Mervyn Stone
November 2014

Foreword by Joan Davis, Chairman of The Community Voice

The Community Voice is a lay organisation representing patients and the public. It is exclusively focused on NHS issues impacting on North West London and South West Hertfordshire. The views of its members on statistical issues range from absolute bafflement, through partial comprehension, to professional expertise. However, for many years, we have been united in wanting fair shares for all in the allocation of NHS resources. The same is probably true for the public at large, but the assessment of what is fair poses great problems for us and for everyone else.

We deplored the old funding formula with its multiplicity of proxy variables to represent local health needs. We have hungered for allocations matching identified demands for services and responding to conspicuous problems such as old buildings, lack of equipment or difficulty in attracting GPs or nurses to local areas—but instead one formula after another has been introduced to control allocation of NHS funds.

Currently, the 211 Clinical Commissioning Groups in England are assessed by a formula that gives each CCG a "funding target" for the year. For some CCGs this is close to last year's funding allocation, but for others the target is much higher or lower. Sudden changes to annual allocations are seen as hard to handle, so additional rules are applied, including a maximum increase for each year, even for those CCGs that will still be way below their "target"—although that is supposed to be a fair allocation to meet their local needs. Conversely, CCGs whose current target is below last year's allocation will not suddenly see a drop in income. Instead, over several years, gaps between allocations and targets will gradually narrow, both up and down.

Different authorities have praised or challenged each NHS funding formula in turn, without convincing evidence or consensus. The same remains true now. Given the statistical complexities and lack of leadership by the Royal Statistical Society, the public must steer a difficult course. There are many vested interests to beware, some professional, others commercial and many political. Inevitably trust is a major factor in whom to believe and from whom to accept guidance.

Mervyn Stone, former Head of Statistical Science at University College London, is a Community Voice member. He embarked on his long study of NHS funding formulas in response to our concerns in 2002. He has worked tirelessly for all the intervening years. We believe his integrity is absolute and his statistical judgement both objective and impartial. His latest work is not afraid to acknowledge that new evidence has changed one of his previous views—such honesty is greatly to his credit.

So what has Stone found that is new? In this paper, he responds to the recent National Audit Office report *Funding Healthcare: Making allocations to local areas* and to the meeting of the

Public Accounts Committee in October 2014, chaired by Margaret Hodge, which dealt with that report. He submitted written evidence to that Committee, based on his own assessment of the report. Much of that assessment he presents afresh in this paper, together with references to the Public Accounts Committee's public hearing, which he attended. Eminent figures were called to be questioned by the committee, including Simon Stevens, Chief Executive of NHS England, but no comparable statistician was invited to give evidence.

Stone's paper notes that both the NAO report and the PAC were not only unquestioning in their acceptance of the formula that calculated CCG target allocations but that they were also unquestioning in their belief that those targets represented local areas' fair shares of available funds. In addition he charges both the NAO and PAC with failing to recognise that leading statisticians consider the target formula an irrational concoction.

In assessing the NAO report, Stone re-analysed the data on which the report was based with the help of his UCL colleague Dr Rex Galbraith. This showed—in a statistical analysis that many lay people will find incomprehensible—that the *only* factor in those data that happens to be associated with whether a CCG had a surplus or deficit was the difference between the CCG's target and its actual allocation. Prof. Stone was surprised by this finding, which some may interpret as validating the target formula and which means that statisticians who reject the formula must find an alternative and plausible explanation for his finding. He then offers his own important and persuasive explanation. He conjectures that CCGs, knowing their targets and allocations throughout the year, managed their accounts to produce acceptable outcomes.

That would hardly be surprising. We might guess that CCG Executives, Boards and Financial Directors receiving above target funding would feel obliged to end the year with surpluses, or at least to break even, whereas those receiving below target income would be comfortable to present deficits. Meeting expected financial outcomes allows those responsible to appear professionally competent, which is personally rewarding. To some extent we all live up to what others expect from us. Why should accountants and Chief Executives be any different from the rest?

What of the future? We all still want a fair NHS. Perhaps the way forward is a standard allocation of funding per head throughout the country, plus special funds to meet justified additional needs. That method would, of course, pose different problems, but it would possibly be more transparent.

The Community Voice will continue to watch, wait, listen and debate the options. We have always greatly valued Stone's professional help in our deliberations and we can only hope that this will long continue. We still find it absurd that areas with low life expectancy receive additional funds for NHS services, rather than funds to tackle the causes of poor health, generally acknowledged to be social issues—poverty, unemployment, poor diet, education, housing etc. We still find it unacceptable that some areas receive very much greater NHS funding per head of population than others. There are still many contentious issues.

However, it would be of great interest if Stone's work were more widely assessed by his peers. The few who have ventured to assist or comment, some very distinguished, are greatly

appreciated, but more are needed. The limited public debate about the way the NHS distributes huge sums of public money is a frustration for all thinking people.

We hope therefore that both statisticians and others will now rise to the challenge that Stone poses about the distribution of NHS funding. We also hope that his readers will have the courage to speak out on the major issues that he has identified. The NHS is our shared national treasure, but it needs more input from the public at large, particularly those with statistical expertise, to contribute to its success.

