

OPERATION INNOVATION

HOW TO MAKE SOCIETY RICHER, HEALTHIER AND HAPPIER

An essay collection from The Entrepreneurs Network



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Operation Innovation

Dr Anton Howes, Philip Salter, Aria Babu and Eamonn Ives

By far the most important issue facing modern societies is the ability to achieve and sustain economic growth. This doesn't simply mean the level of Gross Domestic Product – the total value of goods and services exchanged within an economy in a given year – but rather the annual improvement in the living standards we experience. The taste and smell of our food. The look, hygiene, and comfort of our homes. The ease with which we communicate, travel, relax, and work. Our ability to prevent and cure disease. The quality of our air, and the health of our countryside.

Improvement in all of these – in affordability, safety, health, quality, efficiency – is what lies behind modern, sustained economic growth. And it is innovators who drive those improvements, finding ways to do more with less, making things easier, safer, more sustainable, and effective. Increasing GDP is just the measurable tip of the iceberg.

The effect of accumulated innovations has transformed the world at a pace that would have been unimaginable to our not-so-distant ancestors. Even a rate of 2% growth per year – what is now considered slow – if sustained year after year, results in a doubling of measured living standards in just 35 years. The gap in living standards between 1423 and 1723 may have been noticeable to a typical fifteenth-century person, but the gap between 1723 and 2023 would have been beyond even an eighteenth-century person's wildest imaginings.

In 1723, the typical Brit would have spent a substantial portion of their wage on lighting and heating their home with sputtering candles and smoky coal. They would almost certainly have had no access to running water, been unable to afford to travel abroad, and only just about been able to fund some pastimes – some limited reading, if literate, and perhaps the occasional and expensive sip of a newly-imported luxury like coffee. Their work would have involved back-breakingly long hours, with little recourse for that broken back. They faced the constant threat of an early death from disease.

Thanks to the incremental and accumulated work of just a few thousand innovators in the intervening three centuries, we now enjoy the widespread availability of electricity, central heating, running water, toilets, cars, rail travel, literacy, television, restaurants, office jobs, and instantly effective treatments for many previously debilitating or life-threatening diseases – not to mention commonly available inventions that to the 1723 Brit would seem tantamount to magic, like human flight, impressively accurate weather forecasting, instantaneous communication with anyone in the world, and now machines that can reason and talk.

The effect of accumulated innovations has transformed the world at a pace that would have been unimaginable to our not-so-distant ancestors.

The UK, as the home of so many of those innovators, was often among the earliest beneficiaries of their improvements. It continues to be among the best places in the world to innovate, recently giving us the Oxford/AstraZeneca Covid vaccine, Babylon Health, and DeepMind. But its seventeenth-, eighteenth-, and nineteenth-century pole position, in almost all industries, from agriculture to textiles to machine-making to watchmaking, and everything in-between, has largely been ceded to others.

Countries that once looked to the UK for inspiration on how to innovate and grow, like France, Germany and the United States, now enjoy a comfortable lead in productivity – the living standards their populations on average enjoy for the work they do. They may not always be the first to produce certain inventions or scientific breakthroughs, but increasingly their populations have been faster to enjoy their benefits. The comparison with the United States is especially stark, with the average Brit having lower living standards than those of even Mississippi, the poorest US state. The general manager of a Buc-ee's car wash in Texas earns a higher wage than the UK Prime Minister. The average starting salary for a newly-qualified nurse in the US is just over £42,000, compared to just £27,000 in most of England, and the discrepancy only widens after that. The range and quality of goods, services and housing that they can buy for that higher wage is also typically higher.

The consequences of the UK's lacklustre growth are already severe, with low growth making it harder and more individually costly to support our various public services, especially those most affected by our ageing population, like healthcare, social care, and pensions. And this, in turn, puts pressure on the availability of other vital public services, from education to dealing with crime.

The following series of short essays seeks to remedy this situation. Each of them addresses a key way in which the UK can improve its growth prospects, and all of them focus on how to do this by supporting and harnessing innovation. Some discuss the barriers that prevent people from innovating in the UK, looking at housing, transport, and childcare costs, as well as immigration and taxation policy. Others examine the way we support and fund science and innovation, how we regulate them, how we build a culture that supports them, and how we integrate them into both private and public services. A few deep-dive into specific sectors, such as artificial intelligence, food production, and energy systems. But in all cases we asked authors to push the envelope and point readers towards important ideas that have been overlooked.

This collection is not intended as a final answer to the UK's productivity woes. It is, instead, the beginning of a work in progress. It sketches out the policies and areas that desperately need further work – work that we at The Entrepreneurs Network will be undertaking in the months and years to come, hopefully with your support. This collection sketches out the plan for Operation Innovation, to make the UK the global leader again in productivity and prosperity. It starts now.

