

This essay, done in mid-2021, is about 9500 words long. It was an entry to a [competition](#) asking the question *How would you design and plan new hospitals to radically improve patient experiences, clinical outcomes, staff wellbeing, and integration with wider health and social care?* The essay states that *What is good for the hospital can conflict with what is good for the patient*, and goes on to explain how the [Social Policy Bond](#) concept, applied to a nation's health, could maximise what, in my view, we should be trying to achieve: improvements in health, rather than hospital design. This entry failed to progress into the final stages of the competition. A shorter treatment is available [here](#).

## **Excellent Health Implies Excellent Hospitals: give incentives a chance**

### Introduction

This essay regards hospitals as one element of the wider healthcare system. Its starting point is that healthcare resources are limited, and that any channelling of additional resources to hospitals necessarily implies that resources will be diverted from other healthcare interventions. Hospitals are a critical component of the healthcare system. But they are a single component and, for that reason, this essay embodies the belief that prioritising the health of everyone in the UK will necessarily lead to our hospitals achieving excellence in all their aspects.

The essay therefore does not aim *directly* to improve any aspect of hospitals. It does not seek to specify which improvements should occur, nor how such improvements can be implemented, nor who should carry out such improvements. Rather, it aims to put in place a system that will maximise the physical and mental well-being of society. The role, number, size, design and every other aspect of hospitals would be a function of that system, which aims to ensure that our physical and mental health constantly improve through means that we cannot, and need not, specify in advance.

### Goals

The physical and mental health of our large and complex societies require quantifiable targets and indicators, so that we can measure how effective are our interventions. Unfortunately, the use of numerical indicators for targeting purposes has been largely discredited – not because targeting itself is futile but because, in the view of this author, the targets that have been used are incoherent, narrow, and short term in nature. They usually aim to measure the performance of one small aspect of a larger system. Thus, they often have little to do with long-term societal well-being; indeed, they sometimes conflict with it.

### The four-hour standard

Take, for example, the four-hour Accident and Emergency (A&E) standard for hospitals. In July 2000 the UK Government made this commitment:

By 2004 no-one should be waiting more than four hours in accident and emergency from arrival to admission, transfer or discharge.<sup>1</sup>

Hospitals failing to meet the target would suffer a reduction in their budget. The original, 100 percent, target was later lowered to reflect clinical concerns that there will always be patients

who need to spend slightly longer in the accident and emergency departments. In January 2017 it was announced that the target would in future apply only to 'urgent health problems'.<sup>2</sup> In January 2018 only 77.1% of patients were admitted or discharged within four hours, the worst ever performance for 'type one'<sup>3</sup> A&E departments.<sup>4</sup> In December 2018 it was reported that patients with only minor ailments could be excluded from the target,<sup>5</sup> while more recently it has been reported that the National Health Service (NHS) is considering scrapping it altogether.<sup>6</sup>

What were the effects of this target?

One is that ambulances were obliged to keep waiting outside the hospital, so as to delay admission of the patient<sup>7</sup> and the beginning of the starting time of the four-hour wait. The hospital could then claim it was meeting the target. It was found that patients were delayed inside ambulances for at least 30 minutes almost 1.5 million times in the three years to 2018/19.<sup>8</sup> Another consequence was that patients waiting for a period slightly shorter than four hours were attended to quickly but that, once the four-limit had been breached and because there were no further consequences for the hospital, the average time spent by those patients in A&E who had waited more than four hours was around eight hours. Sometimes the hospital simply refused to accept any emergency patients for a period, and the patient had to be carried to a different hospital. This enabled the first hospital to claim, accurately, that patients who finally reached another hospital had not kept waiting for more than four hours.<sup>9</sup> Such patients suffered by undergoing transport to a more distant hospital, which delayed treatment. People who needed ambulances had to wait longer, because the ambulances were kept hovering outside hospitals or travelling to hospitals further away. Concerns have also been raised that the target has put pressure on A&E staff to compromise patient care.<sup>10 11</sup>

We conclude from this that a hospital could meet its four-hour target at the expense of patients' health. *What is good for the hospital can conflict with what is good for the patient.*

### Five-year cancer survival rate

Less an explicit target, but equally dubious as an indicator of health outcomes are five-year survival rates for particular diseases; notably types of cancer. The five-year survival rate is the proportion of patients still living five years after diagnosis. We can improve the five-year survival rate by better treatment, which is unambiguously good; or by earlier diagnosis, which is far more questionable. Earlier diagnosis can simply mean more intervention and more treatment - and more side effects - but it does not necessarily lead to a reduction in the cancer mortality rate.

One study states succinctly that:

[C]hanges in 5-year survival over time bear little relationship to changes in cancer mortality. Instead, they appear primarily related to changing patterns of diagnosis.<sup>12</sup>

Increasing the five-year survival rate then, does not necessarily imply an improvement in the health of cancer patients, let alone the health of the nation.

### Mortality from a disease

Cancer mortality, the proportion of deaths caused by cancer, would appear to be a more robust indicator than the five-year survival rate. It certainly would be - if all we cared about

were preventing and curing cancer. But, at the national policy level, we are concerned with the overall health of an entire population: we do not want to reduce cancer mortality rates if, in doing so, we divert resources from other health interventions that could lead to significantly better health outcomes for society.

### We need broad metrics

It is this notion of trade-offs – the fact that diverting resources to solve one health problem can lead to worse overall outcomes – that we need to consider when devising healthcare policy. There is no question that targets such as reduced waiting times, better five-year cancer survival rates and reduced cancer mortality were devised by well-meaning, hard-working people with only the best interest of society, as they see it, at heart. But, if our goal is to improve the long-term health of the entire UK population, targets that are narrow and short term, however well intended, are inadequate at best and deleterious at worst. They do not adequately consider the trade-offs that are an inescapable feature of societies whose resources are limited.

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### Box: Health goals

There is a panoply of indicators of public health. None are perfect, and which to choose depends very much on how they will be put to use. For instance, the UK's National Institute for Health and Care Excellence (NICE) uses Quality Adjusted Life Years (QALYs)<sup>13</sup> to determine whether it is worthwhile permitting expenditure on a particular treatment. Currently one QALY for this purpose is considered to be worth £20 000 to £30 000.<sup>14</sup> There are many ethical, conceptual and methodological difficulties associated with the use of QALYs and their complement, Disability Adjusted Life Years (DALYs), and other Summary Measures of Population Health that combine information on mortality and non-fatal health outcomes to represent the health of a particular population in a single numerical index. For instance, the QALY/DALY approach:

- assumes that the lives of disabled people have less value than those of people without disabilities;<sup>15</sup>
- assumes that disabled people are less entitled to scarce health resources for interventions that would extend their lives;<sup>16</sup> and
- uses disability weightings that are artefacts,<sup>17</sup> and likely to be subjective and contentious.