Joan Davis, November 2014

National Auditing beats Public Accounting

Introduction

This article is in response to a National Audit Office (NAO) report for the Public Accounts Committee (PAC) and the comments it has inspired. It is written in wholehearted, principled and well-informed support of NAO's mission to *help the nation spend wisely*. This is how a former Cabinet Secretary ranked the NAO and PAC in his UCL inaugural lecture:

> There are some bodies who look at value for money in the public sector, such as the National Audit Office. In general I believe they do a good job but they are required to operate through a Parliamentary Committee (the PAC) which has meant the process generates far more heat than light.[1]

This note will illustrate the truth of O'Donnell's ranking, as revealed in the 'process' that preceded the Public Accounts Committee hearing on the NAO report of 20 October and that unravelled without obvious consequence at the hearing itself.

Section 1—commenting on an influential scatter-plot in the NAO report

1.1 The report *Funding healthcare: Making allocations to local areas*[2] that NAO prepared for the 20 October hearing noted that there is

> wide variation in the extent to which £79 billion in central funding allocated to local health bodies differs from target allocations that are based on relative need.

The report was published alongside an expression[3] of outrage by PAC's chairman Margaret Hodge at what she saw as the unfairness of the seriously wide variation in the funding of England's 211 clinical commissioning groups (CCGs). The outrage may have been intended to ensure a high degree of media interest:

> It is outrageous that 104 clinical commissioning groups [CCGs] received more than their fair share of the available funding in 2013-14. These bodies had a combined surplus of more than half a billion

pounds at the end of the year. This is all the more ridiculous when you learn that 19 of the 20 CCGs with the tightest financial position received less than their fair share[3].

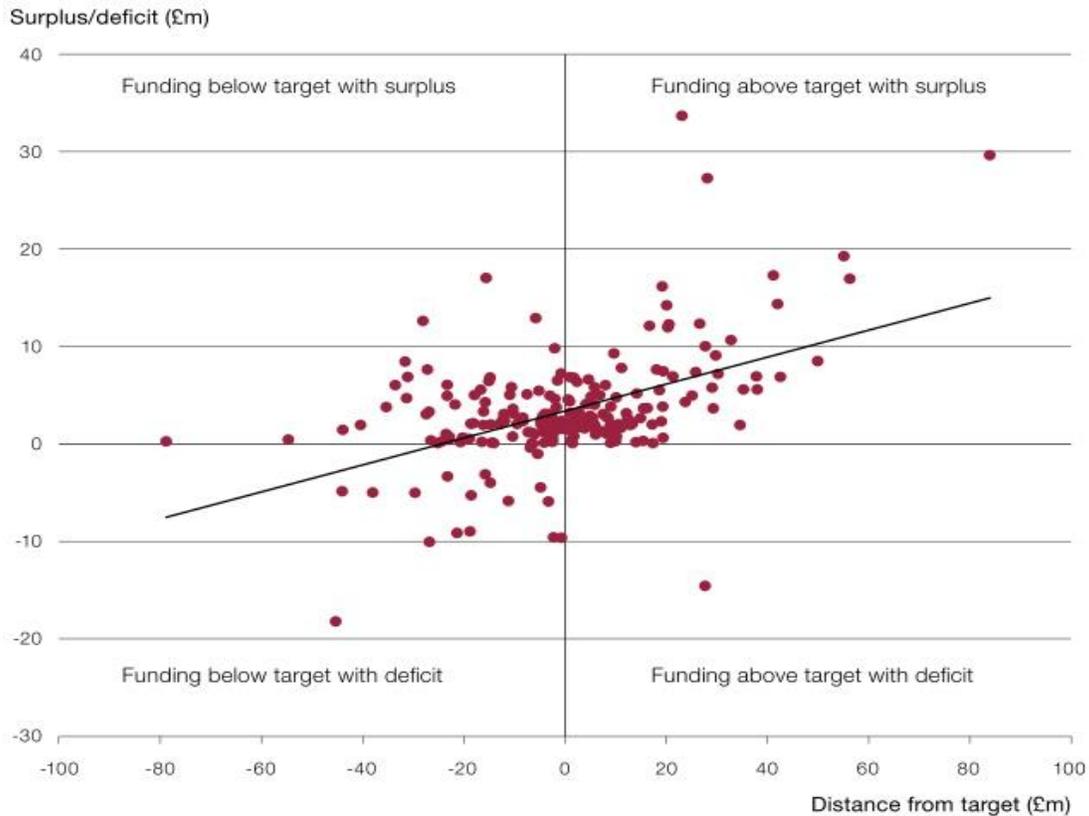The numbers are from the data-base for Figure 7 of the NAO report:

Figure 7 of the NAO report

There is obviously a statistically significant positive correlation in Figure 7, between Surplus (NAO's measure of a CCG's 'financial stability') and Distance from Target, even when the Chair's over-egging is discounted (as if it were somehow like getting 19 heads out of 20 tosses of a fair coin!). But the correlation is rather weak—'explaining' only 23% of the variance of the 211 Surplus values ($R^2 = 0.23$). It may therefore surprise statisticians to see that this weak correlation had already been taken as sufficient ground for action by NHS England, especially as no recognition is given to the possibly dominant component of the correlation that simply reflects the big variation in the population size of CCGs, ranging from 67,000 to 870,000. This is what NHSE's Chief Financial Officer, Paul Baumann, had to say about it:

There is some correlation between CCG financial performance and the distance from target allocation, which we began to address in allocations for 2014/15 and 2015/16[4].