Countries that once looked to the UK for inspiration on how to innovate and grow, like France, Germany and the United States, now enjoy a comfortable lead in productivity.

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Inspiring invention

Dr Lawrence Newport

"I would like us to go back to a country in which we have ticker-tape parades for single individuals. We haven't had such a ticker-tape parade in the 21st century."

– Peter Thiel

"Every vision is a joke until the first man accomplishes it; once realised, it becomes commonplace."

– Robert Goddard

The modern world is a miracle that all odds were stacked against. The future is likely to be filled with yet more abundant, cheap food; longer lives; smarter people; less hatred; more opportunities than we can imagine; and more successes than all of the past combined.

But this process isn't automatic. In fact, there is barely a 'process' at all. At its most simplistic the success of the modern world depended on individuals innovating upon the past. This may have been inventing new technologies, reconfiguring old legal systems, shortening transport links, streamlining communication or anything of a near infinite number of tiny or monumental changes that have added to the complex whole. At its core, the future relies on what's worked for us in the past: innovation.

Perhaps this seems obvious, but if it is, we rarely act like it. Art tells us what we instinctively feel: the future is unknown, frightening, uncertain. What we want from the future is what we like of the past: certainty.

Innovation is the opposite of certainty. It upends institutions, irrevocably alters civilisations and renders careers irrelevant at the drop of a hat. It does all of this while its promises are vague and unknown. It is no surprise then that innovators and innovation are so often feared or mocked. Feared for the results of their creations, mocked for dreaming of 'not yet possible' things, or changes to ancient precedents. This is not a modern phenomenon.

History is replete with examples of inventors exiled for improvements, condemned as heretics or ridiculed as naïve dreamers. In art, Dr Faustus seeks out knowledge, a forbidden dream that requires a pact with the devil; Shakespeare's Prospero breaks his staff and condemns his books as a signal of his character growth away from inherently suspicious knowledge. In reality, novel interpretations of sacred texts, established philosophy or government institutions were criminal heresies; while early scientific history is littered with suppressed discoveries and hushed truths.

The success of the modern world depended on individuals innovating upon the past.

If not heretical or criminal, innovators were dismissed as naïve dreamers. Nineteenth-century cartoons mocked the innovators that believed mechanical powered horses would transport people across the globe, that agriculture could be industrialised or that human flight was within our grasp. On flight, Lord Kelvin, president of the Royal Society, proclaimed it an impossibility less than a decade before the Wright Brothers proved him wrong. Thomas Edison declared aeroplanes to clearly be the incorrect method of flight, and multiple celebrated engineers believed heavier-than-air human flight utterly unviable. Considering the names and positions of those professing it an impossibility, those attempting it were ridiculed as delusional.

Given this, why do we attempt to invent at all? The short answer is: very few people ever do. In fact, most of human history sailed by with little change to living standards. This is not a question of technology – it is not just ‘standing on the shoulders of giants’ that matters for progress. For example, there is little technological reason that it took until the late-nineteenth century to create a bicycle, or why it took modern humans about 32,000 years to invent rope, or around 4,000 years from domesticating horses until the invention of stirrups (which then took a further several centuries to be used in Europe). There is good reason to suspect mediaeval civilisation had the technology to produce hot air balloons, and I am very uncertain as to why it took until the 1970s for someone to add wheels to the bottom of suitcases.

What matters appears to be, as Anton Howes calls it, an ‘improving mentality’. For most people, innovation just never occurs to them. For those few to whom it does, we’ve been sure to add in a fair amount of disincentives. If their invention works, they may become unbelievably rich – in some circumstances – but most of the time the risk is of looking a fool, or facing the wrath of vested interests, guilds and regulators.

We need to address this imbalance. Were nearly all of those that attempted human flight delusional? Almost certainly yes. But we’re lucky that they were. As George Bernard Shaw wrote: “The reasonable man adapts himself to the world... therefore all progress depends on the unreasonable man.” Innovation is a pyramid of success, and there is a lot of madness at its base. We must fight our impulses, embrace the chaos and encourage more of it.

Succeeding in sport is a pyramid too. There are a great number of amateurs – a very small percentage of which have genuine talent. From that pool of talent, only a handful of athletes can manage the pressure and skill required for national competition, and only a very few become truly astoundingly great. We don’t simply pay those that win, however, we revere them. Those who triumph in sport or war are given parades and national holidays. Peter Thiel was derided for suggesting we should have ticker-tape parades for individuals, but we would be seen as absurdly stingy, uncaring and unromantic if we didn’t throw events to celebrate a national team for a World Cup victory.

Innovation is a pyramid of success, and there is a lot of madness at its base. We must fight our impulses, embrace the chaos and encourage more of it.

