

# A fair playing field for the benefit of NHS patients

Supplementary paper  
March 2013

**Cost Modelling**



# Cost modelling – overview and methodology

## Introduction

One part of the evidence base for the review is a cost model which investigates the impact of some of the factors on the costs of delivering particular services by different providers. This paper describes how this modelling was undertaken, and how it supports the discussion of these factors in the supplementary paper on cost.<sup>1</sup>

The purpose of this paper is to provide more detail behind the modelling results that are presented in the main report and accompanying supplementary papers. The modelling provides quantitative ranges which indicate the impact of each factor on providers' costs. This gives one indication of the size of distortion created by the factors. Other evidence is also used to develop the full picture about the size of the distortion.

The cost model considers only those factors which are most amenable to quantitative analysis and where a significant effect might exist. The factors modelled were<sup>2</sup>:

- Corporation Tax;
- Value Added Tax (VAT);
- cost of capital;
- pensions; and
- pay and employee benefits.

## Limitations to the modelling

We have been mindful of a number of limitations of the modelling undertaken. In particular:

- The review only had access to a limited sample of providers' information (particularly non-public sector providers) and so the results have not been interpreted as providing any statistically significant analysis of differences across provider or service types. More detail about the sample is provided in the box below.
- The model is based on provider-level data. The service-level data held by providers is not sufficiently detailed to allow a proper examination of these issues. For example, providers do not identify the proportion of costs which attract VAT, or the proportion of these costs which can be reclaimed through the Continuity of Service (COS) rules at service level. Providers also do not identify pensionable staff costs at

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<sup>1</sup> [www.monitor-nhsft.gov.uk/FPFR](http://www.monitor-nhsft.gov.uk/FPFR)

<sup>2</sup> Some cost modelling of the central procurement support function was also undertaken, but when it became clear that the impact was not significantly different across different types of providers, this area of analysis was not pursued.

## COST MODELLING

a service level<sup>3</sup>. For this reason, the review's modelling uses data from selected groups of providers to estimate the impact of factors on different types of services.

- The modelling compares public sector providers with non-public sector providers as a whole (referred to below as "alternative providers"). This is because the factors considered largely apply in the same way to private sector and VCS providers. Where this is not the case, we have commented on the differences between the private sector and VCS providers in the description of these factors in relevant parts of the report.
- In some cases (e.g. pensions, Corporation Tax) the Government has made announcements about how they might change in the future. The modelling provides a snapshot of the current situation in March 2013. Where there are known future changes, these are incorporated into the interpretation of the overall evidence base (including modelling results) and in the development of our recommendations.
- The modelling does not incorporate any changes in behaviour by providers that might take place if the distortion in question were removed or altered. We consider these issues when we consider recommendations.
- The model is a tool that allowed the review team to investigate different scenarios and a range of possible impacts, rather than providing a single "answer". For example, the difference between public and private pay will vary depending on local labour market conditions for particular jobs. The model includes a baseline scenario but also allows other scenarios to be tested.

### **The sample**

The model draws on a sample of different types of providers (public, private, VCS – see supplementary paper on Methodology for a description of provider types). The sample also consists of providers that focus on different types of care (e.g. mental health, orthopaedics, etc.) in order to allow some analysis of whether distortions vary by type of service (we discuss our approach to illustrative services below).

We collected data from the accounts of public providers for trusts representing the following categories of size and specialism:

- mental health;
- care trust;
- ambulance service;
- acute children's specialist;

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<sup>3</sup> The review team discussed these data issues with the Healthcare Financial Management Association to confirm that the best available (and relevant) data was included within the model.

## COST MODELLING

- acute orthopaedic specialist;
- small acute;
- medium acute;
- large acute; and
- acute teaching.

We also held meetings and requested data from private, voluntary and charitable sector providers. This data was invariably provided on a confidential basis but was used in the same way for the modelling. This includes data provided by primary care providers (including GPs). Primary care data was not used in the modelling but analysed to inform our thinking. Specific assumptions and limitations are discussed elsewhere in this paper.

In total, we have a sample of 23 providers (excluding primary care) in the sample covering these areas. Since we were reliant on providers giving us data, this is not a random sample. Cross-checks were made to understand where the sample may not be representative and, if material to our analysis, adjustments were made. For example, we investigated the aggregate surplus of our public sector providers and compared it to information on the aggregate surplus of all providers to understand how our sample differed from the full population. Specific adjustments arising from this analysis are discussed below under the description of our analysis for each distortion. However, the sample size means that, as emphasised above, the modelling is used to support the wider analysis and investigate the magnitude of impacts.

Given these limitations, it is important to note that the model is only one element of the evidence base drawn upon by the review. A wide range of other evidence was also used to consider the conclusions reached and the recommendations made.

### Overarching approach

The central question examined in the modelling is: compared with a public sector provider, **how much more or less** would it cost a non-public sector provider to deliver the same service(s), **as a result of the factor in question**<sup>4</sup>? The model answers this question starting with the public provision of each service: we take a public sector provider, and estimate the impact on their costs that would result from applying the same conditions faced by an alternative provider. For each of the factors, different “rules” apply to public sector and alternative providers. The model simulates a scenario where the non-public sector “rules” apply to public sector providers. For example, we consider the increase in

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<sup>4</sup> We discuss elsewhere the different types of providers that the review has considered (public, private, voluntary, charitable).

