dentists in England & Wales, Scotland and Northern Ireland with high level 2012/13 results provided for comparison purposes in Chapter 13 towards the end of the report.

This report is part of the Dental Working Hours series of Official Statistics and is a continuation of Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis report[1]. In this report, HMRC tax return data has been analysed alongside the survey responses, enabling investigation of possible links between the motivation and morale of dentists and their taxable income.

The report has been produced by NHS Digital. A joint working group with representation from NHS Digital; the Department of Health (DH); NHS England; NHS Employers; the Welsh Government (WG); the Department of Health, Northern Ireland; the Scottish Government; the British Dental Association (BDA); the secretariat for the Review Body on Doctors' and Dentists' Remuneration (DDRB); NHS Business Services Authority Information Services (NHS BSA Information Services) and the National Association of Specialist Dental Accountants and Lawyers (NASDAL) was consulted on this study and the content of the report.

Experimental Statistics

An important aim of the report is to present results in a clear, concise and accessible way, rather than being overly complex and detailed. As with any statistical publication, the results presented are based on analytical assumptions, which are clearly labelled along with the reasons for their use. These assumptions should be borne in mind when interpreting the results.

This is the first time that a link between earnings and dentists' motivation and morale has been explored and as a result the report has been designated as 'Experimental Statistics', which are new official statistics that are undergoing evaluation. User engagement is crucial to support the ongoing development of these statistics and any feedback or comments are welcome at gpanddentalpay@nhs.net

Averages, Rounding and Population Estimates

All averages are mean averages. The majority of values within tables are rounded and as such totals and differences may appear not to sum. This includes full-year population counts where given, as these are weighted estimates calculated from the entire population and the proportion of dentists who responded to the survey and indicated they worked for the full-year (not including annual leave).

Suppression of Results with Low Sample Size

In order to maintain taxpayer confidentiality, any analyses that produces results for sub-groups with low sample numbers (30 or below) have been supressed. Footnotes are

[1] Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis Experimental Statistics found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

provided in these cases. In addition, to acknowledge a degree of sampling error, taxable income figures have been rounded to the nearest one hundred pounds. Error bars (displaying 95% confidence intervals) have been used for taxable income data in charts to help visualise the degree of statistical significance or otherwise in the results. However, error bars have not been included for working patterns variables (i.e. weekly hours of work, NHS and clinical share (%), annual leave and age) to help maintain chart legibility.

Structure of the Report

This report presents motivation and morale results for dentists linked to their taxable income across the UK in 2013/14. The first chapter presents the basic methodology and underlying assumptions and is followed by results chapters for each country. Due to lower populations (and therefore sample sizes) of dentists in Scotland and Northern Ireland and the subsequent suppression of some results, result chapters for these countries are by necessity shorter. Readers are encouraged to read the England & Wales chapters for a greater understanding of the analysis in the later Chapters.

Following the individual country chapters comparisons are made between countries and with 2012/13 results. The annexes at the end of the report give the population and sample sizes used in the analysis as well as statistical significance and accuracy testing of the results. Finally, the last annex provides a useful glossary of terms.

Report Methodology

1. Motivation Questions and Taxable Income Data

1.1 The analysis in this report is based on answers to a series of motivation and morale questions included in the 2014 Dental Working Patterns (DWP) Survey as well as anonymised data from Self-Assessment tax returns for dentists held at Her Majesty's Revenue and Customs (HMRC).

1.2 The DWP Survey was sent to all dentists in the United Kingdom who conducted some NHS/Health Service work in 2012/13 and/or 2013/14. All dentists included in the analysis for this report answered every motivation and morale question in the survey for the years that they worked. The dentists' survey responses were linked, where possible, to their tax return data for the applicable years. Please refer to Dental Working Hours, 2012/13 & 2013/14 Initial Analysis report[2] for information on the survey methodology and response rates. All tax return data used in this report is for dentists with accounting periods ending in the fourth quarter of 2012/13 and/or 2013/14. Please refer to Dental Earnings & Expenses, 2013/14 Methodology document[3] for more information on HMRC data used for the analysis, including exclusion criteria to construct the final dataset. The exclusion criteria mean that not every dentist who completed the DWP Survey had matching tax return data for the analysis in this report, reducing the sample size when compared to the 2012/13 & 2013/14 Motivation Analysis report. Please see Annex B for the population and sample sizes for each country.

1.3 Please refer to Chapter 1of the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[4] for information on how the individual motivation and morale questions were chosen[5], which are shown in table 1.1.

Table 1.1: Motivation and morale questions in Dental Working Patterns Survey, 2012/13 and 2013/14

Motivation Questions	
A.	I feel good about my job as a dentist
B.	I receive recognition for the work I do[1]
C.	I feel my pay is fair[2]
D.	I have all the equipment and resources I need to do my job properly
E.	My job gives me the chance to do challenging and interesting work
F.	There are opportunities for me to progress in my career
Morale Question	
G.	How would you rate your morale as a dentist in 2012/13 (or 2013/14)?

1. Spoken recognition or acknowledgement (i.e. not financial) from colleagues
2. Pre-tax income (after all expenses removed) for primary care dentistry

[2] Dental Working Hours, 2012/13 & 2013/14, Initial Analysis report found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214
[3] Dental Earnings & Expenses, 2013/14 Methodology document found at: www.content.digital.nhs.uk/pubs/dentalearnexp1314
[4] Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis Experimental Statistics report found at: http://www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation
[5] In total seven questions were originally included in the motivation section of the survey. However, since the final question ('I often think about leaving general dental practice') may be considered to be a consequence of motivation (and morale), rather than a driver, it was not included in the 2012/13 & 2013/14 motivation analysis.

1.4 With regard to the motivation questions A-F, dentists were asked to indicate how strongly they agreed or disagreed using a five-point Likert[6] scale:

- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

1.5 Likert scales are often used in psychology to measure people's attitudes to a particular topic. They are described by some statisticians as ordinal scales where no assumptions can be made about the size of the differences between each category (i.e. between 'strongly agree' or 'agree' and 'neutral' etc.) just that one category is ranked higher or lower than another (e.g. 'strongly agree' is higher than 'agree' etc). Others, however, treat well-constructed Likert scales[7] as an interval scale and assume that the distances between each item are equal and indicative of the degree of difference between responses which allows answers to be scored sequentially and then summed or averaged for each respondent.

1.6 Because of these differing views on the interpretation of Likert scales the results in this report are divided in two. The first approach uses more traditional analytical methods for ordinal scales by analysing questions individually. In the second, the Likert scale is scored sequentially and the answers to questions (A-F) for each dentist are combined to produce their average 'motivation index', which is discussed in the next section.

1.7 For question (G) on morale the answers were described on a similar five point scale from 'very high' to 'very low'.

Analytical Assumptions for the Average 'Motivation Index'

1.8 For the purposes of calculating the 'motivation index', the Likert scale is treated sequentially and the distances between each response are assumed to be equal and they are scored as shown below:

- 'Strongly agree' 100%
- 'Agree' 75%
- 'Neutral' 50%
- 'Disagree' 25%
- 'Strongly disagree' 0%

1.9 The responses from the six motivation questions for each dentist are then combined into a single average figure termed their 'motivation index' (e.g. [% for A + % for B + % for C + % for D + % for E + % for F]/6), which forms the basis of the analysis in the relevant chapters. Such a methodology makes a number of assumptions:

- The perception of the terms 'strongly agree' or 'agree' etc. is the same for each dentist who answers the survey,

[6] A Likert scale is a psychometric scale commonly used in research that employs questionnaires. It is the most widely used approach to scaling responses in survey research.
[7] A well-constructed Likert scale offers symmetry of clearly defined categories about a midpoint. In such symmetric scaling, equidistant attributes will typically be more clearly observed or, at least, inferred. It is when a Likert scale is symmetric and equidistant that it will behave more like an interval-level measurement.

- The perception of the terms 'strongly agree' or 'agree' etc. is the same for all the motivation questions in the survey.

- Combining the responses into one 'motivation index' provides a useful measure of motivation by covering five categories of self, others, equipment, progression and pay that can supplement single question analysis alone. Please see Chapter 1 of the 2012/13 & 2013/14 Motivation Analysis report for a description of the five categories and how the motivation questions fit within them.

- An average 'motivation index' of 100% indicates a dentist who is more motivated than a colleague who scores 0%. However, whilst an average score of 50% might indicate neutrality, no attempt has been made to give the scores an inherent meaning. The 'motivation index' is solely a means to measure differences in motivation between groups under investigation.

1.10 The average 'motivation index' of dentists is considered using bivariate and multivariate analysis. The multivariate analysis also makes a number of assumptions that are explained in more detail in Annex A with results of the assumption tests shown in Annex C.

England & Wales – 2013/14

2. Taxable Income, Dental Working Patterns and Individual Motivation Questions

Taxable Income and Dental Working Patterns

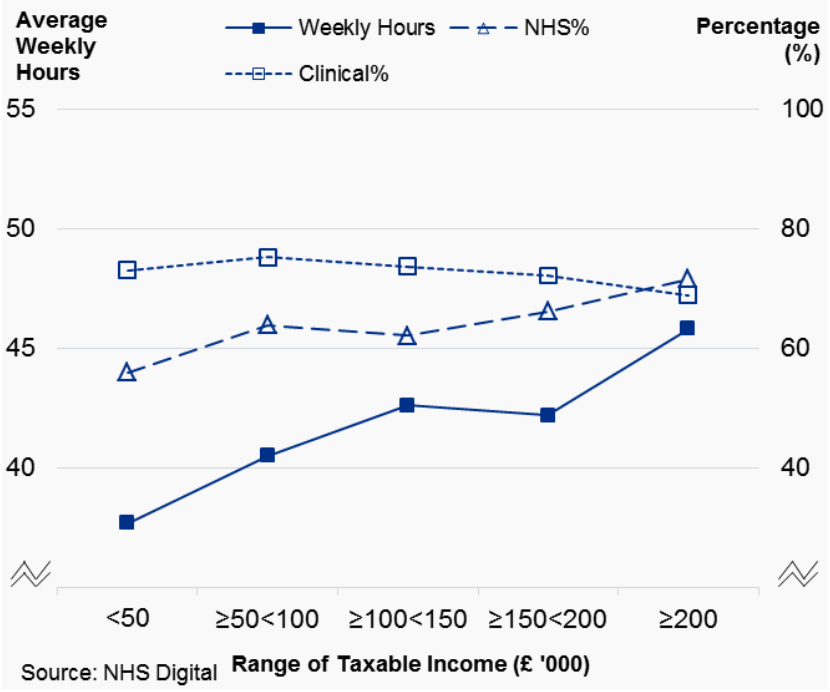
2.1 The first part of this chapter looks at the relationship between the taxable income of dentists and their working patterns as measured in the Dental Working Patterns (DWP) Survey. Table and figure 2.1 show results for Providing-Performer dentists.

Table 2.1: Providing-Performer dentists, taxable income distribution and dental working patterns, England & Wales, 2013/14

Range of Taxable Income (£,000)	Full-Year Popln.		Average				
	Count	(%)	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
<50	714	16.8	51.8	37.7	4.4	55.9	73.0
≥50<100	1,509	35.4	49.7	40.5	4.3	63.9	75.2
≥100<150	1,072	25.2	49.0	42.6	4.4	62.1	73.6
≥150<200	509	12.0	48.6	42.2	4.6	66.1	72.1
≥200	455	10.7	49.4	45.8	4.5	71.6	68.9
Total	**4,258**	**100.0**	**49.7**	**41.3**	**4.4**	**63.2**	**73.4**

Source: NHS Digital

Figure 2.1: Providing-Performer dentists, taxable income distribution and selected dental working patterns, England & Wales, 2013/14



2.2 Figure 2.1 shows that as the taxable income of Providing-Performer dentists increases, so in general do their average weekly hours of work, which might be expected. However, what might be less expected is that for the same increase in taxable income the average NHS share (%) of Providing-Performer dentists also increases. Given that

the anecdotal view in health care is that private work costs more and is more profitable for practitioners, these results are surprising. However, they are in line with findings in the Dental Earnings and Expenses, 2013/14 Initial Analysis report[8], which shows earnings and expenses results by a distribution of NHS share (%), with mainly NHS (≥75%) Providing-Performers earning more than their mainly private (≤25%) colleagues.

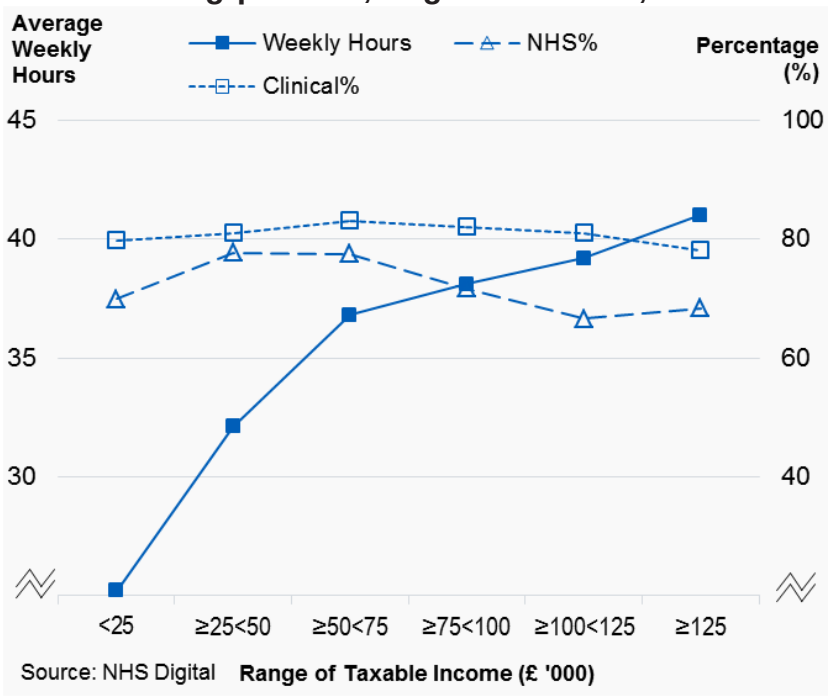
2.3 Table and figure 2.2 show results for Performer Only dentists.

Table 2.2: Performer Only dentists, taxable income distribution and dental working patterns, England & Wales, 2013/14

Range of Taxable Income (£,000)	Full-Year Popln.		Average				
	Count	(%)	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
<25	1,336	8.5	43.2	25.2	4.7	69.9	79.8
≥25<50	3,874	24.8	38.5	32.1	4.4	77.7	81.0
≥50<75	5,764	36.9	37.4	36.8	4.5	77.5	83.1
≥75<100	2,801	17.9	38.8	38.1	4.6	71.7	82.1
≥100<125	950	6.1	41.9	39.2	4.4	66.6	81.0
≥125	906	5.8	43.9	41.0	4.7	68.4	78.1
Total	**15,630**	**100.0**	**39.1**	**35.2**	**4.5**	**74.7**	**81.7**

Source: NHS Digital

Figure 2.2: Performer Only dentists, taxable income distribution and selected dental working patterns, England & Wales, 2013/14



2.4 Similar to the findings for Providing-Performer dentists, the average weekly hours of work of Performer Only dentists increase along with an increase in taxable income. Conversely, for Performer Only dentists, the level of NHS share (%) is generally lower

[8] Dental Earnings & Expenses, 2013/14 Initial Analysis report found at: www.content.digital.nhs.uk/pubs/dentalearnexp1314

at higher levels of taxable income (i.e. ≥£100,000). Once again, this finding is in line with those reported in the Dental Earnings and Expenses report cited earlier.

Individual Motivation Questions and Taxable Income

2.5 This section of the report looks at how responses to the individual motivation questions used in the DWP Survey change with taxable income. The motivation (and morale) questions are listed in Chapter 1 along with a description on how they were analysed.

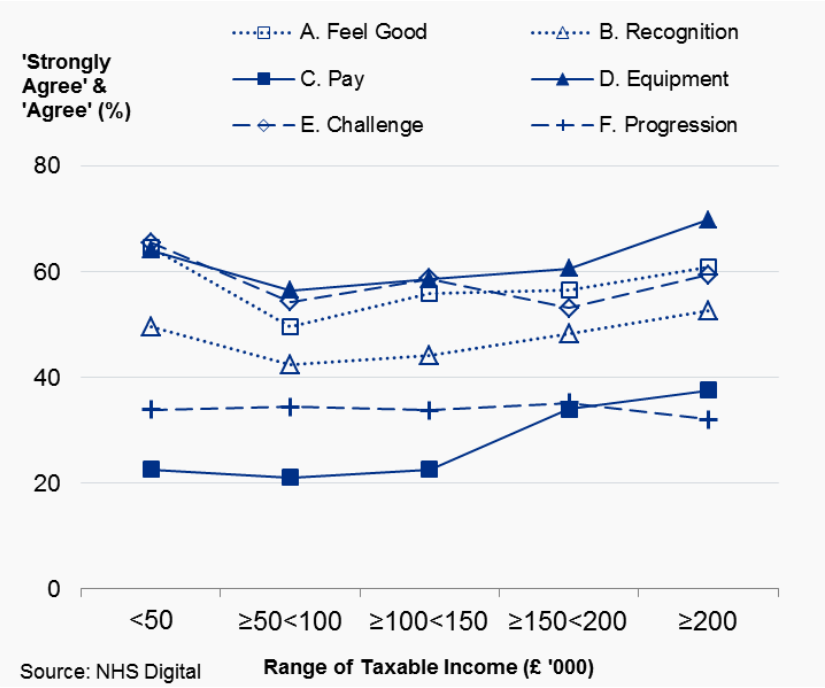
2.6 In brief, dentists were asked to indicate how strongly they agreed or disagreed with each question using a five-point Likert scale (e.g. 'strongly agree', 'agree', 'neutral' etc). Table 2.3 and figure 2.3 show the percentage of Providing-Performer dentists who answered 'strongly agree' or 'agree' to each motivation question and how this changes with taxable income. The 'overall average' figure at the end of the table is the average of the percentage scores (of 'strongly agree' and 'agree') for each question and that particular range of taxable income.

Table 2.3: Providing-Performer dentists, percentage (%) responding 'strongly agree' or 'agree' by motivation question and taxable income, England & Wales, 2013/14

Range of Taxable Income (£,000)	(A) Feel Good	(B) Recognition	(C) Pay	(D) Equipment	(E) Challenge	(F) Progression	Overall Average
<50	64.5	49.7	22.6	64.1	65.5	33.9	**50.1**
≥50<100	49.5	42.4	21.1	56.5	54.3	34.5	**43.1**
≥100<150	55.9	44.1	22.6	58.6	58.7	33.8	**45.6**
≥150<200	56.5	48.2	34.0	60.6	53.1	35.2	**47.9**
≥200	60.9	52.7	37.6	69.8	59.4	32.1	**52.1**
All	**55.7**	**45.9**	**25.0**	**60.2**	**57.7**	**34.1**	**46.4**

Source: NHS Digital

Figure 2.3: Providing-Performer dentists, percentage (%) responding 'strongly agree' or 'agree' by motivation question and taxable income, England & Wales, 2013/14



2.7 Figure 2.3 shows that after the lowest taxable income band (<£50K) the percentage scores (of 'strongly agree' or 'agree') for most questions increase as taxable income increases. This is also apparent in the 'overall average' score at the end of the table and would suggest there is some relationship between motivation and pay for Providing-Performer dentists in England & Wales. The nature of this relationship in England & Wales is explored in more detail in Chapter 4.

2.8 In terms of individual questions, the most notable increase (from the lowest taxable income band to the highest) is for question (C) 'I feel my pay is fair', which might be expected given that answers to the question will be closely linked to the take home pay of dentists. How dentists in England & Wales answered question (C) is explored in more detail in Chapter 3.

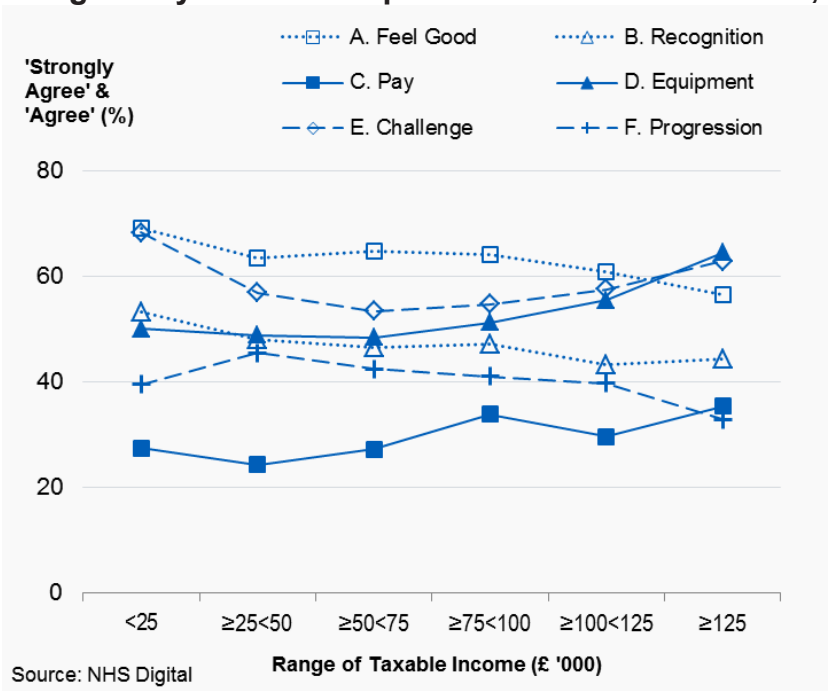
2.9 Table 2.4 and figure 2.4 show results for Performer Only dentists.

Table 2.4: Performer Only dentists, percentage (%) responding 'strongly agree' or 'agree' by motivation question and taxable income, England & Wales, 2013/14

Range of Taxable Income (£,000)	(A) Feel Good	(B) Recognition	(C) Pay	(D) Equipment	(E) Challenge	(F) Progression	Overall Average
<25	69.2	53.3	27.5	50.1	68.3	39.5	**51.3**
≥25<50	63.5	48.0	24.4	48.9	56.9	45.5	**47.9**
≥50<75	64.9	46.6	27.3	48.4	53.4	42.5	**47.2**
≥75<100	64.2	47.3	33.9	51.3	54.7	41.1	**48.8**
≥100<125	60.8	43.3	29.7	55.5	57.6	39.8	**47.8**
≥125	56.6	44.3	35.4	64.5	62.9	32.9	**49.4**
All	**64.1**	**47.3**	**28.4**	**50.6**	**56.6**	**42.0**	**48.2**

Source: NHS Digital

Figure 2.4: Performer Only dentists, percentage (%) responding 'strongly agree' or 'agree' by motivation question and taxable income, England & Wales, 2013/14



2.10 The results for Performer Only dentists are less clear than those for Providing-Performers, with the percentage scores for some questions generally increasing with

taxable income, whilst others show a decrease. The mixed findings are apparent from the 'overall average' score that remains fairly consistently just below 50 percentage points across the range of taxable income explored.

2.11 Only question (C) on pay and (D) on equipment record a higher percentage of 'strongly agree' and 'agree' for the highest taxable income band compared to the lowest. In fact, there is a notable increase in the scores for question (D) 'I have all the equipment and resources I need to do my job properly', which once again, is similar to the result for Providing-Performers.

3. 'I Feel My Pay Is Fair'

3.1 Out of the six motivation questions asked in the Dental Working Patterns (DWP) Survey, question (C) 'I feel my pay is fair' may be the most likely to be linked to taxable income. With that in mind, this chapter explores the relationship between pay and answers to question (C) in more detail than covered in Chapter 2.

3.2 Table 3.1 summarises the relationship between how dentists answered question (C) on pay, different variables measured in the DWP Survey and average taxable income. Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information.

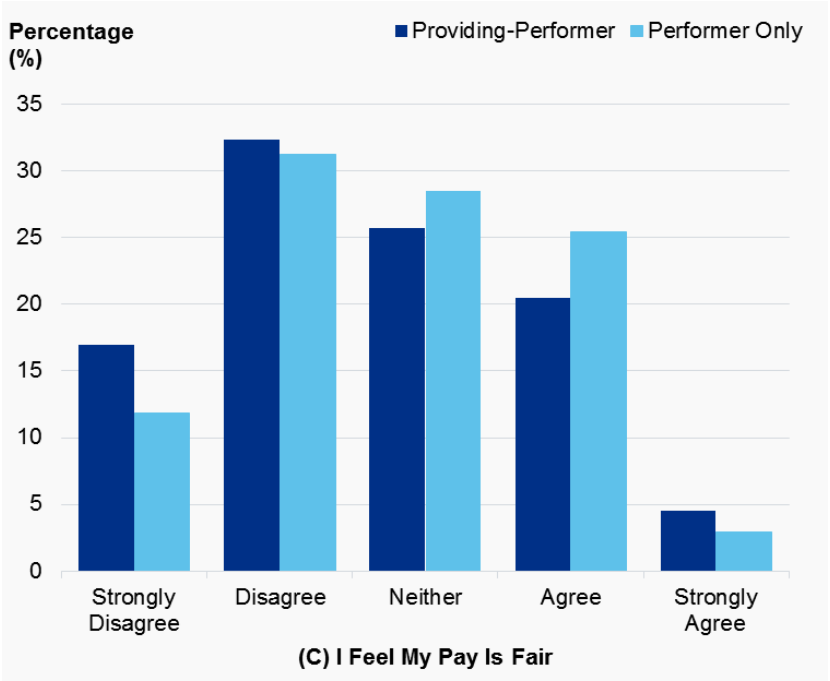
Table 3.1: Relationship between answers to question (C) on pay, different variables from the Dental Working Patterns Survey and taxable income, by dental type, England & Wales, 2013/14

	Question (C)	Full-Year Popln.		Average					
Dental Type	"I Feel My Pay Is Fair"	Count	(%)	Taxable Income	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
Providing-Perfromer	Strongly Disagree	721	16.9	£102,500	50.0	46.0	3.7	74.8	71.9
	Disagree	1,378	32.4	£107,600	49.3	41.3	4.3	67.1	72.5
	Neither	1,095	25.7	£112,600	50.2	40.7	4.4	62.7	74.2
	Agree	871	20.5	£128,900	49.3	38.9	4.8	53.1	75.2
	Strongly Agree	194	4.6	£135,000	51.0	38.4	5.8	40.3	72.1
	All	**4,258**	**100.0**	**£113,600**	**49.7**	**41.3**	**4.4**	**63.2**	**73.4**
Performer Only	Strongly Disagree	1,847	11.8	£63,800	40.2	36.0	4.1	80.0	79.2
	Disagree	4,881	31.2	£63,400	38.9	35.6	4.4	78.2	81.1
	Neither	4,461	28.5	£65,600	38.8	35.4	4.6	74.9	82.0
	Agree	3,981	25.5	£70,500	39.0	34.5	4.8	68.2	83.6
	Strongly Agree	460	2.9	£76,200	39.4	34.0	4.8	69.2	79.8
	All	**15,630**	**100.0**	**£66,200**	**39.1**	**35.2**	**4.5**	**74.7**	**81.7**
All Dentists		**19,889**	**100.0**	**£76,400**	**41.4**	**36.5**	**4.5**	**72.2**	**79.9**

Source: NHS Digital

3.3 The results in the first two columns (full-year population count and percentage) show that for both dental types more dentists 'disagree' or 'strongly disagree' that their pay is fair compared to the corresponding categories of 'strongly agree' or 'agree'. These results are shown in figure 3.1 for both Providing-Performer and Performer Only dentists.