This essay will place a heavy burden on health indicators, as they will function as outcomes to be targeted for monetary reward. Therefore it will not follow the QALY/DALY approach but instead focus on achieving an array of health outcomes simultaneously. Our over-arching goal is to improve the long-term health of the UK population, which will necessitate projects that are likely to have a long lead time. As well, our health targets need to be broad, so as to avoid the mere displacement of problems from one geographical area to another, from one time period to another, or from one cause of poor health to another.

The targets are outcomes: they do not presuppose how they shall be achieved. Specifically, the setting of long-term health targets does not take the number, size, or role of hospitals as a given. Such attributes will result from projects that optimise long-term societal health.

The aim is to improve the health of every permanent resident in the UK, regardless of ethnicity, gender, religion, orientation or citizenship. To maximise buy-in and stability, targeted goals should be agreed by society as a whole, as guided and advised by experts.

Key criteria for the health outcomes to be targeted are that:

- they should be comprehensible to interested people in all walks of life who can then participate in their setting;
- their achievement is desirable in itself, or that they are inextricably correlated with desirable improvements in physical and mental health; and
- they should be readily quantifiable and verifiable.

Targeting decades-long improvements in broad health outcomes allows us to bypass the use not only of QALYs/DALYs, but also of surrogate indicators, which are events or laboratory values that are thought to indicate the presence or absence of an actual disease. For example: blood cholesterol levels are often regarded as surrogates for heart disease, and cholesterol reducing drugs are widely prescribed on the assumption that lowering cholesterol levels will also lower the risk of cardiovascular disease. But such relationships can be tentative, and it would be far preferable to target for reduction actual harms than indicators that might only be loosely correlated with such harms.<sup>18</sup>

Fortunately, the purposes of this essay do not require society's health to be measured by a single indicator. We can instead target improvements in health, over a range of conditions, physical and mental, all of which have to be satisfied simultaneously, for a sustained period, before our health goals can be considered achieved.

### Draft health indicators

The indicators suggested here are intended to be a basis for discussion, refinement and agreement by healthcare professionals and interested members of the public. All would be targeted for simultaneous improvement, from an agreed base level.

### Objective measures

- longevity: the most important causes of premature death in England are: heart disease, stroke, respiratory disease, cancer and (more recently) Alzheimer's disease.<sup>19</sup> Targeting longevity therefore necessitates targeting these scourges.
- infant mortality;
- the number of objectively verified disabilities afflicting the population: eg loss of limbs, loss of sight in one or two eyes; and
- sales of over-the-counter medications.

Some of the impact on longevity of poor mental health disorders could be captured by the longevity target; specifically, that caused by severe, prolonged, mental illness, whose sufferers die on average, between 15 and 20 years earlier than others.<sup>20</sup> However, most indicators of mental health would best be derived from sampled data (below) but, depending on the advice of experts in the field, certain objective metrics that are inextricably correlated with mental health problems could also be used. Metrics such as suicides or prescriptions for psychiatric conditions should not be used, as they can be manipulated relatively easily.

Much useful UK data is gathered for actuarial use, such as by the Big Health and Actuarial Data programme, which models mortality and trends in morbidity, and longevity improvement.<sup>21</sup> Useful for setting baseline levels and improvements, this data could also be a valuable tool used by those holding the Tradeable Health Outcomes Bonds (THOBs) described below.

### Sampled measures

This essay proposes that measures of mental and physical health other than those that are objectively verifiable be taken on the basis of periodic national surveys, including of people's:

- self-reported health, whereby respondents are asked to classify their current health status, and that of family members, as good, fair, or poor;
- self-reported daily living activities; and
- self-reported acute and chronic morbidity conditions.<sup>22</sup>

To forestall manipulation of sampled results it is proposed the identity of the people whose health status would be sampled would not be specified in advance, but randomly chosen shortly before the actual sampling.

### Possible refinements

In Britain in World 2, the most popular protective measures were those that reflected people's preferences, and not necessarily those that provided the greatest safety.<sup>23</sup> For instance, the effects on morale of a large number of deaths in one area were thought to be greater than those of the same number distributed more evenly. The metrics used could be modified to reflect this, and other, societal preferences.

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## Funding and incentives

As with targets, so with resource allocation: it is difficult to reconcile current levels of research funding, for instance, with a view that takes the overall health of the nation as its organising principle. According to one recent study, while an estimated £29 per person is invested in cancer research each year, only half as much is spent on neurological and mental health, and just £9 per person goes to cardiovascular disease research and development.<sup>24</sup> This is despite the fact that the disease burdens of the three conditions are broadly similar. Similarly, the UK in 2011 spent £521 million on cancer research, amounting to approximately £1571 per cancer patient, while the average spent on mental health was £115 million, equating to just £9.75 for each adult with a mental health problem.<sup>25</sup> There has also been a bias in the National Health Service's terminal-care budget which, at least in the recent past, was heavily weighted in favour of cancer conditions.<sup>26</sup> As well, the priorities of pharmaceutical companies are skewed in favour of patentable, commercially lucrative products, rather than those that might achieve better health improvements per pound spent.<sup>27</sup>

In the absence of clearly articulated, coherent, overall health objectives, it appears that health expenditure in the UK, by default, is largely influenced by corporations, medical specialists, and other interest groups, with little incentive or capacity to see improvements in the overall

health of all Britons as their objective. As well, funding decisions are heavily influenced by the public profile of a disease or its victims, rather than on society's needs.

### Health is not the same as medical care

Of course, health is about a lot more than how governments allocate healthcare funds. It is a function of many variables including, most obviously, diet and exercise, and many others that are less definable or quantifiable, such as a sense of belonging, community, and culture.

Thankfully, there is growing recognition of this. For instance: 'A review done in 2019 identified 28 nature-based interventions used in various countries to improve health and well-being, from organised gardening programmes to forest bathing.'<sup>28</sup> A systematic review of the literature found 'strong evidence for significant positive associations between the quantity of green space... and perceived mental health and all-cause mortality, and moderate evidence for an association with perceived general health.'<sup>29</sup> In London, there are now 'social prescription' schemes in which doctors refer patients to such non-medical interventions as gym membership or volunteering: one review of studies of social prescribing showed that, on average, it was associated with a 28% fall in visits to doctors and a 24% drop in attendance at emergency wards.<sup>30</sup>

The problem is a genuine one: how are we to allocate resources between the myriad ways of influencing health? It is something that cannot be the province of any fixed paradigm. Take, for instance, the findings of evidence-based design. It is fairly well established that recovering in-patients in a ward with a view of trees and parkland do better than those whose view is that of a car park.<sup>31</sup> It is less clear, though, whether a hospital's limited funds should be spent on improved landscaping rather than a new ventilator or better personal protective equipment for its staff. The problem is that few people in the public or private sector have incentives to compare the health benefits generated by spending money on such widely differing interventions. But such comparisons are necessary if we are to maximise the health benefits from our limited resources.