1.2   The NAO report, however, presents Figure 7 as factual observation without explicitly endorsing any causal interpretation as a rough guide to what a CCG's Surplus would have been if

it had been given a different allocation but the same target value. NAO encourages realism when it says that

> *the relationship between financial position and distance from target allocation is likely to be complex and vary from area to area.*

NAO advises caution in its recommendation that the Department of Health and NHS England should

> *develop an evidence base to inform their decisions about how quickly to move commissioners towards their fair share of funding and take account of previous changes in local spending patterns, evidence on the effect of distance from target and the views of local commissioners .*

For NAO, allocations and targets are numbers for which others are responsible, and the NAO report is therefore silent about the provenance and acceptability of the target formula:

> *Given the lack of consensus on the best way to measure need, we do not offer judgement on which is the most appropriate method.*

Noting that exactly how need is measured determines the shape of the formulas that fix the target allocation, we can ask whether this NAO caveat was read by any of the participants in the October 20 hearing—Chair of PAC, the Chief Financial Officer of NHSE and the small army of media commentators. No-one appears to have ceased viewing a CCG's target as a sturdy lighthouse in a swirling sea of alternative allocations. In that respect, commentators may have found reassurance in NAO's non-committal concession that

> *target allocations are intended to represent local areas' fair share of the available funding*,

especially when that is strengthened by the generous but ambiguous assessment that

> *the Department and NHS England's approach to allocating funding for healthcare is generally sound.*

Section 2—showing the value of alternative statistical analyses of source data

2.1 The NAO report did not direct readers' attention to three interesting features of Figure 7—the relative sparsity of deficits between zero and £3m, the preponderance of surpluses under £5m, and the appreciable number of points on or near the zero surplus line—as possible manifestations of a *relationship between financial stability and distance from target allocation* that NAO thinks *likely to be complex and vary from area to area.*

2.2   I am grateful to NAO for letting me have the data underlying Figure 7 in a form suitable for alternative analyses with my Minitab 13 software:
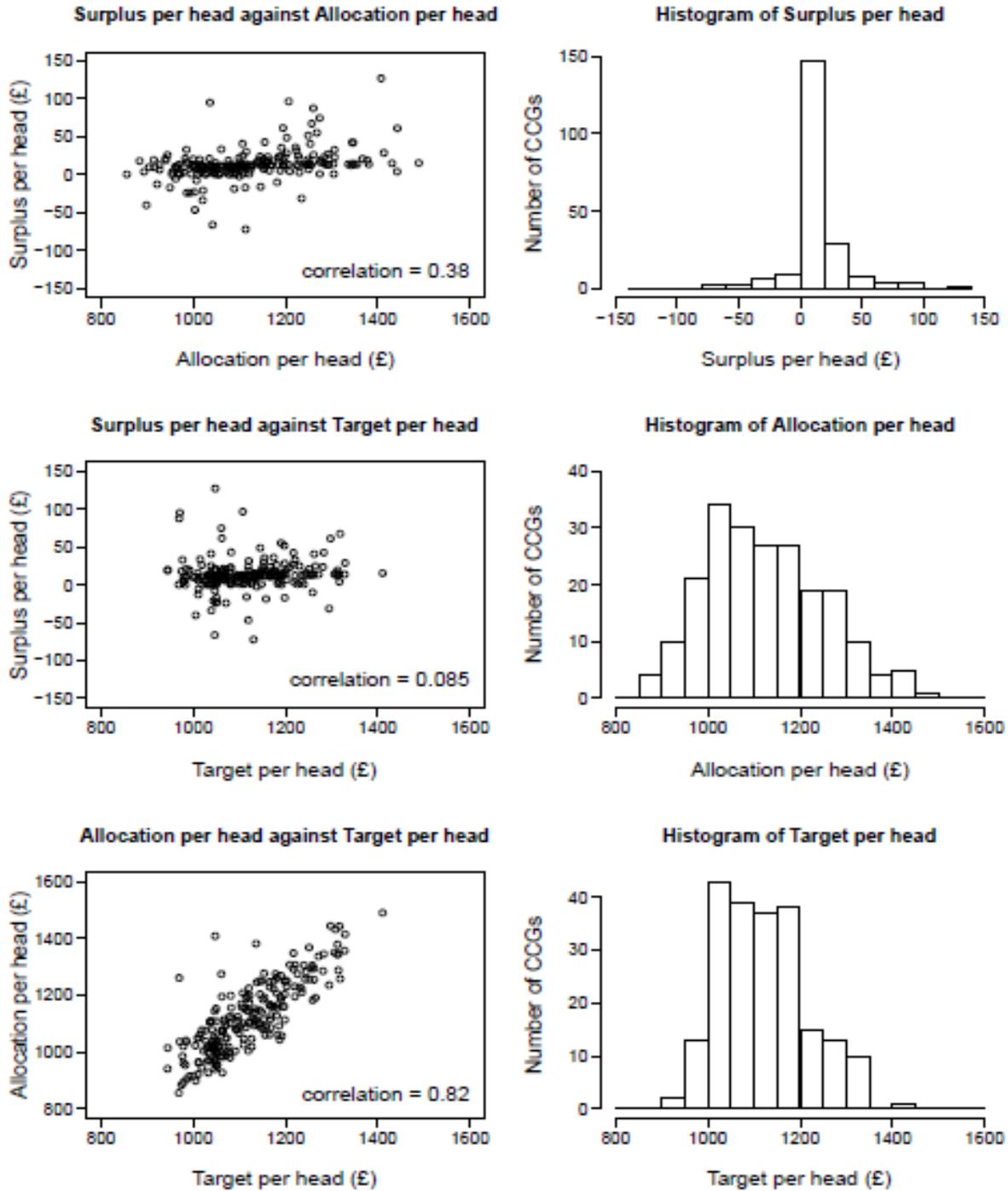
Fig. 1
The three variables involved in NAO's Figure 7