Figure 3.1: Histogram showing how dentists answered question (C) 'I feel my pay is fair', by dental type, England & Wales, 2013/14



3.4 Taking 'Neither' as the central point, the histograms for both dental types are skewed towards the left (i.e. towards disagree) emphasising that fewer dentists consider their pay to be fair compared to those who disagreed with the statement. Table 2.3 and 2.4 in the last Chapter also show that dentists respond less positively to the question on pay compared to all the other motivation questions asked, highlighting an issue with pay for most dentists.

3.5 As might be expected, table 3.1 also shows that dentists who agree their pay is fair receive higher taxable incomes on average when compared to those who disagree. However, as well as increases in pay, there are also some other noticeable changes in the working patterns of these dentists, which are easier to see when plotted graphically, as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

Figure 3.2: Providing-Performer dentists, plot of average taxable income (£ '000) and weeks of leave by answers to question (C) on pay, England & Wales, 2013/14

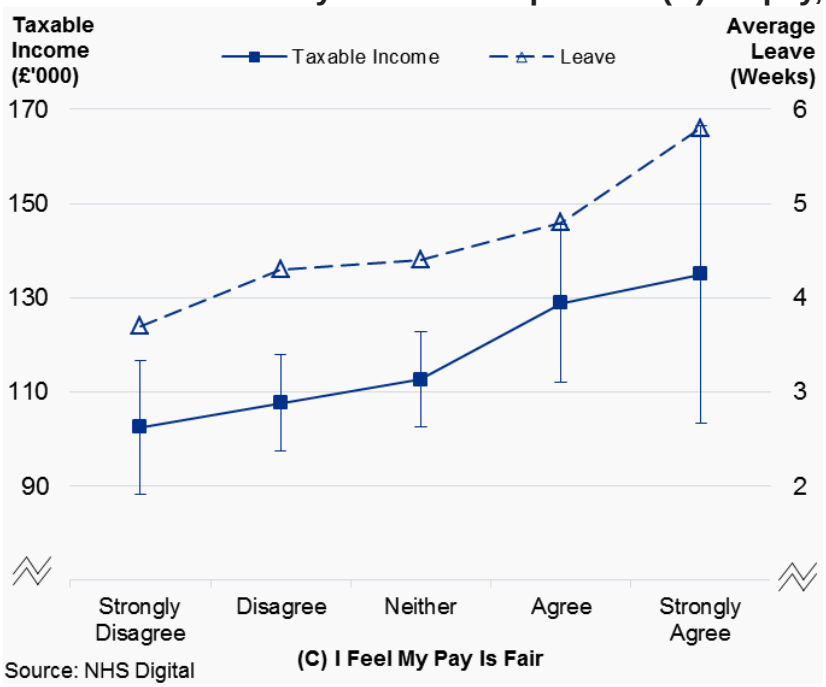
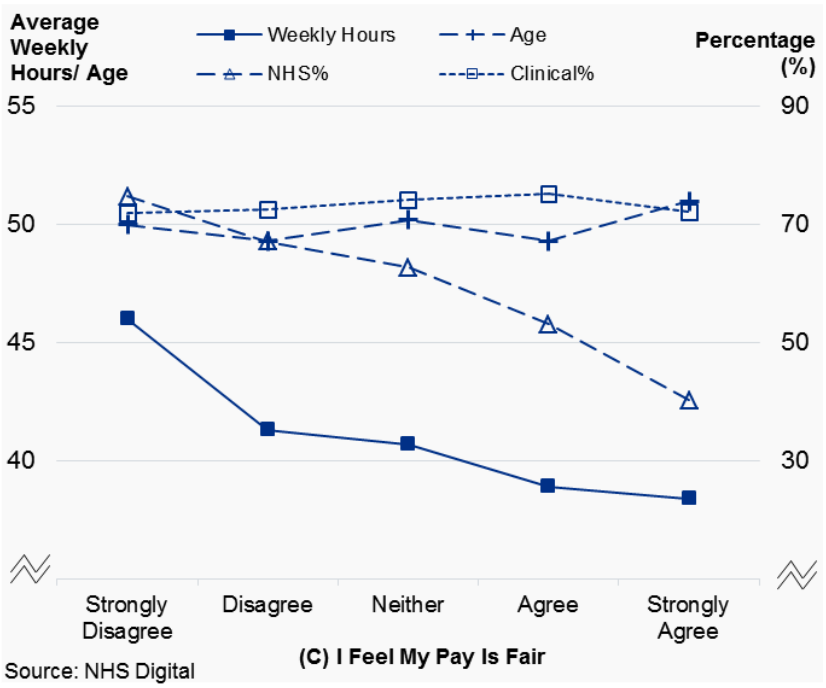


Figure 3.3: Providing-Performer dentists, plot of average weekly hours, NHS and clinical share (%) and age by answers to question (C) on pay, England & Wales, 2013/14



3.6 As well as the increase in taxable income, figure 3.2 shows a noticeable increase in weeks of annual leave taken by Providing-Performer dentists the more they agree with question (C). On the other hand, figure 3.3 shows there is a clear drop in weekly hours of work as well as NHS share (%) the more dentists agree with the question. In other words, how dentists answer question (C) does not depend solely on their taxable income but also upon a range of other factors including weekly hours of work, annual leave and NHS share (%).

3.7 Figures 3.4 and 3.5 show results for Performer Only dentists.

Figure 3.4: Performer Only dentists, plot of average taxable income (£ '000) and weeks of leave by answers to question (C) on pay, England & Wales, 2013/14

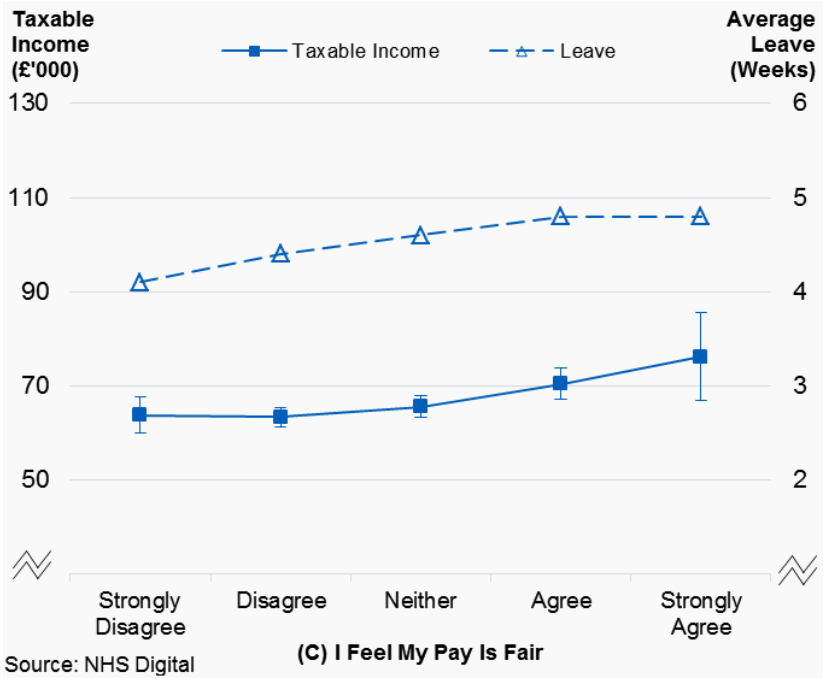
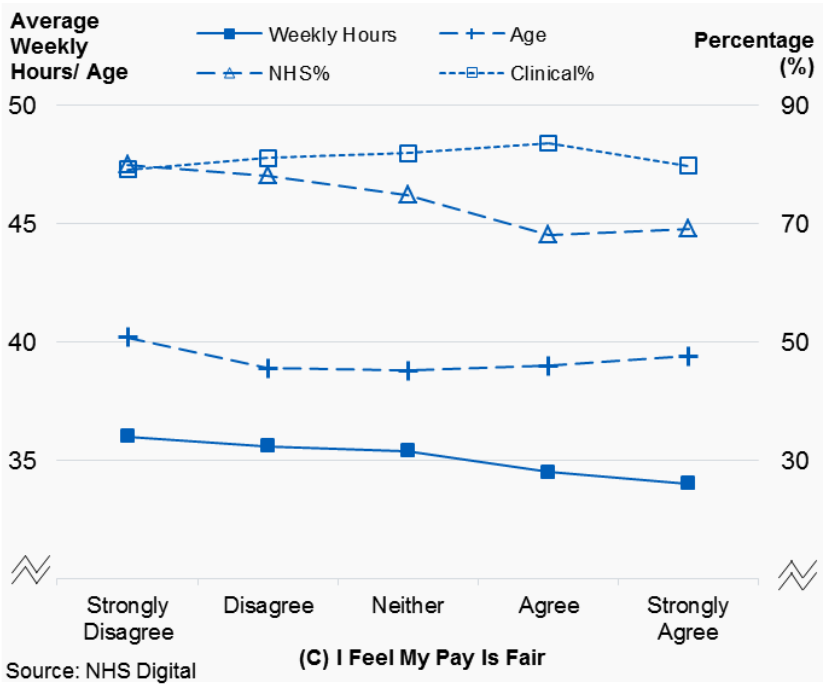


Figure 3.5: Performer Only dentists, plot of average weekly hours, NHS and clinical share (%) and age by answers to question (C) on pay, England & Wales, 2013/14



3.8 It would appear that Performer Only dentists exhibit similar patterns in how they answer question (C) when compared to Providing-Performer dentists but these are somewhat smaller in magnitude. However, in both cases the results suggest that there is more at play than merely higher taxable income for dentists to feel their pay is fair. Based on the results of the survey, these include working fewer hours and taking more leave (and conducting less NHS work). In other words, when dentists are satisfied with their work-

life balance and earn more money they are more likely to answer question (C) in the affirmative.

3.9 Such results are important because they suggest it is unlikely that income alone will have a strong relationship with motivation and morale but rather a range of work-life factors including weekly hours of work, annual leave and NHS commitment.

4. Average 'Motivation Index' and Taxable Income

4.1 The results in this chapter are based on the average 'motivation index' for dentists as described in Chapter 1. The 'motivation index' for each dentist is calculated by taking the average of the responses given to the six motivation questions (that are scored from 100% for 'strongly agree' to 0% for 'strongly disagree'). The highest possible 'motivation index' for dentists is 100% and the lowest is 0%.

4.2 Table 4.1 explores relationships between average 'motivation index', variables measured in the Dental Working Patterns Survey and taxable income. In this case, dentists are separated into four motivation bands of:

i. Very Low (≤25%)
ii. Neutral & Low (>25% & ≤50%)
iii. High (>50% & ≤75%)
iv. Very High (>75%)

4.3 Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information.

Table 4.1: Relationship between 'motivation band', working patterns and taxable income by dental type, England & Wales, 2013/14

		Full-Year Popln.		Average						
Dental Type	Motivation Band	Count	(%)	Taxable Income	Motivation Index (%)	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
Providing-Performer	Very Low	384	9.0	£96,300	16.7	50.0	45.7	3.5	78.9	65.2
	Neutral & Low	1,383	32.5	£112,600	41.5	50.0	41.9	4.3	71.4	73.0
	High	1,973	46.3	£116,800	64.6	49.5	40.8	4.5	58.7	75.4
	Very High	518	12.2	£117,500	88.5	49.5	38.6	5.1	46.9	72.8
	All	**4,258**	**100.0**	**£113,600**	**55.7**	**49.7**	**41.3**	**4.4**	**63.2**	**73.4**
Performer Only	Very Low	1,239	7.9	£66,600	16.1	40.5	36.1	4.2	80.1	79.9
	Neutral & Low	4,714	30.2	£66,400	41.5	39.3	35.2	4.4	80.0	80.9
	High	7,822	50.0	£66,000	64.8	38.8	34.9	4.6	72.5	82.2
	Very High	1,855	11.9	£66,700	85.5	38.8	36.1	4.6	66.8	83.1
	All	**15,630**	**100.0**	**£66,200**	**56.3**	**39.1**	**35.2**	**4.5**	**74.7**	**81.7**
All Dentists		**19,889**	**100.0**	**£76,400**	**56.2**	**41.4**	**36.5**	**4.5**	**72.2**	**79.9**

Source: NHS Digital

4.4 The relationships between the 'motivation index' and working patterns have been discussed in detail in the 2012/13 & 2013/14 Motivation Analysis report. Table 4.1 takes the analysis further with the addition of average taxable income for each motivation band. In general, the results suggest that there is an association between higher taxable income and higher motivation for Providing-Performer dentists. However, this does not appear to be the case for Performer Only dentists whose average taxable income remains relatively constant for each motivation band. The results are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

Figure 4.1: Providing-Performer dentists, plot of average taxable income (£ '000) and weeks of annual leave by motivation band, England & Wales, 2013/14

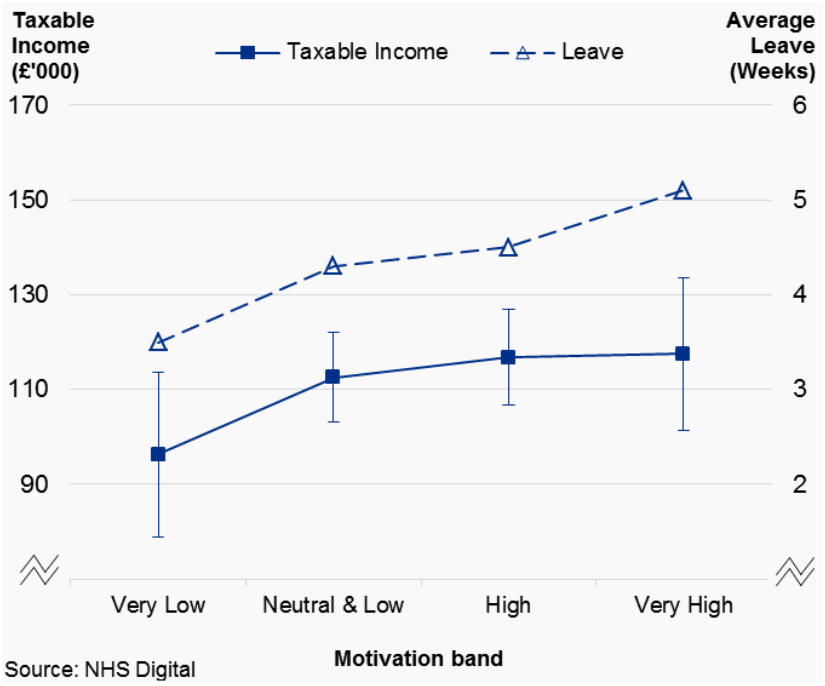
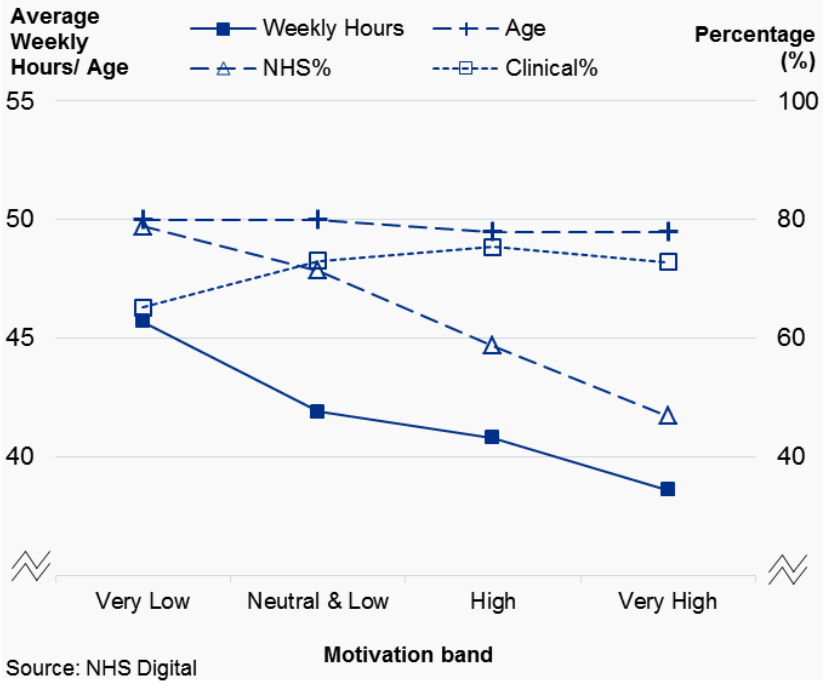


Figure 4.2: Providing-Performer dentists, plot of average weekly hours, NHS and clinical share (%) and age by motivation band, England & Wales, 2013/14



4.5 Figure 4.1 highlights the positive relationship between motivation and taxable income for Providing-Performer dentists although it is important to note that the increases in pay are not statistically significant (as shown by the error bars). In terms of working patterns, average weekly hours of work and NHS share (%) both decrease as motivation increases whilst average weeks of annual leave increases.

4.6 These results make interpretation all the more challenging because, in terms of working patterns, the very conditions that tend to make Providing-Performers more motivated (i.e. fewer weekly hours of work and NHS share (%) and more annual leave) are likely

to reduce potential earnings. In other words, isolating any relationship between motivation and taxable income is difficult when several other variables are in play. One solution is to use multivariate analysis that allows for individual analysis of each relationship in turn. This approach was used in the 2012/13 & 2013/14 Motivation Analysis report and is repeated in paragraph 4.9 onwards in this chapter with the addition of taxable income data.

4.7 Figures 4.3 and 4.4 plot results for Performer Only dentists from table 4.1.

Figure 4.3: Performer Only dentists, plot of average taxable income (£ '000) and weeks of annual leave by motivation band, England & Wales, 2013/14

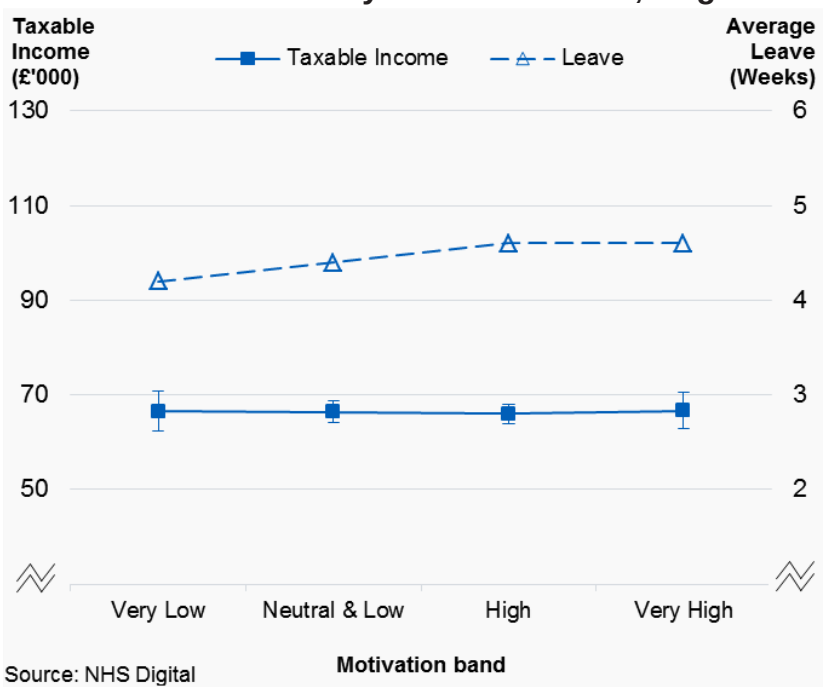
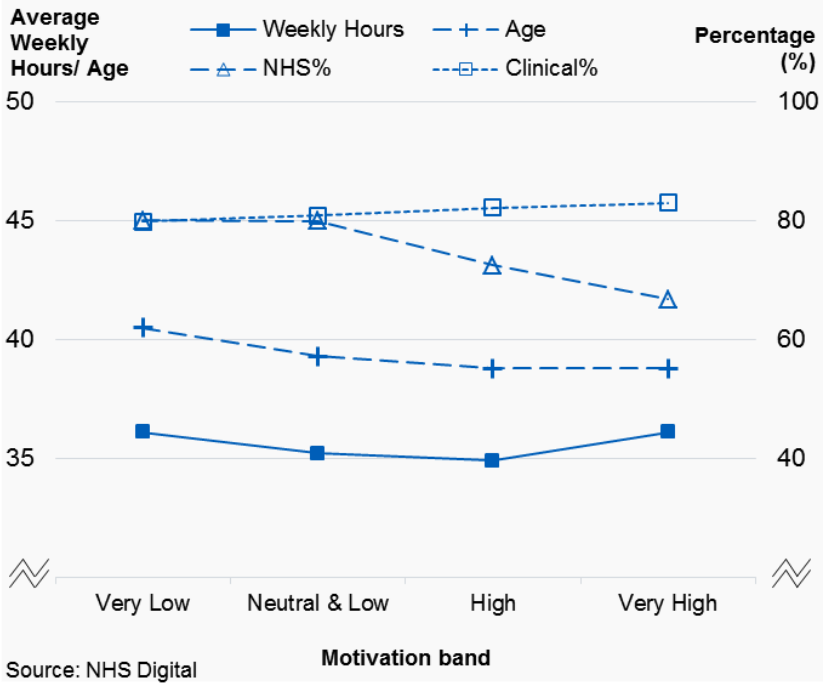


Figure 4.4: Performer Only dentists, plot of average weekly hours, NHS and clinical share (%) and age by motivation band, England & Wales, 2013/14



4.8 Figure 4.3 suggests there is little relationship between taxable income and motivation for Performer Only dentists. In terms of working patterns, there appears a modest rise in annual leave and, as shown in figure 4.4, a decrease in NHS share (%) and age the more motivated Performer Only dentists are. However, as discussed earlier, such relationships are easier to tease apart using multivariate analysis, which is discussed next.

Multivariate Analysis

4.9 Whilst the analysis so far suggests there are some relationships between the measured variables and average 'motivation index' it does not allow analysis of each variable in *isolation* (i.e. while holding other variables constant). One solution is to use multiple linear regression that allows for individual analysis of each relationship in turn. Please see Annex A for a more detailed description of the multiple linear regression methodology as well as the statistical tests for its use with the average 'motivation index'. Annex C lists the statistical significance and adjusted R-squared[9] values for the results in this chapter.

Multiple Linear Regression Results

4.10 Table 4.2 shows the multiple linear regression results by dental type for the average 'motivation index'. Variable results that are not statistically significant are greyed out in the table.

Table 4.2: Parameter estimates[1] for 'motivation index' by dental type using multiple linear regression, England & Wales, 2013/14

Dental Type	Sample	Intercept[1]	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income
Providing-Performer	681	63.37	-0.16	-0.17	0.09	1.13	-0.09	0.000027
Performer Only	3,325	62.88	-0.01	-0.16	0.11	0.55	-0.15	-0.000002

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

4.11 The positive or negative values of the variable results indicate the relationship between each variable and motivation. For example, for both sets of dentists an increase in annual leave correlates with an increase in motivation, whereas increases in NHS share (%) have the opposite correlation. Please see the 2012/13 & 2013/14 Motivation Analysis report for a more detailed discussion of the relationship between the 'motivation index' and working pattern variables.

4.12 For the purposes of this report, the most interesting results are in the final column of table 4.2 where the relationship between taxable income and motivation is shown. Whilst the result for Performer Only dentists is not statistically significant (as suggested by figure 4.3) the result for Providing-Performers is significant. In other words, there is an association between an increase in pay and an increase in motivation for this group of dentists. However, the size of the variable is quite small so that, if all other working patterns remain the same, a £20,000 increase in taxable income is predicted by the

[9] In a multiple linear regression model, adjusted R-squared measures the proportion of variation in the dependent variable (i.e. the 'motivation index') accounted for by the explanatory variables (e.g. weekly hours, NHS share %, taxable income).

linear regression model to be associated with an increase in the 'motivation index' of Providing-Performers of 0.5 percentage point (i.e. £20,000 x 0.000027).

4.13 On first appearance the scale of the Providing-Performer result (and absence of statistically significant results for Performer Only dentists) is perhaps a surprise, particularly as money and the pressure for pay increases are often anecdotally assumed to be a constant in most workforces. However, there is a growing body of evidence suggesting that motivation levels do not increase as salary increases. A Gallup poll in 2011, showed no significant differences in employee engagement by income levels[10] and other researchers point to the importance of intrinsic rewards for job satisfaction[11]. For example, if a job lacks four basic elements - a sense of meaning, a sense of choice in how to work, a sense of competence and a sense of progression – then most will not be motivated to work. Whilst the article in the Ivy Business Journal admits unfair pay can be a de-motivator, they argue that once issues of unfairness are settled, extrinsic rewards (usually financial) become less important and day-to-day motivation is more strongly driven by intrinsic rewards.

4.14 Nonetheless, the taxable income result for Providing-Performer dentists is significant and the linear regression results in table 4.2 enable this to be given more context. For example, it has been predicted by the model that an increase in taxable income of £20,000 is associated with a 0.5 percentage point increase in motivation and a similar increase is also predicted to be available by working 3.4 fewer hours per week or by taking an extra half week's annual leave. It is important not to extrapolate much further from these results as they are based only on a predictive model. (For example, it is not possible to say that decreasing weekly hours of work by 3.4 hours would cost dentists on average £20,000). The main point is that for Providing-Performer dentists in England & Wales there is evidence of a positive relationship between motivation and taxable income which, although small, is comparable to changes in working patterns that would likely have an effect on their work-life balance.

4.15 As discussed, Performer Only dentists show no significant relationship between pay and motivation. Whilst this might at first also be surprising, table 4.2 also shows that weekly hours of work have no significant relationship with motivation. This latter finding was discussed in the 2012/13 & 2013/14 Motivation Analysis report with the point made that a third of these dentists work part-time (<35 weekly hours), which is likely to affect the result. In other words, if there is more variation in the work-life balance of a particular workforce (i.e. full and part-time working, greater variation in annual leave) then the motivation level of the entire group might be less affected by changes in pay levels. Interestingly, the motivation (and morale) levels of Performer Only dentists were also greater than those of Providing-Performers in 2013/14 as shown in the 2012/13 & 2013/14 Motivation Analysis report.

4.16 Overall, the results in this chapter show that for Providing-Performer but not Performer only dentists, pay does have a positive relationship with motivation. However, it is important to note that whilst regression analysis provides evidence for the existence of relationships between variables, it does not provide measures of causality. In other words, whilst there may well be a relationship between taxable income and motivation for Providing-Performers, it is not possible to determine if more pay motivates these dentists or whether motivated dentists tend to earn more.

[10] http://www.gallup.com/poll/150383/majority-american-workers-not-engaged-jobs.aspx
[11] http://iveybusinessjournal.com/publication/the-four-intrinsic-rewards-that-drive-employee-engagement/

5. Morale of Dentists and Taxable Income

5.1 This chapter looks at answers to question (G) 'How would you rate your morale as a dentist in 2013/14?' treating it separately to the motivation questions used in previous chapters. Please see Chapter 4 in the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[12] for more background on the definition of morale and how it differs from motivation. In brief, whereas motivation is usually defined as the internal drive of an individual their morale generally relates to feelings of satisfaction and confidence in their life.