Government has to make its resource allocation decisions on the basis of data that are necessarily incomplete. It cannot know the effect that spending on, say, cancer diagnostic machinery will have on the overall health of the nation, as compared with subsidising the cost of nicotine chewing gum or public transport, or the promotion of green spaces in cities. As well as items considered beyond the remit of health spending, such as agricultural subsidies, public transport and city planning, a comprehensive targeting of health should encompass the possibility of remote but catastrophic events including not only pandemics, but civil strife or war. A broad remit targeting sustained improvements to the health of the UK's population could conceivably see more effort devoted to terminating research at home and overseas into virological 'gain of function', or lowering the probability of a nuclear exchange anywhere in the world. No focus on any single aspect of traditional healthcare categories - including hospitals - can address the threats posed by the panoply of possible influences on people's mental and physical well-being.

The way government is structured, with its discrete areas of responsibility, makes it unlikely that policies that transcend departmental and professional priorities will influence funding decisions. But in fact no conventionally structured organisation can be expected to, nor has the incentive to, identify the huge numbers of variables, with all their time lags and interactions, that influence the nation's health; still less on a continuing, long-term, basis,

when circumstances, including our understanding and scientific knowledge, are rapidly changing.

What we can and should do, though, is devise a system that rewards people who explore and implement the most cost-effective health solutions, even when circumstances are changing continuously. The ultimate aim would be succinctly stated: to distribute scarce public funds in ways that would maximise the health benefits gained per pound spent.

## Markets

Economic theory and empirical evidence show that competitive markets are our most cost-effective way of allocating scarce resources. Markets encourage people and firms to try different approaches, and to assess the outcomes of these approaches. Markets also hold people accountable for these outcomes and ensure that ineffective or counterproductive approaches are terminated once they are seen to be failing. They both generate and make good use of a phenomenal information processing power that central planning simply cannot emulate.

Unfortunately, markets can be subverted and manipulated to favour powerful interest groups at the expense of society. Leading corporations, for example, influence the regulatory environment to favour their operations. Though they may have attained their dominance within a competitive market, once they have done so they are tempted to abuse their power by, for example, suppressing would-be competitors. Though the claim is that such behaviour is in accordance with free market principles, it is actually the antithesis of competitive behaviour in a free market. We see the results everywhere: huge and powerful corporations, crushing or snapping up the competition, and abusing their dominance to influence government in ways that further concentrate their power and wealth. The benefits arising from self-interest, a powerful motivating force, are more and more being captured by a self-entrenching elite. As a result, many believe that market forces must inevitably conflict with social goals.

So it is important to remind ourselves that market forces and self-interest can serve public, as well as private, goals. Often, these private goals coincide with social goals, so that, for instance, the market routinely performs such vital tasks as the provision of such indispensables as clothes, food and other consumer goods and services. These are exceedingly complex tasks, which are impossible for central planners to co-ordinate, and they are undertaken continuously and reliably by a multiplicity of agents operating in reasonably competitive markets. They are accomplished in ways that fulfil not only the private goals of the firms and consumers involved but also society's goal of efficient supply of goods and services. This feat results from the combination of the self-interest of large numbers of market players, and their ability to react appropriately to ever-changing circumstances.

Free, unguided, markets are widely thought to be inappropriate as means of allocating such essential goods and services as basic food, health, education and shelter. And so they can be, especially for the poor and disadvantaged. But this essay is concerned with national, not individual, spending power, so that it is not the individuals' ability to pay that is being considered: it is society's. Moreover, it is essential to remember that offering people or organisations that might already be wealthy a bigger incentive to provide a good or service

doesn't only increase their profits (or necessarily do so): it also stimulates a greater supply of that good or service.

## Tradeable Health Outcome Bonds

The rest of this essay describes how a new financial instrument, Tradeable Health Outcome Bonds (THOBs) could channel the market's incentives and resource allocation efficiencies into the sustained improvement of the nation's health. It assumes that the bonds will be issued and backed by the government, whose goal is to maximise the physical and mental well-being of the entire population for a given level of resources.

Government would issue and back a large number of tradable non-interest bearing bonds, redeemable for (say) £1m each once all society's health improvement goals have been achieved and sustained. It would float the bonds by auction on the open market, so that they would be bought by the highest bidders. The bonds would be redeemable only when all the targeted physical and mental health goals had been reached and sustained for a specified length of time. This time period could be as long as thirty years or more. If the health targets are ambitious, then the bonds would fetch a correspondingly low price, perhaps just a few thousand pounds, when floated. It is the promise of redemption, and the market's view of how easily the multiple goals can be achieved, that would determine the bonds' market value. (The relative appeal of alternative investments would also be a factor.) The bonds would be freely tradeable after issue, and their market value, which would vary over time, would be openly quoted. THOBs would differ from conventional bonds in that they would have an uncertain redemption date which, in combination with a fixed redemption value, implies an uncertain yield: holders would raise their bonds' yield by helping to achieve the targeted health objectives quickly. Only when these objectives had been achieved and sustained would the government would redeem the bonds.

The bonds would work by creating an interest group - bondholders - who have a strong interest in co-operating with each other to achieve the targeted health objectives efficiently and quickly, or in paying others to do so. This structure and composition of this group could change over time.

The price of THOBs would be quoted openly; it would depend entirely on the market's view of how likely, and how soon, the government's health goals will be achieved. That in turn would depend on the market's view of how effective bondholders' health-improving initiatives will be, and on other variables beyond the control of bondholders. Investors could sell their bonds at any time, realizing any capital gain they have made and allowing new investors to take the next steps toward reaching society's health targets. Bondholders would have incentives to co-operate with each other in researching and implementing the most cost-effective ways of improving the nation's health. This includes setting up payment systems that reward people in ways that maximise their contribution to the targeted health outcomes.