Recently, a pandemic was stopped in its tracks through new vaccine technology, developed in 48 hours, produced and then deployed in record speed – and yet far from the scientists behind it being celebrated nationally, this stunning achievement was quickly underplayed in news cycles or even simply viewed with outright suspicion. A year later, political pressure grew on the British government to declare a public holiday on the back of a potential England victory in the Euros.

Innovation is so easy to miss because miracles have become mundane. The Great Exhibition of 1851 made the vast reality of technological achievement manifest before a truly enthused population. An unmitigated success, visited by an equivalent of a third of the entire British population. Statues litter the sacred spaces of governments, made of political figures that broke all expectations or redefined a nation. Civilisations instinctively memorialise those they respect for the same reason we say thank you to those that are kind – we want more of it in those we meet, see and hear of.

How should we encourage innovation? The answer is to look to the things we do for those we consider heroes – the people we want more of, and do the same. Parades, statues and exhibitions. This idea is simple, reflects cross-cultural human practices over thousands of years and is instinctively obvious as a response to a wide variety of human achievements. Ironically, the innovation here is anything but innovative – rather, it is simply applying our tried and tested practices to the things we otherwise easily miss, the mad discoverers of soon-to-be mundane miracles we want more of. Those we want to encourage to embrace the chaos, and try – even with the high likelihood of total failure.

Parades, statues, honours and exhibitions: the idea is easily dismissed, and very certainly capable of ridicule – what brilliant company it keeps.

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Innovation is so easy to miss because miracles have become mundane.

Funding fundamentals

Matt Clancy

The financing of companies and investments has a central role in modern society. An entire academic discipline – finance – is devoted to the topic, and it accounts for significant proportions of national economies.

Despite its enormous long-run impact on our technological capabilities, however, the way we allocate funding in science is comparatively unexamined. We know our current system isn't perfect: one can draw up a [long list](#) of breakthrough scientific ideas whose arrival was delayed by years due to challenges obtaining funding (and one cannot list the ideas who never arrived, because they never secured funding!). And there is good reason to think our current imperfect system isn't simply the best that's feasible either. Part of the reason is that science is – rightfully – not a market: it's not easy to get rich by funding science better than your peers. But if it were, we might see a lot more competition and attempts at innovation in this space. Another challenge is that evaluating the quality of science often takes time and expertise. That means individuals and organisations don't get great feedback on the quality of their decision-making, which makes it very hard to improve, even if they want to. With weak incentives to improve, and weak information to direct us towards better ways, it's unlikely we lucked into the best possible arrangement.

As with finance, at the heart of the scientific funding enterprise are individuals who make decisions about what to fund (often in conjunction with peer review, but enjoying some discretion too). I'll call them grant makers here. If we can find ways to make these individuals more effective at their jobs, the rewards to science could be enormous. We need a new metascience research agenda focused on the best ways to select, train, and incentivise our grant makers. With information in hand, we can then use the levers of democratic civil society to reform our public and private grant makers.

Let's start with how we select grant makers. What are the kinds of traits associated with great grant-making? Generalist or specialist knowledge? Do early career or late career scientists make better, or even different, kinds of grants? What about people from different backgrounds: socioeconomic, but also work experience? Or is it all about innate 'taste'? If the latter, are there ways we can find that, via the way we screen prospective grant makers? Could we ask applicants to make predictions about the outcomes of different funded grant proposals or which projects successfully replicate? Or perhaps we should encourage more scientists to rotate through temporary stints as grant makers, while the outcomes of their projects are tracked. Years later, perhaps we can identify people with a talent for spotting overlooked scientific opportunities, and recruit them.

Next, we can turn to how we enable science funders to get better at their job. To start, are there training programmes that work? Mentoring programmes?

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Beyond that, there is plenty of scope to improve the quality of feedback grant makers receive. Naturally, one can track the ultimate outcomes of grants. The trouble is, this can take many years to play out, too slow to help a grant maker improve. But there are other options for generating more rapid feedback on a grant maker's judgement. Prediction markets, whether internal or external, have been used in some settings to help generate information on events that are distant in time or uncertain, and there have been some efforts to use them in science as well. My own employer, Open Philanthropy, has adopted a simpler strategy for getting its grant makers feedback, by asking them to make a series of probabilistic forecasts associated with every grant. Over many grants, a grant maker can begin to see if they consistently misjudge elements of a grant and adapt accordingly.