## COST MODELLING

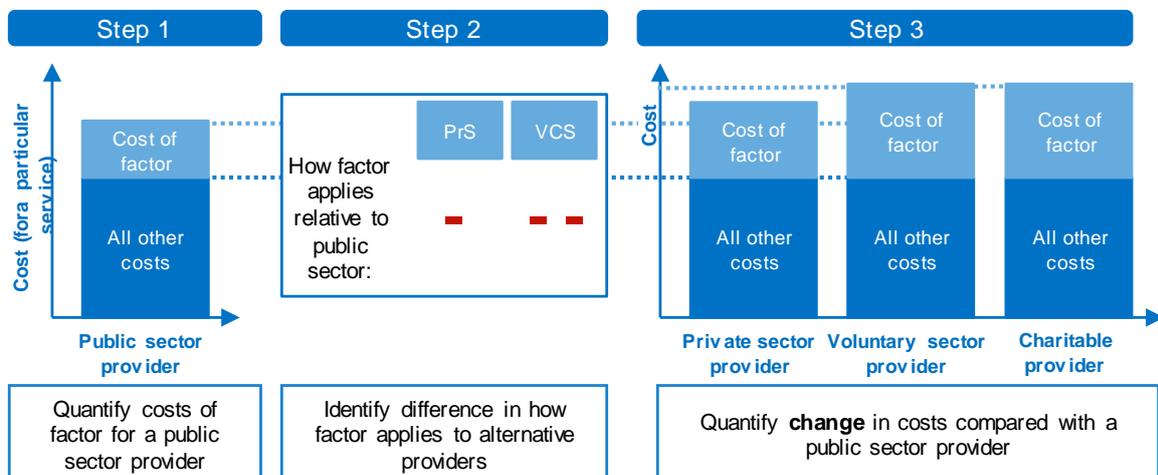
costs associated with paying the full cost of pensions, or from removing the VAT rebate for contracted-out services.

The review hypothesised that the impact of these factors would vary across different health care services. Depending on the types of inputs used to deliver a service, the above factors may be more or less important in determining total costs. For example, a differential in pension costs is likely to be more significant for services which have a higher proportion of staff costs. The model approaches this issue by considering illustrative services, i.e. services which illustrate this variation in underlying cost structures. This is discussed in more detail later in this paper.

A three-step approach (common across all the services) was developed and is illustrated in Figure 1 below:

1. The first step is to quantify the costs of the factor to a public sector provider.
2. The second step is to identify the difference in how the factor applies to alternative providers.
3. Finally, the model quantifies change in costs as a result of the factor, for alternative providers compared to a public sector provider.

**Figure 1. Steps to answer the key modelling question, for each factor**



*Notes:* Prs = private sector provider; VCS = voluntary and community sector provider;

“-” lower cost, “- -” much lower cost. Figure above is purely illustrative.

At the third step – quantifying the change in costs – the review’s modelling includes two different approaches. The key difference between the approaches is the assumed cost base for the calculation. The two options are:

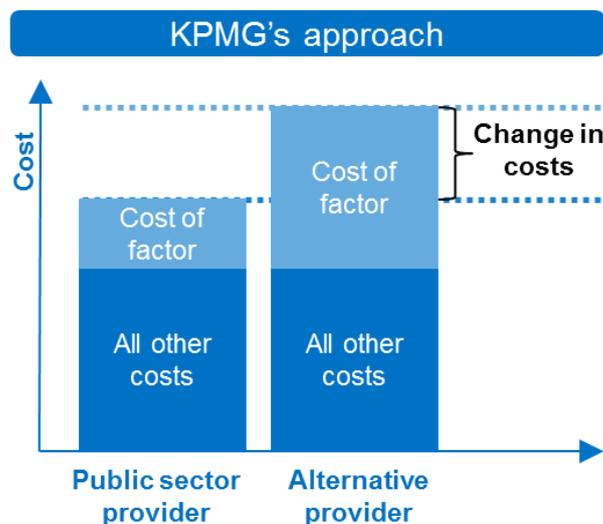
## COST MODELLING

- using public sector providers' actual costs; or
- using public sector providers' costs, adjusted to reflect the cost *structure* of an alternative provider.

The first approach considers the direct effect upon a public sector provider's costs if it faces the non-public sector "rules". The second approach recognises that public and non-public sector providers may have different cost structures. The impact of any particular factor on a non-public sector provider might therefore be greater or smaller than the impact estimated by the first approach. In the second approach, the model adjusts the public sector provider's cost base to mirror the non-public sector provider, before then considering (exactly as in the first approach) the impact of applying the non-public sector "rules".

Our modelling approach builds on that developed by KPMG as part of the Fair Playing Field Report (2009) commissioned by the Department of Health. KPMG's model compares the current observed costs of a factor to a public sector provider with the current observed costs to an alternative provider, as illustrated in Figure 2 below.

**Figure 2. KPMG's modelling approach**



This change in costs includes the direct cost impact of the factor and also the cost impact of the provider's response to the factor. For example, where alternative providers face higher pension costs (direct cost impact) this could lead them to use more machines and fewer staff, at the margin (provider response).

Our approach builds on KPMG's by separating out these two impacts and quantifying the first. The direct impact of the factor is estimated by assuming no other changes to the way in which a public sector provider operates, only the way in which a particular factor applies to that provider (e.g. whether they are reimbursed for some VAT expenses or not). We do not model any provider response, such as a change in their behaviour. To ensure that this second impact is still captured, we have collected evidence on this from our stakeholder

## COST MODELLING

discussions. That evidence is discussed in detail in interpreting the findings of the modelling in each of the relevant factor discussions.

This approach results in a model with three main sections:

1. Identification of the key cost drivers for each of the factors.
2. Assumptions used for each of the factors.
3. Service and provider data.

These sections are described in more detail below.