### The importance of tradability

Tradeable Health Outcome Bonds are a variant of Social Impact Bonds (SIBs, also known as Pay-for-Success Bonds), a relatively new financial instrument first issued in 2010. SIBs aim to reward suppliers of social services according to their performance. The better they do, the more they will earn from holding the bonds. About 130 SIBs have been issued in 25 countries, with such goals as reducing recidivism, reducing homelessness, and supporting at-



risk youth. One health-oriented SIB has the goal of reducing asthma in Fresno, California, one of the US's asthma hotspots.<sup>32</sup> While there have been many papers discussing various aspects of SIBs, the literature assessing their performance is scanty. Indications are that they have had only limited success.<sup>33</sup>

This essay contends that SIBs are inherently constrained by their lack of tradeability. Though it seems like a minor technical feature, tradeability would in fact greatly enlarge and enhance the scope of the goals that can be targeted, as well as the efficiency of doing so. Whereas SIBs favour existing institutions, are inherently narrow and short-term in scope, and impose relatively high monitoring costs THOBs' tradeability would allow the targeting of national, long-term, health goals, many of which will require years of research, trials and refinement before they can be achieved. Investors would buy the bonds only if they expect to make a profit on them within a limited time frame. THOBs' tradeability means that investors would not have to hold them to redemption to make a profit on their investment, which means that would-be investors would consider holding the bonds even when their time horizons are likely to be much shorter than the time required for the targeted goals to be achieved. Many – perhaps most – health goals require multiple steps, taking many years before they are reached. The people who can best make an initial step toward improving people's health will not necessarily be those who are best placed to take subsequent steps. We cannot specify in advance what any of these steps will entail; still less can we identify those best placed to take them. Tradability would ensure that the bonds are always in the hands of the most efficient operators, because the bonds will be worth more to those who are (or who believe they are) the people who can advance progress toward our health goals most quickly and cost-effectively. These people can afford to bid more for the bonds than they are worth to current holders. The market for THOBs would favour the most cost-effective operators at every stage on the way to achieving our targeted health outcomes.

Especially important for sustained improvements in society's health, THOBs' tradeability ensures that our goals can be:

- broad, so that they cannot be achieved simply by shifting the problem from one geographical area to another; and
- long term, so that they cannot be achieved simply by delaying diagnosis and treatment.

### Cascading incentives

As THOBs are traded, they – or the incentives they generate - will tend to flow towards those who are most able to help achieve our targeted health goals. In fact, though, trading of bonds would not always have to occur. Large bondholders might simply decide to subcontract out the required work to many different agents, while they themselves could hold the bonds from issue to redemption. The key point is that the bond mechanism would ensure that the people who allocate the finance have an incentive to do so efficiently and to reward successful health outcomes, rather than merely to pay people for undertaking activities.

So long as there are sufficient funds available for the bonds' redemption, there would be no need artificially to boost investor interest in the bonds: the anticipated supernormal profit arising from early redemption of the bonds generates the required self-interest and so supplies the motivation for improving the nation's health. Were progress toward the health goals

deemed to be too faltering, the government could allocate more redemption funds, increasing either the redemption value of each bond, or the number of bonds. (THOBs would be an unusual financial instrument, in that the more that were issued, the higher would be their value.)

We cannot say much about the projects that a THOB regime would stimulate. The determinants of physical and mental health vary according to space and time, and our knowledge of them, while inevitably incomplete, is always expanding. New opportunities and new threats are constantly emerging. A THOB regime would reward those people who can best improve society's health in the face of new challenges and changing circumstances.

### A new type of organisation

Too large a number of small bondholders would probably do little, on their own, to help raise many people's health status. If there were too many small holders, it is likely that the value of their bonds would fall until there were aggregation of holdings by people or institutions large enough to initiate effective health improvement projects. In much the same way as share privatisation issues the world over have turned out, the bonds might end up mainly in the hands of large holders, be they individuals or institutions.

These bodies would probably have a protean compositions and structure, subordinated and solely dedicated to achieving society's health goals as efficiently as possible. If at any point they become inefficient, would-be investors will bid more for the bonds than their market value, and the inefficient holders would be better off selling them. Under a THOB regime the membership, structure and activities of any organisation involved in improving the nation's health would be entirely in the service of society's over-arching goal - that of improving society's health as cost-effectively as possible.

Investors, however many bonds they hold, might still not be big enough, on their own, to achieve much without the cooperation of other bondholders. They might also resist initiating projects until they could be sure that few of the bonds were in the hands of those hoping to benefit from such projects by 'free-riding' on them. So there would be a powerful incentive for all bondholders, tacitly or formally, to cooperate with each other to help improve society's health. They would share the same interest in seeing the targeted objectives achieved quickly and would share information, trade bonds with each other, or collaborate on health-improvement projects. They could also set up payment systems to ensure that people, bondholders or not, had incentives to help achieve the targeted health goals. This might mean that bondholders pay people not according to how much they actually help contribute to an outcome - which can be difficult to determine - but according to how much bondholders estimate they are contributing to the outcome. But while there might on those occasions be no direct link between payment and efficiency in achieving the overall outcome, bondholders would have strong incentives to strengthen that linkage where it is worthwhile to do so. If they failed to do that, they would not maximise their own rewards from holding THOBs.

## Advantages of THOBs

### Efficiency

THOBs would make the achievement of social and environmental objectives more efficient by injecting the market's incentives into every activity undertaken to improve the nation's

health. Under a THOB regime, investors would have incentives to seek out and develop those ways of improving people's health that are most cost effective, while terminating less promising approaches. The existence, structure, and activities undertaken by any formal or informal coalition that bondholders create would be entirely subordinate to their over-arching objective, which will be to achieve society's agreed targeted health goals as efficiently as they can. To this end they would explore diverse, adaptive approaches, impartially with respect to the identity of the beneficiaries. Bondholders would have incentives to take a long-term view, and to research, experiment and implement the most efficient of what will undoubtedly be a very large number of approaches to improving the nation's health

Under a THOB regime, it is likely that we should see more funding for preventive health and more for the less glamorous aspects of health care, including those that few wish to discuss openly. Bondholders would also have powerful incentives to cut down on wasteful spending on health, which does appear to be significant in the UK as well as the other industrialised countries.<sup>34</sup>

THOBs would ensure that investors competing in the open market would decide roughly how much it costs to reach the specified health goals. They would do this when they bid for the bonds at issue and at all times thereafter. Under a THOB regime the formidable information-processing power of the market would be channelled into minimising the costs of achieving our health goals. This fact, and the would-be bondholders' continuous incentive to minimise their costs, contrast with the current system in which the costs of achieving particular outcomes, if they are calculated at all, are not widely known nor subject to competitive bidding.