Lastly, the way we incentivise grant makers matters just as much. In finance, if you make a contrarian bet and win, you get rich. In science, the upside is small, but the professional downsides may be real. Among career grant makers, is a larger promotion feasible for making a contrarian bet that pays off? Better information on how grants perform, discussed above, would also make stronger incentives possible. At one extreme, some portion of compensation for grant makers could be tied to the eventual performance of funded science, as judged by later scientists. On the other extreme, we could merely try to provide some reputational incentive to make bold calls, for example by annually recognising the best out-of-consensus grant maker of the last 20 years. Would these kinds of incentives matter in science? Finally, it's also possible to provide stronger incentives to peer reviewers: perhaps, years later, the reviewers whose scores are most highly correlated with the performance of grants could be given additional research grants of their own, as a prize for exceptional peer reviewing.

We don't really know which of these reforms would improve the quality of our grant-making, which would degrade it, and which don't matter at all. And that's the point: it's past time we found out.

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In finance, if you make a contrarian bet and win, you get rich. In science, the upside is small, but the professional downsides may be real.

Embracing uncertainty

Ben Reinhardt

It's easy to forget, but until a few decades ago, overpopulation was a dire existential threat to humanity. Well-respected experts like [Paul Ehrlich](#) warned that, without drastic measures, increasing populations would overwhelm the world's ability to create food and the subsequent migrations and unrest would create a domino effect that would bring down civilisation. Clearly that never happened. The eight billionth person was born recently with little fanfare. Many studies now predict that human population will [peak within a century](#) and people are now becoming concerned with decreasing populations. What created this drastic change?

It wasn't money poured into policies to reduce birth rates. Nor was it research into technologies that would directly address the population problem, like better contraception. It was the Haber-Bosch Process and new genetic engineering technologies that drastically increased food production combined with many other technologies that increased GDP. (Wealth and education consistently decrease fertility rates.)

You see the same pattern repeated throughout history: electricity cleaned formerly soot-blackened cities and saved the whales; the laser, originally mocked for its uselessness, has connected the world; solar panels created to power satellites are a major part of the climate change solution; the list goes on.

The point is not that we're bad at predicting what technologies will be useful (although we are). It's weirder than that.

Second order effects dominate the impact of technology. That is, throughout history, technologies have had the largest impacts on society not by performing the function they were built for, but by changing constraints that obliquely solve problems or make them irrelevant. Some technologies expand far beyond their imagined use, causing a cascade of changes that unseat built-in assumptions about how the world works.

A brief aside to address an elephant in the room. Technologies can also have negative second-order effects. It will always be a concern that requires more space to unpack than I have here. But two points make me optimistic:

1. With time, we've consistently mitigated negative second order effects with culture or technology: new theories of government addressed the religious conflicts driven by the printing press; electricity and natural gas mitigated the dismal clouds created by coal-burning factories; there are many promising ways to mitigate modern issues like atmospheric carbon dioxide. The way around is through.

Throughout history, technologies have had the largest impacts on society not by performing the function they were built for, but by changing constraints that obliquely solve problems or make them irrelevant.

2. However, there are technologies like runaway AI or modified super-organisms that some argue pose actual existential risks to humanity. All of these share some attributes (like self-replication) that are worth unpacking and making exceptions around, but those concerns shouldn't extend to the vast preponderance of technologies.

And yet, impact-via-second order effects flies in the face of how policies the world over treat technology. Grants are based only on direct impacts that researchers can happen to imagine. Grant programmes themselves filter based on consensus opinion about what impacts are feasible and important. Regulations codify current capabilities and use-cases, which constrains a technology's ability to generalise to a new area. Government support is written with existing paradigms in mind

All of these approaches are 'reasonable' but completely ignore the history of how technology actually improves the world.

What is to be done? We can't just support things randomly (although some promising experiments have been done in randomised grant making). Notably, there are some historical patterns in technologies with positive second order effects: they tend to be new forms of energy, materials, or manufacturing. In the very abstract: new arrangements of atoms, methods to rearrange them, and ways to provide the energy to do that rearrangement. These 'general-purpose technologies' enable other, hard-to-predict applications.

Some actionable ways to embrace positive second order effects include:

- Giving potential general-purpose technologies more support so that they can actually generalise instead of being forced into a niche. General-purpose technologies often take more 'piddling around' than other technologies;
- Supporting and incentivising scaling, not just invention. Often, scaling up a material or manufacturing technology takes just as much research as inventing it in the first place. This support can come in many forms: grants judged on scalability instead of just novelty, low-interest loans to build pilot plants, and market precommitments;
- Regulating based on outputs, not inputs. For example, specify sound levels for aircraft, not speeds; damage limits to crash test dummies, not crumple zones; choose desired pollution levels, not specific filters. Focusing on outputs enables radically new ways of achieving them.

More broadly, we can enable more positive second-order effects by asking not "what problems will this technology solve?" but "what capabilities will this technology give people to turn their imaginations into reality?"

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Impact-via-second order effects flies in the face of how policies the world over treat technology.