5.2 Table 5.1 summarises the relationship between how dentists answered the morale question and the measured variables in the Dental Working Patterns (DWP) Survey as well as average taxable income. Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information.

Table 5.1: Relationship between morale of dentists, variables from the Dental Working Patterns Survey and taxable income by dental type, England & Wales, 2013/14

		Full-Year Popln.		Average					
Dental Type	Morale Level	Count	(%)	Taxable Income	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
Providing-Perfromer	Very Low	640	15.0	£109,300	50.5	45.4	3.9	78.2	72.0
	Low	1,178	27.7	£115,700	50.4	44.0	4.4	63.2	72.1
	Neither	1,216	28.6	£109,500	48.9	38.7	4.3	62.5	72.9
	High	887	20.8	£122,500	49.3	38.3	4.8	53.2	75.6
	Very High	337	7.9	£106,200	50.2	41.8	4.4	63.6	76.4
	All	**4,258**	**100.0**	**£113,600**	**49.7**	**41.3**	**4.4**	**63.2**	**73.4**
Performer Only	Very Low	1,303	8.3	£71,500	41.3	35.9	4.2	81.9	79.8
	Low	3,374	21.6	£66,500	40.2	35.0	4.4	78.3	80.9
	Neither	4,338	27.8	£67,800	39.0	34.7	4.7	73.6	81.8
	High	4,765	30.5	£64,800	38.0	35.3	4.6	71.0	81.9
	Very High	1,851	11.8	£61,900	38.4	36.4	4.4	75.0	83.8
	All	**15,630**	**100.0**	**£66,200**	**39.1**	**35.2**	**4.5**	**74.7**	**81.7**
All Dentists		**19,889**	**100.0**	**£76,400**	**41.4**	**36.5**	**4.5**	**72.2**	**79.9**

Source: NHS Digital

5.3 The relationships between dentists' morale and their working patterns have been discussed in detail in the Motivation Analysis report. Table 5.1 takes the analysis further with the addition of average taxable income for each morale level. The results suggest that there is little relationship between taxable income and morale levels for Providing-Performer dentists. However, there is evidence of a *negative* relationship between taxable income and morale levels Performer Only dentists (i.e. dentists who report higher morale levels have a lower average taxable income). The results are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However,

[12] Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis Experimental Statistics report found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

error bars for the working pattern variables have been omitted to help maintain chart legibility.

Figure 5.1: Providing-Performer dentists, plot of average taxable income (£ '000) and weeks of annual leave by morale level, England & Wales, 2013/14

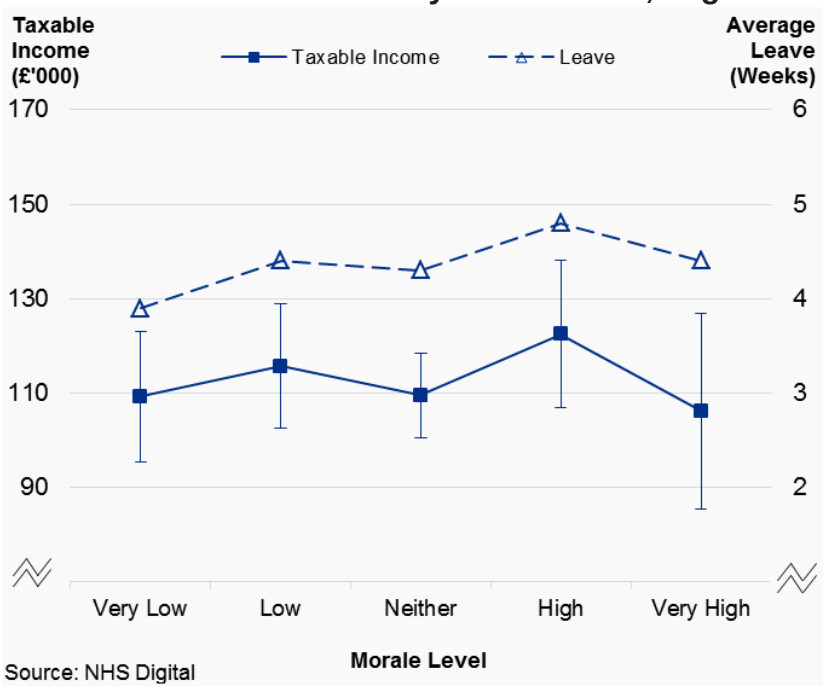
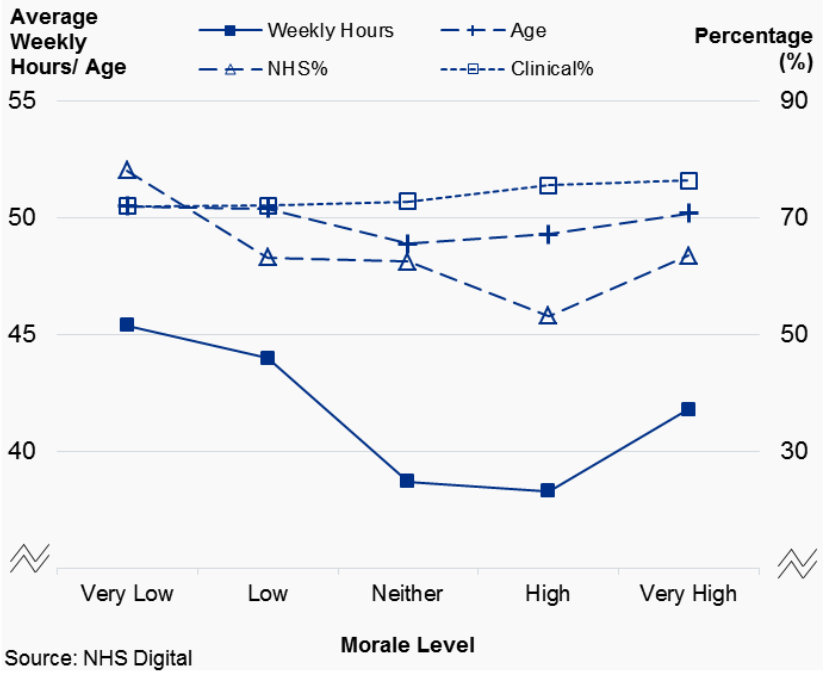


Figure 5.2: Providing-Performer dentists, plot of average weekly hours, NHS and clinical share (%) and age by morale level, England & Wales, 2013/14



5.4 Figure 5.1 shows how taxable income of Providing-Performer dentists fluctuates between £110,000 and £120,000 as the morale level of the dentists increases from 'very low' to 'very high'. This is in contrast to a general increase in annual leave and corresponding decrease in NHS share (%) and weekly hours (shown in figure 5.2) – all factors that are likely to decrease pay.

5.5 Figures 5.3 and 5.4 show the results from table 5.1 for Performer Only dentists.

Figure 5.3: Performer Only dentists, plot of average taxable income (£ '000) and weeks of annual leave by morale level, England & Wales, 2013/14

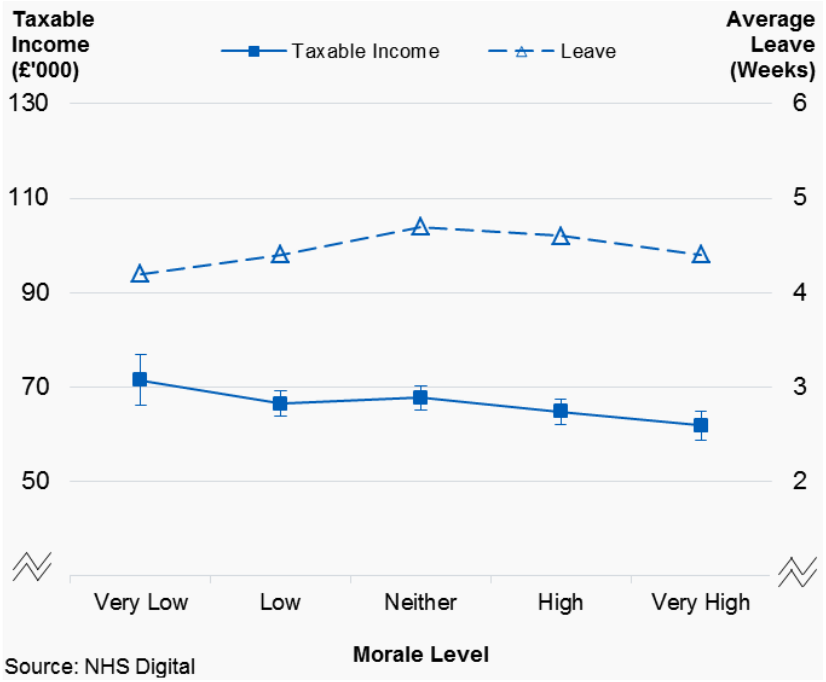
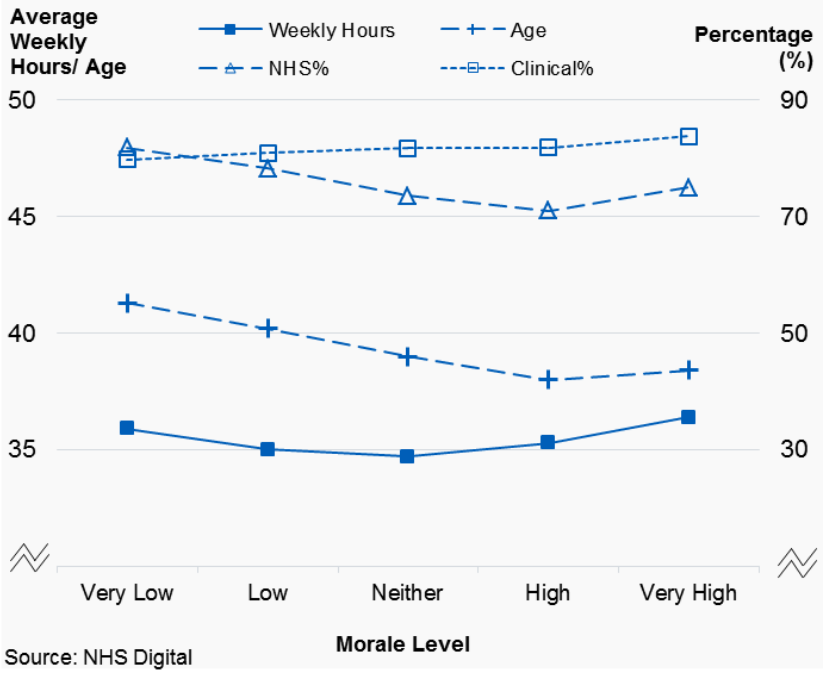


Figure 5.4: Performer Only dentists, plot of average weekly hours, NHS and clinical share (%) and age by morale level, England & Wales, 2013/14



5.6 Compared to the Providing-Performer results, those for Performer Only dentists are noticeably different. As discussed earlier, average taxable income actually decreases as dental morale increases for Performer Only dentists and the difference is statistically significant when comparing the 'very low' morale figure (£71,510) to the 'very high' figure (£61,949). Changes in working patterns which could potentially affect earnings are less pronounced, particularly when comparing 'very low' morale Performer Only dentists to those with 'very high' morale, which further supports this finding.

Multivariate Analysis

5.7 Similar to the issue for the average 'motivation index', the fact that a number of variables show a relationship with the morale of dentists (certainly for Providing-Performers) makes it harder to assess each relationship in isolation when using results from the above analysis alone. As morale is measured by only one question in the DWP Survey it is possible to use logistic regression (in a similar fashion to linear regression in Chapter 4) to allow for independent analysis[13]. Please see Annex A for a more detailed description of the logistic regression methodology and Annex C for the statistical significance and accuracy testing of the results in this chapter.

5.8 For the individual question analysis in Chapter 2 those who answered 'strongly agree' or 'agree' were combined for each question which is also the approach used in this section by combining 'very high' with 'high' and 'very low' with 'low' morale. Logistic regression modelling can then predict the probability of dentists responding positively or negatively to the morale question, adding more completeness to the analysis. Table 5.2 gives results this analysis for Providing-Performer dentists. Variable results that are not statistically significant are greyed out in the table.

Table 5.2: Providing-Performer dentists, parameter estimates[1] for morale level probability using logistic regression, England & Wales, 2013/14

Dental Type	Morale Level	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
Providing-Performer	Very High & High	-0.400	-0.017	-0.009	0.011	0.070	-0.011	0.0000020
	Very Low & Low	-3.695	0.043	0.009	-0.003	-0.003	0.029	-0.0000017

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

5.9 Similar to results for the average 'motivation index', the positive or negative values for the variables indicate the relationship between each variable and either high or low morale. In the case of the taxable income variable, the results suggest there is no statistically significant relationship between the morale of Providing-Performers and pay. Such a result might be expected given the results discussed earlier in this chapter.

5.10 Table 5.3 shows results for Performer Only dentists.

Table 5.3: Performer Only dentists, parameter estimates[1] for morale level probability using logistic regression, England & Wales, 2013/14

Dental Type	Morale Level	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
Performer Only	Very High & High	0.249	0.010	-0.009	0.007	0.021	-0.016	-0.0000036
	Very Low & Low	-1.708	-0.003	0.013	-0.009	-0.080	0.022	0.0000024

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

5.11 Unlike the results for Providing-Performers, the taxable income results for Performer Only dentists are both significant, suggesting there is a relationship between morale

[13] Logistic regression can be used when there are only two possible outcomes for the model. For example, possible outcomes could be either that dentists express very high and high levels of morale, or that they do not.

and pay for these dentists. However, one important caveat to point out is that the AUC value, which is the output of a statistical test for logistical regression[14], for the 'very high' and 'high' morale logistic regression result is 0.59, which is traditionally considered a fail (i.e. lower than 0.6). The 'low' and 'very low' morale AUC value is 0.62 (not a fail) and is the one considered in more detail here.

5.12 Perhaps the most surprising finding of the taxable income results is the positive and negative values of each. In the case of the 'low' and 'very low' morale result, a positive score (+0.0000024) predicts that as pay increases so does the probability of Performer Only dentists reporting they have *low* morale. In this case, a £20,000 increase in taxable income (above their 2013/14 average of £66,200 from table 5.1) is predicted by the logistic regression model to increase the chance of Performer Only dentists reporting low morale by 1.0 percentage point. In other words, in 2013/14, 29.9% of Performer Only dentists reported their morale as either 'low' or 'very low'; the results presented in table 5.3 suggest that this figure would increase to 30.9% if Performer Only dentists received a pay increase of £20,000. These results suggest that pay has a positive correlation with low morale for Performer Only dentists in England & Wales, which is also supported by the results discussed earlier in this chapter.

5.13 It is difficult to explain these findings. While the Gallup poll discussed in Chapter 4 provided evidence that motivation levels do not increase along with salary, the fact that pay may have a negative correlation with morale is harder to understand; this is discussed further in Chapter 12 and 13 when results from each country and between 2012/13 and 2013/14 are compared. It is also important to note that in England & Wales it is known there may be some incorrectly classified Providing-Performer dentists in the Performer Only group[15]. As Providing-Performers have lower average morale compared to Performer Only dentists, and usually earn more, this could provide some explanation.

5.14 Due to differences in the methodology for identifying dental type, such misclassification issues are less likely to arise in Scotland and Northern Ireland Associate dentist results, which are discussed later in this report.

[14] Annex A provides background on the 'area under the receiver operating characteristic curve' (AUC) value as one way of classifying the accuracy of logistic regression modelling.
[15] Annex C of Dental Working Hours, 2012/13 & 2013/14 Initial Analysis report provides a more detailed discussion of how England & Wales dentists are assigned dental type for the Dental Working Hours series of publications (www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation)

6. Effect of Different Dental Populations

6.1 Chapter 5 of the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[16] pointed to the existence and effect of different populations within each dental group that could be further explored. In consideration of the findings, this chapter repeats the analysis of the last two Chapters using the same subsets of dentists used in the earlier report. The three subsets are:

i. Part-time (<35 weekly hours) or full-time (≥35 hours)
ii. Mainly NHS (or mainly private) dentists[17]
iii. Gender

6.2 As the methodology has already been described in detail, the results are presented in summary form and readers are asked to refer to the earlier Chapters for more detailed explanations of terms.

Average 'Motivation Index'

6.3 Table 6.1 compares results for the average 'motivation index' for Providing-Performer dentists. The first row ('All') repeats the results from Chapter 4 for all Providing-Performers, with the subsequent rows showing results for more defined subsets based on the three populations listed. As before, variable results that are not statistically significant are greyed out in the table.

Table 6.1: Providing-Performer dentists, parameter estimates[1] for 'motivation index' by split populations using multiple linear regression, England & Wales, 2013/14

	Sample			Weekly	NHS	Clinical			Taxable
Population	Count	(%)	Intercept[1]	Hours	(%)	(%)	Leave	Age	Income
All	**681**	**100.0**	**63.37**	**-0.16**	**-0.17**	**0.09**	**1.13**	**-0.09**	**0.000027**
<35 Hours	140	20.6	7.93	0.24	-0.11	0.17	1.18	0.46	0.000090
≥35 Hours	541	79.4	80.44	-0.32	-0.19	0.05	1.19	-0.19	0.000023
Mainly NHS[2]	365	53.6	68.90	-0.29	-0.32	0.16	0.80	0.11	0.000027
Mainly Private[2]	167	24.5	71.60	0.15	-0.43	-0.01	1.60	-0.31	0.000031
Male	511	75.0	61.65	-0.12	-0.18	0.12	1.04	-0.13	0.000024
Female	170	25.0	58.41	-0.17	-0.17	0.02	1.05	0.19	0.000039

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.
2. 'Mainly NHS' and 'Mainly Private' percentages will not sum to 100% due to omission of the 'mixed NHS/Private' cohort.

6.4 There are some interesting differences when the Providing-Performer dentists are split into different cohorts. In terms of taxable income, those dentists who work part-time (<35 hours) display a stronger positive relationship between 'motivation index' and pay compared with their full-time colleagues. In the case of these part-time dentists, a £20,000 increase in pay is associated to a 1.8 percentage point increase in motivation

[16] Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis Experimental Statistics report found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation
[17] Mainly NHS dentists spend ≥75% of their time on NHS work and mainly private dentists spend ≤25% of their time on NHS work.

(compared to 0.5 percentage points for full-time dentists). As part-time dentists earn less on average than their full-time colleagues, it is possible that pay levels are more of a concern to this group.

6.5 Mainly private (≤25% NHS) Providing-Performers do not show a significant relationship between 'motivation index' and taxable income, unlike their mainly NHS (≥75%) colleagues. As first noted in the 2012/13 & 2013/14 Motivation Analysis report, the mainly private group show only one significant result (for annual leave in table 6.1) and appear to be less affected by their working patterns compared to the mainly NHS group, which may have some bearing on the taxable income result. Interestingly, the 2012/13 & 2013/14 Motivation Analysis report also shows they have a higher average 'motivation index' score than their mainly NHS colleagues (63.5% compared to 50.3%).

6.6 Finally, table 6.1 shows that taxable income has a greater association with motivation for female Providing-Performers compared to their male colleagues. As female dentists tend to work fewer weekly hours than male Providing-Performer dentists (36.8 hours compared to 42.1) this finding may also provide another explanation for why part-time dentists show a stronger positive relationship between 'motivation index' and pay. However, it is important to note that there will be other variables affecting motivation that are not covered in the regression models, and that any conclusions drawn should not be taken as a definitive explanation. Table 6.2 shows the results for Performer Only dentists.

Table 6.2: Performer Only dentists, parameter estimates[1] for 'motivation index' by split populations using multiple linear regression, England & Wales, 2013/14

	Sample			Weekly	NHS	Clinical			Taxable
Population	Count	(%)	Intercept[1]	Hours	(%)	(%)	Leave	Age	Income
All	**3,325**	**100.0**	**62.88**	**-0.01**	**-0.16**	**0.11**	**0.55**	**-0.15**	**-0.000002**
<35 Hours	1,222	36.8	66.01	-0.16	-0.17	0.05	0.80	-0.09	0.000008
≥35 Hours	2,103	63.2	70.20	-0.19	-0.16	0.14	0.41	-0.17	-0.000005
Mainly NHS[2]	2,307	69.4	77.18	0.02	-0.35	0.12	0.54	-0.10	-0.000015
Mainly Private[2]	396	11.9	61.70	-0.04	-0.03	0.13	0.56	-0.23	0.000025
Male	1,536	46.2	61.65	-0.10	-0.14	0.10	1.01	-0.10	-0.000003
Female	1,789	53.8	64.07	0.08	-0.19	0.12	0.26	-0.21	0.000012

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.
2. 'Mainly NHS' and 'Mainly Private' percentages will not sum to 100% due to omission of the 'mixed NHS/Private' cohort.

6.7 As discussed in Chapter 4, Performer Only dentists show no significant relationship between taxable income and motivation. This remains the case even when splitting this dental group into different population cohorts, emphasising that regardless of the work-life balance (or gender) of Performer Only dentists there is no measurable link between the two.

Morale of Dentists

6.8 Tables 6.3 and 6.4 show results for probability modelling of how dentists answer the morale question. The first row in each table repeats the results from Chapter 5 for both dental types, with the subsequent rows based on the population subsets as defined in

paragraph 6.1. Once again, variable results that are not statistically significant are greyed out in the table.

Table 6.3: Providing-Performer dentists, parameter estimates[1] for 'very high' or 'high' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Intercept[1]	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income
All	**-0.400**	**-0.017**	**-0.009**	**0.011**	**0.070**	**-0.011**	**0.0000020**
<35 Hours	-3.701	0.014	-0.007	0.014	0.019	0.031	0.0000048
≥35 Hours	0.492	-0.021	-0.011	0.009	0.091	-0.024	0.0000020
Mainly NHS	-0.204	-0.031	-0.016	0.023	0.064	-0.009	0.0000020
Mainly Private	0.403	-0.016	-0.036	0.001	0.058	-0.005	0.0000030
Male	-0.409	-0.011	-0.007	0.009	0.077	-0.019	0.0000011
Female	-1.899	-0.019	-0.019	0.019	0.043	0.025	0.0000059

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

6.9 As discussed in Chapter 5, Providing-Performer dentists as a whole show no significant relationship between taxable income and morale. This largely remains the case even when splitting the Providing-Performer group into different cohorts. However, one notable exception can be seen in table 6.3, which is for female Providing-Performers who show a positive and statistically significant relationship between pay and morale. In this case, a £20,000 increase in taxable income (above their 2013/14 average of £101,800 from the Dental Earnings & Expenses, 2013/14 Additional Analysis report) is predicted by the logistic regression model to increase the chance of these dentists reporting high morale by 2.9 percentage points. In other words, in 2013/14, 36.8% of female Providing-Performer dentists reported their morale as either 'very high' or 'high'; the results presented in table 6.3 suggest that this figure would increase to 39.7% if they each received a pay increase of £20,000.

6.10 Table 6.4 shows results for Performer Only dentists. As Chapter 5 concentrated on modelling Performer Only dentists who recorded their morale as 'low' and 'very low', the same approach is used here.

Table 6.4: Performer Only dentists, parameter estimates[1] for 'low' or 'very low' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Intercept[1]	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income
All	**-1.708**	**-0.003**	**0.013**	**-0.009**	**-0.080**	**0.022**	**0.0000024**
<35 Hours	-1.977	0.005	0.017	-0.006	-0.085	0.017	0.0000018
≥35 Hours	-2.551	0.020	0.011	-0.010	-0.070	0.024	0.0000027
Mainly NHS	-4.103	-0.012	0.049	-0.012	-0.060	0.010	0.0000046
Mainly Private	-2.278	0.023	-0.029	-0.004	-0.204	0.047	-0.0000029

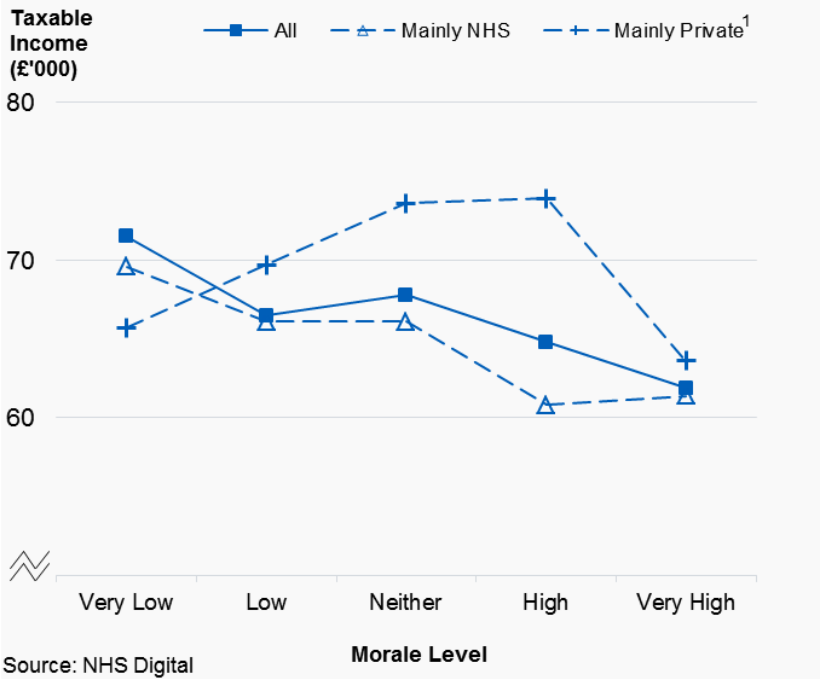
Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
The 'low' and 'very low' logistic regression analysis did not include gender.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

6.11 As discussed in Chapter 5, a surprising finding is that taxable income appears to have a positive correlation with low morale for Performer Only dentists in England & Wales. In terms of time spent on NHS work, the results in table 6.4 suggest that part of this effect is dependent upon how much time Performer Only dentists spend on NHS work. Mainly NHS (≥75%) dentists demonstrate a stronger and statistically significant positive correlation between low morale and pay compared to the mainly private cohort. In this case, a £20,000 increase in taxable income (above their 2013/14 average of £60,900 from the Dental Earnings & Expenses, 2013/14 Initial Analysis report) is predicted by the model to increase the chance of Mainly NHS (≥75%) dentists reporting low morale by 2.0 percentage points.

6.12 To help give the results more meaning, figure 6.1 shows a plot of taxable income by morale level for Performer Only dentists and shows results defined by the amount of NHS work undertaken. Please note, to ensure sufficient sample size for this analysis, the mainly private cohort was defined as ≤50% of time spent on NHS work (and not ≤25% as normally used to define mainly private in the rest of this report). The mainly NHS cohort remained unchanged at ≥75% of time spent on NHS work (with the >50% to <75% cohort excluded for chart readability purposes).

Figure 6.1: Performer Only dentists, plot of average taxable income (£ '000) by morale level and time spent on NHS work, England & Wales, 2013/14



1. To ensure sufficient sample size for the analysis, the mainly private cohort was defined as ≤50% of time spent on NHS work (and not ≤25% as normally used to define mainly private in the rest of this report).