### Transparency, consensus and buy-in

Another big advantage of THOBs is that they would oblige our policymakers to be transparent about society's health goals, and to help form a consensus about them. People can more readily understand broad health goals than the legislation, structures and funding arrangements of the bodies that are ostensibly designed to achieve them. When people understand, have been consulted, and broadly agree with the goals of a policy, we can participate more in its development, refinement and implementation. We shall better understand the limitations and trade-offs that are inherent in all public policymaking. This is an end in itself as well as a means to another valuable end: buy-in. The baleful cynicism about certain players in the healthcare sector has become clear during the current pandemic largely, in this author's view, because the motives of such players and those of the general population are not seen to be aligned. THOBs would change that: investors' goals would be made explicit and decided in consultation with the public. Under a THOB regime, therefore, we should be more likely to support these goals, and to accept and comply with measures taken to achieve them. The gap between politicians and the citizens they are supposed to represent on the other, would narrow.

### Stable policy goals

Policy instability is a significant deterrent to people's undertaking long-term projects that could benefit society. A THOB regime's goals would have a necessarily long lead time but holders of the bonds would not be deterred from taking measures to achieve them by fears of reversals of government policy - or indeed, changes of government. In the current

policymaking environment, decisions about projects are plagued by policy uncertainty arising from government decisions that are subject to the whims and inefficiencies of political expediency. Stability also implies that goals decided in advance can be designed to be not only non-discriminatory, but made on a rational basis, rather than in reaction to unanticipated events. In stark contrast to the health sector itself, with its constantly emerging new threats, new technologies and rapidly expanding scientific knowledge, society's health goals, as articulated and targeted by government, would be stable over time.

If this appears too abstract consider, for example, European governments' singular focus on greenhouse gas emissions, which led them to offer subsidies and other inducements to buy diesel cars – which are now thought to emit higher levels of pollutants other than CO<sub>2</sub> that probably cause more illness and death.<sup>35 36</sup> Another example: studies estimate that pollution from tire wear can be many times that of a car's exhaust emissions,<sup>37</sup> while particulate emissions from car braking systems are thought to be just as toxic as diesel emissions.<sup>38</sup>

Such research conclusions drastically affect how we should approach air pollution and its health effects. No conventional policy approaches, with their emphasis on fixed science, regulatory bodies, and insufficiently flexible funding arrangements, can adapt to such expanding knowledge. Health-improving technology and techniques change constantly, as do their relative costs. The interdependencies between activity and outcome are complex and beset by time lags. In former times, links between cause and effect, while not always obvious, were at least discoverable by dedicated medical individuals, such as John Snow who could trace an outbreak of cholera in London in 1854 to one water pump.<sup>39</sup> Today, no single conventional body, public- or private-sector, can effectively monitor all relevant new developments and react accordingly. But while our understanding of the determinants of health is always improving, the goal of better health, achieved in part through cleaner air, is stable, and it is this goal that THOBs would target, not the means of achieving it.

## Information

Another benefit of THOBs is that the market for the bonds would generate extremely valuable information for policymakers and bondholders. It would do so even as the bonds are issued: the price they fetch will be an important indicator of how remote the market believes is the achievement of the targeted health goals. Thereafter bond prices and their movements would supply continuously updated, publicly available, information on which policy programmes are, in the market's view, likely to be most effective at achieving the targeted goal, and which external events are most likely to affect the achievement of these goals.

Let us look at the benefits of this information in more detail.

Say, for example, THOBs are issued that aim to increase all the measures of health from their baseline by 5 percent, sustained for 30 years. Assume that the government issue one million bonds targeting this goal, each redeemable for \$10 million once the thirty-year period of improved health has elapsed. The maximum cost to the government of achieving this objective would then be \$10 trillion. But if the bonds, when issued, fetched \$5 million each, then the market would be saying that it thought it could achieve this objective for just \$5 trillion. It wouldn't be explicitly saying *when* it thought it could achieve that objective, but that could be inferred from market behaviour and the market value of the bonds compared with other financial indicators. But what if the bonds sold for virtually nothing and the market

value of the bonds failed to move from that floor? That would mean that the government had miscalculated: in the market's view there would be no realistic chance of the objective being achieved for an outlay of \$10 trillion in the foreseeable future. The government could respond in different ways:

- It could wait for new technology to arrive, or for circumstances to change in other ways, such that the market would see the objective as becoming more easily achievable, leading to a corresponding increase in the value of the bonds. Or
- It could issue more bonds, with the same specification, also redeemable for \$10 million. It might do this in stages, gauging the market reaction to each new tranche of bonds, which would tell government the maximum cost of achieving the objective.

Either way, the government could be reasonably sure that it would be getting the best possible deal expressed as 'improvement in society's health per pound outlay'. This important benefit is worth spelling out in more detail. The government could cap the maximum cost of achieving the objectives by limiting the total number of bonds issued and their redemption value. It would be the collective wisdom of those in the market for bonds that would determine how much the government (that is, taxpayers) would actually pay to achieve the targeted health improvements, and they would have every incentive to minimise that cost.

But the bond mechanism would not merely minimise the *total* cost of achieving a specified objective. It would also indicate the *marginal* cost of achieving further improvements during or after the lifetime of a bond issue. Say that the one million THOBs, each redeemable for £10 million, sell for £5 million each on flotation. This would tell the government that the present value of the expected maximum cost, including bondholders' profits, of achieving the health goals by 5 percent would be \$5 trillion (£10 trillion minus the £5 trillion received for the bonds on flotation). The government might then suppose that it could afford to be more ambitious, and aim for a further 5 percent health improvement. It could issue a million additional bonds; again, each redeemable for £10 million. These might have an initial market value of less than \$5 million each, reflecting the (possibly) diminishing returns to efforts made to increase society's health still further. The point is that, by letting the market price the bonds, the government would be getting an informed view of the *marginal* cost of its objectives. So if the bonds targeting the new level were to sell for £3 million each, then the maximum cost of achieving that objective would be £12 trillion, being equal to: £5 trillion (paid out when the first 5 percent increase had been achieved and sustained) plus £7 trillion (being equal to the £10 trillion to be paid out when second 5 percent health improvement had been sustained minus the £3 trillion received on the bonds' flotation). The marginal cost of a second 5 percent increase in society's health thus have been revealed to have risen from the £5 trillion of the first increase to £7 trillion. Should the government aim for a further increase in society's health status? Following such bond issues *it would have robust information about the cost of doing so.*

This is, of course, a greatly simplified example and in fact the bond market would be continuously updating its pricing information.