### **Identification of key cost drivers**

Each of the factors modelled has an impact on providers' costs through a slightly different mechanism. For instance, whereas the impact of Corporation Tax depends on a provider's surplus, the impact of VAT depends on the mix of inputs they purchase in order to deliver their services. In each case there are different relevant cost drivers.

In order to estimate the impact of each factor, the model is based on an analysis of these cost drivers for different types of providers. Figure 3 below summarises the relevant cost drivers for each factor.

## COST MODELLING

**Figure 3. Cost drivers**

	Cost drivers
Corporation Tax	Gross surplus/deficit or profit/loss for a provider*
VAT	All operating costs, excluding: <ul style="list-style-type: none"> <li>• pay costs</li> <li>• bad debts</li> <li>• depreciation &amp; amortisation</li> <li>• clinical negligence costs</li> <li>• services from NHS trusts and NHS bodies</li> </ul>
Pensions	Total employer's pension contributions
Pay and employee benefits	Total employee costs (excluding pension contributions)
Cost of capital	Interest paid on public capital (e.g. PDC, DH loans, FTFF loans)  Interest paid on private capital

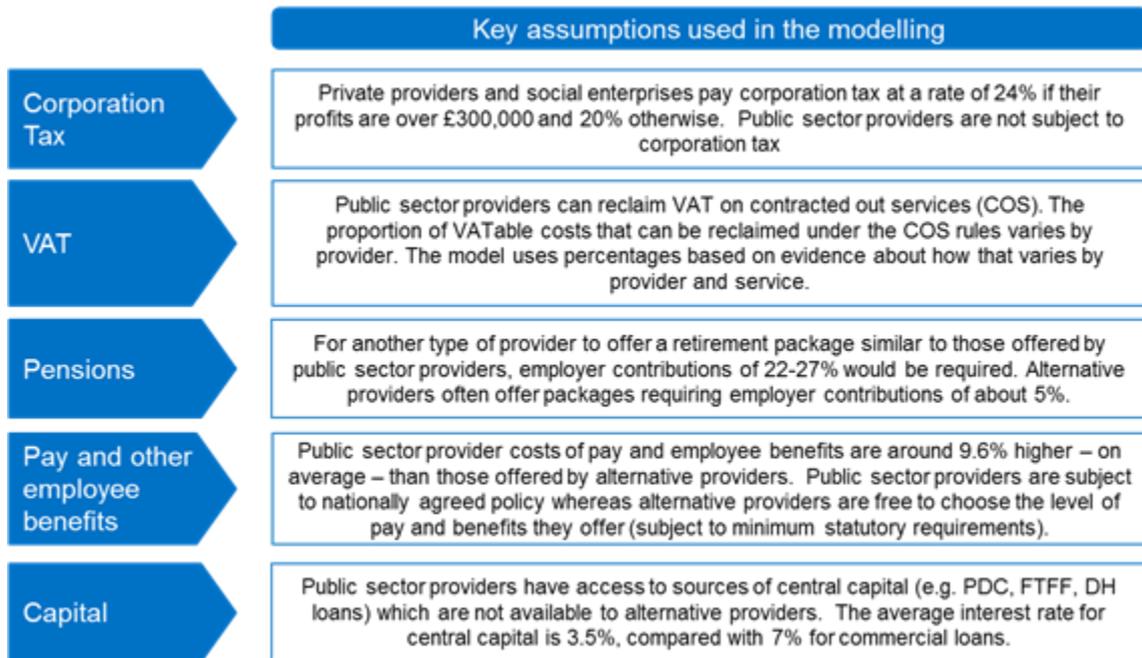
\* adjustments were made to public providers' reported surpluses to generate as accurate as possible a measure of the surplus relevant for Corporation Tax purposes. These adjustments were agreed with HM Revenue & Customs (HMRC) based on their views of what would drive liability for Corporation Tax. In all cases the analysis assumes no further mitigation activity on the part of providers exposed to an additional cost because of the factor under consideration. The wider work in the review considered the broader impact of a range of corporate taxes; the modelling focuses on Corporation Tax.

### Factor assumptions

The second key section of the model is the set of assumptions used in relation to each of the factors. These assumptions draw on evidence about the factor impact from other sources, such as tax authorities, pensions and other experts. A full discussion of factor-specific assumptions and their sources is contained in the supplementary paper on each factor. Figure 4 below shows the key baseline assumptions used within the model.

## COST MODELLING

**Figure 4. Baseline modelling assumptions**



As shown in the figure above, a number of assumptions are made in relation to the individual factors under consideration. In addition, some assumptions were made which apply to all the factors considered. These are discussed in turn below.

### *Corporation Tax*

Corporation Tax is paid by private sector providers at a rate of 24% if profits exceed £300,000, and 20% otherwise<sup>5</sup>. Marginal relief applies to profits of between £300,000 and £1,500,000<sup>6</sup>. These rates apply to the 2012-13 financial year<sup>7,8</sup>.

To understand the impact of the distortion, the model calculates the potential impact on public providers of being liable for corporate tax. Total Corporation Tax paid is calculated by multiplying the rate of Corporation Tax with the taxable profits of the provider. We calculated taxable profits for public sector providers (to compare with that faced by private providers) in the following way:

<sup>5</sup> Source: HMRC website, at <http://www.hmrc.gov.uk/rates/corp.htm>

<sup>6</sup> Marginal relief is computed for the simplest case of an organisation having no ring-fenced profits, no associated company, no franked investment income, and an accounting period falling entirely within one financial year. Discussions with HMRC suggested that these simplifying assumptions would not significantly affect the results of the modelling.