6.13 As predicted by the logistic regression results, figure 6.1 suggests there is a negative correlation between morale and taxable income for all Performer Only dentists overall as well as for those who spend the majority of their time on NHS work (≥75%). The relationship is generally in the opposite direction for those dentists who spend ≤50% of their time on NHS work (apart from a drop in average income for those dentists with 'very high' morale, which likely explains why the logistic regression results are not significant for this group). Once again it is difficult to explain the negative correlation findings but it is interesting that this is a phenomenon that appears confined to mainly NHS dentists. The issue is discussed further in Chapters 12 and 13 when results from each country and between 2012/13 and 2013/14 are compared.

Scotland and Northern Ireland Analysis

7. Effects of Smaller Sample Sizes on Scotland and Northern Ireland Results

7.1 As discussed in the Introduction, in order to maintain taxpayer confidentiality, any analyses that produce results with low sample numbers (30 or below) have been supressed. Whilst this has not affected the granularity of results from England & Wales (combined) it places greater limits on what is possible for results from Scotland and Northern Ireland, which is reflected in the reduced content of the results chapters for these two countries.

7.2 Readers are encouraged to read the England & Wales Chapters for a greater understanding of the analysis in the following chapters.

Scotland – 2013/14

8. Average 'Motivation Index' and Taxable Income

8.1 The results in this chapter are based on the average 'motivation index' for dentists as described in Chapter 1. The 'motivation index' for each dentist is calculated by taking the average of the responses given to the six motivation questions (that are scored from 100% for 'strongly agree' to 0% for 'strongly disagree'). The highest possible 'motivation index' for dentists is 100% and the lowest is 0%.

8.2 Table 8.1 explores relationships between average 'motivation index', variables measured in the Dental Working Patterns Survey and taxable income. In the 2012/13 & 2013/14 Motivation Analysis report dentists were separated into four motivation bands based of:

i. Very Low (≤25%)
ii. Neutral & Low (>25% & ≤50%)
iii. High (>50% & ≤75%)
iv. Very High (>75%)

8.3 However, due to sample size limitations for this analysis, some of the motivation bands were combined for analytical and reporting purposes as shown in table 8.1. Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information.

Table 8.1: Relationship between 'motivation band', working patterns and taxable income by dental type, Scotland, 2013/14

		Full-Year Popln.		Average						
Dental Type	Motivation Band	Count	(%)	Taxable Income	Motivation Index (%)	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
Principal	≤50%	328	52.6	£102,600	34.2	50.6	41.7	4.2	77.8	73.4
	>50%	295	47.3	£100,900	63.8	45.6	43.4	4.7	65.6	74.7
	All	**624**	**100.0**	**£101,800**	**48.2**	**48.2**	**42.5**	**4.4**	**72.0**	**74.0**
Associate	≤50%	600	36.8	£55,500	39.8	38.0	35.3	4.4	85.1	82.4
	>50% ≤75%	869	53.3	£59,200	63.8	35.7	35.9	4.4	79.7	83.3
	>75%	160	9.8	£51,000	84.5	38.8	37.6	4.2	79.2	80.8
	All	**1,629**	**100.0**	**£57,000**	**57.0**	**36.8**	**35.8**	**4.4**	**81.6**	**82.8**
All Dentists		**2,253**	**100.0**	**£69,400**	**54.5**	**40.0**	**37.7**	**4.4**	**79.0**	**80.3**

Source: NHS Digital

8.4 The relationships between the 'motivation index' and working patterns have been discussed in detail in the 2012/13 & 2013/14 Motivation Analysis report. Table 8.1 takes the analysis further with the addition of average taxable income for each motivation band. In general, the results suggest that there is no association between average taxable income and motivation for dentists in Scotland. These are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

Figure 8.1: Principal dentists, plot of average taxable income (£ '000) and weeks of annual leave by motivation band, Scotland, 2013/14

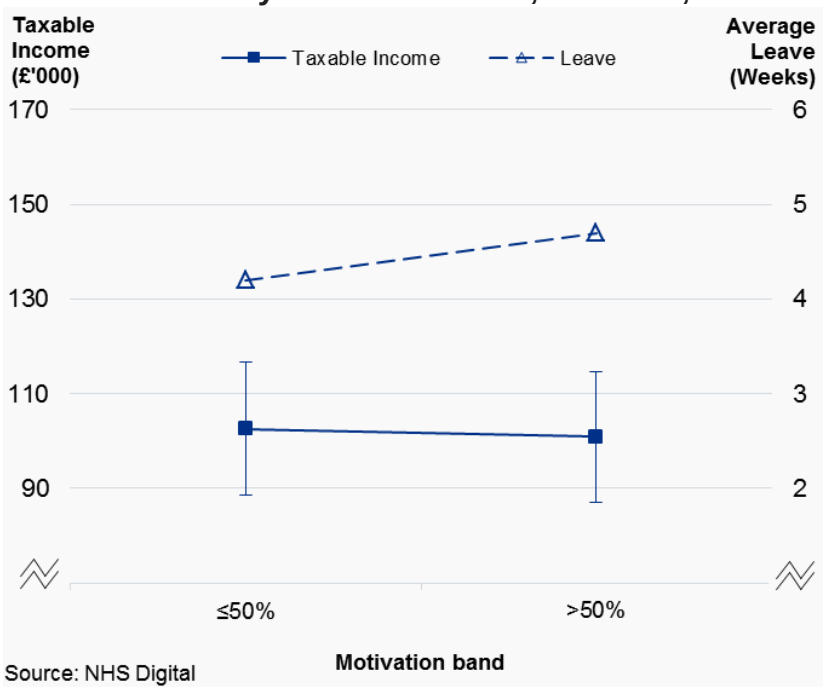
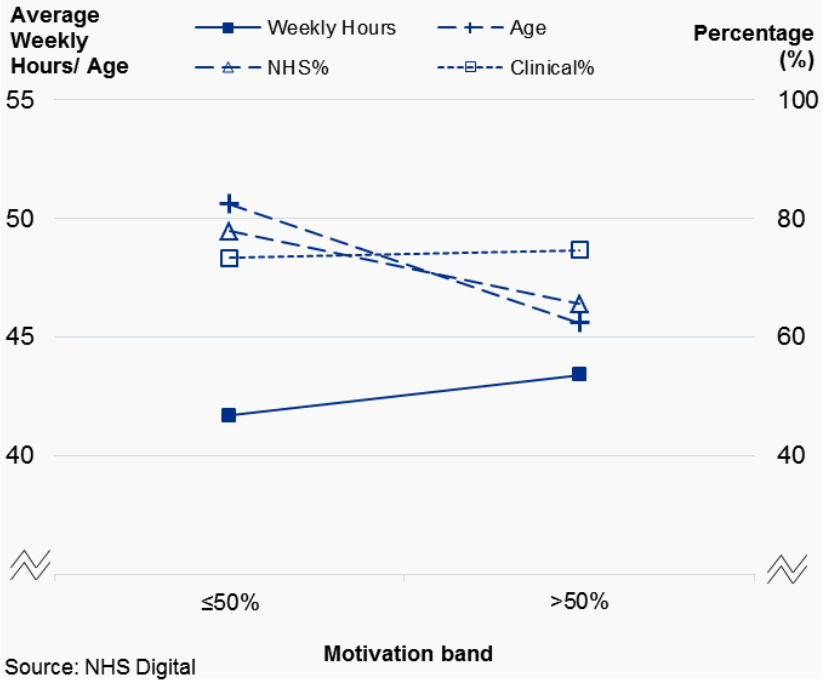


Figure 8.2: Principal dentists, plot of average weekly hours, NHS and clinical share (%) and age by motivation band, Scotland, 2013/14



8.5 Figure 8.1 shows little change in average taxable income for Principal dentists as motivation increases. In terms of working patterns, average weekly hours of work and annual leave both increase as motivation increases whilst percentage of NHS share (and age) noticeably decrease.

8.6 These results make interpretation challenging because isolating any possible relationship between motivation and taxable income is more difficult when several variables are also changing in the background. For example, the results suggests that more motivated Principal dentists tend to work longer hours and do less NHS work both

of which will have an effect on earnings. One solution is to use multivariate analysis that allows for individual analysis of each relationship in turn. This approach was used in the 2012/13 & 2013/14 Motivation Analysis report and is repeated in paragraph 8.9 onwards in this chapter with the addition of taxable income data.

8.7 Figures 8.3 and 8.4 plot results for Associate dentists from table 8.1.

Figure 8.3: Associate dentists, plot of average taxable income (£ '000) and weeks of annual leave by motivation band, Scotland, 2013/14

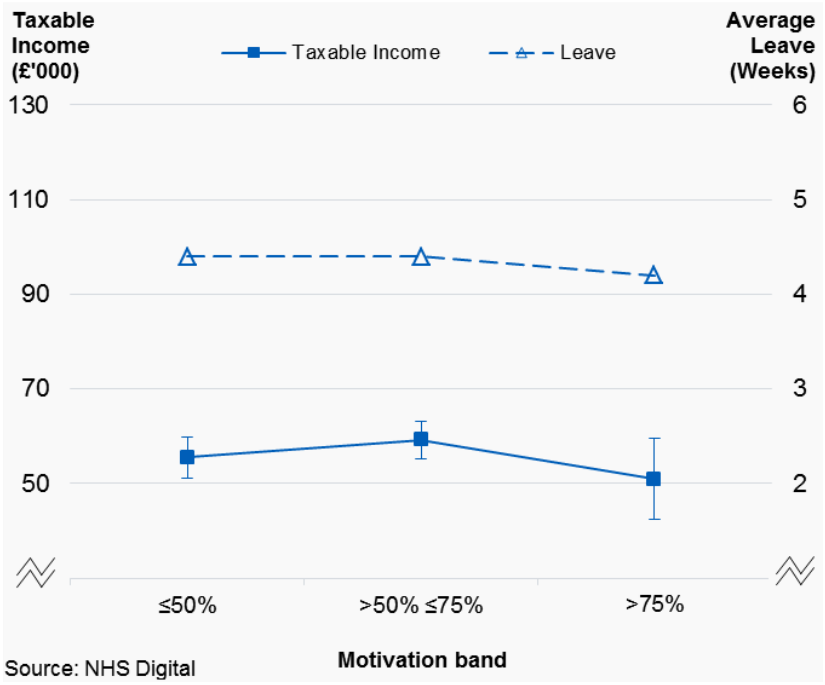
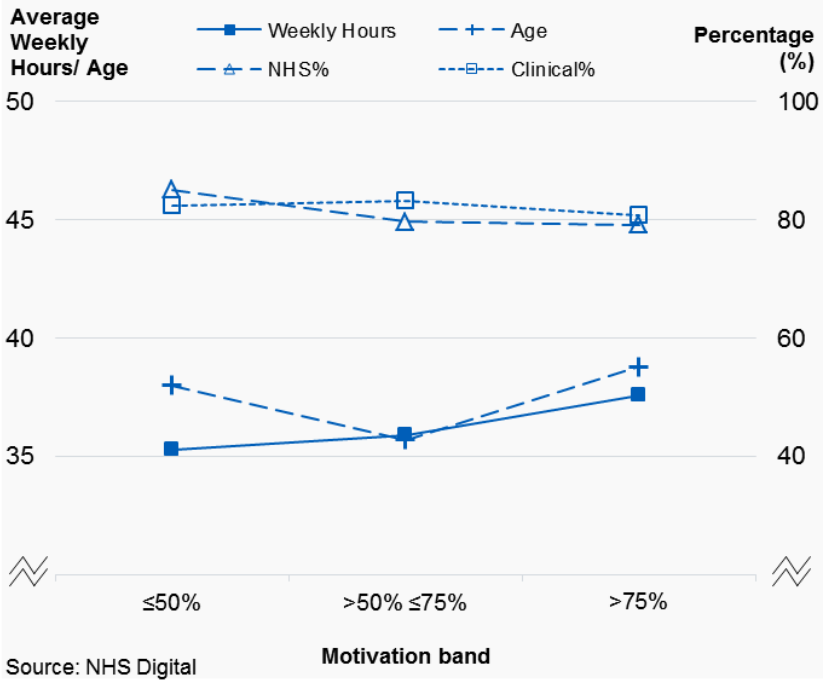


Figure 8.4: Associate dentists, plot of average weekly hours, NHS and clinical share (%) and age by motivation band, Scotland, 2013/14



8.8 Similar to results for Principal dentists, figure 8.3 suggests there is little relationship between taxable income and motivation for Associate dentists. In terms of working

patterns, when moving from the lowest to highest motivation band, changes in some variables fluctuate and appear quite modest although there is a continued drop in NHS share (%) and an increase in average weekly hours. However, as discussed earlier, such relationships are easier to tease apart using multivariate analysis, which is discussed in the following section.

Multivariate Analysis

8.9 Whilst the analysis so far suggests there are some relationships between the measured variables and average 'motivation index' it does not allow analysis of each variable in *isolation*. One solution is to use multiple linear regression that allows for individual analysis of each relationship in turn. Please see Annex A for a more detailed description of the multiple linear regression methodology as well as the statistical tests for its use with the average 'motivation index'. Annex C lists the statistical significance and adjusted R-squared[18] values for the results in this chapter.

Multiple Linear Regression Results

8.10 Table 8.2 shows the multiple linear regression results by dental type for the average 'motivation index'. Variable results that are not statistically significant are greyed out in the table.

Table 8.2: Parameter estimates[1] for 'motivation index' by dental type using multiple linear regression, Scotland, 2013/14

Dental Type	Sample	Intercept[1]	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income
Principal	110	73.81	0.07	-0.14	0.07	1.79	-0.64	-0.000006
Associate	334	64.69	0.09	-0.10	0.02	0.11	-0.13	-0.000009

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

8.11 The positive or negative values of the variable results indicate the relationship between each variable and motivation. For example, for both sets of dentists an increase in NHS share (%) correlates with a decrease in motivation. Please see the 2012/13 & 2013/14 Motivation Analysis report for a more detailed discussion of the relationship between the 'motivation index' and working pattern variables.

8.12 In the case of this report, the most interesting results are in the final column of table 8.2 where the relationship between taxable income and motivation is shown. As suggested by the results discussed earlier in this chapter, the results for both Principal and Associate dentists are not statistically significant. In other words, there does not appear to be a notable link between motivation and taxable income for dentists in Scotland. Chapter 9 next looks at the results for morale of dentists.

[18] In a multiple linear regression model, adjusted R-squared measures the proportion of the variation in the dependent variable (i.e. the 'motivation index') accounted for by the explanatory variables (e.g. weekly hours, NHS share %, taxable income).

9. Morale of Dentists and Taxable Income

9.1 This chapter looks at answers to question (G) 'How would you rate your morale as a dentist in 2013/14?', treating it separately to the motivation questions listed in Chapter 2. Please see Chapter 4 in the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[19] for more background on the definition of morale and how it differs from motivation.

9.2 Table 9.1 summarises the relationship between how dentists answered the morale question, measured variables in the Dental Working Patterns (DWP) Survey and average taxable income. Please note that due to sample size restrictions the two upper and lower morale levels (i.e. 'very high' & 'high' and 'very low' & 'low') were combined to ensure results were not supressed. However, due to the small sample size of Principals in Scotland, most results still need to be supressed.

Table 9.1: Relationship between morale of dentists, variables from the Dental Working Patterns Survey and taxable income by dental type, Scotland, 2013/14

		Full-Year Popln.		Average					
Dental Type	Morale Level	Count	(%)	Taxable Income	Age	Weekly Hours	Leave	NHS (%)	Clinical (%)
Principal	Very Low & Low	368	59.0	£98,400	49.6	44.0	4.2	76.2	71.7
	Neither[1]	-	-	-	-	-	-	-	-
	Very High & High[1]	-	-	-	-	-	-	-	-
	All	**624**	**100.0**	**£101,800**	**48.2**	**42.5**	**4.4**	**72.0**	**74.0**
Associate	Very Low & Low	513	31.5	£61,500	39.4	35.4	4.3	84.6	83.0
	Neither	533	32.7	£57,700	36.2	35.7	4.3	82.1	82.2
	Very High & High	583	35.8	£52,400	35.2	36.4	4.5	78.6	83.1
	All	**1,629**	**100.0**	**£57,000**	**36.8**	**35.8**	**4.4**	**81.6**	**82.8**
All Dentists		**2,253**	**100.0**	**£69,400**	**40.0**	**37.7**	**4.4**	**79.0**	**80.3**

Source: NHS Digital

1. Suppressed figures

9.3 The relationships between dentists' morale and their working patterns have been discussed in detail in the 2012/13 & 2013/14 Motivation Analysis report. Table 9.1 takes the analysis further with the addition of average taxable income. In general, the results suggest there is a negative relationship between taxable income and morale levels for Associate dentists (i.e. dentists who report higher morale levels have a lower average taxable income). The results are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

[19] Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis Experimental Statistics report found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

Figure 9.1: Associate dentists, plot of average taxable income (£ '000) and weeks of annual leave by morale level, Scotland, 2013/14

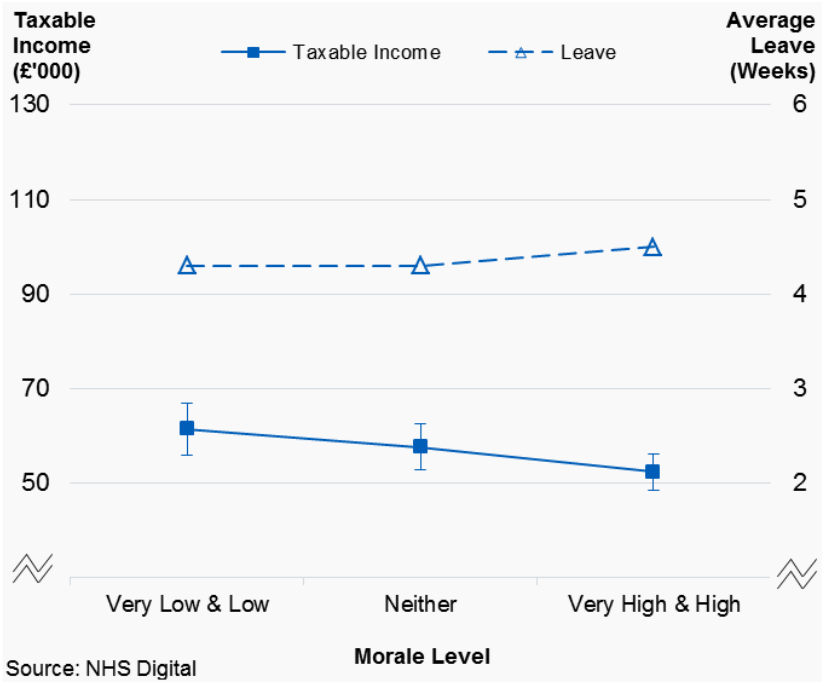
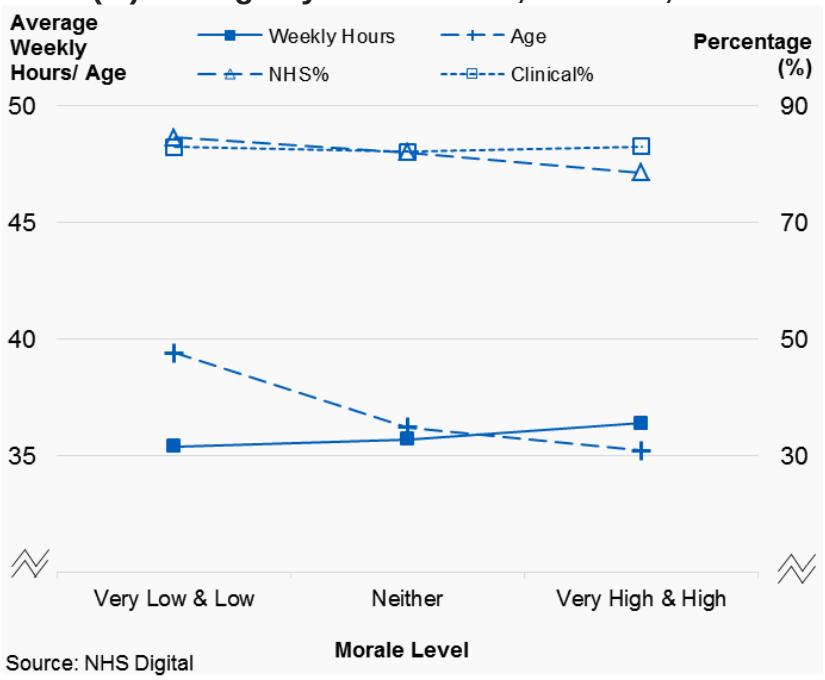


Figure 9.2: Associate dentists, plot of average weekly hours, NHS and clinical share (%) and age by morale level, Scotland, 2013/14



9.4 Similar to the motivation results for Associate dentists in Chapter 8, the changes in working patterns as morale increases are generally quite modest. Nonetheless, it is noticeable that average weekly hours increase as morale increases and NHS share (%) decreases, which mimics the motivation results. However, unlike the motivation results, there appears to be a drop in taxable income that is almost (but not quite) significant as shown by the size of the error bars in figure 9.1.

Multivariate Analysis

9.5 Like the issue for the average 'motivation index', the fact that some variables (i.e. taxable income and weekly hours) show a relationship with the morale of dentists makes it harder to assess each relationship in isolation when using results from the above analysis alone. As morale is measured by only one question in the DWP Survey it is possible to use logistic regression (in a similar fashion to linear regression in Chapter 8) to allow for independent analysis[20]. Please see Annex A for a more detailed description of the logistic regression methodology and Annex C for the statistical significance and accuracy testing of the results in this chapter.

9.6 For the individual motivation question analysis in the 2012/13 & 2013/14 Motivation Analysis report those dentists who answered 'strongly agree' or 'agree' were combined for each question which is also the approach used in this section by combining 'very high' with 'high' and 'very low' with 'low' morale. Logistic regression modelling is then able to predict the probability of dentists responding positively or negatively to the morale question, adding more completeness to the analysis. Table 9.2 gives results this analysis for Principal dentists. Variable results that are not statistically significant are greyed out in the table.

Table 9.2: Principal dentists, parameter estimates[1] for morale level probability using logistic regression, Scotland, 2013/14

Dental Type	Morale Level	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
Principal	Very High & High[2]	-	-	-	-	-	-	-
	Very Low & Low	-2.334	0.047	0.017	-0.026	-0.296	0.064	-0.0000029

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.
2. Suppressed figures.

9.7 Similar to results for the average 'motivation index', the positive or negative values for the variables indicate the relationship between each variable and either high or low morale. In the case of the taxable income variable, the results suggest there is no significant relationship between ('low' and 'very low') morale of Principals and pay. The sample size of the 'very high' and 'high' morale analyses was insufficient to pass HMRC disclosure limits and the results have been supressed. Table 9.3 shows results for Associate dentists.

Table 9.3: Associate dentists, parameter estimates[1] for morale level probability using logistic regression, Scotland, 2013/14

Dental Type	Morale Level	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
Associate	Very High & High	0.516	0.021	-0.011	0.006	0.077	-0.023	-0.0000200
	Very Low & Low	-3.042	-0.010	0.011	-0.001	-0.036	0.032	0.0000130

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

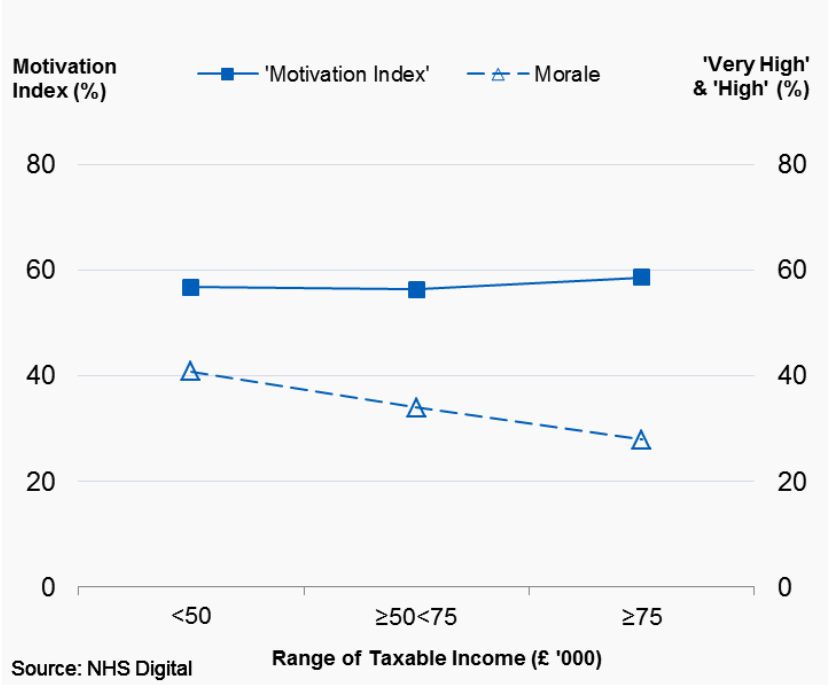
[20] Logistic regression can be used when there are only two possible outcomes for the model. For example, possible outcomes could be either that dentists express very high and high levels of morale, or that they do not.

9.8 Unlike the results for Principals, the taxable income results for Associate dentists are statistically significant, suggesting there is a relationship between morale and pay for these dentists. As discussed earlier in this chapter, the results predict a *negative* relationship between taxable income and high morale levels for Associate dentists. For example, in the case of the 'very high' and 'high' morale result, a negative score (-0.000020) predicts that the probability of Associate dentists reporting they have high morale decreases as pay increases. In this case, a £20,000 increase in taxable income (above their 2013/14 average of £57,000 from table 9.1) is predicted by the logistic regression model to decrease the chance of dentists reporting high morale by 7.8 percentage points. In other words, in 2013/14, 35.8% of Associate dentists reported their morale as either 'very high' or 'high'; the results presented in table 9.3 suggest that this figure would drop to 28.0% if Associate dentists received a pay increase of £20,000.

9.9 In terms of 'low' and 'very low' morale the positive score in table 9.3 (+0.000013) predicts that the probability of Associate dentists reporting they have low morale *increases* as pay increases. Whilst the figure is not as large as the result for high morale, a pay increase of £20,000 is predicted by the model to increase the chance of dentists reporting low morale by 5.8 percentage points.

9.10 Such results suggest that pay has a *negative* correlation with morale for Associate dentists in Scotland, which is different to the motivation results discussed in Chapter 8 (where there was no significant correlation). Figure 9.3 highlights these differences with a plot of the average 'motivation index' score and percentage of Associates who record 'very high' or 'high' morale against taxable income.

Figure 9.3: Associate dentists, average 'motivation index' and percentage response (%) to the morale question by taxable income, Scotland, 2013/14



9.11 Figure 9.3 clearly shows a drop in morale for Associate dentists as taxable income increases, whilst the 'motivation index' score remains relatively stable with a hint of an increase at the highest pay band. It is difficult to account for these findings, which are discussed further in Chapters 12 and 13 when results from each country and between 2012/13 and 2013/14 are compared.

Northern Ireland – 2013/14

10. Average 'Motivation Index' and Taxable Income

10.1 The results in this chapter are based on the average 'motivation index' for dentists as described in Chapter 1. The 'motivation index' for each dentist is calculated by taking the average of the responses given to the six motivation questions (that are scored from 100% for 'strongly agree' to 0% for 'strongly disagree'). The highest possible 'motivation index' for dentists is 100% and the lowest is 0%.