## Social cohesion

A less obvious benefit of THOBs would arise from their status as a means of acquiring wealth whereby private gain is inextricably correlated with public benefit. Many bondholding organisations or individuals would be wealthy and, if their bonds were redeemed early, would become wealthier. But this would occur only if they had worked to bring about health improvements, and this socially acceptable way of acquiring wealth would make it easier for other, less socially beneficial forms of wealth accumulation (inheritance, or activities of little or negative social benefit), to be taxed more heavily.

## Existing institutions and the transition to a Tradeable Health Outcome Bond regime

Few of the bodies charged with achieving health goals are currently paid in ways that reward better performance. Nevertheless, many of these bodies, being perhaps the largest repository of expertise for raising the health of the population, are likely to be efficient, or to be capable of becoming efficient. It would be unwise as well as unfair and unnecessary for a government moving towards a THOB regime to cut their funding too severely. The solution could be a gradual transition.

The UK Government's expenditure on health care, which includes spending by the NHS, local authorities and other public bodies financing health care, equates to just under four-fifths (78%) of total current healthcare expenditure.<sup>40</sup> Central government provides funding for regional health authorities (for spending on doctors, hospitals and prescriptions) according mainly to population level, age and need. Government also supplies funds directly to medical research organisations and academic institutions. A transition to a THOB-based, rather than institution- or activity-based, funding programme would see the direct funding from government gradually decline, while expenditure allocated by bondholders to the targeted health outcomes would gradually rise. On introducing a THOB regime the government could decide to reduce its funding of health authorities and research institutes by, say, 1 percent a year, in real terms. So, after five years, each health authority would be receiving directly from central government only 95 percent of the funding that it had formerly received. But bondholders could choose to supplement the income of some of these health bodies. They may judge a particular group of health authorities to be especially effective at converting the funds they receive into measurable health benefits, as defined by the THOBs' redemption terms. Particularly effective health authorities might be working in deprived areas, where small outlays typically bring about larger improvements in health. Or bondholders might judge a particular research body to be worthy of additional funding, because it is conducting excellent research into a condition that would be likely to respond especially effectively, in terms of health outcomes, to additional expenditure. In such cases, bondholders would supplement their selected health authorities' or research institutes' funding. It may well be that these favoured bodies would end up receiving a large boost in income throughout the lifetime of a bond regime.

Non-government spending has four main sources: people's out of pocket expenditure for prescriptions and other healthcare goods and services, private healthcare schemes, charitable financing, and employers. Whereas the introduction of a THOB regime would see a gradual reduction in the direct government funding of the NHS and public bodies, it would also seek

to influence, less directly, non-government spending, aiming to re-direct such expenditure in ways that enhance their cost-effectiveness.

Holders of THOBs would also be motivated to look at completely new ways of achieving health objectives; ways that currently receive no, or very little, funding from any source. They may investigate, for example, whether an effective way of achieving society's longevity objectives is to deter teenage drinkers from driving. Following this logic, they may find that one of the most efficient ways of doing so would be to subsidise taxis for teenagers attending nightclubs or parties on Friday and Saturday nights – but only in certain parts of the country. Or holders of THOBs (or their agents) might decide that the costs in mental or physical health of closing down ailing manufacturing enterprises are outweighed by the benefits that would be gained by subsidising their continued operation. In areas of the country where youth violence is particularly high, they might subsidise sports clubs. They might explore, and subsequently seek to address, the consistent association between being adopted early in life and poor mental health outcomes in adulthood.<sup>41</sup> The point is that THOBs would encourage initiatives aimed at improving health in ways that fall well outside traditional healthcare boundaries. Under the current regime, few have incentives to look at the health implications of such interventions. Under a THOB regime, such diverse and innovative approaches would be encouraged, so long as they are efficient ways of advancing toward society's health goals. Note that they would also be adaptive, as well as diverse; THOB holders would find it in their interests to keep following events and trends, to ensure that their resources flow into those initiatives that promise the best health improvement per pound spent. It is difficult to imagine how our current centralised government fund allocation mechanisms could respond so readily to changing circumstances. A THOB regime would be strongly motivated to intervene in those cases where health would respond most readily to quick and inexpensive solutions, and is likely also to eliminate some of the more obvious disparities in health care matters.<sup>42</sup> It is also likely that holders of bonds targeting health outcomes would greatly expand funding in areas such as health education or preventive medicine, where small investments appear to generate dramatic health improvements.

Could bonds targeting remote objectives, such as a large rise in longevity, be compatible with a gradual transition of the type described above, where funding to existing health institutions reduces by 1 percent annually? At first sight there would seem to be an apparent mismatch between such incremental reductions in government spending and the time scale needed to reach long-range objectives. The critical point here is that bondholders would be investing not on the basis of the annual reductions in government expenditure on existing health institutions, but on the basis of the redemption value of all the bonds issued. To be more precise, it would be the estimated present value of this total redemption value, minus the current market value of the bonds, that would inform bondholders' investment decisions. This sum could be many times each year's incremental reduction in government's institution-based spending. One of the virtues of a THOB regime is that bondholders could expect capital gains in the short run from investments that will begin to make an impact on the targeted goal only in the long run. By doing the initial groundwork efficiently and speedily – not usually a very lucrative proposition under the current funding regime – they could see short-term rises in the bond price and early capital appreciation. Bondholders might see no need to attenuate existing efforts to improve society's health: efforts undertaken by bondholders could complement existing efforts. Or bondholders could look at existing

organisations and their approaches and choose to replicate or enhance their most successful activities. At all times, bondholders or would-be bondholders would be motivated to be flexible about which approaches are best for which geographical area. The gradual introduction of THOBs would allow existing organisations to adapt to the new incentive regime.

## The human factor

The human dimension is the implicit backdrop to this essay, which has been long on abstract notions including market forces, financial instruments, incentives and efficiency. Some commentators' apotheosis of such concepts has been linked, rightly in many cases, to a worsening of the mental and physical health of human beings. Notably, the proliferation of temporary, flexible jobs, has meant less secure and more stressful working conditions for millions of British citizens, while other macro-economic factors, such as the cost of housing, impose similarly onerous health burdens. The pandemic has highlighted, especially, the circumstances of people who work in care homes and the healthcare sector.

A THOB regime would encourage investors in the bonds to consider carefully the health impacts of looser employment regulation and it is quite likely that they would lobby for legislation ensuring better employment conditions that could greatly improve many people's health. Such lobbying, so long as it is transparent, is a legitimate activity and could lead to significant benefits for relatively little outlay. The important points are that many aspects of our lives and society affect our health, and that we need to offer incentives to people to constantly look into all such influences, especially those whose health implications, for whatever reason, may have been neglected.