<sup>7</sup> Reductions in Corporation Tax are planned to take effect in April 2013; in particular, the 24% standard rate will fall to 23%. Budget announcements in March 2013 set out further reductions in future years. See <http://www.hmrc.gov.uk/rates/corp.htm>. These will reduce further the differential tax treatment of public sector and non-public sector providers. As noted above, for all factors the model is based on the situation in March 2013 but known changes are incorporated into the interpretation of the results and development of recommendations.

<sup>8</sup> The financial data included within the model is from 2011-12 and 2010-11. We have used the most recent tax rates – rather than the rates which applied in these tax years – as this provides a better indication of the current impact of this factor on providers.

## COST MODELLING

- identify total surplus reported in the accounts;
- add back public dividend capital dividends; and
- add back depreciation on property, land and equipment.

These two adjustments ensure that the taxable profit figure is comparable to the taxable profits figure for a non-public sector provider. PDC payments can be considered equivalent to shareholder dividends for a non-public sector provider; since shareholder dividends are paid from post-tax profits, we calculate “pre-PDC dividend profits” to calculate pre-tax public sector profits. Depreciation was added back based on HMRC guidance.

The secondary care public providers in our sample exhibit slightly larger surpluses when compared with the entire population of secondary care public providers. Failing to account for this would lead to overestimating the average impact of Corporation Tax<sup>9</sup>. To ensure that our model results are as representative as possible of all providers, we make the following adjustments to the surpluses in our sample:

- we obtained the average Corporation Tax ‘costs’ as a percentage of operating costs for all foundation trusts using Monitor’s consolidated accounts;
- we then obtained the same average figure across all the service providers in our sample; and
- we took the ratio between the former and the latter.

If Corporation Tax did apply to public sector providers:

- other allowances and reliefs may also apply, reducing the level of taxable profits; and
- providers may have the incentive to minimise their tax liability, and take action that would bring their surpluses below the levels currently observed.

As a consequence, our figures can be thought of as an upper bound of the impact that corporation tax has on providers.

### *Value Added Tax*

The review’s modelling focuses on the impact of the differential treatment of providers due to the contracted-out services (COS) VAT rebate scheme. The COS scheme allows only public sector providers to reclaim the VAT paid on a range of services. The impact of zero-rated inputs (for charitable spending on certain inputs), which may also imply differences across provider types, were not modelled due to paucity of data, but are discussed further in the main report.

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<sup>9</sup> The impact is estimated accurately for these particular providers; however, the results would not be representative of the impact upon providers in general.

## COST MODELLING

In order to estimate the impact of COS rebates, the model first calculates the providers' total cost subject to VAT. The model then estimates the proportion of these VAT costs that could be reclaimed due to the COS rules. Multiplying the cost base onto which the COS rules would apply by the current VAT rate, we obtain an estimate of the saving realised by a public sector provider.

Total costs subject to VAT are computed from provider financial data, specifically: all non-pay costs excluding bad debts, depreciation & amortisation, clinical negligence and services from NHS bodies and trusts. The financial data for providers in our sample is not sufficiently detailed to determine expenses on contracted-out services for each individual provider. Instead, the review's model includes estimates of the proportion of VATable costs subject to COS, based on a sample of different types of providers<sup>10</sup>.

The impact of the COS exemption might be larger where the provider has a Private Finance Initiative (PFI) in place. In that case, the management of the asset financed through the PFI would be contracted out. Our estimates do not account for this impact because of the lack of data on the management charges involved in the PFI schemes of the providers in our sample. Our estimates are therefore a conservative estimate of the impact of the COS scheme, in respect of providers with PFI deals. These issues are considered in reaching our conclusions for VAT in the main report.

### *Pensions*

Public sector providers must offer the NHS Pension Scheme (NHS PS) and pay 14% employer contributions. Alternative providers either must offer an equivalent scheme (if their staff are under TUPE regulations) or is free to choose (if not TUPE). In order to offer an NHS PS-equivalent scheme, an alternative provider has to pay employer contributions at a rate of 22-27%<sup>11</sup>. When independent providers are free to choose, the typical rate for their contributions is 5%<sup>12</sup>.

This gives two scenarios, one which implies a cost advantage to the public sector (when independent sector staff are in large part under TUPE), while the other implies a cost disadvantage (when independent providers have no or few staff under TUPE).

The review's modelling focuses on the financial cost of different pension schemes, not controlling for local labour markets or quality differences in staff. For example, offering less generous pensions could result in attracting fewer staff and/or less able staff. The review's modelling does not attempt to estimate the impact of this. Moreover, the modelling considers specifically the cost in terms of employer contributions to pension schemes, holding constant both (a) employee contributions and (b) basic pay constant. (a) could affect the impact of pensions if there is substitution between employer and employee contributions – e.g. lower employer contributions have to be matched by higher

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<sup>10</sup> Sources: KPMG, Fair Playing Field Review (2009); supplemented by review team research on a small sample of public sector providers.

<sup>11</sup> Sources: Private and VCS provided that they have responded to the review; supplemented by review team analysis. This is discussed in more detail in the pensions section of the supplementary paper on cost.

<sup>12</sup> Sources: Association of Consulting Actuaries (2011), Pension trends report; data on VCS providers in our sample.

## COST MODELLING

employee contributions, and these have to be matched by higher pay; (b) might affect pension costs because employer contributions are a percentage of pay. These issues are considered in reaching conclusions about pensions in the main report.

### *Pay and other employee benefits*

We consider pay and other benefits in isolation from pensions, estimating the cost differential in total salaries and wages between a public sector and an independent sector provider.