10.2 Table 10.1 explores relationships between average 'motivation index', variables measured in the Dental Working Patterns Survey and taxable income. In the 2012/13 & 2013/14 Motivation Analysis report dentists were separated into four motivation bands based of:

i. Very Low (≤25%)
ii. Neutral & Low (>25% & ≤50%)
iii. High (>50% & ≤75%)
iv. Very High (>75%)

10.3 However, due to sample size limitations for this analysis, dentists were separated into two motivation bands for analytical and reporting purposes of 'very low, low & neutral (≤50%)' and 'high & very high (>50%)' as shown in table 10.1. Despite merging motivation bands, the small sample of Principal dentists in Northern Ireland means results still need to be suppressed, however, the larger sample size of Associate dentists means results are available for this group as shown in table 10.1. Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information on rounding.

Table 10.1: Relationship between 'motivation band', working patterns and taxable income by dental type, Northern Ireland, 2013/14

		Full-Year Popln.		Average						
Dental Type	Motivation Band	Count	(%)	Taxable Income	Motivation Index (%)	Age	Weekly Hours	Leave	HS (%)	Clinical (%)
Principal	≤50%[1]	-	-	-	-	-	-	-	-	-
	>50%[1]	-	-	-	-	-	-	-	-	-
	All	**302**	**100.0**	**£116,100**	**43.6**	**47.4**	**40.8**	**3.8**	**73.6**	**66.1**
Associate	≤50%	298	50.9	£58,100	34.0	38.9	33.1	3.7	77.5	80.1
	>50%	287	49.1	£56,200	65.2	34.4	33.1	4.2	76.9	85.7
	All	**585**	**100.0**	**£57,100**	**49.3**	**36.7**	**33.1**	**3.9**	**77.2**	**82.8**
All Dentists		**886**	**100.0**	**£77,200**	**47.4**	**40.3**	**35.7**	**3.9**	**76.0**	**77.2**

Source: NHS Digital

1. Suppressed figures

10.4 The relationships between the 'motivation index' and working patterns have been discussed in detail in the 2012/13 & 2013/14 Motivation Analysis report. Table 10.1 takes the analysis further with the addition of average taxable income for each motivation band. In general, the results suggest that there is no association between average taxable income and motivation for Associate dentists in Northern Ireland.

These are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

Figure 10.1: Associate dentists, plot of average taxable income (£ '000) and weeks of annual leave by motivation band, Northern Ireland, 2013/14

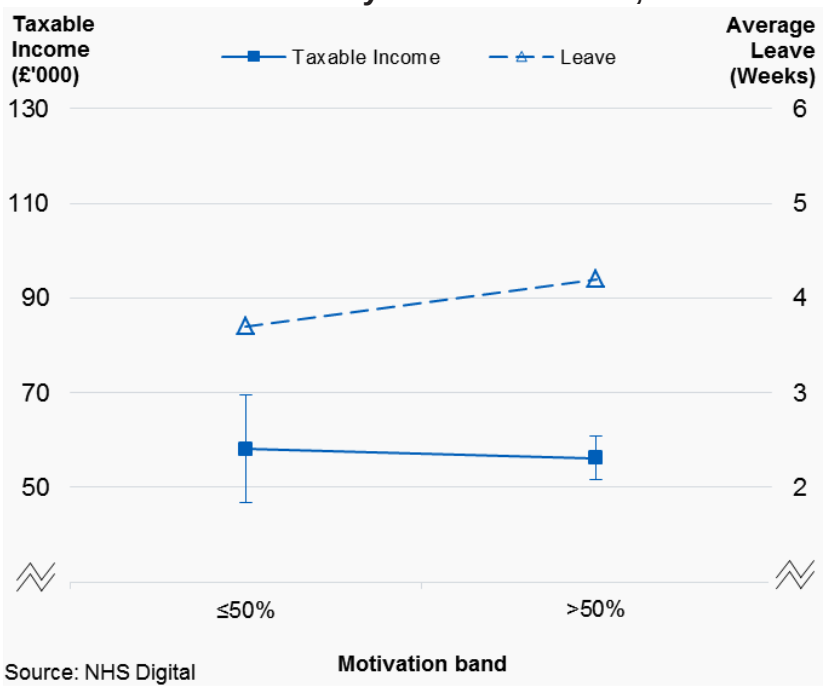
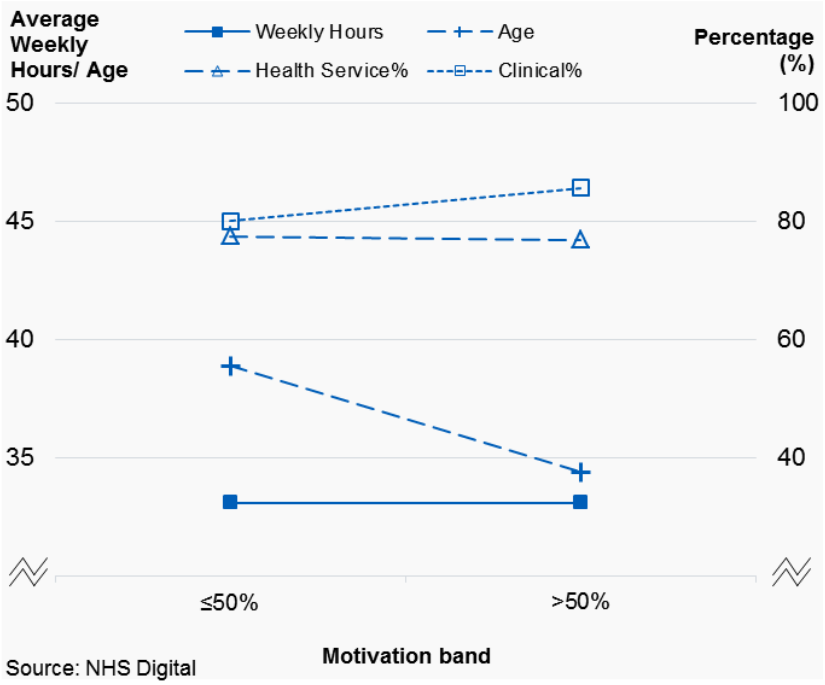


Figure 10.2: Associate dentists, plot of average weekly hours, Health Service and clinical share (%) and age by motivation band, Northern Ireland, 2013/14



10.5 Figure 10.1 shows little change in average taxable income for Associate dentists as their motivation increases. In terms of working patterns, clinical share (%) and annual leave both increase as motivation rises (whilst age noticeably decreases).

10.6 These results make interpretation challenging because isolating any possible relationship between motivation and taxable income is more difficult when several variables are also changing in the background. For example, the results suggest that more motivated Associate dentists tend to take more leave and do more clinical work (and less administration) both of which will have an effect on earnings. One solution is to use multivariate analysis that allows for individual analysis of each relationship in turn. This approach was used in the 2012/13 & 2013/14 Motivation Analysis report and is repeated in the next section of this chapter with the addition of taxable income data.

Multivariate Analysis

10.7 Whilst the analysis so far suggests there are some relationships between the measured variables and average 'motivation index' it does not allow analysis of each variable in *isolation*. One solution is to use multiple linear regression that allows for individual analysis of each relationship in turn. Please see Annex A for a more detailed description of the multiple linear regression methodology as well as the statistical tests for its use with the average 'motivation index'. Annex C lists the statistical significance and adjusted R-squared[21] values for the results in this chapter.

Multiple Linear Regression Results

10.8 Table 10.2 shows the multiple linear regression results by dental type for the average 'motivation index'. Variable results that are not statistically significant are greyed out in the table.

Table 10.2: Parameter estimates[1] for 'motivation index' by dental type using multiple linear regression, Northern Ireland, 2013/14

Dental Type	Sample	Intercept[1]	Weekly Hours	HS (%)	Clinical (%)	Leave	Age	Taxable Income
Principal	64	100.25	-0.37	-0.28	-0.12	-0.67	-0.34	0.000059
Associate	182	89.09	-0.56	-0.17	0.15	2.99	-0.95	0.000051

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

10.9 The positive or negative values of the variable results indicate the relationship between each variable and motivation. For example, for both sets of dentists an increase in Health Service share (%) correlates with a decrease in motivation. Please see the 2012/13 & 2013/14 Motivation Analysis report for a more detailed discussion of the relationship between the 'motivation index' and working pattern variables.

10.10 In the case of this report, the most interesting results are in the final column of table 10.2 where the relationship between taxable income and motivation is shown. As suggested by the findings discussed earlier, the linear regression results for Associate dentists are not statistically significant. In other words, there does not appear to be a notable link between motivation and taxable income for Associates in Northern Ireland. However, whilst the smaller sample of Principal dentists limited univariate

[21] In a multiple linear regression model, adjusted R-squared measures the proportion of the variation in the dependent variable (i.e. the 'motivation index') accounted for by the explanatory variables (e.g. weekly hours, NHS share %, taxable income).

analysis of the 'motivation index' (in table 10.1) it is sufficient for multivariate analysis (which is based on the entire sample rather than being broken down by motivation band). In this case, the taxable income result for Principals is statistically significant. In other words, increasing pay is related to an increase in motivation for this group of dentists. However, the size of the variable is quite small so that, if all other working patterns remain the same, a £20,000 increase in taxable income is predicted by the linear regression model to increase the 'motivation index' of Principals by 1.2 percentage points (i.e. £20,000 x 0.000059).

10.11 On first appearance the scale of the Principal result (and absence of statistically significant results for Associate dentists) is perhaps a surprise, particularly as money and the pressure for pay increases are often anecdotally assumed to be a constant in most workforces. However, there is a growing body of evidence suggesting that motivation levels do not increase as salary increases and are more closely linked to intrinsic factors (as opposed to extrinsic factors such as pay). Please see Chapter 4 for further information and links to other research. Nonetheless, the Principal dentists' taxable income result is significant and using the linear regression results in table 10.2 it is possible to provide greater context. For example, a similar 1.2 percentage point increase in motivation (potentially produced by an annual pay increase of £20,000) is predicted by the model to be achievable by working 3.2 fewer hours per week[22], which would likely make a positive contribution to the work-life balance of such dentists.

10.12 It is important not to extrapolate much further from these results as they are only based on a predictive model. (For example, it is not possible to say that dropping 3.2 hours' work would cost dentists on average £20,000). The main point is that for Principal dentists in Northern Ireland there is evidence of a positive relationship between motivation and taxable income which, although small, is comparable to changes in working patterns that would likely affect the work-life balance of dentists in a positive way.

10.13 Annex C tests assumptions around the use of linear regression for the 'motivation index' in each country (as described in Annex A). The 2013/14 results for Principals in Northern Ireland suggest that not all assumptions are met which should be borne in mind when considering these results. However, the 2012/13 Principal results do meet the assumptions, meaning these earlier results, which are shown in Chapter 13, are more reliable. Please see Annex C for a further discussion and results from the accuracy testing used in this report.

10.14 Finally, it is important to note that whilst regression analysis provides evidence for the existence of relationships between variables, it does not provide measures of causality. In other words, whilst there may well be a relationship between taxable income and motivation for Principals, it is not possible to determine if more pay motivates these dentists or whether motivated dentists tend to earn more.

[22] The prediction is based on the weekly hour result for Principals in table 10.2, which is not significant. However, with a larger sample size of 198 in the 2012/13 & 2013/14 Motivation Analysis report the result was significant leading to its use in this report just for predictive purposes.

11. Morale of Dentists and Taxable Income

11.1 This chapter looks at answers to question (G) 'How would you rate your morale as a dentist in 2013/14?' treating it separately to the motivation questions listed in Chapter 2. Please see Chapter 4 in the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[23] for more background on the definition of morale and how it differs from motivation.

11.2 Table 11.1 summarises the relationship between how dentists answered the morale question and the measured variables in the Dental Working Patterns (DWP) Survey as well as average taxable income. Due to sample size restrictions the two upper and lower morale levels (i.e. 'very high' & 'high' and 'very low' & 'low') were combined to try and ensure results were not supressed. However, due to the small sample size of Principals in Northern Ireland, most results still had to be supressed. Please note, the full-year population counts are rounded estimates and as such the totals may not appear to sum. Please see the Introduction for further information on rounding.

Table 11.1: Relationship between morale of dentists, variables from the Dental Working Patterns Survey and taxable income by dental type, Northern Ireland, 2013/14

		Full-Year Popln.		Average					
Dental Type	Morale Level	Count	(%)	Taxable Income	Age	Weekly Hours	Leave	HS (%)	Clinical (%)
Principal	Very Low & Low	210	69.5	£119,100	47.2	41.5	3.8	78.5	69.5
	Neither[1]	-	-	-	-	-	-	-	-
	Very High & High[1]	-	-	-	-	-	-	-	-
	All	**302**	**100.0**	**£116,100**	**47.4**	**40.8**	**3.8**	**73.6**	**66.1**
Associate	Very Low & Low	284	48.5	£58,900	38.3	34.2	3.9	78.7	79.0
	Neither	171	29.2	£54,900	36.2	32.4	3.9	75.8	85.0
	Very High & High	129	22.1	£56,300	33.8	31.7	4.1	75.6	88.6
	All	**585**	**100.0**	**£57,100**	**36.7**	**33.1**	**3.9**	**77.2**	**82.8**
All Dentists		**886**	**100.0**	**£77,200**	**40.3**	**35.7**	**3.9**	**76.0**	**77.2**

Source: NHS Digital

1. Suppressed figures

11.3 The relationships between dentists' morale and their working patterns have been discussed in detail in the 2012/13 & 2013/14 Motivation Analysis report. Table 11.1 takes the analysis further with the addition of average taxable income. In general, the results suggest that there is little relationship between taxable income and morale levels for Associate dentists. The results are easier to see when plotted graphically as shown in the following charts. Error bars (displaying 95% confidence intervals) are shown for taxable income data to help visualise the degree of statistical significance or otherwise in the results. However, error bars for the working pattern variables have been omitted to help maintain chart legibility.

[23] Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis Experimental Statistics found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

Figure 11.1: Associate dentists, plot of average taxable income (£ '000) and weeks of annual leave by morale level, Northern Ireland, 2013/14

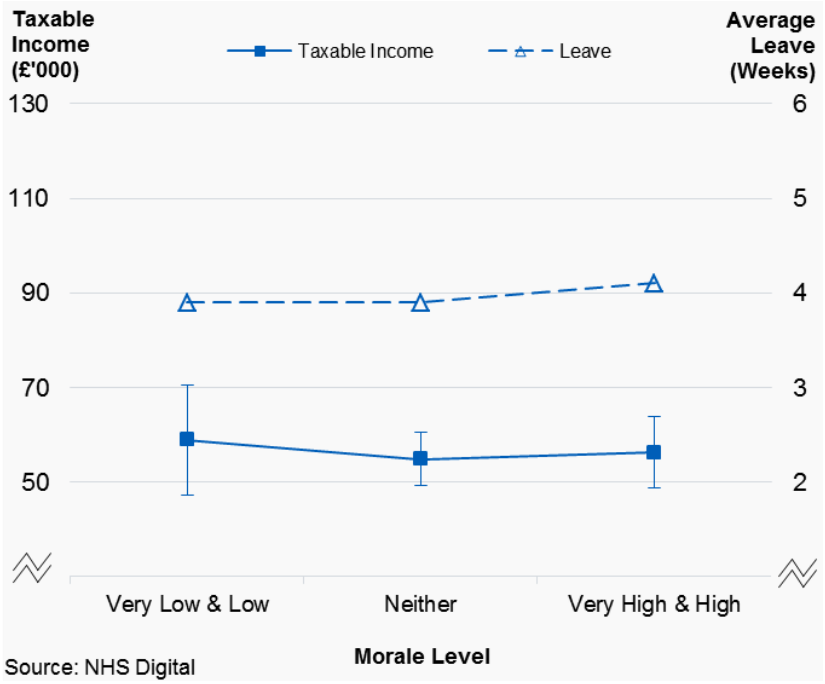
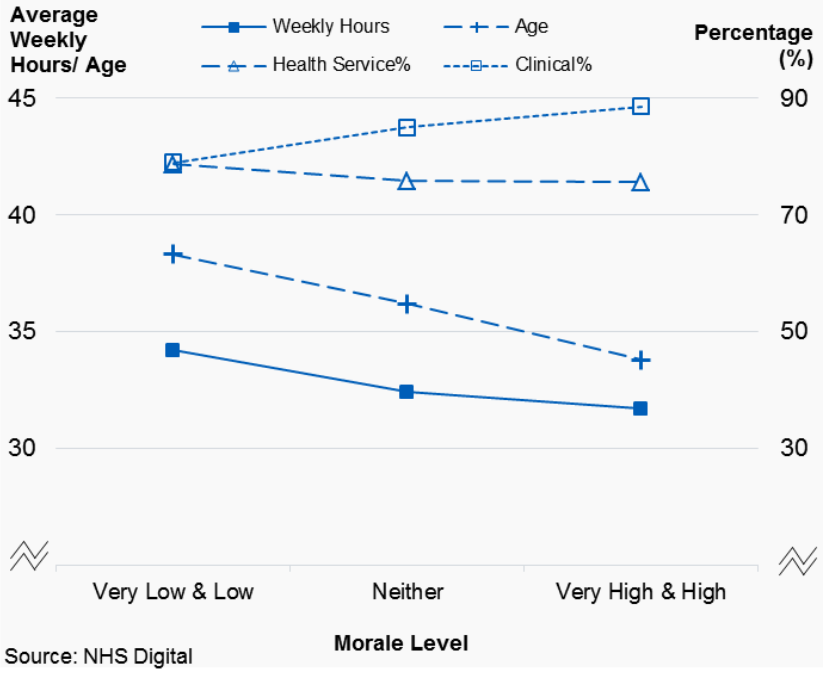


Figure 11.2: Associate dentists, plot of average weekly hours, Health Service and clinical share (%) and age by morale level, Northern Ireland, 2013/14



11.4 There are some similarities and differences when compared to the motivation results for Associate dentists in Chapter 10. For example, as morale levels increase, both annual leave and clinical share (%) increase (and average age decreases), which is similarly the case for increasing motivation. However, there is also a drop in average weekly hours, which remained constant for the motivation results. In terms of taxable income, there appears little change as morale levels increase, which also mimics motivation results for Associate dentists.

Multivariate Analysis

11.5 Like the issue for the average 'motivation index', the fact that some variables (i.e. weekly hours and clinical share) show a relationship with the morale of dentists, makes it harder to assess each relationship in isolation when using results from the above analysis alone. As morale is measured by only one question in the DWP Survey it is possible to use logistic regression (in a similar fashion to linear regression in Chapter 10) to allow for independent analysis[24]. Please see Annex A for a more detailed description of the logistic regression methodology and Annex C for the statistical significance and accuracy testing of the results in this chapter.

11.6 For the individual motivation question analysis in the 2012/13 & 2013/14 Motivation Analysis report those dentists who answered 'strongly agree' or 'agree' were combined for each question which is also the approach used in this section by combining 'very high' with 'high' and 'very low' with 'low' morale. Logistic regression modelling is then able to predict the probability of dentists responding positively or negatively to the morale question, adding more completeness to the analysis.

11.7 Table 11.2 gives results of both version of the analysis for Associate dentists. Variable results that are not statistically significant are greyed out in the table. Please note that, the sample sizes of the morale bands for Principal dentists were insufficient to pass HMRC disclosure limits, so their results had to be supressed and cannot be shown here.

Table 11.2: Associate dentists, parameter estimates[1] for morale level probability using logistic regression, Northern Ireland, 2013/14

Dental Type	Morale Level	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
Associate	Very High & High	0.951	-0.064	-0.016	0.036	0.189	-0.085	0.0000042
	Very Low & Low	-2.975	0.053	0.016	-0.027	-0.150	0.078	-0.0000017

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

11.8 Similar to results for the average 'motivation index', the positive or negative values for the variables indicate the relationship between each variable and either high or low morale. In the case of the taxable income variable, the results suggest there is no significant relationship between the morale of Associates and their pay. Such a result might be expected given the results discussed earlier in this chapter (and shown in figure 11.1).

[24] Logistic regression can be used when there are only two possible outcomes for the model. For example, possible outcomes could be either that dentists express very high and high levels of morale, or that they do not.

UK Comparisons – 2013/14

12. Average 'Motivation Index', Morale and Taxable Income

12.1 This section of the report compares 2013/14 multivariate results between each country. Comparisons are first made for the 'motivation index' followed by the morale results. For the sake of simplicity of prose, Providing-Performer and Performer Only dentists in England & Wales are referred to as Principals and Associates, respectively, matching nomenclature for dentists in the other countries.

Motivation Results

12.2 Tables 12.1 and 12.2 compare the linear regression results for average 'motivation index' for dentists in each country. Please see country specific Chapters and Annexes for a more detailed description of linear regression and results. As before, variable results that are not statistically significant are greyed out in the table.

Table 12.1: Principal dentists, parameter estimates[1] for 'motivation index' using multiple linear regression by country, 2013/14

Country	Sample	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	681	63.37	-0.16	-0.17	0.09	1.13	-0.09	0.000027
Scotland	110	73.81	0.07	-0.14	0.07	1.79	-0.64	-0.000006
Northern Ireland	64	100.25	-0.37	-0.28	-0.12	-0.67	-0.34	0.000059

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

Table 12.2: Associate dentists, parameter estimates[1] for 'motivation index' using multiple linear regression by country, 2013/14

Country	Sample	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	3,325	62.88	-0.01	-0.16	0.11	0.55	-0.15	-0.000002
Scotland	334	64.69	0.09	-0.10	0.02	0.11	-0.13	-0.000009
Northern Ireland	182	89.09	-0.56	-0.17	0.15	2.99	-0.95	0.000051

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

12.3 One of the standout results when comparing the 'motivation index' results across countries is the fact that the relationship to NHS/HS Share (%) is statistically significant and negative for all dentists. This has been discussed in more detail in the 2012/13 & 2013/14 Motivation Analysis report[25] and readers are asked to refer to that publication for more information. In terms of this report, the taxable income results show that out of both groups of dentists, only Principals in England & Wales and Northern Ireland demonstrate a significant relationship between motivation and pay. In both cases the results are positive indicating that higher motivation has a

[25] Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis Experimental Statistics found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

relationship with higher pay. As discussed in the country specific Chapters, in terms of predicted motivation levels, there would have to be a substantial increase in pay to make an appreciable difference to the 'motivation index' but, when equated to changes in working patterns (using the same regression results), adjustments in pay are comparable with changes that would likely have a positive effect on the work-life balance of dentists.

Relationship between Taxable Income and Working Patterns

12.4 To make this even clearer, table 12.3 shows the scale of changes in taxable income and working patterns that are predicted by the linear regression models to be associated with a one percentage point increase in the 'motivation index' for Principal dentists in England & Wales and Northern Ireland.

Table 12.3: Principal dentists, predicted changes in working patterns or taxable income associated with a one percentage point increase in 'motivation index', by country, 2013/14

Country	Weekly Hours	NHS/HS (%)	A/L Weeks	Taxable Income
England & Wales	-6.3	-5.8	0.9	£37,300
Northern Ireland[1]	-2.7	-3.5	n/a	£16,900

Source: NHS Digital

1. Calculations on non-statistically significant variable results from table 12.1 are not applicable in this table. Please see footnote 24 about the weekly hours result for Northern Ireland.

12.5 Table 12.3 predicts that for Principal dentists in England & Wales taking one extra week's leave each year or working six fewer hours per week is equivalent *in terms of the 'motivation index'* to a pay rise of £37,300. Seen in this light, whilst the relationship between taxable income and motivation does not necessarily appear strong, when compared to working patterns taxable income has a more notable effect.

12.6 Table 12.1 shows that Principals in Northern Ireland exhibit a stronger relationship between taxable income and motivation than those in England & Wales. This is also evident in table 12.3 where it is predicted by the model that a £16,900 increase in pay is associated with a one percentage point increase in the 'motivation index', compared to £37,300 in England & Wales. This is equivalent to working nearly three fewer hours per week[26] compared to over six fewer hours in England & Wales. This latter result is in keeping with those of the Motivation Analysis report which showed that in 2013/14 dentists in Northern Ireland had stronger relationships between their working patterns and motivation when compared to the other countries; this provides one potential explanation for why these dentists had lower overall motivation.

Morale Results

12.7 Tables 12.4 and 12.5 compare the logistic regression results in each country for the probability of dentists responding 'low' or 'very low' to the morale question. As before, results that are not statistically significant are greyed out in the table. Please see the

[26] This prediction is based on the weekly hour result for Principals in table 10.2, which is not significant. However, with a larger sample size of 198 in the 2012/13 & 2013/14 Motivation Analysis report the result was significant leading to its use in this report just for predictive purposes.

relevant country specific Chapters and Annexes for a more detailed description of logistic regression and results.

Table 12.4: Principal dentists, parameter estimates for 'low' or 'very low' morale level probability using logistic regression by country, 2013/14

Country	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	-3.695	0.043	0.009	-0.003	-0.003	0.029	-0.0000017
Scotland	-2.334	0.047	0.017	-0.026	-0.296	0.064	-0.0000029
Northern Ireland[2]	-	-	-	-	-	-	-

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.
2. Suppressed figures.

Table 12.5: Associate dentists, parameter estimates for 'low' or 'very low' morale level probability using logistic regression by country, 2013/14

Country	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	-1.708	-0.003	0.013	-0.009	-0.080	0.022	0.0000024
Scotland	-3.042	-0.010	0.011	-0.001	-0.036	0.032	0.0000130
Northern Ireland	-2.975	0.053	0.016	-0.027	-0.150	0.078	-0.0000017

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

12.8 As discussed in the country specific Chapters, where measurable, Principal dentists do not have a relationship between taxable income and morale. However, Associate dentists in England & Wales and Scotland show a statistically significant relationship between the two with higher pay being associated with lower morale, which is perhaps surprising. The strength of the relationship is noticeably stronger in Scotland than in England & Wales, as shown by the results in table 12.5. However, it is important to note the same analysis did not produce statistically significant results in 2012/13 as discussed in the next Chapter.

Relationship between Taxable Income and Morale Levels

12.9 Similar to the results for the 'motivation index' earlier in this chapter, table 12.6 shows the scale of changes in taxable income and working patterns that would be predicted by the logistic regression models to be associated with a one percentage point increase in Associate dentists reporting 'low' or 'very low' morale in England & Wales and Scotland. As Associates in Scotland do not show a statistically significant relationship between morale levels and NHS share (%) or annual leave (as shown in table 12.5), only the taxable income result is shown for these dentists.

Table 12.6: Associate dentists, predicted changes in working patterns or taxable income associated with a one percentage point increase in dentists reporting 'low' or 'very low' morale, by country, 2013/14

Country	NHS/HS (%)	A/L Weeks	Taxable Income
England & Wales	3.6	-0.6	£19,600
Scotland[1]	n/a	n/a	£3,600

Source: NHS Digital

1. Calculations on non-statistically significant variable results from table 12.5 are not applicable in this table.

12.10 The results demonstrate how sensitive morale levels of Associates in Scotland are predicted to be. For example, an increase of £3,600 in taxable income is predicted to increase the probability for dentists having 'low' or 'very low' morale by one percentage point. Results in England & Wales demonstrate less sensitivity, requiring an estimated £19,600 pay increase to produce the same one percentage point effect, and equating to a reduction of three and half day's annual leave.