Revitalising research

Ben Southwood

It can be difficult to imagine doing things differently from how they have always been done in one's own time period. Today most of our best new ideas come out of a single channel. To massively over-simplify, academics at universities, funded by grants, do research. If the research is successful and can be used to make new products, this work is 'spun out' into small start-up firms which either get acquired by big firms, or grow into companies making use of the research.

This pathway of academics to start-ups and venture capital has been pretty successful. We can thank it for many of our favourite recent innovations. But it is far from the only way of doing things – even today, other models exist alongside the dominant one.

Some research is done by academics funded directly as individuals by organisations like the [Howard Hughes Medical Institute](#). These researchers don't need to apply for grants for the projects they pursue, and they have more freedom to pursue whatever seems most fruitful – following up on serendipitous tangents.

Still other research is done by academic-style researchers, likely with PhDs and having previously held postdoctoral positions, but in national labs. These, like the Lawrence Livermore National Laboratory in California, USA, which [achieved nuclear fusion](#) at the end of 2022, or the Max Planck Institute in Frankfurt am Main, Germany, which at the end of 2022 [celebrated 4,800 inventions and 180 company spin-offs](#), are funded directly by their respective governments. Individual researchers in these labs need not spend up to 50% of their time applying for grants, updating funders on progress, and generally doing administrative work.

Less common is the historic system merging the academic and the lab models, whereby university departments are funded with block grants.

One model that has recently been rejuvenated is the 'DARPA model', which in its original incarnation funded a huge range of transformative computing technologies, and whose use of autonomous programme managers – with short tenures and high tolerance for failure – has been copied around the world. The UK's new ARIA (Advanced Research and Invention Agency) is in part inspired by this model, though it has also been given freedom to forge its own path.

There is yet another model, however. It still goes on today, especially in the pharmaceutical industry, and increasingly in the artificial intelligence sector, such as in Google's DeepMind, OpenAI, Anthropic and elsewhere. This last model is the industrial R&D lab.

Back during the period of America's and the world's fastest productivity growth in all of history, and possibly the period of fastest technological progress we have ever seen as well – that is the 1930s to the 1960s – the industrial R&D lab predominated in the research sector. There was no assumption that the smartest thinkers would work for a top university – it was just as likely they would work for AT&T's Bell Labs, where the transistor was invented, or Xerox's Palo Alto Research Centre, where the personal computer and mouse came about.

Claude Shannon, known as 'the father of information theory' for coming up with a whole range of the theory needed for modern communications – including the internet – for example, spent much of his career at Bell Labs.

In the 1960s, DuPont, the chemicals giant, published more in the Journals of the American Chemical Society than both MIT and Caltech combined. R&D Magazine, which awards the R&D 100 to the hundred innovations it judges most innovative in a given four year period, gave 41% of its awards to Fortune 500 companies in its 1971 iteration and 47% in 1975. By 2006 this had fallen to a mere 6%.

If these labs were so effective – which they were – why did they decline?

One argument is that R&D labs never really paid their funders back properly, and eventually they realised this for some reason or another. Shannon's work on information theory, for example, spurred research projects across the economy, but did not lead to AT&T Bell dominating the internet. PARC may have essentially invented the personal computer, but it was Apple and Microsoft that commercialised the technology.

According to this view, spillovers are inherently so significant that commercial lab-type work is unsustainable, as too many of the benefits escape to society at large.

Another argument is that spillovers have become more difficult to avoid, partly because of technology, and partly because of policy.

Information technology, thanks in part to the R&D labs of the past, has advanced at a blistering pace. It is easier and easier to keep up with the new ideas put out into the world. There is evidence that this matters for technology. One piece of evidence looking at 800,000 corporate publications produced 1980-2015 suggests that rivals are indeed using technology to ever more effectively keep up with and copy the innovations of their competitors.

AT&T Bell was forcibly split up by antitrust authorities in 1982. Because of that, its entire stock of patents, which was 1.3% of the total patent stock in the USA at the time, was invalidated. Evidence clearly shows that this spurred a great deal of follow-on innovation by allowing a wide range of innovators to play with and build on Bell's ideas.

There was no assumption that the smartest thinkers would work for a top university – it was just as likely they would work for AT&T's Bell Labs.

However, it seems likely that these invalidations and aggressive antitrust enforcement also had downsides. If firms are going to be punished for innovation by being broken up and having their ideas forcibly shared with their rivals, then they are going to be less eager to invest in the sort of expensive and long-term research that might allow them to corner the market and dominate it for years. Without the possibility of dominating a market it may not be possible for firms to justify employing the sorts of researchers whose ideas eventually benefit everyone.