The fact that I had to make a Freedom of Information request for the data raises the question of public availability of the data, given that Figure 7 was already a matter of interest to PAC and

commenting media. But I will not quibble about that, given their informative presentation in Fig. 1 and the surprising outcome of their analysis in para. 2.5.. The Pearson correlation 0.82 of Allocation p.h. and Target p.h. could be expected to be fairly strong but the correlation 0.085 of Allocation p.h. and Surplus p.h. is small enough to excite curiosity. There is nothing remarkable about the mild degree of positive skewness in the histograms for Allocation p.h and Target p.h., but the 'abnormality' of the histogram for Surplus p.h. (the dearth of small deficits compared with the number of small surpluses) confirms the speculation of para 2.1.

2.3   Fig. 2 removes the main influence on the observed correlation in Figure 7 of the big differences in CCG population size. The value of R^2 (the explained fraction of the variance of the 211 Surpluses) goes up from 23% to 29%, probably due to the increased positive skewness of the 'x-values'.
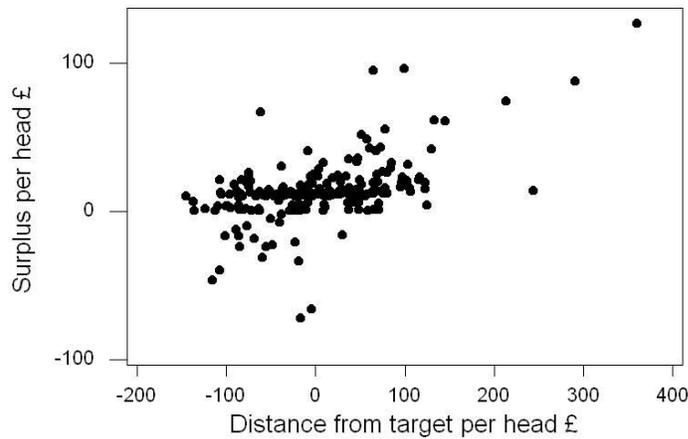

Fig. 2

2.4   Fig. 3 is a clearer version of one of the boxes in Fig. 1. The x-axis variable of Fig. 3 has been replaced by *Allocation p.h.*, which takes the *Target p.h.* variable out of the picture. The correlation is still highly significant but R^2 goes *down* from 0.29 to 0.14 (the square of the 0.38 in the relevant box on Fig. 2). How much of this reduction is due to its smaller dependency on the skewness of the three points in the top right corner of Fig. 2? In a best-forgotten comment on Neil Merrett's September 12th piece in *Government Computing*, I rashly conjectured that a Fig. 3 might show a correlation at least as good as that of NAO's Figure 7—in the conviction (shared by leading statisticians) that the target formula is an irrational concoction.
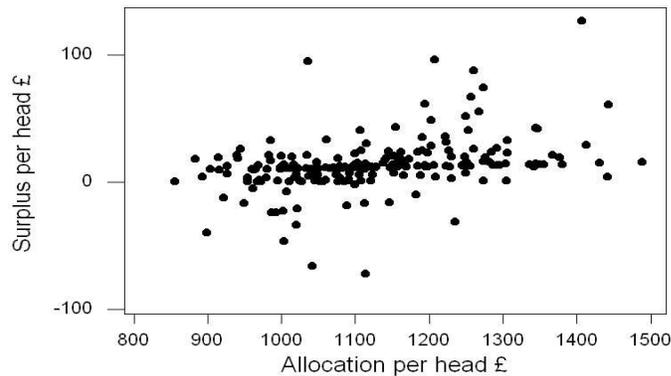
Fig. 3

The technical analysis of my next paragraph proves that the conjecture was actually so far wrong that it is better to see the correlation in Fig. 3 as 100% artefactual—the correlation is there only because Allocation p.h. is positively correlated with Distance from Target p.h..

2.5 The rashness of the conjecture is decisively established by the results of bivariate least-squares regression of *Surplus per head* (Y, say) on the two competing 'explanatory' variables *Distance from Target p.h.* (X_1, say) and *Allocation p.h.* (X_2, say). The best-fitting plane to the scatter-plot of 211 points in three dimensions is

$$Y = 11.55 + 0.1557\,X_1 + 0.0009\,X_2 \qquad (1)$$

with an R^2 of 0.29—no larger than that of the best-fitting straight line to Fig. 2 using only X_1. The residuals (i.e. unexplained bits) of the fitting of equation (1) appear to be random when plotted against X_1 or X_2 or CCG population. The t-value of the coefficient 0.0009 of X_2 is 0.06 with a P-value of 0.95, showing that *Distance from Target p.h.* can be said to be almost 100% responsible for the increase in R^2 from 0.23 (for Figure 7) to 0.29. It rarely happens in a multiple regression with as many as 211 observations that a plausibly relevant variable such as X_2 (an ingredient of X_1, it may be noted) fails to reach the 5% significance level. So a P-value as insignificant as 0.95 strongly suggests that X_2 does not influence the degree of financial instability, once X_1 is 'on the table'. Indeed, if one were bold enough to suggest a single causal factor from the two variables, it would have to be X_1, the variable used by NAO in Figure 7—not X_2, the one I had suggested in *Government Computing*!