To obtain this, we use research undertaken by the ONS (2012), and the IFS (2012), which estimates that the public sector pays on average about 8% more than the private sector. The Office of National Statistics (ONS) used data from the Annual Survey of Hours and an annual survey of employers to estimate the general public-private sector pay differential, while the Institute for Fiscal Studies (IFS) used the Labour Force Survey. Both studies used regression analysis to obtain an estimate of the pay differential after controlling for the characteristics of workers in both sectors, including gender, age, occupation and qualifications. The differential does not account for differences in annual leave (see below) but appears to account for differences in sick pay and unsocial hours payments. However there are a number caveats to these estimates:

- the estimates are not specific to health care but compare public and private sector pay and benefits across a range of sectors;
- the estimates are an average across all types of worker. The estimate for more senior staff is close to zero – evidence from the IFS suggests that the differential is largest at the lowest end of the wage distribution and gradually declines to zero at the upper end;
- there may be geographic variations in the wage differential which these average estimates do not capture; and
- the estimate is taken at one point in the business cycle – if private sector pay is more flexible than public sector pay we would expect that, relatively, public sector pay will be higher in a recession and lower in an economic boom.

We have also quantified the potential public-private difference in labour costs arising from different minimum standards for policy relating to leave. These differences are not fully reflected in the ONS and IFS estimates. NHS Terms and Conditions give NHS employees between 7 and 13 additional days of leave compared to the UK statutory minimum, depending on service. We make an assumption, by way of example, that employees receive 4 fewer days leave from an independent sector provider, which is 1.6% of the working days in a year (252). This illustrative assumption has been made in the absence of systematic data on alternative leave offered by independent sector providers. Combining this 1.6% with the 8% pay advantage leads to an overall public-private differential of 9.6%.

## COST MODELLING

The 9.6% differential may not fully take into account sources of public-private differences that are not captured by the source data (the Annual Survey of Hourly Earnings (ASHE) and the Labour Force Survey, other than annual leave. These may include benefits such as travel expenses, or, in part, for the ASHE, bonus payments<sup>13</sup>. In calculating the differential between public and alternative providers, the model also assumes an average mix of staff; we have not attempted to model the different profiles of staff (e.g. by seniority) which may exist between different types of provider.

### *Cost of capital*

We estimate what a public sector provider's financial costs would be if it relied on commercial funding only, rather than having access to PDC, the Foundation Trust Financing Facility (for foundation trusts), and Private Finance Initiatives.

Based on the composition of the provider's finance costs, and on data on typical interest rates, we estimate the average interest rate paid by the provider<sup>14</sup>. We found typical rates to be: 3.5% for PDC and FTFF loans; 7% for commercial loans<sup>15</sup>; and 6-7% for PFIs<sup>16</sup>. These rates represent the historic, average cost of capital experienced by providers. The rates achieved today and in the future (for marginal capital requirements) may vary from these baseline assumptions.

We compute the total costs for a provider paying interest on a commercial rate (7%) only. In practice, this involves two steps: (1) dividing the provider's total finance costs by the average interest rate to work out the underlying asset base; and (2) multiplying the asset base by 7%. This approach takes providers' existing estimates of their asset base (used for the purpose of calculating PDC payments) and applies an alternative funding rate to that asset base (rather than, for example, calculating their asset base afresh from more detailed financial data).

The accuracy of the results is dependent on whether the typical rates we used are representative of the cost of capital faced by the provider. While the PDC rate and FTFF rates are largely fixed, an amount of uncertainty remains on commercial funding and PFIs. The alternative approach of determining what rates each provider is facing on a case-by-case basis would require additional detailed financial data not available to the review. The model does allow alternative scenarios to be examined, and these were investigated in formulating findings and recommendations.

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<sup>13</sup> See NHSPR (2012), Market Facing Pay, Chapter 2, for a discussion.

<sup>14</sup> This is obtained computing a weighted average of the interest rates for the different types of funding (PDC, FTFF, commercial funding, PFIs) with the weights being the costs borne by the provider for each of the types.

<sup>15</sup> Sources: ThomsonOne, LoanConnector

<sup>16</sup> Sources: Historic 20 year LIBOR swap rates, PFI margins from HM Treasury, 2012, A new approach to public private partnerships, historic size of health care PFI deals from [http://www.hm-treasury.gov.uk/ppp\\_pfi\\_stats.htm](http://www.hm-treasury.gov.uk/ppp_pfi_stats.htm), assumptions on gearing and cost of equity from KPMG, 2009, Fair Playing Field Report, Stage 4.

### Illustrative services

The importance of cost drivers varies by service. For example, some services are more labour-intensive than others and so might be more affected by changes in employment costs. The model was used to examine whether the factors have a significantly different impact across different types of services. The review's approach was to consider illustrative services. The rest of this section sets out in more detail how the illustrative services were developed.

Services can be characterised by the relationships between the inputs they use and the outcomes they produce. The modelling focuses on differences in the inputs. The modelling considers three dimensions in which they differ<sup>17</sup>:

- economies of scale;
- economies of scope; and
- labour intensity.

We consider each of these in turn in order to indicate why they were included as relevant dimensions to define illustrative services.

#### *Economies of scale*

Economies of scale exist where treating a larger number of patients is much more efficient per patient (in financial cost terms) than treating a smaller number of patients<sup>18</sup>. For example, it would be inefficient for every A&E to operate their own ambulance service; the fixed costs of operating this service are much better spread across a larger number of hospitals. This leads to a "minimum efficient scale" for providers, i.e. a minimum number of patients or geographical catchment which a single provider needs to cover in order to minimise average costs. The higher the minimum efficient scale, the fewer providers we would expect to see on the playing field. This often (but not always) arises where services are more capital intensive and so this affects cost drivers (e.g. any differences in the cost of capital may be relatively more important for these services).