Innovation has been organised in many different ways in history. Today's academia-centred research model has produced quite a few benefits, but it also has drawbacks. Getting innovation back to the speed enjoyed in the 1940s may involve learning from the institutions of that time.

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Getting innovation back to the speed enjoyed in the 1940s may involve learning from the institutions of that time.

Innovative by design

David Stallibrass and John Fingleton CBE

“You can become wealthy by creating wealth or by appropriating wealth created by other people. When the appropriation of the wealth of others is illegal it is called theft or fraud. When it is legal, economists call it rent-seeking.”

– John Kay

Uncertain or discretionary regulation is a common vector for rent-seeking. A firm will spend up to the total of the advantage it gets from a particular way a regulation might be interpreted in lobbying and other rent-seeking effort to attain that interpretation. Firms are good at this. Almost every opportunity to lobby and influence government and regulators to a firm’s benefit will be taken advantage of.

Not all lobbying is duplicitous. Much of it can be constructively aimed at ensuring regulators and policymakers understand the industries and issues they grapple with. But it does destroy value. It misallocates resources, undermines a firm’s culture, and poisons the well of entrepreneurial spirit; of innovating for consumers and firms competing on their merits.

The greater the discretion, and the higher the stakes, the more rent-seeking will take over. Whatsmore, the harm that rent-seeking imposes on productivity growth in each sector is likely to grow over time:

“...rent-seeking activities exhibit very natural increasing returns. That is, an increase in rent-seeking activity may make rent-seeking more (rather than less) attractive relative to productive activity. This can lead to [...] very high levels of rent-seeking and low levels of output.”

Perhaps the clearest example is in big-tech, where a significant set of smaller firms seem to spend almost as much effort taking regulatory chunks out of the incumbents as they do actually trying to compete on the merits.

There is a clear risk of similar substitution of competition for regulatory engagement in financial services where the highly discretionary Consumer Duty imposed by the Financial Conduct Authority (FCA) encourages firms to benchmark performance, pricing, and behaviour against each other while engaging in extensive ongoing compliance conversations with the regulator, albeit with the regulator urging firms to be innovative in the way they do so.

Regulators are often asked to show more flexibility and discretion in the name of supporting innovation: both in the regulations they write and in the way they interpret the ones that currently exist. Where this creates a shift from rigid pro-incumbent regulation then it is sensible, but a constant state of flexibility triggers risks.

The [2022 report](#) by the Regulatory Horizons Council (RHC), ‘Closing the gap: getting from principles to practices for innovation friendly regulation’, suggests a “less codified, more outcomes-focused approach” to regulation. The Taskforce on Innovation, Growth and Regulatory Reform (TIGGR) also extolled “a framework based on risk and outcomes, not ‘tick-box’ compliance” in their [2021 report](#) on a similar subject.

Both reports contain a broad range of sensible suggestions, and correctly highlight some of the benefits of more flexible regulatory approaches in accommodating new and innovative technologies and business models. However, neither report considers the very real costs of increased regulatory discretion and decreased regulatory certainty.

This is the paradox at the centre of increased regulatory flexibility: while it may make space for more innovative business methods and products, it also creates a vector for rent-seeking and lobbying that can undermine the entrepreneurial spirit of entire sectors.

The solution is to adopt the objectives and methods advocated by reports such as those from TIGGR and the RHC, but doing so while targeting and designing regulatory discretion so that any benefits clearly exceed the costs. By making regulations and regulators pro-innovation by design.

It is true that the process of changing regulations to be more innovation focused is itself an opportunity for lobbying and rent-seeking. However, if done well it replaces repeated discretionary decisions with one-shot reform which, due to its size and public and political nature, will also likely be more resilient to accidental regulatory capture. Examples of such pro-innovation reform include:

- **Ensuring the objectives of outcome-focussed regulation are clear and unambiguous.** Good ‘outcome regulation’ includes, for example, replacing the requirement that a heat-pump be 1m away from a boundary wall in order for the noise to not interfere, with a requirement that the measured noise output at the boundary be less than a given number. This precisely captures the underlying issue – noise reduction – but allows firms maximum flexibility in how to address it. Less helpful ‘outcome regulation’ might include the FCA consumer duty that stipulates that consumers must get ‘good outcomes’ across a range of potentially conflicting measures;
- **Reducing the number of regulators’ objectives.** The more objectives that a regulator has to balance in their prioritisation and policy decisions, the less predictability and the greater the discretion. The objectives of Ofcom, [for example](#), have ballooned from two primary and six secondary objectives in 1984 to two principle objectives, ten other duties, and six principles of community obligation, many of which are in tension with each other and require delicate discretionary balancing;

The harm that rent-seeking imposes on productivity growth in each sector is likely to grow over time.