Once you have properly *taken account of* the Distance from Target variable, the statistical evidence is that Allocation p.h. plays no additional role in explaining the correlation with Surplus p.h. that can be seen in Fig. 2 (or NAO's Figure 7)—which is a quite remarkable finding. According to NAO, the joint influence of Target and Allocation on the end-of-year balance is *likely to be complex and vary from area to area.* If so, is it likely that the plethora of day-to-day expenditures on health services throughout 2013-14 somehow colluded so that the end-of-year balance left no statistical trace of the huge variation of Allocation p.h. between CCGs—once account had been taken of the influence of the specific combination Allocation p.h. minus Target

p.h. that interested NAO. With 211 'observations' and only 2 variables, I think most statisticians would say No.

2.6 More to the point here, does the remarkable finding mean that statisticians should eat their words about the target formula, and renege on their well-documented dismissal of it as a concoction only tenuously related to any true measure of health-care need and hence to any concept of fairness? The answer can be confidently negative only if a plausible and eventually persuasive explanation can be found for the finding and one that is consistent with such dismissal. If such an explanation can be found, there would be no need to regard the correlation in Fig. 2 (or NAO's Figure 7) and its relatively small surpluses & deficits as supporting the view that the target formula can be accepted without question—as NHSE's Paul Baumann and the PAC Chair appear to do.

2.7   Back in 2007 when he was chairman of United Health Europe, Simon Stevens (witness for NHSE at the October 20 hearing) assured any readers of the Health Services Journal worried about their PCT's deficit that *numerous academic studies have failed to show that it is fundamentally a resourcing problem*[5]. Perhaps Mr Stevens deserves an apology for my accusing him in *Failing to Figure*[6] of being a naive 'it's about right' defender of the AREA formula. His HSJ article was in support of the idea that, when 'health economy' accounts were taken to define deficits rather than PCT accounts, the *problem* could be seen as one of PCT management rather than anything to do with the question of fairness of the AREA formula.

2.8   I would like to know what NAO thinks about the conjecture that, knowing their allocation and target before and throughout their first financial year, CCG finance officers managed expenditure so that all but one of the 104 CCGs given more than their target made sure they did not end the year with an embarrassing deficit—whereas those given less than their target were happy to show either a deficit or a relatively small surplus. Perhaps these possibilities were at work for the following figure from HC 1204-II[7]—data that Healthcare Commission's Alexa Knight was probably commenting on in her Ev 58. The surplus ('% of turnover') values of 301 PCTs had a distribution that mirrors features of NAO's Figure 7 suggestive of management artefact and (who knows?) the x-variable may have had a high correlation with the Distance from Target for 2004.
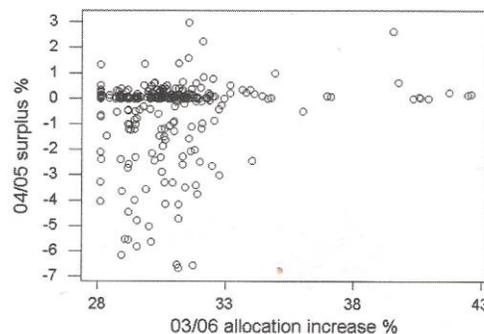
Data about surpluses from HC 1204-II

According to para.2.24 of its report, NAO had (to its credit)

sought to investigate whether receiving funding that is above or below target allocation appears to affect a local area's health services or outcomes. Given the multiple factors that affect health outcomes, we explored the relationship between distance from target at a local level and measures of how health services are provided, namely the number of GPs, hospital beds and hospital-based NHS staff. Our exploratory analysis did not identify any significant associations between the resourcing of health services by NHS providers and commissioners' distances from target allocations.

NAO may have been puzzled by these negative findings, but they are fully consistent with a management artefact conjecture. If NHSE could now be persuaded to see Figure 7 as an artefact in which managers' knowledge of *Distance from target p.h.* plays the only part, it would have to reconsider whatever it *began to address* in response to the Figure 7 correlation (see para. 1.1).

2.9 The PAC Chair's expression of outrage in her September 11th statement makes good sense if the target formula can be relied on as a fair measure of the need for local healthcare—but not when there is evidence that the current formula is the outcome of two decades of misuse of statistical reasoning and econometric techniques, stretching back to the University of York's Centre for Health Economics formula of 1994. The misuse has been nurtured in the Health Economics sub-discipline of Economics and has long had the tacit support of ministers and finance officers who appreciate the policy-making freedom that the sub-discipline's variegated pieces of contracted research made possible.