And so we return to the theme of this essay competition: hospitals. This essay has had little explicit to say about the role and performance of hospitals. This is deliberate: the number of hospitals and their degree of excellence are less important than the excellence of the health system of which they are an integral part. It is a safe assumption that all aspects of hospitals, including staff well-being and pride, would increase in parallel with improvements in the health of the population, as would patient satisfaction. Optimising the health of every British resident necessarily implies that hospitals' number, size and role will be appropriate, and that every aspect of their performance will improve. We cannot say in advance whether hospitals would assume a bigger or lesser role in a society where improving the health of every citizen is approached from every possible angle. But we can say that every single aspect of hospitals would be scrutinised by bondholders whose over-arching interest would be to improve the health of all who work or are treated therein.

It is worth reminding people too that the panoptic, market-led approach advocated hitherto would not preclude other, less mercenary, initiatives, including voluntary, local efforts, aimed at making hospitals a better environment for staff, patients and visitors alike.

Under a THOB regime government would still articulate society's broad desired health outcomes and, in backing the bonds, would still be raising the revenue for their achievement. These are tasks that democratic governments do very well. What government, or any single conventional organisation, does less well is actually achieving our health goals: that is a resource allocation question that, on all the evidence, would be best left to the market. THOBs would encourage investors to allocate resources efficiently *in the public interest*.



THOBs would require that government relinquish its power to decide how health resources shall be spent, and who shall spend it and this might, at first, be a difficult step to take. But the transition to a THOB regime would be gradual, and the benefits of a healthier population should convince even the most power-hungry politicians and officials that the trade-off is worth making.

Resources are always going to be limited and THOBs will not change that. The UK Government's spending on health is large and likely to grow still larger. Even relatively small gains in the efficiency of this spending could greatly benefit the physical and mental health of large numbers of British citizens.

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The web addresses, of all online sources given in the endnotes were checked and found to be correct between 13 May 2021 and 15 May 2021.

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<sup>1</sup> 'The NHS Plan', Cm 4818-I, July 2000. <http://1nj5ms2lli5hdggbe3mm7ms5.wpengine.netdna-cdn.com/files/2010/03/pnsuk1.pdf>

<sup>2</sup> 'NHS Targets', Wikipedia. [https://en.wikipedia.org/wiki/NHS\\_targets](https://en.wikipedia.org/wiki/NHS_targets)

<sup>3</sup> Type one A&E departments are those that offer a consultant-led 24-hour service with full resuscitation facilities and designated accommodation for the reception of accident and emergency patients. Source: [https://datadictionary.nhs.uk/data\\_elements/emergency\\_care\\_department\\_type\\_\\_patient\\_level\\_information\\_costing\\_.html](https://datadictionary.nhs.uk/data_elements/emergency_care_department_type__patient_level_information_costing_.html)

<sup>4</sup> 'NHS Targets', Wikipedia. [https://en.wikipedia.org/wiki/NHS\\_targets](https://en.wikipedia.org/wiki/NHS_targets)

<sup>5</sup> *ibid*

<sup>6</sup> NHS is to test scrapping the four hour A&E target. *thebmj*, 12 March 2019. <https://doi.org/10.1136/bmj.l1148>, 12 March 2019.

<sup>7</sup> 'Don't leave patients in ambulances to hit A&E targets, hospitals told', Robert Watts and Laura Donnelly, 27 October 2012. <https://www.telegraph.co.uk/news/9637865/Dont-leave-patients-in-ambulances-to-hit-AandE-targets-hospitals-told.html>

<sup>8</sup> '1.5m patients kept waiting in ambulances for half an hour or more', Peter Walker, 29 November 2019. <https://www.theguardian.com/society/2019/nov/29/15m-patients-kept-waiting-in-ambulances-for-half-an-hour-or-more>

<sup>9</sup> This expired blog post by James Bartholomew discusses the issue: [https://web.archive.org/web/20100214144611/http://www.thewelfarestatewerein.com/archives/2009/06/lies\\_damned\\_lie\\_1.php](https://web.archive.org/web/20100214144611/http://www.thewelfarestatewerein.com/archives/2009/06/lies_damned_lie_1.php).

<sup>10</sup> 'Target "putting A&E care at risk"', BBC News, 13 March 2005. <http://news.bbc.co.uk/2/hi/health/4339653.stm>

<sup>11</sup> Similar problems arose from the earlier government target stipulating that doctors' patients should not have to wait more than 48 hours for an appointment. Some doctors, it was found, simply stopped taking appointment bookings in advance to keep their time free to meet the 48-hour requirement. '48-hour target "damaging GP care"', BBC News, 23 September 2004. <http://news.bbc.co.uk/2/hi/health/3682920.stm>.

<sup>12</sup> Welch HG, Schwartz LM, Woloshin S. 'Are increasing 5-year survival rates evidence of success against cancer?' *JAMA*. 2000 Jun 14;283(22):2975-8. doi: 10.1001/jama.283.22.2975. PMID: 10865276.

<sup>13</sup> 'What we measure and why', Institute for Health Metrics and Evaluation, 10 July 2019. <http://www.healthdata.org/acting-data/what-we-measure-and-why>

<sup>14</sup> 'CHTE methods review, Modifiers:Task and finish group report', National Institute for Health and Care Excellence, October 2020. <https://www.nice.org.uk/Media/Default/About/what-we-do/our-programmes/nice-guidance/chte-methods-consultation/Modifiers-task-and-finish-group-report.docx>

<sup>15</sup> A brief summary is given here: 'How summary measures of population health are affecting health agendas', Paul J. van der Maas, *Bulletin of the World Health Organization* 2003, 81 (5)

<sup>16</sup> *ibid*

<sup>17</sup> *ibid*

<sup>18</sup> 'Evidence-based medicine in disguise: beware the surrogate', MD Whistleblower (blog by Michael Kirsch), 1 August 2010. <http://mdwhistleblower.blogspot.com/2010/08/evidence-based-medicine-in-disguise.html>

<sup>19</sup> 'Big Health Actuarial Data', University of East Anglia. <http://www.bighealthactuarialdata.ac.uk/project>