- **Increased use of sandboxes to inject bounded and targeted discretion into otherwise rigid regulatory regimes.** Regulatory sandboxes, where rigid regulatory systems are replaced with more discretion and closer outcome-monitoring for particular innovative firms or products, was pioneered by the FCA and supported by both the TIGGR and RHC reports. They are a powerful mechanism to provide targeted regulatory flexibility to more entrepreneurial firms without undermining broader regulatory stability. Perhaps an economy wide regulatory sandbox could be introduced?;
- **Increased use of block-exemptions to inject clarity into more discretionary regulatory regimes.** Block exemptions, as used extensively in European Union competition law and, thankfully, likely to continue to be implemented in domestic British law, allow particular categories of firm or industry exemption from compliance with otherwise complex and discretionary competition law. They are usually targeted at smaller firms, or industries where there is a low risk of harm. Extension of the block-exemption principle to other areas of complex or discretionary regulations would complement the use of sandboxes for more rigid regulatory systems.

It is tempting for policy makers to just tell regulators to be more sensitive to innovation, to be more flexible, to just ‘make it so’. But to truly make regulation more supportive of entrepreneurs and innovation, regulation needs to be pro-innovation by design. This requires hard work from regulators and government, but without that work, pro-innovation meddling in regulatory regimes may well do more harm than good.

to truly make regulation more supportive of entrepreneurs and innovation, regulation needs to be pro-innovation by design.

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Investment plumbing

Ben Yeoh

The infrastructure for ownership of investments – in particular equity investments in company shares – is an example of a ‘good’ that is mostly intangible, has public value for society, and is routinely underinvested in.

Investment plumbing is a template for how underinvestment in public good assets and in particular intangible ones, has contributed, in my view, to declining productivity. Intangible capital investment is needed, but private actors have incentive and coordination challenges to that capital investment much like they do for public utilities.

What is investment plumbing? Components of investment plumbing include: trading platforms, settlement, reporting and custody systems. Importantly, one area of underappreciated plumbing is on share proxy voting. Share proxy voting refers to the process by which shareholders of a corporation vote on important matters related to the company, such as the election of directors, approval of mergers and acquisitions, and other significant decisions. Shareholders who own common or preferred stock in a company have the right to vote on these matters, either in person at shareholder meetings or through a proxy vote.

In a proxy vote, shareholders are asked to appoint a proxy, such as a broker, investment advisor, or other designated representative, to vote on their behalf. The proxy is given a set of instructions regarding how the shareholder wants their vote to be cast, and the proxy then casts the vote at the shareholder meeting.

The use of proxy voting is important because it allows shareholders to participate in important decisions related to the company, even if they are not able to attend shareholder meetings in person. It also helps ensure that all shareholders have an equal voice in the decision-making process, regardless of the size of their investment.

The investment plumbing of proxy voting is useful for society because it promotes good governance in companies and protects the rights of shareholders. By providing a transparent and secure way for shareholders to vote on important matters related to the company, the investment plumbing of proxy voting helps ensure that companies are managed in the interests of their owners, the shareholders. This is important because companies play a critical role in the economy, and their success or failure can have a significant impact on the lives of shareholders, employees and communities. By promoting good governance, society can help ensure that companies are managed in a responsible and sustainable manner.

In addition, the investment plumbing of proxy voting helps reduce the risk of fraud, errors and other problems, which can have a negative impact on the economy and the financial system.

The investment plumbing of proxy voting also helps promote accountability and transparency in corporate decision-making. By allowing shareholders to vote on important matters related to the company, the investment plumbing of proxy voting helps ensure that companies are managed in a manner that is aligned with the interests of their owners. This promotes a culture of accountability and transparency, as companies are more likely to make decisions that are in the best interests of their shareholders when they know that those decisions will be subject to shareholder scrutiny and approval.

In this way, the investment plumbing of proxy voting can be seen as promoting democracy by giving shareholders a voice in the governance of the companies they invest in and by promoting accountability and transparency in corporate decision-making.

In particular, fostering the link of ownership, voting rights and expression; as well as accountability creates trust in society.

If this is all so great, what's the problem? Most people in the United Kingdom are owners of shares in companies but they are disintermediated from their vote. They will own shares via their pension or ISA, but they own these shares indirectly. The problem is most companies do not know who their ultimate owners are.

Lawyer, Mark Austin, completed a review in July 2022 for the UK government suggesting the average FTSE100 company had one third of its investor base as unallocated (according to Refinitiv data). The government should be aware of this. Near the end of the government's list of 'Edinburgh reforms' for revitalising UK financial services was this: "Delivering the outcomes of the secondary capital raising review" where Mark Austin spells it out.