Section 3—exchanges in the transcript of the PAC hearing[8]

3.1 Rt. Hon. Margaret Hodge opened the hearing with a direct challenge to Mr Stevens:

 Chair: *... the subject is ridiculously complex ... What is the point of labouring for ever on hugely complex funding formulae, which I can't get my head around, having tried over the weekend, when you say you can't apply them without destabilising the health economy?*

Stevens: *The point is that having a funding formula goes to the heart of what the NHS is, which is allocating care on the basis of ability to benefit according to need, so what we **try** to do through the formula is establish what is equal access to equal need, together with some element for unmet need, and then establish a pace of change at which we can get there. … in my judgment this is the most transparent and most accurate **application of a** funding formula since 1976, when the health service first started at it. … The consequence of going faster would be that we would have to make real reductions per person in some parts of the country. … We definitely would like to go further and faster, but, to make it very practical, if you look out the position for 2015-16 on the formula as we've got it, Barking and Dagenham* [a bold reference to the Chair's constituency] *would be £3.1 million over—getting too much **…***

Chair: *What's our deficit—£40 million, £50 million?*

Stevens: *That is my point. The **deficit demonstrates** that going very fast can be a struggle.*

It would be nice to think that Mr Stevens' use of the word '*try*' and the phrase '*application of a*' in these exchanges means that he shares NAO's reserve about the 'appropriateness' of the way need is measured in the formula. But the logical force of the phrase '*deficit demonstrates*' suggests that he has ignored NAO's cautious interpretation of Figure 7—preferring to accept the formula and agree with Paul Baumann that the correlation expresses a 'distance as a cause of deficit' effect for individual CCGs. If that is so, his attention should be drawn to the remarkable finding of my para. 2.5.

Some of the October 20 exchanges concerned the 10% of CCG money that is now allocated for either *unmet need* or *health inequalities* but which started as a ministerially-dictated pre-election 15% adjustment of the CARAN formula. Mr Stevens boldly referred to research:

> *published in the British Medical Journal recently by Ben Barr and colleagues [suggesting]that having the inequalities focus in the NHS allocation formula was associated with closing the class inequality in death rates and life expectancy. So I think we **know** that it can have an impact. … If you look at what happened during the 2000s, the research study ... shows that the pro-inequalities resource allocation in deprived areas **apparently** cut the gap between poor and rich areas in male mortality amenable to health and saved 35 lives per100,000 people.*

Even if we ignore the contradiction of the '*know*' by the '*apparently*', the problem with that is that the four authors of the study[9] (the GP Ben Barr and three professors of public health) themselves recognized four limitations on the validity of their research. One of these was the exclusion of smoking—a factor highly correlated with male mortality (the dependent variable in the statistical modeling) and whose decline during the 2000s arguably renders the whole study worthless (given that *there is considerable expert opinion to suggest that the different smoking rates between social classes explains more than half of the health inequalities in the country* as Mr Stevens himself acknowledged elsewhere in his evidence). Ben Barr and colleagues should be willing to accept the '*apparently*' and deny the '*know*'; the 'elsewhere' is where Mr Stevens offers a verbal justification of the allocatory status quo:

> *When you look at the formula that we have used for health inequalities, particularly the standardised mortality ratios* [SMRs] *for those under 75, one of the advantages over the prior arrangements is that we can look at quite small geographical areas* [MSOAs] *within a borough, city or town. That then enables you more precisely to target the effort that will you make to cut inequalities.*

Michael Chaplin's excellent *Technical Guide*[10] does its best to explain the complexity that belies the simplicity of this summary description of how the 10% is allocated to CCGs, but it does not claim to justify it. Each of the ward-sized MSOAs gets an allocation proportional to a rather recondite function of its SMR (ratio of number of deaths to the number it would have if its age-bands had the national death rates). The CCG gets the total of its constituent MSOA allocations. The complexity is fully documented in my Civitas piece[11] which, on the question of justification, concludes that the formula is an *elaborate but poorly understood procedural deception,* diverting attention from the quite feasible direct measurement of the health status of stratified random samples of GP-registered individuals in the 211 CCGs.

The 10% allocation formula featured later as an element in an ethereal and fruitless exchange between Chair and Witness—to reveal only that the P in PAC may be more personal than public and that England clearly needs a broader forum of accountability:

Chair: *Can I ask a few general questions? First, I want to get this clear in my own mind. Under the formula we are talking about, 10% goes on health inequalities and 90% goes on need. Right?*
Stevens: *Well, there is an additional 10% over and above what is already captured by the rest of the formula. The 90% for the CCG part of the allocation is already allocating according to need for care, based on a detailed, person-based allocation.*
Chair: *Okay. We get into the need. I understand that—it is based on need—but there are additional health inequalities. The definition of need at present is primarily based on age.*
Stevens: *Age plus usage over and above age.*
Chair: *Okay. If you want to be your socially activist intervener in the health and wellbeing of the nation, why don't you use poverty rather than age?*
Stevens: *It is a question of using a blend of both. The fact is that, as people get older, all things being equal, they have more health problems.*

The PAC works to a crowded programme and is limited in the amount of Written Evidence it can handle. Its secretariat therefore declined to publish my own unsolicited response to the NAO report. What is published, however, is the special pleading of three East Berkshire CCGs whose evidence ended on what looks like a forlorn hope:

> *The current inequity [of funding], and its real impact on patients, is poorly understood by many in the NHS, and is even more opaque to the wider public. Discussing this at the Committee can only help raise the profile of this important issue.*

Section 4—summarizing the historical and personal evidence that the target formula in current use is the outcome of a long string of extraordinarily subjective judgements.

4.1   In 2002, Joan Davis asked me to explain a peculiar socio-economic formula that Hillingdon's Director of Public Health wanted to use to justify transfer of resources from affluent to deprived wards—based on some national model of such discrimination. The model was the now-historical AREA formula for PCT funding—then being ministerially promoted as a remedy for subjectively-assessed inadequacies in the quite different formula that had been used since 1994. It was an eye-opener! So I discussed what I found with statistician John Fox who was then Head of Profession at the Department of Health and who kindly squeezed me onto the programme of the 2004 Royal Statistical Society (RSS) Manchester Conference to talk about it there.