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- <sup>20</sup> ‘NICEimpact Mental Health’, National Institute for Health and Care Excellence, March 2019. <https://www.nice.org.uk/media/default/about/what-we-do/into-practice/measuring-uptake/niceimpact-mental-health.pdf>.
- <sup>21</sup> ‘Big Health Actuarial Data’, University of East Anglia. <http://www.bighealthactuarialdata.ac.uk/project>.
- <sup>22</sup> based on: Kuhn R, Rahman O, Menken J. ‘Survey Measures of Health: How Well Do Self-Reported and Observed Indicators Measure Health and Predict Mortality?’ In: ‘National Research Council (US) Committee on Population’; Cohen B, Menken J, editors. ‘Aging in Sub-Saharan Africa: Recommendation for Furthering Research.’ Washington (DC): National Academies Press (US); 2006. 10. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK20307>.
- <sup>23</sup> [https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366\(20\)30342-4/fulltext](https://www.thelancet.com/journals/lanpsy/article/PIIS2215-0366(20)30342-4/fulltext)
- <sup>24</sup> ‘The Science-Based Economy: the role of health research’, Chris Thomas and Shreya Nanda, IPPR, July 2020 (<http://www.ippr.org/research/publications/the-science-based-economy>).
- <sup>25</sup> ‘UK Mental Health Research Funding’. [http://b.3cdn.net/joinmq/1f731755e4183d5337\\_apm6b0gll.pdf](http://b.3cdn.net/joinmq/1f731755e4183d5337_apm6b0gll.pdf)
- <sup>26</sup> ‘Equity in the Provision of Palliative Care in the UK: Review of Evidence’, Josie Dixon, Derek King, Tihana Matosevic, Michael Clark and Martin Knapp, Personal Social Services Research Unit, London School of Economics and Political Science, April 2015, <https://www.mariecurie.org.uk/globalassets/media/documents/policy/campaigns/equity-palliative-care-uk-report-full-lse.pdf>. Earlier research showed that 95 percent of the NHS palliative care budget was allocated to the 25 percent of the UK’s population who die from cancer, and just 5 percent to the 75 percent who die from all other causes. See ‘Alternative endings’, Radio Times (UK), 13 July 2002. This was the subject of a British Channel 4 television documentary ‘Death: you’re better off with cancer’, broadcast on 16 July 2002.
- <sup>27</sup> Alfredo Yegros, Robert Tijssen, María-Francisca Abad-García, and Ismael Ràfols, ‘Drug research priorities at odds with global disease toll’, Nature Index, 16 March 2018. <https://www.natureindex.com/news-blog/drug-research-priorities-at-odds-with-global-disease-toll>.
- <sup>28</sup> ‘The nature fix’, Kate Douglas, New Scientist, 27 March 2021.
- <sup>29</sup> van den Berg, M. M. H. E., ‘Mental health benefits of green spaces’. VU Research Portal, 2017. [https://scholar.google.com/scholar\\_url?url=https://research.vu.nl/files/42580666/chapter%25202%2520Health%2520Benefits%2520of%2520Green%2520Spaces%2520in%2520the%2520Living%2520Environment:%2520A%2520systematic%2520Review.pdf&hl=en&scisig=AAGBfm31JoEmCAIBzkXCUMsfCGhkLLWHAA&nossl=1&oi=scholar](https://scholar.google.com/scholar_url?url=https://research.vu.nl/files/42580666/chapter%25202%2520Health%2520Benefits%2520of%2520Green%2520Spaces%2520in%2520the%2520Living%2520Environment:%2520A%2520systematic%2520Review.pdf&hl=en&scisig=AAGBfm31JoEmCAIBzkXCUMsfCGhkLLWHAA&nossl=1&oi=scholar).
- <sup>30</sup> ‘Tango classes, ukulele lessons: the rise of “social prescriptions”’, The Economist, 17 February 2018. <https://www.economist.com/britain/2018/02/15/tango-classes-ukulele-lessons-the-rise-of-social-prescriptions>.
- <sup>31</sup> ‘The results of several studies have collectively suggested that different manifestations of nature, such as a view of nature from a window, images of nature, and indoor plants, can positively affect patients' outcomes, including decreased pain, anxiety, and depression of patients and their lengths of stay.’ from Saman Jamshidi, Jan S. Parker, Seyedehnashtaran Hashemi, ‘The effects of environmental factors on the patient outcomes in hospital environments: A review of literature’, Frontiers of Architectural Research, Volume 9, Issue 2, 2020, Pages 249-263, ISSN 2095-2635, <https://doi.org/10.1016/j.foar.2019.10.001>. (<https://www.sciencedirect.com/science/article/pii/S2095263519300779>).
- <sup>32</sup> ‘Social Impact Bond’, Wikipedia. [https://en.wikipedia.org/wiki/Social\\_impact\\_bond](https://en.wikipedia.org/wiki/Social_impact_bond)
- <sup>33</sup> ‘Social Impact Bonds: Promises versus facts, What does the recent scientific literature tell us?’ Julie Rijpens, Marie J. Bouchard, Emilien Gruet & Gabriel Salathé-Beaulieu, CIRIEC No. 2020/15, <http://www.ciriec.uliege.be/wp-content/uploads/2020/12/WP2020-15.pdf>.
- <sup>34</sup> ‘Tackling Wasteful Spending on Health: Highlights’, OECD, 2017. <https://www.oecd.org/els/health-systems/Tackling-Wasteful-Spending-on-Health-Highlights-revised.pdf>.
- <sup>35</sup> ‘Are diesel cars really better for the environment than petrol ones?’ thejournal.ie, Melanie May, 25 September 2017. <https://jrnl.ie/3611217>.
- <sup>36</sup> ‘The rise of diesel in Europe: the impact on health and pollution’, John Vidal, The Guardian, 22 September 2015., <https://www.theguardian.com/environment/2015/sep/22/the-rise-diesel-in-europe-impact-on-health-pollution>.
- <sup>37</sup> ‘Emissions Analytics finds pollution from tire wear can be 1,000x worse than exhaust emissions’, Green Car Congress, 8 March 2020. <https://www.greencarcongress.com/2020/03/20200308-emissionsanalytics.html>.
- <sup>38</sup> ‘Brake dust as toxic as diesel fumes, warn scientists’, Ethan Jupp, Motoring Research, 9 January 2020. <https://www.motoringresearch.com/car-news/brake-dust-toxic-diesel-fumes/>
- <sup>39</sup> ‘John Snow’, Wikipedia. [https://en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)
- <sup>40</sup> ‘Healthcare expenditure, UK Health Accounts: 2018’, Office for National Statistics. <https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/healthcaresystem/bulletins/ukhealthaccounts/2018>
- <sup>41</sup> Kelli Lehto, Sara Hägg, Donghao Lu, Robert Karlsson, Nancy L. Pedersen, Miriam A. Mosing,

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‘Childhood Adoption and Mental Health in Adulthood: The Role of Gene-Environment Correlations and Interactions in the UK Biobank, *Biological Psychiatry*’, Volume 87, Issue 8, 2020, Pages 708-716, ISSN 0006-3223, <https://doi.org/10.1016/j.biopsych.2019.10.016..>