12.11 Regardless of the sensitivity levels of Associates to changes in taxable income, what remains surprising is the *negative* relationship between morale levels and pay in both countries. As discussed in Chapter 5, in England and Wales a possible reason could be misclassification of some Principal dentists as Associates[27]. As Principals earn more than Associates and have lower morale on average, this could explain Associate's negative relationship between pay and morale in England & Wales. If the analysis were to be repeated in the future, an option could be to investigate other methods of assigning dental type in England & Wales and testing if this affected the results.

12.12 In Scotland (and Northern Ireland) dental type classification is by self-declaration (in the DWP Survey) and it is assumed that the methodology is more robust when compared to in England & Wales. Whilst this adds further credence to the result, as discussed earlier, the same analysis did not produce a statistically significant result in 2012/13, which is discussed in the next Chapter.

[27] Please see Annex C of Dental Working Hours, 2012/13 & 2013/14 Initial Analysis report for a detailed discussion of how England & Wales dentists are assigned dental type for the Dental Working Hours series of publications.

Comparisons with 2012/13 Results

13. Average 'Motivation Index', Morale and Taxable Income

13.1 The Dental Working Patterns (DWP) Survey is run biennially and records two years of data each time. Whilst the results discussed so far in this report relate to 2013/14, the majority of the analysis has also been carried out for 2012/13 data and is reproduced in Annex E (the CSV which accompanies this report). This section of the report briefly summarises the 2012/13 multivariate results by each country and dental type.

13.2 Please see the Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[28] for a more detailed summary of 2012/13 results, including individual motivation question analysis, and comparisons with 2013/14 data. Once again, for the sake of simplicity of prose, Providing-Performer and Performer Only dentists in England & Wales are referred to as Principals and Associates, respectively, matching the nomenclature for dentists in the other countries.

Motivation Results

13.3 Tables 13.1 and 13.2 compare the linear regression results for average 'motivation index' for dentists in each country by year. Please see country specific Chapters and Annexes for more detailed explanation of the results. As before, variable results that are not statistically significant are greyed out in the table.

Table 13.1: Principal dentists, parameter estimates[1] for 'motivation index' using multiple linear regression by country, 2012/13 and 2013/14

Country	Year	Sample	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	2012/13	698	66.13	-0.18	-0.14	0.01	1.10	-0.03	0.000029
	2013/14	681	63.37	-0.16	-0.17	0.09	1.13	-0.09	0.000027
Scotland	2012/13	109	48.52	0.06	-0.11	0.18	2.06	-0.18	-0.000047
	2013/14	110	73.81	0.07	-0.14	0.07	1.79	-0.64	-0.000006
Northern Ireland	2012/13	64	73.80	-0.35	-0.19	0.08	-1.71	-0.07	0.000045
	2013/14	64	100.25	-0.37	-0.28	-0.12	-0.67	-0.34	0.000059

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

[28] Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis Experimental Statistics found at: http://www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

Table 13.2: Associate dentists, parameter estimates[1] for 'motivation index' using multiple linear regression by country, 2012/13 and 2013/14

Country	Year	Sample	Intercept[1]	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income
England & Wales	2012/13	3,124	57.14	-0.01	-0.13	0.09	0.60	-0.05	0.000017
	2013/14	3,325	62.88	-0.01	-0.16	0.11	0.55	-0.15	-0.000002
Scotland	2012/13	299	50.00	0.24	-0.05	0.00	0.60	-0.02	-0.000007
	2013/14	334	64.69	0.09	-0.10	0.02	0.11	-0.13	-0.000009
Northern Ireland	2012/13	154	82.67	-0.60	-0.20	0.17	1.87	-0.62	0.000127
	2013/14	182	89.09	-0.56	-0.17	0.15	2.99	-0.95	0.000051

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

13.4 With a few exceptions, tables 13.1 and 13.2 show quite similar variable results when comparing 2012/13 and 2013/14 for each country and dental type. For example, NHS/HS share (%) has a negative relationship for all dentists with the 'motivation index', which remains significant for both years except 2012/13 for Associates in Scotland. In terms of taxable income there is similar agreement; results for both years are consistently significant or not, which gives further credence to the findings.

13.5 Taken overall, whilst results between the two years do show small changes, there are few notable differences from one year to the next. This in part will be due to the fact that dentists answered questions for both years at the same time, even though the first set of questions related to 2012/13 and the other to 2013/14. Another reason might be that the 'motivation index' is calculated as the average of six questions, meaning potential changes in one will have less effect on the overall average. Please see Chapter 14 of the 2012/13 & 2013/14 Motivation Analysis report for a comparison of individual motivation questions between both years.

13.6 As such, the taxable income results in tables 13.1 and 13.2 reiterate those from earlier Chapters that suggest there is a positive relationship between 'motivation index' and pay for Principals in England & Wales and Northern Ireland only and not for other dentists. However, as discussed in Chapter 10 (paragraph 10.13), please note that the linear regression accuracy testing results for Principals in Northern Ireland suggest that not all assumptions were met which should be borne in mind when considering these results. However, the 2012/13 Principal results do meet the assumptions, meaning the earlier results are more reliable. Please see Annex C for a further discussion of and results from the accuracy testing used in this report.

Morale Results

13.7 Tables 13.3 and 13.4 compare logistic regression results in each country by year for the probability of dentists responding 'low' or 'very low' to the morale question.

Table 13.3: Principal dentists, parameter estimates for 'low' or 'very low' morale level probability using logistic regression, 2012/13 and 2013/14

Country	Year	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
England & Wales	2012/13	-2.653	0.034	0.006	0.002	-0.101	0.021	-0.0000020
	2013/14	-3.695	0.043	0.009	-0.003	-0.003	0.029	-0.0000017
Scotland	2012/13	0.103	0.065	0.008	-0.037	-0.245	0.009	0.0000002
	2013/14	-2.334	0.047	0.017	-0.026	-0.296	0.064	-0.0000029
Northern Ireland[2]	2012/13	-	-	-	-	-	-	-
	2013/14	-	-	-	-	-	-	-

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.
2. Suppressed figures.

Table 13.4: Associate dentists, parameter estimates for 'low' or 'very low' morale level probability using logistic regression, 2012/13 and 2013/14

Country	Year	Intercept[1]	Weekly Hours	NHS%	Clinical%	Leave	Age	Taxable Income
England & Wales	2012/13	-1.277	-0.006	0.011	-0.008	-0.078	0.017	0.0000015
	2013/14	-1.708	-0.003	0.013	-0.009	-0.080	0.022	0.0000024
Scotland	2012/13	-1.899	-0.008	0.007	0.003	-0.160	0.019	0.0000087
	2013/14	-3.042	-0.010	0.011	-0.001	-0.036	0.032	0.0000130
Northern Ireland	2012/13	-0.816	0.052	0.007	-0.022	-0.407	0.052	-0.0000053
	2013/14	-2.975	0.053	0.016	-0.027	-0.150	0.078	-0.0000017

Source: NHS Digital

Note: Variable results that are greyed out are not statistically significant. Please see Annex C for all significance values.
1. Please see Annexes A and C for descriptions of parameter estimate and intercept.

13.8 Compared to the 'motivation index' results, those for morale in tables 13.3 and 13.4 show slightly greater variability between the years. One reason may be that results are based on a single question (as opposed to the average of six), which could add greater variation. Please see Annexes A and C for a further discussion on the accuracy of both the linear and logistic regression results used in both reports.

13.9 In terms of the taxable income results in tables 13.3 and 13.4, Associate dentists in both England & Wales and Scotland show a positive relationship between low morale and pay (i.e. higher pay is associated with lower morale) that is significant in 2013/14 but not 2012/13. As a result, the significant taxable income results for 2013/14 should be treated with a degree of caution as they are not reproducible for both years. However, it is important to note that the taxable income variable results remain positive for both years in each country, and even if they are not significant, they still point to the surprising association between low morale and pay.

13.10 Once again it is difficult to explain the findings but one explanation could be Associate dentists reaching the limits of what they can feasibly earn. There is some evidence for this suggestion in the England & Wales results discussed in Chapter 6. In this case, the negative relationship between morale and taxable income for Associate dentists is not found when part-time dentists are considered in isolation. One explanation could be that part-time Associate dentists recognise they may earn less money by virtue of their working patterns and, as a result, their morale has less association with pay. Full-time Associates, on the other hand, may feel they have less control over their income, which could be a source of frustration.

13.11 Furthermore, as shown in figure 6.1 and table 6.4 in Chapter 6, it appears that the relationship between pay and low morale is only applicable to those Associate dentists who conduct mainly NHS work, which illustrates the complex nature of these interlinked relationships.

Annex A: Regression Analysis and Key Assumptions

Multiple Linear Regression Analysis

A.1 Linear regression analysis attempts to model the relationship between a dependent variable y (in the case of this report, the 'motivation index') and an independent (explanatory) variable denoted x (such as average weekly hours or NHS/HS share). Multiple linear regression considers more than one explanatory variable at a time (x_1, x_2, x_3…) and quantifies the strength of relationships between them (recorded as parameter estimates) and the dependent variable y. The analysis also allows prediction modelling (in this case of the 'motivation index') based on knowledge of the significant variables.

A.2 Unlike other results in the report, the multiple linear (and logistic) regression analysis is not weighted. Normally in regression analysis it is assumed that the standard deviation of the error term is constant over all values of the explanatory variables. Weighting allows certain observations to be assigned more weight in the regression analysis (thereby having more influence on the calculated parameter estimates) because it is believed that they are more accurate. Without weighting, all the observations are treated equally, which is the preferred option for this report.

A.3 The 'goodness of fit' of a multiple linear regression model can be assessed by considering the adjusted R-squared value produced in the analytical output. The adjusted R-squared value measures the proportion of the variation in the dependent variable accounted for by the explanatory variables. The values of adjusted R-squared range from 0 to 1, with a value of 1 indicating that the regression line perfectly fits the data. The results in the report are generally lower than 0.2, which would traditionally be seen as low in many *objective* prediction models. However, in prediction models found in psychology, the R-squared values are usually lower and since the goal is to determine which variables are statistically significant and how they relate to changes in the response variable, the adjusted R-squared value becomes less important. Please see Annex C for the statistical significance and adjusted R-squared values for the multiple linear regression results in this report.

Assumption Testing of Linear Regression Models[29]

A.4 There are four principal assumptions which justify the use of linear regression models for purposes of inference or prediction:

i. Linearity and additivity of the relationship between the dependent and independent variables
ii. Statistical independence of errors
iii. Constant variance of the errors
iv. Normality of the error distribution

A.5 Violations of linearity or additivity are extremely serious: if a linear model is fitted to data which are nonlinearly or nonadditivity related, then the predictions are likely to be in serious error. In multiple regression models, nonlinearity or nonadditivity may be tested by systematic patterns in plots of the residuals versus individual explanatory variables. The points should be symmetrically distributed around the horizontal line

[29] The majority of the material used in this section was taken from 'Statistical forecasting: notes on regression and time series analysis' website, Faqua School of Business, Duke University: http://people.duke.edu/~rnau/testing.htm

with a roughly constant variance. In terms of statistical independence of errors, the residuals should be randomly and symmetrically distributed around zero under all conditions. To satisfy constant variance of errors, the residuals should not get systematically larger in any one direction of the explanatory variables by a *significant amount.* Annex C presents the residual plots for both dental types in each country.

A.6 Violations of normality create problems for determining whether model coefficients are significantly different from zero and for calculating confidence intervals for forecasts. Sometimes the error distribution is "skewed" by the presence of a few large outliers. Since parameter estimation is based on the minimization of *squared* error, a few extreme observations can exert a disproportionate influence on parameter estimates. Calculation of confidence intervals and various significance tests for coefficients are all based on the assumptions of normally distributed errors. If the error distribution is significantly non-normal, confidence intervals may be too wide or too narrow.

A.7 One of the best tests for normally distributed errors is a normal quantile plot of the residuals. This is a plot of the fractiles of error distribution versus the fractiles of a normal distribution having the same mean and variance. If the distribution is normal, the points on such a plot should fall close to the diagonal reference line. Annex C presents the plots for both dental types in each country.

Logistic Regression Analysis

A.8 Logistic regression can be used to predict the probability of how responders answer questions using ordinal scales (e.g. ‘very high’, ‘high’ to ‘very low’) by separating the available responses into two groups and making the dependent variable binary. For example, in this report logistic regression is used to model the probability of how dentists answer the question on morale either positively (i.e. ‘very high or ‘high’) or negatively (i.e. ‘very low’ or ‘low’) based on *Exponential (y) / [1 + Exponential (y)]* where *y* denotes the outcome of the regression.

A.9 In statistics, a receiver operating characteristic curve, or ROC curve, is a graphical plot that illustrates the performance of a binary classifier system. The ‘area under the ROC curve’ (AUC) is one way of classifying the accuracy of logistic regression models. Like the R-squared results for average ‘motivation index’, the AUC values are quite low in the report (0.6 to 0.7) but the majority are above a ‘fail’, which is traditionally between 0.5 and 0.6. Once again, the subjective nature of the modelling (i.e. trying to measure morale) makes it harder to achieve a higher AUC value but the fact that many of the explanatory variables exhibit significant relationships (i.e. p-value <0.05) gives validity to the models. Please see Annex C for the statistical significance and AUC values for logistic regression the results in this report.

Annex B: Population, Sample Sizes and Representativeness of Survey Data

B.1 Chapter 1 of this report gives links to relevant Dental Working Hours (DWH) and Dental Earnings and Expenses reports that contain useful background information on:

i. Dental Working Patterns (DWP) Survey methodology and response rates in Dental Working Hours, 2012/13 & 2013/14 Initial Analysis report.[30]

ii. How the motivation and morale questions were chosen and assumptions in their analyses in Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report.[31]

iii. Information on HMRC data used for the analysis, including exclusion criteria to construct a final dataset in Dental Earnings & Expenses, 2013/14 Methodology document.[32]

B.2 In order to reduce duplication, readers are encouraged to use these links for detailed information on each area. This Annex (and the next) covers additional information required for the analysis found in this report.

Population, sample sizes and weighting

B.3 The results presented in this report are estimates based on samples. To give a more accurate estimate, the report samples are weighted up to the report populations when calculating averages. The relevant country specific Annexes of the DWH, 2012/13 & 2013/14 Initial Analysis report describe the stratification variables used for weighting sample results (which are also listed in this Annex).

B.4 Tables B1 and B2 list the population and sample sizes for the England & Wales 2012/13 and 2013/14 Dental Working Hours (DWH) analysis. This includes the population and sample for the first three DWH reports in the series (covering initial, additional and motivation analysis) as well as the sample for this report (covering motivation and earnings analysis). The estimated full-year population figures shown are weighted estimates based on the number of 'full-year' dentists found in the DWP Survey (i.e. those dentists who indicated they worked for a full year, regardless of annual leave). Total figures may not sum due to rounding.

[30] Dental Working Hours, 2012/13 & 2013/14, Initial Analysis report found at: www.content.digital.nhs.uk/pubs/dentalworkinghours1214
[31] Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis Experimental Statistics report found at: http://www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation
[32] Dental Earnings & Expenses, 2013/14 Methodology document found at: http://www.content.digital.nhs.uk/pubs/dentalearnexp1314

Table B1: Population and sample sizes for the Dental Working Hours series of reports, England & Wales, 2012/13

		Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Dental Type	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
Providing-Performer	5,202	2,125	1,927	4,716	773	698	4,708
Performer Only	18,543	6,789	5,325	14,418	3,824	3,124	15,194
All Dentists	**23,745**	**8,914**	**7,252**	**19,134**	**4,597**	**3,822**	**19,902**

Please see table A2 for relevant footnotes *Source: NHS Digital*

Table B2: Population and sample sizes for the Dental Working Hours series of reports, England & Wales, 2013/14

		Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Dental Type	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
Providing-Performer	4,810	2,014	1,795	4,275	769	681	4,258
Performer Only	19,246	7,020	5,568	15,115	4,097	3,325	15,630
All Dentists	**24,056**	**9,034**	**7,363**	**19,390**	**4,866**	**4,006**	**19,889**

Source: NHS Digital

1. DWH Initial (UK1), Additional (UK2), Motivation (UK3) and Motivation and Earnings Analysis (UK4)
2. Population includes all dentists who conducted NHS activity in 2013/14, regardless if they worked for a full year or not
3. Full-year sample only includes those who worked for 12 months of the year (including annual leave). Results in all DWH reports are based only on the full-year sample.
4. Following exclusion criteria for construction of the matched (survey/HMRC) dataset
5. As this estimate is based on the full-year matched (survey/HMRC) sample, it varies when compared to UK1/2/3 reports

B.5 Tables B3 and B4 list the population and sample sizes for Scotland 2012/13 and 2013/14 DWH analysis. Unlike England & Wales, dental type in Scotland (and Northern Ireland) is based on self-declaration in the DWP Survey and it is not, therefore, possible to know the split of these dentists across the whole population. As a result, the population and sample results are based on the six strata used for weighting (i.e. gender and age).

Table B3: Population and sample sizes for the Dental Working Hours series of reports, Scotland, 2012/13

				Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Strata	Gender	Age	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
1	Male	<35	469	159	143	422	83	76	429
2		35-44	345	125	115	317	51	48	325
3		45+	598	253	242	572	91	86	565
4	Female	<35	518	189	146	400	105	83	409
5		35-44	302	122	103	255	72	64	268
6		45+	264	119	112	248	55	51	245
All Dentists			**2,496**	**967**	**861**	**2,215**	**457**	**408**	**2,242**

Please see table A4 for relevant footnotes *Source: NHS Digital*

Table B4: Population and sample sizes for the Dental Working Hours series of reports, Scotland, 2013/14

				Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Strata	Gender	Age	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
1	Male	<35	479	168	149	425	84	79	450
2		35-44	332	128	117	303	61	55	299
3		45+	601	260	240	555	94	84	537
4	Female	<35	535	222	181	436	124	102	440
5		35-44	328	121	97	263	77	62	264
6		45+	270	131	125	258	64	62	262
All Dentists			**2,545**	**1,030**	**909**	**2,240**	**504**	**444**	**2,253**

Source: NHS Digital

1. DWH Initial (UK1), Additional (UK2), Motivation (UK3) and Motivation and Earnings Analysis (UK4)
2. Population includes all dentists who conducted NHS activity in 2013/14, regardless if they worked for a full year or not
3. Full-year sample only includes those who worked for 12 months of the year (including annual leave). Results in all DWH reports are based only on the full-year sample.
4. Following exclusion criteria for construction of the matched (survey/HMRC) dataset
5. As this estimate is based on the full-year matched (survey/HMRC) sample, it varies when compared to UK1/2/3 reports

B.6 Tables B5 and B6 list the population and sample sizes for Northern Ireland 2012/13 and 2013/14 DWH analysis.

Table B5: Population and sample sizes for the Dental Working Hours series of reports, Northern Ireland, 2012/13

				Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Strata	Gender	Age	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
1	Male	<35	140	66	60	127	43	40	130
2		35-44	144	79	76	139	45	45	144
3		45+	219	109	103	207	28	26	203
4	Female	<35	235	121	95	185	73	61	196
5		35-44	162	77	64	135	34	27	129
6		45+	89	50	49	87	19	19	89
All Dentists			**989**	**502**	**447**	**879**	**242**	**218**	**892**

Please see table A6 for relevant footnotes

Source: NHS Digital

Table B6: Population and sample sizes for the Dental Working Hours series of reports, Northern Ireland, 2013/14

				Survey Analysis (UK1/2/3)[1]			Survey/HMRC Analysis (UK4)[1]		
Strata	Gender	Age	Popln.[2]	Sample	Full-Year Sample[3]	Estimated Full-Year Popln.	Matched Sample[4]	Full-Year Matched Sample	Estimated Full-Year Popln.[5]
1	Male	<35	136	66	59	122	44	40	124
2		35-44	146	82	79	141	54	54	146
3		45+	225	112	109	219	29	27	209
4	Female	<35	228	121	92	173	89	67	172
5		35-44	173	78	68	151	44	37	145
6		45+	103	62	55	91	24	21	90
All Dentists			**1,011**	**521**	**462**	**897**	**284**	**246**	**886**

Source: NHS Digital

1. DWH Initial (UK1), Additional (UK2), Motivation (UK3) and Motivation and Earnings Analysis (UK4)
2. Population includes all dentists who conducted Health Service activity in 2013/14, regardless if they worked for a full year or not
3. Full-year sample only includes those who worked for 12 months of the year (including annual leave). Results in all DWH reports are based only on the full-year sample.
4. Following exclusion criteria for construction of the matched (survey/HMRC) dataset
5. As this estimate is based on the full-year matched (survey/HMRC) sample, it varies when compared to UK1/2/3 reports

Representativeness of the survey responder population – 2013/14

B.7 To assess whether the composition of the matched (survey/HMRC) sample was representative of the dental population, the relationship between the numbers of dentists in each was evaluated. Table B7 shows that, on the whole, in England & Wales the distribution of dentists in 2013/14 was similar for the dental population and survey/HMRC sample; that is, the proportion of dentists in most of the 32 strata used for weighting was quite similar.

B.8 Please note, unlike results presented in the main body of the report, the figures in this section are based on dentists who worked for either a full or part-year. Without survey data, it is not possible to accurately define this characteristic for non-responders, hence both cohorts of dentists were used to allow more accurate comparisons between the sample and population.

Table B7: Number and percentage of dentists in each stratum of the dental population and survey/HMRC sample, England & Wales, 2013/14

						Sample		Percentage (%)			Diff.[2]
Strata	Type	Contract	Gender	Age	Popln.[1]	Initial	HMRC	Popln.	Initial Sample	HMRC Sample	HMRC-Popln.
1	Providing-Performer	GDS	Male	<35	134	52	31	0.6	0.6	0.6	0.1
2				35-44	689	218	105	2.9	2.4	2.2	-0.7
3				45-54	1,355	600	205	5.6	6.6	4.2	-1.4
4				55+	1,056	468	147	4.4	5.2	3.0	-1.4
5			Female	<35	35	14	11	0.1	0.2	0.2	0.1
6				35-44	264	85	42	1.1	0.9	0.9	-0.2
7				45-54	371	168	71	1.5	1.9	1.5	-0.1
8				55+	175	90	36	0.7	1.0	0.7	0.0
9&10[3]		PDS	Male	<45	64	25	9	0.3	0.3	0.2	-0.1
11				45-54	135	61	22	0.6	0.7	0.5	-0.1
12				55+	95	52	17	0.4	0.6	0.3	0.0
13&14[3]			Female	<45	25	12	4	0.1	0.1	0.1	0.0
15				45-54	50	21	11	0.2	0.2	0.2	0.0
16				55+	30	13	5	0.1	0.1	0.1	0.0
17		GDS/PDS	n/a	n/a	332	135	53	1.4	1.5	1.1	-0.3
18	Performer Only	GDS	Male	<35	3,227	1,003	581	13.4	11.1	11.9	-1.5
19				35-44	2,065	824	500	8.6	9.1	10.3	1.7
20				45-54	1,435	607	239	6.0	6.7	4.9	-1.1
21				55+	1,143	475	232	4.8	5.3	4.8	0.0
22			Female	<35	4,216	1,341	874	17.5	14.8	18.0	0.4
23				35-44	2,389	948	679	9.9	10.5	14.0	4.0
24				45-54	1,159	541	320	4.8	6.0	6.6	1.8
25				55+	349	153	74	1.5	1.7	1.5	0.1
26		PDS	Male	<35	193	44	24	0.8	0.5	0.5	-0.3
27				35-44	212	66	28	0.9	0.7	0.6	-0.3
28				45-54	164	70	17	0.7	0.8	0.3	-0.3
29				55+	143	48	19	0.6	0.5	0.4	-0.2
30			Female	<35	269	79	41	1.1	0.9	0.8	-0.3
31				35-44	322	115	57	1.3	1.3	1.2	-0.2
32				45-54	220	104	32	0.9	1.2	0.7	-0.3
33				55+	95	44	13	0.4	0.5	0.3	-0.1
34		GDS/PDS	n/a	n/a	1,645	558	367	6.8	6.2	7.5	0.7
			All Dentists		**24,056**	**9,034**	**4,866**				

Source: NHS Digital

1. The population covers all dentists who conducted NHS activity in 2013/14, regardless if they worked for a full year or not. For this reason, the total number is higher than the estimated full-year population in the report.
2. Percentage point difference between survey/HMRC sample and population percentages.
3. Strata labelled as 9 & 10 and 13 & 14 cover two age bands (i.e. <35 and 35-44 years) due to small numbers of younger PDS Providing-Performer dentists.

B.9 Tables B8 and B9 show results for dentists in Scotland and Northern Ireland based on the six strata of gender and age.

Table B8: Number and percentage of dentists in each stratum of the dental population and survey/HMRC sample, Scotland, 2013/14

				Sample		Percentage (%)			Diff.[2] (%)
Strata	Gender	Age	Popln.[1]	Initial	HMRC	Popln.	Initial Sample	HMRC Sample	HMRC-Popln.
1	Male	<35	479	168	84	18.8	16.3	16.7	-2.2
2		35-44	332	128	61	13.0	12.4	12.1	-0.9
3		45+	601	260	94	23.6	25.2	18.7	-5.0
4	Female	<35	535	222	124	21.0	21.6	24.6	3.6
5		35-44	328	121	77	12.9	11.7	15.3	2.4
6		45+	270	131	64	10.6	12.7	12.7	2.1
			2,545	**1,030**	**504**				

1. The population covers all dentists who conducted NHS activity in 2013/14, regardless if they worked for a full year or not. For this reason, the total number is higher than the estimated full-year population in the report.
2. Percentage point difference between survey/HMRC sample and population percentages.

Table B9: Number and percentage of dentists in each stratum of the dental population and survey/HMRC sample, Northern Ireland, 2013/14

				Sample		Percentage (%)			Diff.[2] (%)
Strata	Gender	Age	Popln.[1]	Initial	HMRC	Popln.	Initial Sample	HMRC Sample	HMRC-Popln.
1	Male	<35	136	66	44	13.5	12.7	15.5	2.0
2		35-44	146	82	54	14.4	15.7	19.0	4.6
3		45+	225	112	29	22.3	21.5	10.2	-12.0
4	Female	<35	228	121	89	22.6	23.2	31.3	8.8
5		35-44	173	78	44	17.1	15.0	15.5	-1.6
6		45+	103	62	24	10.2	11.9	8.5	-1.7
			1,011	**521**	**284**				

1. The population covers all dentists who conducted Health Service activity in 2013/14, regardless if they worked for a full year or not. For this reason, the total number is higher than the estimated full-year population in the report.
2. Percentage point difference between survey/HMRC sample and population percentages.