The extent of economies of scale varies between services. The existence of this in practice can be illustrated by considering the scale of providers delivering NHS services today.

- In any given town, there are likely to be a number of GP practices, pharmacies, dentists and opticians. This is because primary care operates on a relatively small

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<sup>17</sup> Monitor has published a detailed study that looks at these issues and how they affect different services, "A study investigating the extent of economies of scale and scope in health care markets and how these can be measured by Monitor" (2012). This study includes a literature review of relevant studies.

<sup>18</sup> Economies of scale can be measured in a number of different ways. For example, economies of scale might be driven by the number of local residents covered by a service, the number of patients presenting, or the number of treatments received.

## COST MODELLING

scale, i.e. any one provider can serve a relatively small population of a few thousand patients. NHS data indicates that the average GP list size is around 7,000 patients<sup>19</sup>.

- In the same town, there is likely to be just one local hospital or A&E (or this may be shared with neighbouring towns). This reflects the larger minimum efficient scale required to run a hospital. NHS data suggests that:
  - a hospital providing elective care typically serves approximately 160,000 people;
  - a hospital providing non-elective care serves approximately 270,000;<sup>20</sup> and
  - an A&E serves a local population of approximately 350,000 people<sup>21</sup>.
- Similarly, the vast majority of care trusts serve a local population of between 150,000 and 560,000 people<sup>22</sup>.
- Then there are more specialist services, such as some cancer and paediatric services, which serve an entire region of hundreds of thousands or millions of people. The minimum efficient scale of these services is larger still. For instance, under Payment by Results, 34 providers are eligible for the top-up for specialised children's services, suggesting that each specialist provider serves – on average – a population of 1.6m<sup>23</sup>. Figure 5 below illustrates these estimates.

### Figure 5 Estimates of average population served by providers across services

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<sup>19</sup> Health and Social Care Information Centre, QMAS database, 2010/11 data as at end of July 2011.

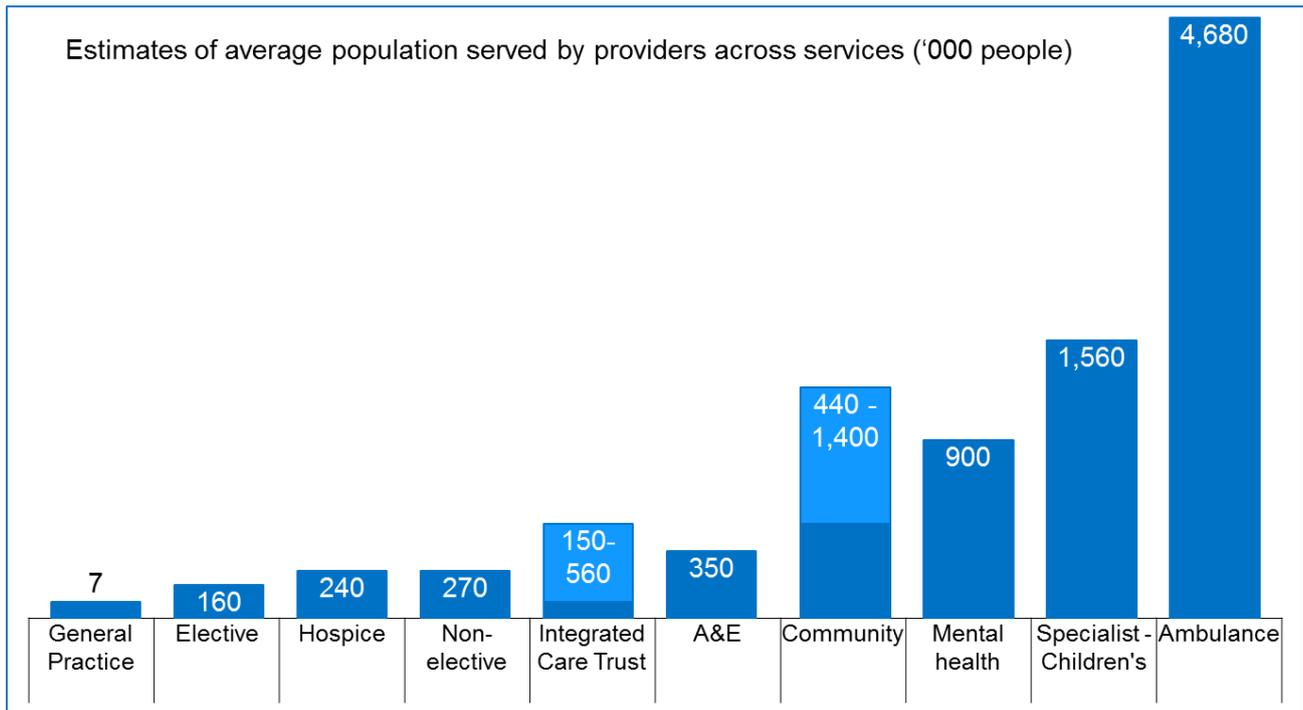
<sup>20</sup> DH Monthly Activity Return, Monthly hospital activity, June 2012 to November 2012, January 2013.

<sup>21</sup> DH unify2 data collection QMAE, Total time spent in A&E Q2 2011-12, November 2011.

<sup>22</sup> Information gathered from 6 care trust websites. One trust serves a population of 1.5m.

<sup>23</sup> DH, Confirmation of Payment by Results arrangements for 2012-13, February 2012.

## COST MODELLING



These estimates are based on the typical size of the population covered by individual providers of services, rather than (for example) the number of patients or the number of treatments. This allows direct comparison between providers.