4.2   The talk led to the 2006 RSS Series A paper *How not to fund hospital and community health services in England* and to my written/oral evidence to the Health Committee inquiry into *NHS Deficits*—all of which was boiled down into the chapter *Kill or cure by statistical formula* of *Failing to Figure*. The book has a Foreword from the world's leading Bayesian statistician Dennis Lindley, and received an outspokenly favourable review from Scotland's foremost classical statistician David Finney. But I did not manage to get funding to distribute it to all MPs and Lordships, as the world's most distinguished statistician Sir David Cox had privately suggested. Copies were, however, distributed to members of the Rural Services APPG in support of my oral evidence alongside two health economists—AREA's staunchest defender,

Matt Sutton, and its most knowledgeable critic, Sheena Asthana. The APPG met three months before the 2010 election. My curiosity about what a change of government would do about the formula was passed up the line, but the message that came down confirmed my present wish that handling of evidence be depoliticized and not used as a cover for other considerations—"*If we lose the election, we'll come back to you. But if we win, we'll be doing our own statistics*."

4.3   Doing its own statistics in 2003, the Department of Health had been able to find an explanation for a puzzling feature of the initial version of the AREA formula—that it would have financially penalized PCTs with larger BME populations. The explanation was that there was an 'unmet need' in such populations (just one aspect of a manifest 'health inequality' in deprived areas) that was not reflected in the ward-level utilization costs to which the formula was fitted. The problem of penalization was resolved by simply deleting the offending feature before AREA was implemented. The (almost in-house) advisory committee ACRA went on to commission research on much bigger changes to AREA.

4.4   There were two complications when a fresh team of health economists came up with its replacement, CARAN (acronym for *Combining age-related and additional needs*) which was in effect 18 separate formulas—one for each age-band. The first complication was that there was no feature of CARAN that could justify compensatory extra funding for 'unmet need'—the second was that, since the age-profile factor dominated the proposed new formula, funds would move funds from 'deprived' to 'affluent' areas. Both problems were resolved by ministerial patch-up—the grafting of an *ad hoc* 'health inequality' variable onto CARAN for the allocation of 15% of total funding.

4.5   To its credit, the CARAN report (RARP 30) devoted two of its 229 pages to a rebuttal of the 2006 RSS paper—to which Jane Galbraith and I duly responded in 2011 with a 'read' Series A paper entitled *The abuse of regression in the National Health Service allocation formulae*. There were 12 easily-read contributions to the published Discussion—11 from individuals and one from five of the lead researchers on the CARAN, AREA and York formulas, who combined to complain that it was *impossible to provide a full rebuttal within the imposed word limit* of 400 words—and to promise a *detailed response in due course.* If the five health economists had not combined forces, they would have had 2000 words between them. Jane Galbraith and I are still waiting for the *full rebuttal* more than three years later.

4.6   In parallel with the patch-up to CARAN, some new thinking was under way. My evidence to the Health Committee in 2006 may have been among the voices that persuaded the committee to recommend that *consideration should be given to basing the formula on actual need rather than proxies for need.* DH and ACRA had the job of putting flesh on the bones of that suggestion by engaging more academics to tender for the research contract. The winning formula is PBRA3—the third Nuffield Trust formulation of a Person Based Resource Allocation formula and a major element of the current NHS England funding of CCGs. It perpetuates the CARAN adjustment for health inequality but at a reduced level of 10%. The NAO report is referring to that element of the formula as an *adjustment that moves money towards areas with lower life expectancies,* when it observes that the *evidence is unclear on the extent to which increasing funding can help to reduce health inequalities*.

Section 5—trying to understand why England is blessed with such complexity and makes a suggestion of how to break the prevailing impasse and ensure a wider and deeper academic discourse.

5.1 In June 2013, a lunch gathering of civil servants in Wellington House politely listened for two hours as I explained the multiple iniquities of PBRA3. In September, I struggled physically to attend the London NHSE workshop to hear Michael Chaplin explain PBRA3 to a large audience. A waiter carrying my cup of coffee had nervously ushered me onto a prominent table at the front that I then shared with some key-role CCG officers. The perhaps-embarrassed chairman kindly allowed me to ask some questions in line with NHS England's objective *to encourage an open and honest debate around the allocation process* and to distribute copies of my Civitas piece *Explicating 'wrong' or questionable signs in England's NHS funding formulas: correcting wrong explanations.* Just one example of the latter!—the Hospital & Maternity formula of PBRA3 has a negative sign for the over-65s dementia coefficient that would deduct £250 for every such patient referral in a CCG—the Nuffield explanation attributes the sign to the fact that the cost of a dementia referral is put onto the Mental Health account, not Hospital & Maternity. The piece gives an interpretable algebraic expression for a least-squares estimated dummy coefficient which, duly interpreted, shows that the Nuffield explanation is a logical howler. There may well be logical and plausible ways of explaining the negative dementia sign that are consistent with *faith* in the subjectively-determined and hugely complex PBRA3 formula. Statisticians have their own (inconsistent) explanation—just get *secular*!