B.10 Table B8 shows that, on the whole, in Scotland the distribution of dentists in 2013/14 was fairly similar for the dental population and survey/HMRC sample. However, it is noticeable that there is under representation in strata 3 for male dentists 45 years or older (by 5 percentage points) and over representation in strata 4 for female dentists under 35 years (by 3.6 percentage points). Interestingly, these two strata show the largest differences in Northern Ireland as well (strata 3 and 4 in table B9), which appear more a result of HMRC exclusion criteria than initial DWP Survey response (as seen when comparing the 'Initial Sample' and 'HMRC Sample' percentages in both tables).

B.11 Overall, it is difficult to predict what effect this will have on the figures in the report. However, where it has been possible to account for differences in the survey responder sample and HMRC exclusion criteria we have done so by stratifying the sample to account for the major variables of dental and contract type (in England & Wales only), as well as gender and age (for all countries), which will lessen some of the effects.

Comparison of Dental Earnings and Expenses and Dental Working Hours Weighting

B.12 For all reports in the Dental Working Hours series, the DWP Survey response sample (for UK1/2/3 reports) or matched DWP Survey/HMRC sample (for this report) are weighted up to the dental population to give more accurate estimates. This weighting methodology differs in one distinct way to that found in the Dental Earnings and Expenses (DEE) reports based on DWP Survey data.

B.13 The DEE methodology is based on a complete dental population dataset sent to HMRC from NHS Digital. HMRC statisticians then match self-assessment tax return data of dentists to the entire population dataset. This matching entails exclusion criteria listed in Dental Earnings & Expenses, 2013/14 Methodology document and results in a matched HMRC sample that is weighted up to the dental population for the analysis. The DEE reports contain several Chapters based on responses to the DWP Survey (i.e. NHS share (%), weekly hours of work and business arrangements) which means the matched HMRC sample is linked to DWP Survey responses, producing a matched DWP Survey/HMRC sample, which in effect is the same as used in this report. However, in the DEE Chapters based on DWP Survey data, no change to the initial DEE weighting methodology is applied by HMRC statisticians, so that average results for all dentists include 'All [DWP Survey] responders', 'No survey' dentists and finally 'All Dentists'.

B.14 These differences mean that average taxable income figures in this report will not match those found in the DEE report of the same year, even when comparing them with the 'All [DWP Survey] responders' in the DEE reports.

Annex C: Regression Analysis – Detailed Results and Assumption Testing

C.1 This Annex gives the linear and logistic regression results from the report in more detail (including P-value and accuracy results) and also tests assumptions around the use of linear regression for the 'motivation index'. Please see Chapter 1 for a list of the analytical assumptions made and Annex A for a more general description of multiple linear and logistic regression methodology. As logistic regression does not make many of the key assumptions of linear regression its suitability for analysis is not investigated here.

Multiple Linear Regression Analysis of the Average 'Motivation Index'

C.2 Tables C1and C2 show the 2012/13 and 2013/14 linear regression results listed in the report together with the P-value and adjusted R-squared results. The intercept represents the value of the 'motivation index' when all explanatory variables are zero.

Table C1: Providing-Performer and Principal dentists, parameter estimates and P-values for 'motivation index' using multiple linear regression by country, 2012/13 and 2013/14

Country	Year	Sample	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Adjusted R^2
England & Wales	2012/13	698	Estimate	66.128	-0.180	-0.138	0.012	1.099	-0.029	0.000029	0.092
			P-value	<.0001	0.005	<.0001	0.754	0.010	0.744	0.001	
	2013/14	681	Estimate	63.367	-0.158	-0.171	0.088	1.133	-0.090	0.000027	0.116
			P-value	<.0001	0.016	<.0001	0.026	0.008	0.311	0.004	
Scotland	2012/13	109	Estimate	48.518	0.063	-0.114	0.184	2.056	-0.177	-0.000047	0.054
			P-value	0.004	0.712	0.037	0.084	0.051	0.340	0.155	
	2013/14	110	Estimate	73.807	0.071	-0.139	0.072	1.789	-0.639	-0.000006	0.111
			P-value	<.0001	0.691	0.013	0.439	0.119	0.001	0.853	
Northern Ireland	2012/13	64	Estimate	73.801	-0.345	-0.195	0.078	-1.711	-0.074	0.000045	0.098
			P-value	0.003	0.143	0.015	0.550	0.420	0.835	0.023	
	2013/14	64	Estimate	100.248	-0.374	-0.284	-0.119	-0.674	-0.342	0.000059	0.227
			P-value	<.0001	0.112	0.000	0.272	0.734	0.254	0.016	

Note: P-values and adjusted R^2 shown at 3 decimal places but rounded from data originally at 4 decimal places

Source: NHS Digital

Table C2: Performer Only and Associate dentists, parameter estimates and P-values for 'motivation index' using multiple linear regression by country, 2012/13 and 2013/14

Country	Year	Sample	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Adjusted R^2
England & Wales	2012/13	3,124	Estimate	57.139	-0.009	-0.133	0.093	0.601	-0.052	0.000017	0.040
			P-value	<.0001	0.803	<.0001	<.0001	0.000	0.144	0.077	
	2013/14	3,325	Estimate	62.883	-0.007	-0.161	0.108	0.551	-0.146	-0.000002	0.051
			P-value	<.0001	0.840	<.0001	<.0001	0.001	<.0001	0.855	
Scotland	2012/13	299	Estimate	50.000	0.238	-0.046	0.001	0.597	-0.016	-0.000007	0.001
			P-value	<.0001	0.044	0.304	0.982	0.411	0.876	0.852	
	2013/14	334	Estimate	64.689	0.090	-0.097	0.022	0.109	-0.128	-0.000009	0.008
			P-value	<.0001	0.448	0.023	0.657	0.880	0.200	0.808	
Northern Ireland	2012/13	154	Estimate	82.668	-0.597	-0.200	0.171	1.875	-0.618	0.000127	0.127
			P-value	<.0001	0.002	0.004	0.026	0.074	0.002	0.074	
	2013/14	182	Estimate	89.094	-0.560	-0.169	0.152	2.995	-0.953	0.000051	0.178
			P-value	<.0001	0.001	0.006	0.061	0.004	<.0001	0.117	

Note: P-values and adjusted R^2 shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

C.3 Based on these results, it is possible to predict the 'motivation index' for dentists. For example, for Associate dentists in 2013/14 in Northern Ireland, this is given as:

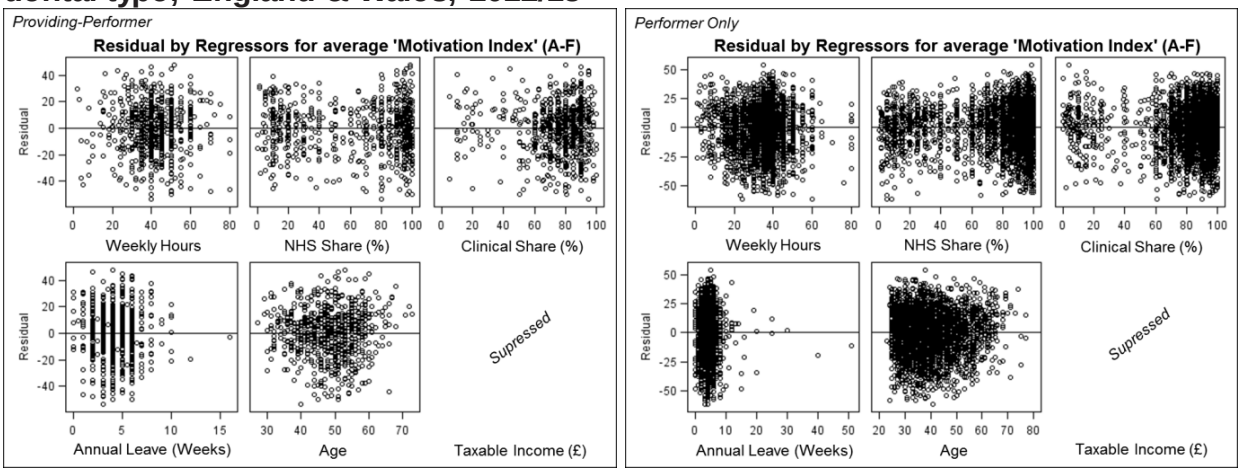
89.094 - (0.560 x Weekly Hours) - (0.169 x Health Service%) + (0.152 x Clinical%) + (2.995 x Annual Leave Weeks) - (0.953 x Age) + (0.000051 x Taxable Income)

Assumption Testing of the Multiple Linear Regression Models

C.4 Annex A describes four principal assumptions which justify the use of linear regression models for the purposes of inference or prediction, as well as descriptions of residual and normal quantile plots to enable testing of these assumptions. This section of Annex C reproduces residual plots (that test the first three assumptions) and normal quantile plots (that tests the fourth) for the linear regression the results in this report.

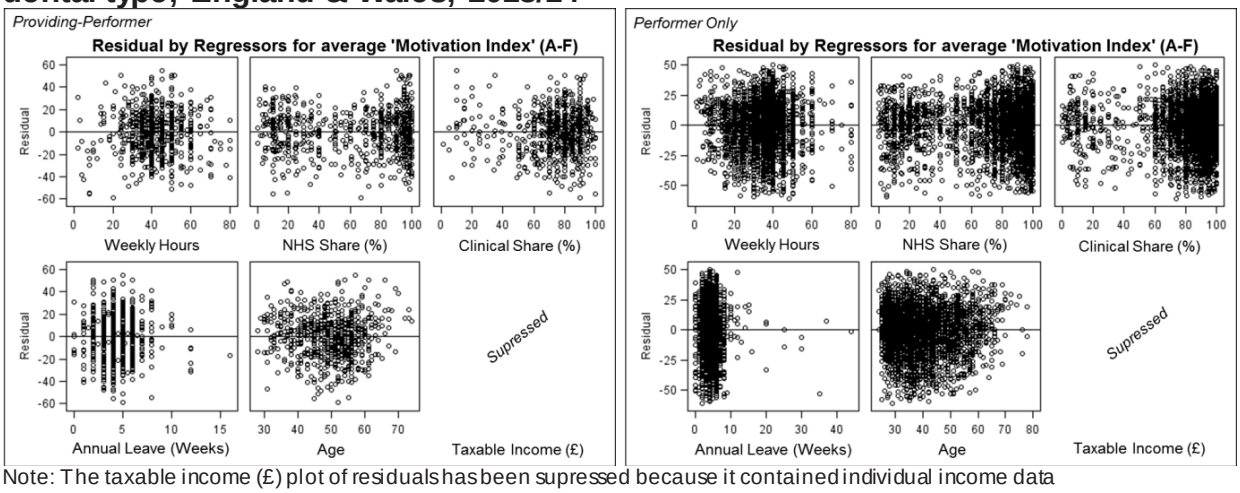
C.5 Figures C1 to C8 show the plots for Providing-Performer and Performer Only dentists in England & Wales in 2012/13 and 2013/14.

Figures C1 and C2: Plot of residuals versus individual explanatory variables by dental type, England & Wales, 2012/13



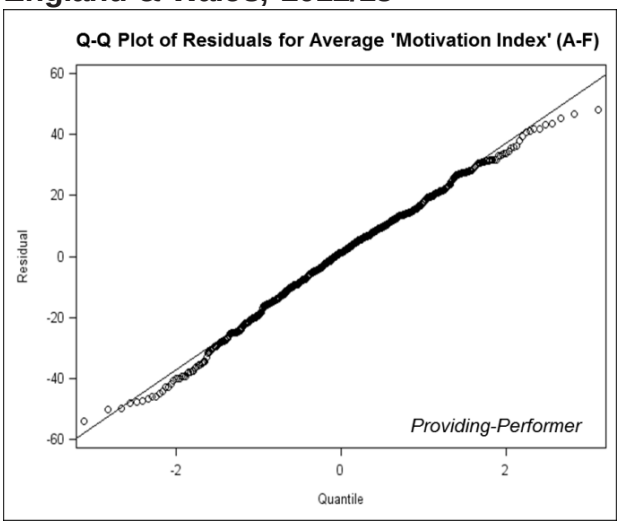
Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

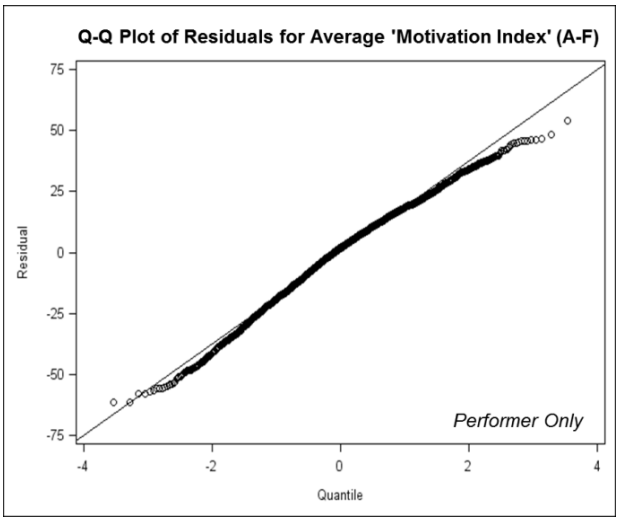
Figures C3 and C4: Plot of residuals versus individual explanatory variables by dental type, England & Wales, 2013/14



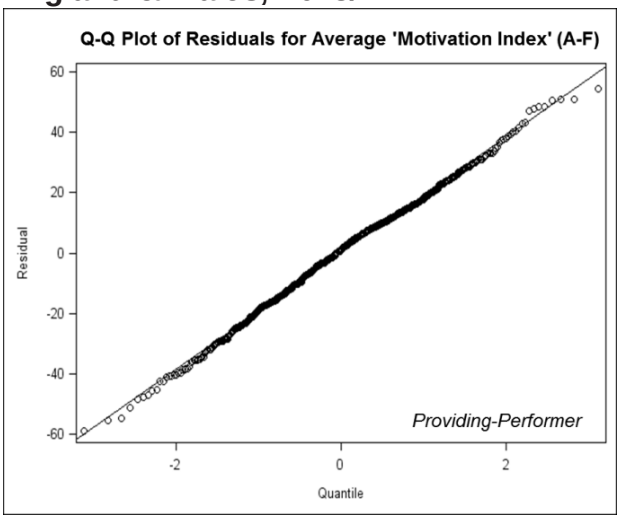
Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

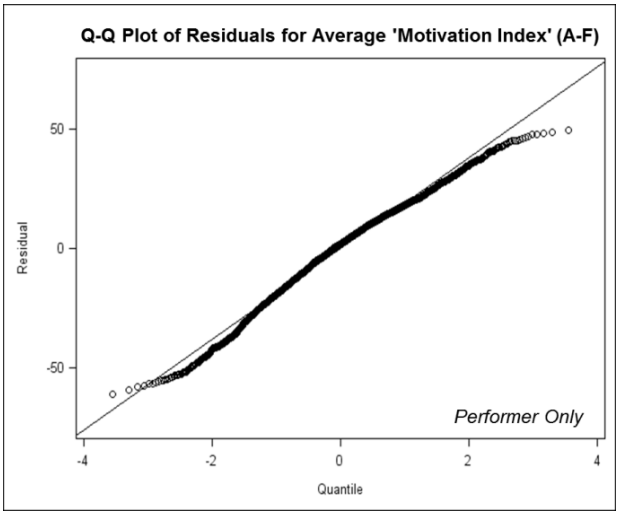
Figures C5 and C6: Normal quantile plot of residuals, by dental type, England & Wales, 2012/13





Figures C7 and C8: Normal quantile plot of residuals, by dental type, England & Wales, 2013/14



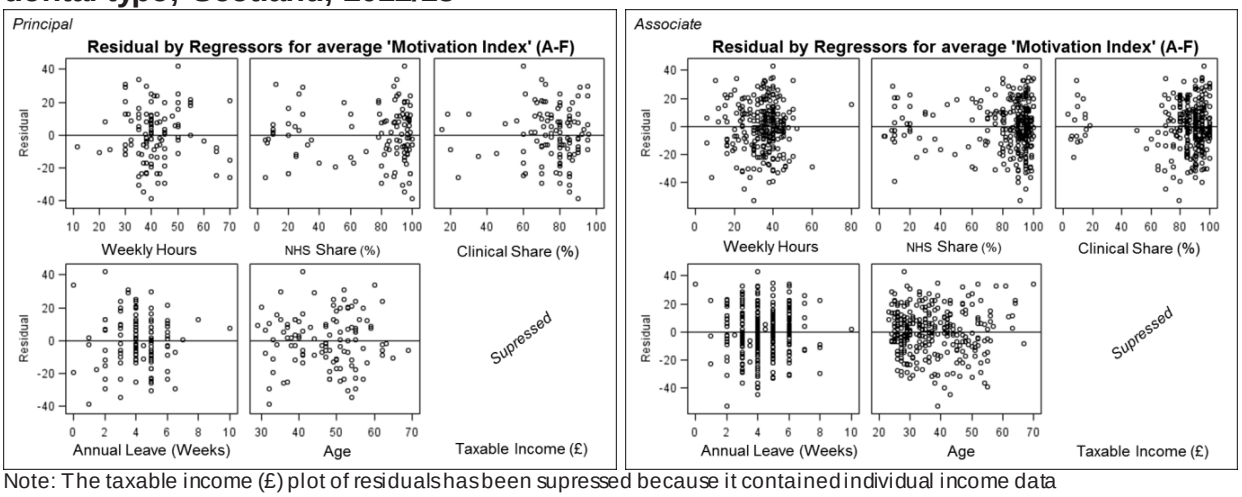


C.6 Overall, the residual plots (Figures C1 to C4) support the first three assumptions of multiple linear regression for average 'motivation index' as listed in paragraph A4 in Annex A. The Providing-Performer normal quantile plot results (Figures C5 and C7) are linear with no significant departure from normality, whilst the Performer Only plots exhibits slight bowing (Figures C6 and C8). This curved shape suggests some skewing of the residuals distribution plot for Performer Only dentists that may be the result of the greater positive skew for average 'motivation index' for this cohort of dentists (as seen in figure 3.2, Chapter 3 in Dental Working Hours, 2012/13 & 2013/14 Motivation Analysis report[33]).

C.7 Figures C9 to C16 show the residual and normal quantile plots for Principal and Associate dentists in Scotland in 2012/13 and 2013/14.

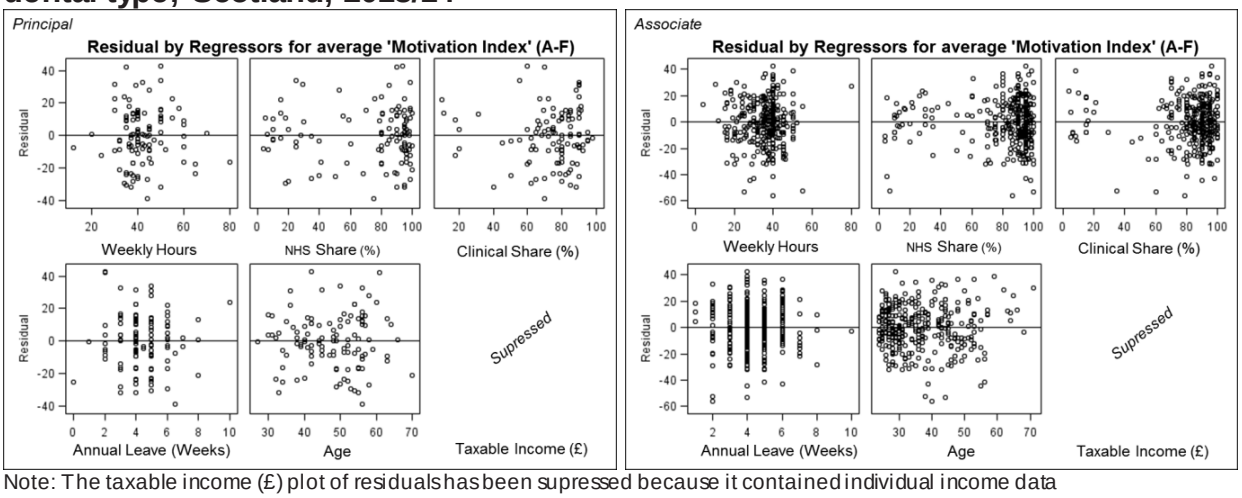
[33] Dental Working Hours, 2012/13 & 2013/14, Motivation Analysis Experimental Statistics report found at: http://www.content.digital.nhs.uk/pubs/dentalworkinghours1214motivation

Figures C9 and C10: Plot of residuals versus individual explanatory variables by dental type, Scotland, 2012/13



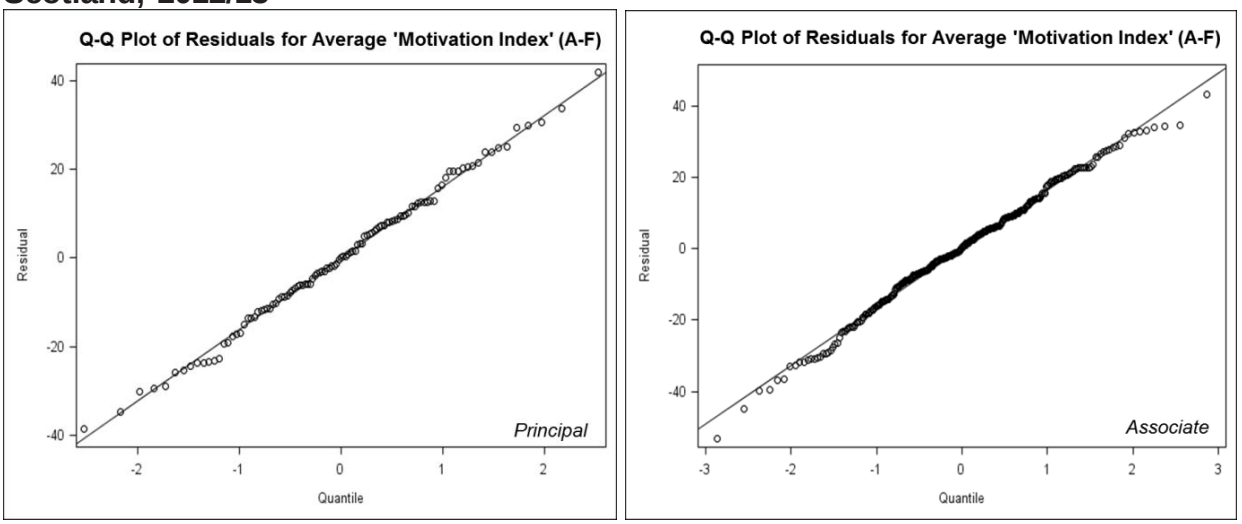
Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

Figures C11 and C12: Plot of residuals versus individual explanatory variables by dental type, Scotland, 2013/14

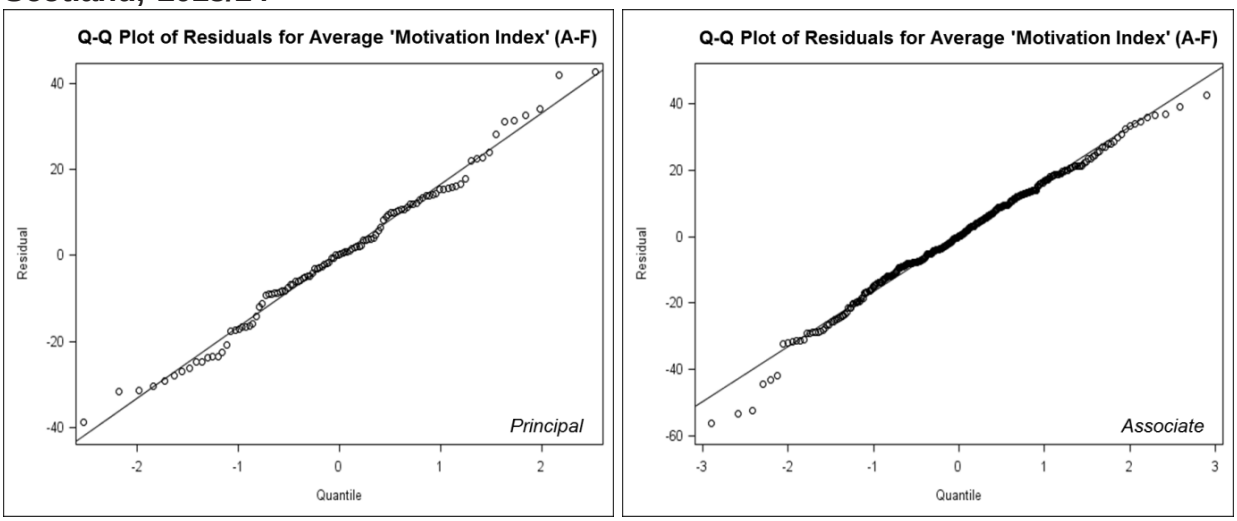


Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

Figures C13 and C14: Normal quantile plot of residuals by dental type, Scotland, 2012/13



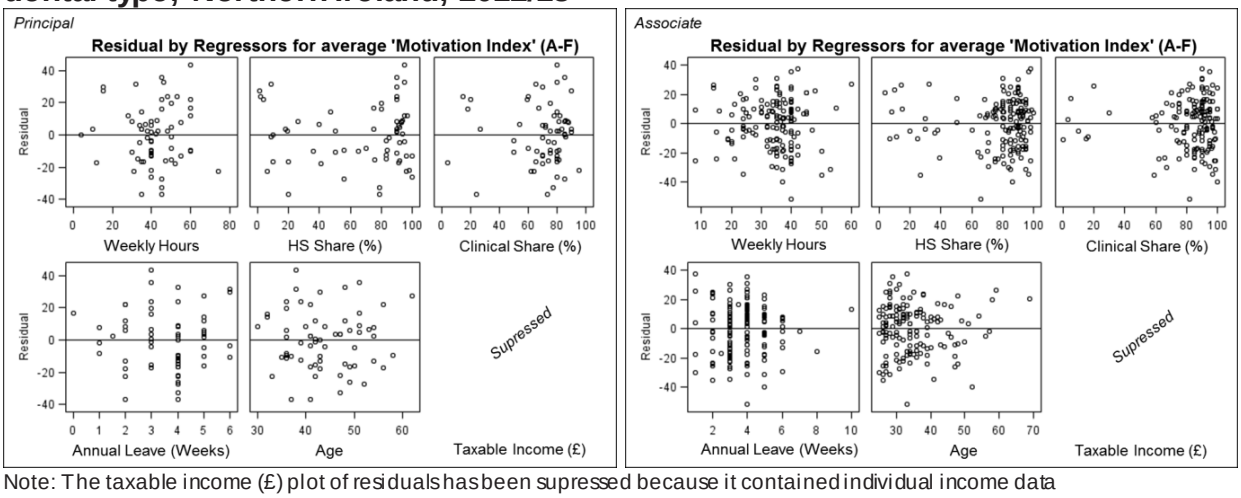
Figures C15 and C16: Normal quantile plot of residuals by dental type, Scotland, 2013/14



C.8 Like Providing-Performer plots for England & Wales, the Principal results for Scotland (Figures C9, C11, C13 and C15) support the four assumptions of multiple linear regression for average 'motivation index' listed in the 2012/13 & 2013/14 Motivation Analysis report. However, the residual plots for Associate dentists (Figures C10 and C12) are not quite symmetrically distributed around the horizontal line (as evidenced by the residual y-axis that ranges from -60 to +40 in Figure C12), which suggests departure from nonlinearity or nonadditivity. There is also some evidence that the error distribution for Performer Only dentists in Scotland departs slightly form normality as seen at the bottom of the diagonals in figures C14 and C16. As such, the linear regression results for these dentists in 2013/14 should be treated with a degree of caution.