Existing patterns of provision are not a perfect indicator of these underlying characteristics. For example, they are in part the results of historical accident, and may not always be the most efficient possible configuration. In some areas the configuration of services has changed recently, or is in the process of changing. Nevertheless, the patterns we observe help to illustrate the characteristics identified above.

There is also some academic literature relating to economies of scale. This suggests that economies of scale do exist in hospitals, up to a certain threshold where diseconomies of scale may begin to be observed (although the level of this threshold is debated)<sup>24</sup>. The evidence is more mixed at service level: some academic work suggests that services such as diagnostics, trauma, elective hip, and obstetrics exhibit economies of scale, but other evidence suggests scale may be less important. The evidence relating to intensive care is more ambiguous<sup>25</sup>.

### *Economies of scope*

Economies of scope exist where it is more efficient to provide some services alongside other particular services. For example, some treatments are more effectively delivered where there is access to a broad range of diagnostic and specialist support (e.g. emergency care) or where there are multiple requirements (e.g. integrated treatment for

<sup>24</sup> For example, see Marini and Miraldo (2009).

<sup>25</sup> Goudie, R. and Goddard, M. (2011), *Frontier Economics* (2012).

## COST MODELLING

some patients with comorbidities). Scope economies are often associated with strong interdependency between services, such as between A&E and various clinical support services.

The current configuration of services also relates to the economies of scope of provision. For example:

- A&E and trauma services are usually co-located with a range of diagnostic and surgical services; whereas
- ambulance services are provided by standalone organisations which are dedicated to delivering that particular service.

Kittlesen and Magnusson (2002) found that economies of scope varied across services in a hospital, from strong economies for surgical and medical services, intermediate for inpatient and outpatient production, and minimal for elective cases.

### *Labour intensity*

Labour intensity refers to the proportion of total costs which is due to staff costs<sup>26</sup>. The nature of economies of scale and scope are also related to the degree to which the delivery of a service is labour intensive. Services with limited economies of scale are likely to be more labour intensive (i.e. requiring a relatively higher proportion of labour input). For example, many community and primary care services are relatively labour intensive, as well as mental health provision and some acute services (e.g. midwife-led births).

When a service is more labour intensive, financial and clinical decision making depend much more on the role of staff. For example, decisions on whether to expand will be informed by the ability to recruit skilled staff, and less so by the need to fund capital expenditure on facilities or equipment. Within health care, some services - such as community nursing - are more labour intensive than others, such as diagnostics<sup>27</sup>. Figure 6 below illustrates this variation.

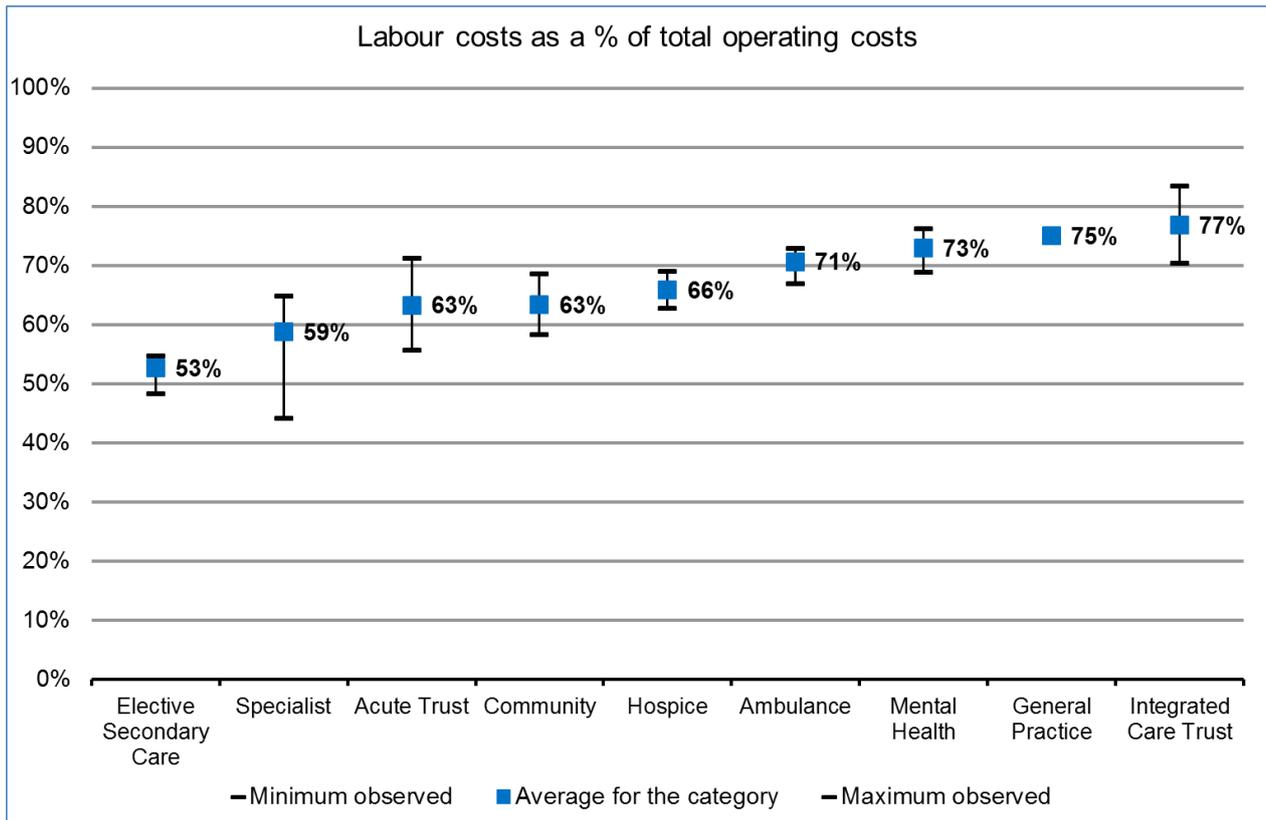
### **Figure 6. Labour intensity across different services**

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<sup>26</sup> Labour intensity can also be defined using other measures, for example, by estimating the total number of staff, and the mix of those staff, required to provide a particular service/treatment. However it is measured, labour intensity increases when – all else being equal – more staff are required to provide a service.