5.2 My final technicality is an early illustration of the casual way that complexity can be treated by health economists. It comes down two decades from where our current complexity started—the multiplicative York model of 1994. The model used a variable BLACK[*], the proportion of ward population *not* in black ethnic groups (the 'not' changes the model, perhaps in the interest of avoiding logarithms of zero). The York report[12] explained the role it would have to play in the model, given that the least-squares coefficient of the 'log BLACK[*]' variable in the model as fitted was of questionable sign (in this case a positive):

... areas with higher proportions of black residents exhibit lower utilization than expected. The York team and its advisors interpreted this finding as reflecting **supply** *rather than need, perhaps because wards with large ethnic minority populations tend to be close to acute hospitals. The BLACK[*] variable was therefore not considered as a needs variable.*

Note that the explanation for the unexpected sign did not invoke the largely post-millenial concept of 'unmet need'.

5.3 A leading author of the York report was economist Peter Smith. His influential 2007 book *Formula Funding of Public Services* may have let the cat out of the bag when it said that

... the **procedure** *for deriving an allocation of funds often has a vital importance over and above any consideration of the* **outcome** *of the allocation.*

It is not just the Department of Health that may have seen 'procedure' as trumping 'outcome'. What else can explain the continued absurdity of features of the Revenue Support Grant for local authorities (see pp. 35-37 of *Failing to Figure*)? There may be more than an element of truth in the suggestion in Peter Smith's book that governments try to *devolve to the technical domain increasingly fraught political debates over funding decisions*—in other words, devolution to a straightforward use of technical obfuscation as a cover under which important political objectives can be achieved. An unanalysed concept of fairness of any funding formula may in truth be no more than a rationalist chimera—and uninformed efforts to realize it may constitute the prime example of such technical obfuscation.

5.4 The Royal Statistical Society paper referred to in para. 4.5 suggested that

> *... any allocation formula should at least demonstrate that it is better than* **comprehensive equality***, i.e. a uniform per capita allocation ... to very large populations ... Should there be any departure from this without good reason for doing so?*

In their joint contribution to the Discussion of the paper, the five health economists held that it was absurd for the authors to say that *current knowledge cannot justify a departure from uniform per capita allocations* (which is not what the paper said)—and proceeded to justify the accusation of absurdity by the sadly indisputable statement that *current National Health Service funding formulae are based on exhaustive analysis and detailed technical scrutiny, and are in our view fit for purpose*. Both NAO and PAC should be concerned that DH (and now NHSE) have relied on researchers happy to argue thus, while managing to side-line a larger group—statisticians who have looked carefully at the *exhaustive analysis and detailed technical scrutiny* and found it wanting. Is there not therefore a case for something like a Royal Commission inquiry with the Royal Society well-represented?

Acknowledgment

References

1. O'Donnell, Gus (24 April 2013) *Building a Better Government.* UCL inaugural lecture. (https://www.ucl.ac.uk/constitution-unit/events/inaugural_lecture_24042013)

2. National Audit Office (2014) *Funding healthcare: Making allocations to local areas.* (http://www.nao.org.uk/report/funding-healthcare-making-allocations-to-local-areas)

3. Hodge, Margaret (2014) *Statement of 11 September as Chair of PAC*. (http://www.parliament.uk/business/committees/committees-a-z/commons-select/public-accounts-committee/news/funding-local-healthcare-chairs-statement/)

4. Baumann, Paul (May 2014) *Consolidated 2013/14 Finance Report*. NHSE Board Paper. (http://www.england.nhs.uk/wp-content/uploads/2014/05/item6-board-0514.pdf)

5. Stevens, Simon (2007) On the Lost Art of Analysis. *Health Service Journal* (*29 March*) (www.hsj.co.uk/simon-stevens-on-the-lost-art-of-analysis/58027.article)

6. Stone, M. (2009) *Failing to Figure: Whitehall's costly neglect of statistical reasoning.* London: Civitas. (www.civitas.org.uk/pdf/FailingToFigure.pdf)

7. House of Commons Health Committee (2006) *NHS Deficits.* HC 1204-II, Ev 187. (http://www.publications.parliament.uk/pa/cm200506/cmselect/cmhealth/1204/1204ii.pdf)

8. Public Accounts Committee (2014) *Oral evidence: Funding Healthcare: making allocations to local areas*, HC 676. (http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/public-accounts-committee/funding-healthcare-making-allocations-to-local-areas/oral/14909.html)

9. Barr, B., Bambra, C., Whitehead, M. and Duncan, W.H. (2014) The impact of NHS resource allocation policy on health inequalities in England 2001-11: longitudinal ecological study. *British Medical Journal,* **348**, g3231. (www.bmj.com/content/348/bmj.g3231)

10. NHS England (2014) *Technical Guide to the formulae for 2014-15 and 2015-16 revenue allocations to Clinical Commissioning Groups and Area Teams.* (http://www.england.nhs.uk/2014/03/27/allocations-tech-guide/)

11. Stone, M. (2014) *Foolish Formulas: Breaking the SMR grip on the NHS public health funding formula*. London: Civitas. (www.civitas.org.uk/**nhs**/download/**SMR**CMF.pdf)

12. Carr-Hill, R. et al (1994) *A formula for distributing NHS revenues based on small area use of hospital beds.* Occasional paper 22, Centre for Health Economics, University of York. http://www.york.ac.uk/media/che/documents/papers/occasionalpapers/CHE%20Occasional%20Paper%2022.pdf