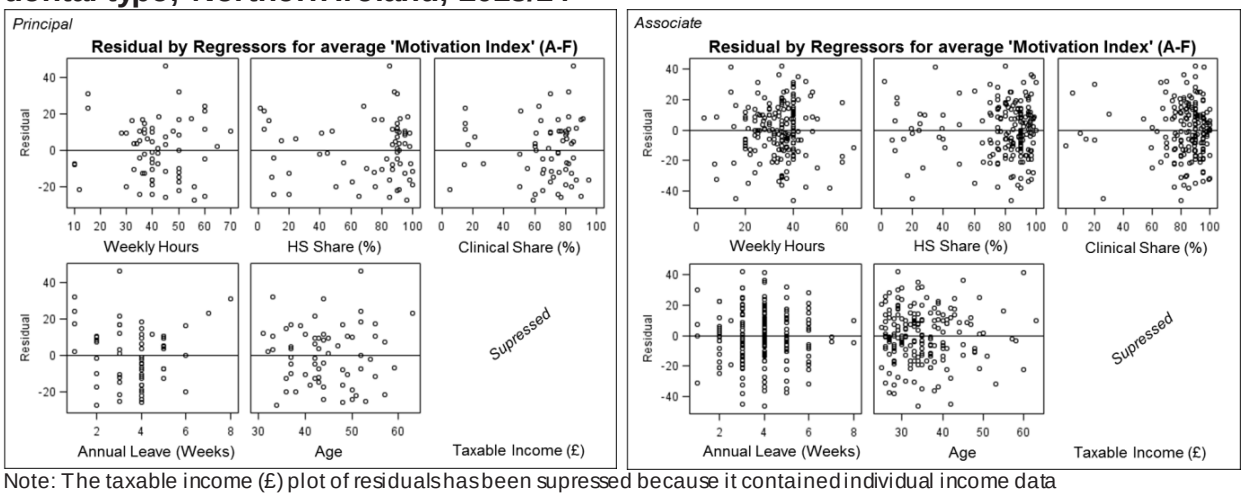
C.9 Figures C17 to C24 show the residual and normal quantile plots for Principal and Associate dentists in Northern Ireland in 2012/13 and 2013/14.

Figure C17 and C18: Plot of residuals versus individual explanatory variables by dental type, Northern Ireland, 2012/13



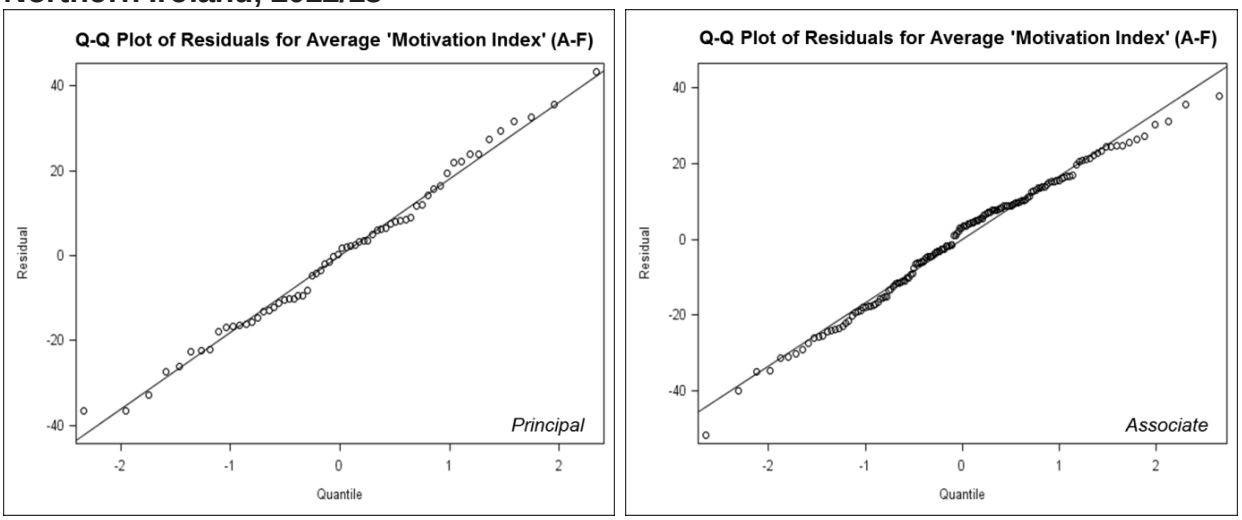
Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

Figure C19 and C20: Plot of residuals versus individual explanatory variables by dental type, Northern Ireland, 2013/14

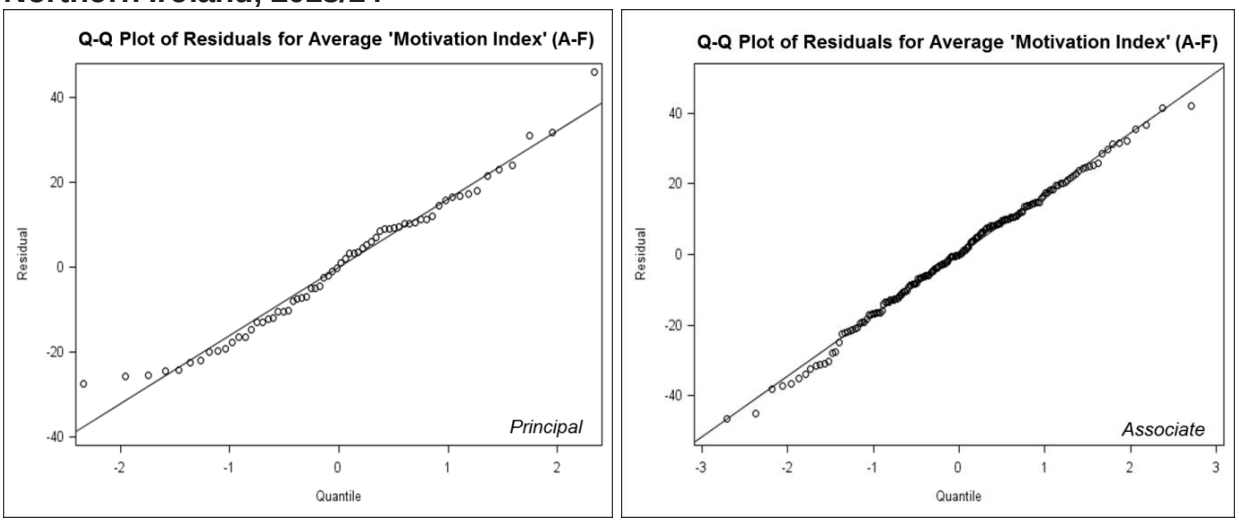


Note: The taxable income (£) plot of residuals has been supressed because it contained individual income data

Figures C21 and C22: Normal quantile plot of residuals by dental type, Northern Ireland, 2012/13



Figures C23 and C24: Normal quantile plot of residuals by dental type, Northern Ireland, 2013/14



C.10 Whilst the Associate dentists plots for Northern Ireland support the four assumptions of multiple linear regression for average 'motivation index' in both 2012/13 and 2013/14, the Principal residual plot for 2013/14 shows more asymmetry (as evidenced by the

residual y-axis that ranges from -20 to +40 in Figure C19). There is also evidence that the error distribution for Principal dentists departs from normality as seen in the diagonal in figure C23.

C.11 As such, like Associate dentists in Scotland, the linear regression results for these dentists in 2013/14 should be treated with a degree of caution. However, the Principal residual plots for 2012/13 (figure C17) show more symmetry and the normal quantile plot lies closer to the diagonal (figure C21) meaning the results for this group are more reliable in terms of assumption testing than those from 2013/14.

Logistic Regression Analysis

C.12 Tables C3 to C6 show the parameter estimate results for morale level probability together with the P-value and area under ROC curve (AUC)[34] values. The intercept represents the value of the dependent variable (y) when all explanatory variables are zero.

Table C3: Providing-Performer and Principal dentists, parameter estimates and P-values for 'high' or 'very high' morale level probability using logistic regression by country, 2012/13 and 2013/14

Country	Year	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
England & Wales	2012/13	Estimate	-0.472	-0.021	-0.006	0.003	0.093	-0.001	0.0000019	0.627
		P-value	0.546	0.007	0.011	0.488	0.064	0.901	0.066	
	2013/14	Estimate	-0.400	-0.017	-0.009	0.011	0.070	-0.011	0.0000020	0.633
		P-value	0.616	0.033	0.000	0.029	0.146	0.280	0.055	
Scotland[1]	2012/13	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-
	2013/14	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-
Northern Ireland[1]	2012/13	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-
	2013/14	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*
1. Suppressed figures

[34] Annex A provides background on the 'area under the receiver operating characteristic curve' (AUC) value as one way of classifying the accuracy of logistic regression modelling.

Table C4: Providing-Performer and Principal dentists, parameter estimates and P-values for 'low' or 'very low' morale level probability using logistic regression by country, 2012/13 and 2013/14

Country	Year	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
England & Wales	2012/13	Estimate	-2.653	0.034	0.006	0.002	-0.101	0.021	-0.0000020	0.658
		P-value	0.001	<.0001	0.021	0.680	0.041	0.035	0.066	
	2013/14	Estimate	-3.695	0.043	0.009	-0.003	-0.003	0.029	-0.0000017	0.672
		P-value	<.0001	<.0001	0.000	0.459	0.948	0.003	0.097	
Scotland	2012/13	Estimate	0.103	0.065	0.008	-0.037	-0.245	0.009	0.0000002	0.736
		P-value	0.966	0.017	0.232	0.019	0.088	0.714	0.965	
	2013/14	Estimate	-2.334	0.047	0.017	-0.026	-0.296	0.064	-0.0000029	0.746
		P-value	0.300	0.080	0.024	0.044	0.054	0.013	0.491	
Northern Ireland[1]	2012/13	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-
	2013/14	Estimate	-	-	-	-	-	-	-	-
		P-value	-	-	-	-	-	-	-	-

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*
1. Suppressed figures

Table C5: Performer Only and Associate dentists, parameter estimates and P-values for 'high' or 'very high' morale level probability using logistic regression by country, 2012/13 and 2013/14

Country	Year	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
England & Wales	2012/13	Estimate	-0.182	0.014	-0.008	0.005	0.030	-0.009	-0.0000019	0.577
		P-value	0.540	0.001	<.0001	0.017	0.087	0.016	0.075	
	2013/14	Estimate	0.249	0.010	-0.009	0.007	0.021	-0.016	-0.0000036	0.589
		P-value	0.391	0.010	<.0001	0.000	0.228	<.0001	0.001	
Scotland	2012/13	Estimate	-0.861	0.030	-0.006	0.003	0.052	-0.005	-0.0000090	0.606
		P-value	0.465	0.048	0.276	0.674	0.577	0.728	0.075	
	2013/14	Estimate	0.516	0.021	-0.011	0.006	0.077	-0.023	-0.0000200	0.640
		P-value	0.650	0.162	0.034	0.377	0.407	0.082	0.004	
Northern Ireland	2012/13	Estimate	-1.249	-0.050	-0.020	0.066	0.071	-0.085	0.0000081	0.744
		P-value	0.672	0.080	0.046	0.005	0.644	0.014	0.418	
	2013/14	Estimate	0.951	-0.064	-0.016	0.036	0.189	-0.085	0.0000042	0.721
		P-value	0.685	0.012	0.064	0.039	0.182	0.008	0.321	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C6: Performer Only and Associate dentists, parameter estimates and P-values for 'low' or 'very low' morale level probability using logistic regression by country, 2012/13 and 2013/14

Country	Year	Parameter Estimate	Intercept	Weekly Hours	NHS/HS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
England & Wales	2012/13	Estimate	-1.277	-0.006	0.011	-0.008	-0.078	0.017	0.0000015	0.599
		P-value	<.0001	0.165	<.0001	0.000	0.001	<.0001	0.186	
	2013/14	Estimate	-1.708	-0.003	0.013	-0.009	-0.080	0.022	0.0000024	0.617
		P-value	<.0001	0.515	<.0001	<.0001	0.001	<.0001	0.022	
Scotland	2012/13	Estimate	-1.899	-0.008	0.007	0.003	-0.160	0.019	0.0000087	0.610
		P-value	0.142	0.604	0.247	0.715	0.104	0.150	0.071	
	2013/14	Estimate	-3.042	-0.010	0.011	-0.001	-0.036	0.032	0.0000130	0.650
		P-value	0.015	0.514	0.076	0.922	0.713	0.014	0.013	
Northern Ireland	2012/13	Estimate	-0.816	0.052	0.007	-0.022	-0.407	0.052	-0.0000053	0.721
		P-value	0.666	0.036	0.445	0.040	0.007	0.041	0.555	
	2013/14	Estimate	-2.975	0.053	0.016	-0.027	-0.150	0.078	-0.0000017	0.711
		P-value	0.079	0.013	0.055	0.018	0.233	0.002	0.655	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

C.13 Based on these results, the predicted probability that Associate dentists in Northern Ireland in 2013/14, for example, will record either 'low' or 'very low' morale levels is given as:

Exponential (y) / [1 + Exponential (y)] *where:*

y = -2975 + (0.053 x Weekly Hours) + (0.16 x Health Service%) - (0.027 x Clinical%) - (0.150 x Annual Leave Weeks) + (0.078 x Age) - (0.0000017 x Taxable Income)

Different Dental Populations

C.14 Tables C7 and C8 show the linear regression results together with the P-value and adjusted R-squared results for different dental populations (as defined in Chapter 6) for 2013/14 in England & Wales. Tables C9 to C12 show the equivalent parameter estimate results for morale level probability together with the P-value and AUC values. 2012/13 results are found in Annex E (the CSV which accompanies this report).

Table C7: Providing-Performer dentists, parameter estimates and P-values for 'motivation index' by split populations using multiple linear regression, England & Wales, 2013/14

Population	Sample	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Adjusted R^2
All	**681**	**Estimate**	**63.367**	**-0.158**	**-0.171**	**0.088**	**1.133**	**-0.090**	**0.000027**	**0.116**
		P-value	**<.0001**	**0.016**	**<.0001**	**0.026**	**0.008**	**0.311**	**0.004**	
<35 Hours	140	Estimate	7.931	0.238	-0.108	0.169	1.180	0.460	0.000090	0.096
		P-value	0.619	0.276	0.036	0.065	0.182	0.031	0.002	
≥35 Hours	541	Estimate	80.436	-0.324	-0.191	0.050	1.190	-0.194	0.000023	0.145
		P-value	<.0001	0.001	<.0001	0.260	0.013	0.049	0.015	
Mainly NHS	365	Estimate	68.901	-0.294	-0.318	0.163	0.805	0.114	0.000027	0.073
		P-value	<.0001	0.003	0.023	0.008	0.209	0.348	0.023	
Mainly Private	167	Estimate	71.604	0.148	-0.433	-0.013	1.602	-0.306	0.000031	0.058
		P-value	<.0001	0.210	0.051	0.841	0.029	0.097	0.182	
Male	511	Estimate	61.650	-0.125	-0.176	0.115	1.036	-0.132	0.000024	0.113
		P-value	<.0001	0.100	<.0001	0.012	0.029	0.207	0.034	
Female	170	Estimate	58.409	-0.170	-0.169	0.022	1.046	0.187	0.000039	0.121
		P-value	<.0001	0.210	0.000	0.772	0.281	0.285	0.015	

Note: P-values and adjusted R^2 shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C8: Performer Only dentists, parameter estimates and P-values for 'motivation index' by split populations using multiple linear regression, England & Wales, 2013/14

Population	Sample	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Adjusted R^2
All	**3,325**	**Estimate**	**62.883**	**-0.007**	**-0.161**	**0.108**	**0.551**	**-0.146**	**-0.000002**	**0.051**
		P-value	**<.0001**	**0.840**	**<.0001**	**<.0001**	**0.001**	**<.0001**	**0.855**	
<35 Hours	1,222	Estimate	66.012	-0.156	-0.168	0.052	0.804	-0.085	0.000008	0.072
		P-value	<.0001	0.044	<.0001	0.057	0.004	0.108	0.647	
≥35 Hours	2,103	Estimate	70.202	-0.190	-0.157	0.138	0.410	-0.168	-0.000005	0.050
		P-value	<.0001	0.005	<.0001	<.0001	0.033	0.000	0.629	
Mainly NHS	2,307	Estimate	77.183	0.024	-0.351	0.117	0.540	-0.098	-0.000015	0.029
		P-value	<.0001	0.587	<.0001	<.0001	0.006	0.024	0.225	
Mainly Private	396	Estimate	61.705	-0.038	-0.026	0.125	0.563	-0.230	0.000025	0.054
		P-value	<.0001	0.670	0.841	<.0001	0.077	0.017	0.234	
Male	1,536	Estimate	61.650	-0.095	-0.143	0.097	1.013	-0.103	-0.000003	0.048
		P-value	<.0001	0.100	<.0001	0.000	0.001	0.038	0.818	
Female	1,789	Estimate	64.070	0.084	-0.186	0.122	0.262	-0.209	0.000012	0.065
		P-value	<.0001	0.058	<.0001	<.0001	0.152	<.0001	0.395	

Note: P-values and adjusted R^2 shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C9: Providing-Performer dentists, parameter estimates and P-values for 'high' or 'very high' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
All	**Estimate**	**-0.400**	**-0.017**	**-0.009**	**0.011**	**0.070**	**-0.011**	**0.0000020**	**0.633**
	P-value	**0.616**	**0.033**	**0.000**	**0.029**	**0.146**	**0.280**	**0.055**	
<35 Hours	Estimate	-3.701	0.014	-0.007	0.014	0.019	0.031	0.0000048	0.616
	P-value	0.032	0.544	0.192	0.169	0.835	0.163	0.106	
≥35 Hours	Estimate	0.492	-0.021	-0.011	0.009	0.091	-0.024	0.0000020	0.636
	P-value	0.631	0.100	0.001	0.121	0.112	0.047	0.088	
Mainly NHS	Estimate	-0.204	-0.031	-0.016	0.023	0.064	-0.009	0.0000020	0.659
	P-value	0.913	0.018	0.338	0.012	0.406	0.527	0.148	
Mainly Private	Estimate	0.403	-0.016	-0.036	0.001	0.058	-0.005	0.0000030	0.617
	P-value	0.785	0.226	0.149	0.859	0.479	0.808	0.256	
Male	Estimate	-0.409	-0.011	-0.007	0.009	0.077	-0.019	0.0000011	0.603
	P-value	0.673	0.239	0.022	0.104	0.154	0.123	0.397	
Female	Estimate	-1.899	-0.019	-0.019	0.019	0.043	0.025	0.0000059	0.712
	P-value	0.221	0.274	0.001	0.055	0.716	0.233	0.025	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C10: Providing-Performer dentists, parameter estimates and P-values for 'low' or 'very low' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
All	**Estimate**	**-3.695**	**0.043**	**0.009**	**-0.003**	**-0.003**	**0.029**	**-0.0000017**	**0.672**
	P-value	**<.0001**	**<.0001**	**0.000**	**0.459**	**0.948**	**0.003**	**0.097**	
<35 Hours	Estimate	1.551	0.007	0.003	-0.020	-0.115	-0.005	-0.0000059	0.657
	P-value	0.384	0.791	0.609	0.046	0.260	0.836	0.091	
≥35 Hours	Estimate	-5.063	0.053	0.011	0.002	0.021	0.035	-0.0000017	0.665
	P-value	<.0001	<.0001	<.0001	0.759	0.694	0.002	0.123	
Mainly NHS	Estimate	-3.768	0.054	0.011	-0.005	0.024	0.019	-0.0000019	0.663
	P-value	0.026	<.0001	0.465	0.432	0.731	0.146	0.143	
Mainly Private	Estimate	-4.171	0.022	0.053	-0.002	0.008	0.038	-0.0000007	0.649
	P-value	0.012	0.144	0.051	0.836	0.922	0.096	0.820	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C11: Performer Only dentists, parameter estimates and P-values for 'high' or 'very high' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
All	**Estimate**	**0.249**	**0.010**	**-0.009**	**0.007**	**0.021**	**-0.016**	**-0.0000036**	**0.589**
	P-value	**0.391**	**0.010**	**<.0001**	**0.000**	**0.228**	**<.0001**	**0.001**	
<35 Hours	Estimate	0.663	-0.010	-0.013	0.004	0.052	-0.012	-0.0000011	0.621
	P-value	0.151	0.236	<.0001	0.257	0.114	0.046	0.578	
≥35 Hours	Estimate	0.911	-0.007	-0.007	0.008	0.003	-0.017	-0.0000048	0.583
	P-value	0.045	0.352	0.000	0.001	0.870	0.001	0.000	
Mainly NHS	Estimate	1.362	0.020	-0.033	0.012	0.005	-0.004	-0.0000069	0.611
	P-value	0.032	<.0001	<.0001	0.000	0.818	0.380	<.0001	
Mainly Private	Estimate	1.543	-0.016	0.010	0.002	0.061	-0.043	0.0000027	0.633
	P-value	0.031	0.120	0.500	0.503	0.143	0.000	0.266	
Male	Estimate	0.274	0.000	-0.009	0.006	0.071	-0.016	-0.0000033	0.587
	P-value	0.563	0.976	<.0001	0.031	0.021	0.003	0.018	
Female	Estimate	0.082	0.021	-0.011	0.008	-0.011	-0.016	-0.0000028	0.602
	P-value	0.835	<.0001	<.0001	0.004	0.590	0.005	0.107	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Table C12: Performer Only dentists, parameter estimates and P-values for 'low' or 'very low' morale level probability by split populations using logistic regression, England & Wales, 2013/14

Population	Parameter Estimate	Intercept	Weekly Hours	NHS (%)	Clinical (%)	Leave	Age	Taxable Income	Area Under ROC Curve
All	**Estimate**	**-1.708**	**-0.003**	**0.013**	**-0.009**	**-0.080**	**0.022**	**0.0000024**	**0.617**
	P-value	**<.0001**	**0.515**	**<.0001**	**<.0001**	**0.001**	**<.0001**	**0.022**	
<35 Hours	Estimate	-1.977	0.005	0.017	-0.006	-0.085	0.017	0.0000018	0.644
	P-value	<.0001	0.571	<.0001	0.064	0.023	0.007	0.361	
≥35 Hours	Estimate	-2.551	0.020	0.011	-0.010	-0.070	0.024	0.0000027	0.608
	P-value	<.0001	0.010	<.0001	0.000	0.016	<.0001	0.032	
Mainly NHS	Estimate	-4.103	-0.012	0.049	-0.012	-0.060	0.010	0.0000046	0.631
	P-value	<.0001	0.018	<.0001	<.0001	0.020	0.033	0.001	
Mainly Private	Estimate	-2.278	0.023	-0.029	-0.004	-0.204	0.047	-0.0000029	0.662
	P-value	0.011	0.055	0.106	0.267	0.016	0.000	0.329	

Note: P-values shown at 3 decimal places but rounded from data originally at 4 decimal places *Source: NHS Digital*

Annex D: Glossary of Terms

[Link back to start]

Table D1 provides definitions of the most common terms used in this report. Where terms relate to individual countries, this is indicated by (EW) for England & Wales, (Sc) for Scotland and (NI) for Northern Ireland.

Table D1: Glossary of terms used in the report

Associate Dentist	Sc	A dental practitioner who is self-employed and enters into an agreement with a Principal Dentist that is neither partnership nor employment. Also has an arrangement with a NHS Board to provide general dental services.
	NI	A dental practitioner who is self-employed and enters into an agreement with a Principal Dentist that is neither partnership nor employment. Holds a dental surgeon (DS) number and performs primary care dental services.
Clinical Share	UK	Defined as the percentage of time dentists devote to clinical work (compared to administration). For the purpose of answering the Dental Working Patters (DWP) Survey, clinical work is defined as all face-to-face contact with patients (including preventative care).
Dental Type	EW	For the purpose of this enquiry, a dentist is assigned a dental type based upon whether they held at least one contract with NHS England /Local Health Board (LHB) and had records of dental activity in the relevant year (i.e. Providing-Performer dentists) or if they only had records of activity but did not hold a contract with NHS England/LHB in the relevant year (i.e. Performer Only dentists). Please see the relevant glossary entries for further definitions of dentist types.
	Sc NI	For the purpose of this enquiry, a dentist is assigned a dentist type (i.e. Principal or Associate) as declared on their survey return.
Estimated Full-Year Population	UK	Full-year population counts (in the report) are weighted estimates calculated from the entire population and the proportion of dentists who responded to the survey who indicated they worked for the full-year (not including annual leave). The population counts may not sum due to rounding.
Experimental Statistics	UK	Experimental Statistics are new official statistics undergoing evaluation. They are published in order to involve users and stakeholders in their development and as a means to build in quality at an early stage.
Likert Scale	UK	Psychometric scale commonly used in research to measure people's attitudes to a topic.

Linear and Logistic Regression	UK	Please see Annex A for a description of multiple linear and logistic regression methodology.
'Motivation Index'	UK	Based on the average response to the six questions designed to measure the motivation of dentists. Please see Chapter 1 for a more detailed description of the questions, how the 'motivation index' is calculated and key assumptions made.
Multivariate Analysis	UK	Multivariate analysis (MVA) is based on the statistical principle of multivariate statistics, which involves observation and analysis of more than one statistical outcome variable at a time.
NHS/Health Service Share	UK	Defined as the percentage of time dentists devote to NHS/Health Service dentistry (compared to private).
Ordinal Scale	UK	Scale for rank order (1^{st}, 2^{nd}, 3^{rd} etc.) by which data can be sorted but does not allow for relative degree of difference between them.
Parameter (Estimate)	UK	Descriptive measurements of a population. As results in the report are based on samples (of the population) they are termed estimates.
Performer Only	EW	A dentist that performs NHS activity on a contract, but does not hold a contract with NHS England/Local Health Board themselves.
Principal Dentist	Sc	A dental practitioner who is also an owner, director or partner of a dental practice(s), has an arrangement(s) with a NHS Board to provide general dental services.
	NI	A dental practitioner who is also an owner, director or partner of a dental practice, holds a dental surgeon (DS) number, and also performs primary care dental services.
Provider Only	EW	A dentist that holds a contract with NHS England/Local Health Board but does not perform dentistry on this or any other contract (i.e. all dentistry provided under the contract is sub-contracted); these dentists are excluded from the analyses in this report.
Providing-Performer	EW	A dentist that holds a contract with NHS England/Local Health Board and also performs NHS dentistry on this or another contract.
Taxable Income	UK	Income before tax or pension contributions have been deducted, made up of gross earnings less total expenses, also known as net income.
Weekly Working Hours	UK	Total number of hours per week spent performing primary care dentistry (includes both clinical and non-clinical work), as derived from responses to the Dental Working Patterns Survey.

Information and technology
for better health and care

www.digital.nhs.uk

0300 303 5678

enquiries@nhsdigital.nhs.uk

@nhsdigital

ISBN 978-1-78734-022-0

This publication may be requested
in large print or other formats.

Published by NHS Digital, part of the Government Statistical Service