<sup>27</sup> Labour intensity is estimated as the ratio of labour costs to total operating costs on the basis of annual reports published by providers in each category.

## COST MODELLING



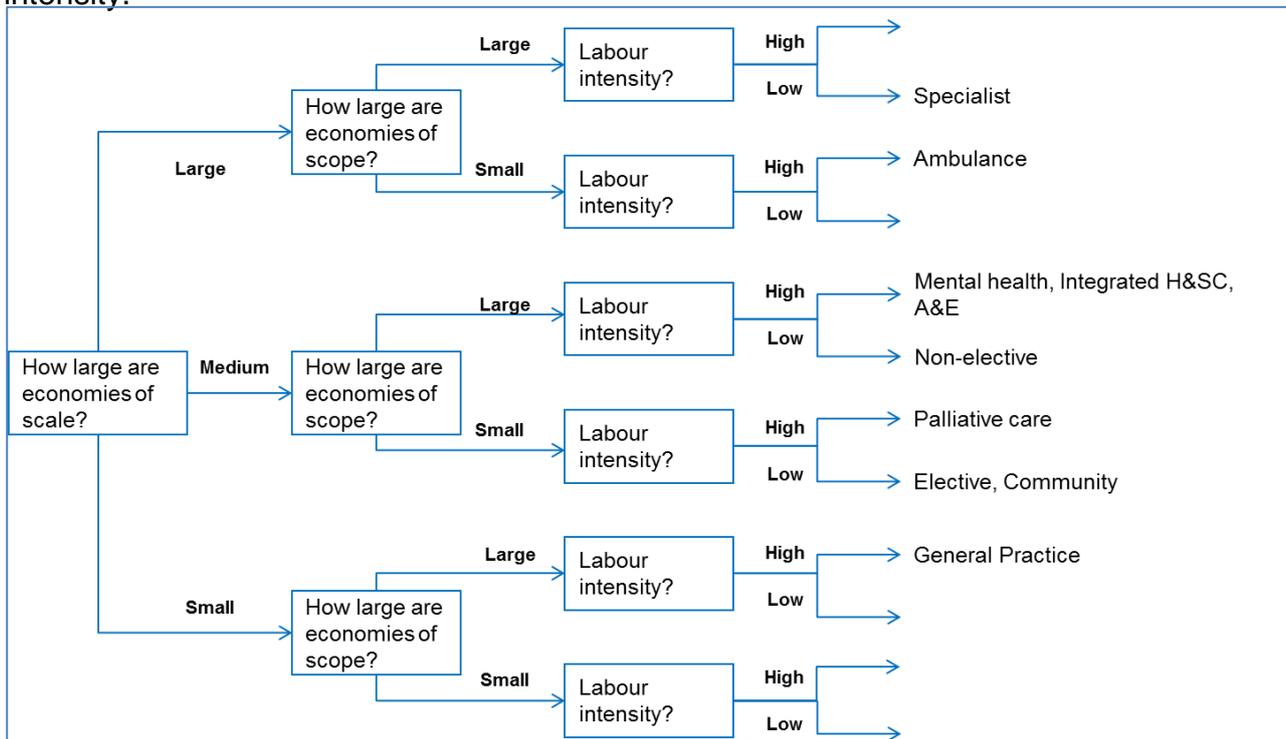
### *Illustrative services*

Based on these three characteristics (economies of scale and scope, and labour intensity) we have identified a selection of specific services where we expect the impact of the factors to be different.

Our illustrative services were chosen to illustrate the different possible “combinations” of the above characteristics (e.g. high economies of scale and scope but low labour intensity, etc.). The services we have identified provide examples of services that have particular characteristics which are important for estimating the impact of factors. Figure 7 below shows how a variety of different NHS-funded services could be assessed against these dimensions.

## COST MODELLING

**Figure 7.** Illustrative services assessed for economies of scale and scope, and labour intensity.



*Note:* blanks at the end of the tree indicate areas we did not examine or for which no good example of a service was found.

These services are not intended to represent a comprehensive breakdown of all NHS-funded care. Rather they are used to provide an insight into:

- the variation between different services and the range of impacts caused by individual distortions to the fair playing field;
- particular services where we might expect a greater impact; and
- the underlying drivers of this impact, and the mechanisms through which they create a fair playing field problem.

The modelling results, and how these vary between services, are described in more detail in our description of each individual factor.

A number of other characteristics may also affect how services are delivered. For example, the clinical requirements for certain services to be co-located or for clinical staff to undertake a certain number of procedures a year (e.g. for training accreditation) can determine service configuration. These clinical requirements – as well as financial considerations – have an impact on entry, exit and expansion work. Similarly, the nature of the care required (such as its urgency) may also affect how providers have to structure themselves, e.g. how much spare capacity they must hold. In turn, this may affect their cost structure.

## COST MODELLING

### **Summary**

The review undertook modelling of factors that are amenable to quantitative analysis. The modelling forms one part of the evidence base about their impact on patients. It is based on looking at differences across types of provider and types of service, drawing on a sample of provider data. The services are characterised by the extent of economics of scale or scope and their labour intensity. The results of the modelling are presented in the main report and the relevant supplementary paper under the discussion of each factor.