There are two interrelated problems: rules and technology. There is a two-tier system where retail investors still hold paper share certificates. Part of the reason this system remains is that there is no cheap practical alternative for this if you want to also keep individual shareholder rights easily expressed and maintained. Most retail investors hold shares through a nominee account and thus they are disintermediated and find it hard to vote or find out information about voting.

There is limited incentive for any of the major stakeholders to invest to solve this problem, even if they could coordinate. It's more resource intensive for companies and intermediaries, and benefits shareholders, the public and investors diffusely. Companies want less democracy not more democracy.

This is a microcosm of the incentive problem for public goods and suggests a role for state capacity, or another coordinating force, in catalysing a solution. Learning from some of the success on open financial data shows this type of work can be done and increase consumer welfare.

By promoting good governance, society can help ensure that companies are managed in a responsible and sustainable manner.

The famous father of value investing Benjamin Graham wrote in 1946:

“In dealing with undervalued securities, the analyst is likely to become greatly interested in specific corporate developments, and therefore in proper corporate policies. And from being interested in corporate policies, he may pass over into being critical of wrong policies and actively agitating to bring about correct policies – all of which he considers to be in the stockholders’ interests. For it is true that in a fairly large percentage of cases the undervaluation in the market can be removed by proper action by or in the corporation.

Consequently, by insensible stages of reasoning, the specialist in undervalued securities finds himself turning into that abomination of Wall Street known as a disgruntled stockholder.

I want to say a word about disgruntled stockholders. The trouble with stockholders, in my humble opinion, is that not enough of them are disgruntled. And one of the great troubles with Wall Street is that it cannot distinguish between a mere troublemaker or ‘strike-suitor’ in corporation affairs and a stockholder with a legitimate complaint which deserves attention from his management and from his fellow stockholders.”

Graham outlines techniques of “being critical of wrong policies and actively agitating to bring about correct policies – all of which he considers to be in the stockholders’ interests.” His strategy of ‘shareholder activism’ relies on investment plumbing being able to allow participation from shareholders.

This seemingly esoteric backwater area of financial infrastructure highlights the value of intangible infrastructure. Such infrastructure has public good value for society, which are ultimately shareholders, as well as the companies involved. There are incentive and coordination challenges, but a coordinating force could be a good example of the innovation and investment required to enhance trust and productivity in the UK.

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Responsive regulators

Andrew Bennett

The UK's tech sector now stands on its own two feet. But today's founders are increasingly being held back: no longer primarily by a lack of tax incentives or visa reforms, but by a slow-moving regulatory state. Fixing this can help end our stagnation.

The traditional recipe for societal progress is broken, with public institutions increasingly necessary but not sufficient to solving problems: electoral cycles are too limiting to take a long-term view, structural inertia holds back even the most ambitious policymakers, and the state no longer has a monopoly on large-scale impact.

In contrast, startups are coming to the fore as engines of progress, proving how small, tightly coordinated teams can have an outsized impact on the world. Venture capital, while often derided, is an important ingredient to this model: it's productive – focused on value, not just financial arbitrage, and well-suited to intangible innovation; it's catalytic – enabling capital-intensive advances; and it's patient, working to ten-year timelines. Startups are not arms of the state, but unlocking their breakthrough potential must be a priority for any government.

Indeed, most of the UK's startup successes today have been in regulated markets. These are 'markets that matter', where policymakers and founders can partner in the public interest. And now, the next generation are bringing much-needed innovation both to traditional regulated markets – think real-time credit data or personalised health care – or building in new sectors where the policy framework is still taking shape – think carbon markets or cultivated meat.

Early regulatory innovation has been key to this success. The UK's fintech experience is a case in point. Here, the Financial Conduct Authority's regulatory sandbox provided a virtuous feedback loop between startups and regulators: faster authorisation, improved supervision, and a sustained mechanism to surface barriers and accelerate future regulatory change.

But we are yet to see similar progress in other sectors where, increasingly, founders are focusing and policymakers are under pressure. Too often, we are subject to endless 'red tape challenges' or 'one in, one out' deregulatory mantras, instead of building a continuous, durable capability to understand the frontier of innovation, identify appropriate regulatory reforms, and deliver them as quickly as possible.

The first task of any government looking to fix this is as simple as it is boring: fund and empower the regulators. This might be one of today's most neglected policy levers, but one which has a disproportionately high return on investment. Shouldn't we aim for near-instant decisions on approving licences or permissions? Shouldn't we enable emerging technologies as soon as safely possible?

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Yet regulators, no matter how ambitious, can quickly become a bottleneck if they are without the necessary resources and incentives to take risk.

Consider the Food Standards Agency (FSA): no one is born with the knowledge of how to regulate cultivated meat, but the FSA now stands ready with ambitious reforms on both novel foods and genetic technologies. Only, they can't crack on with setting up new regulatory regimes for these innovations in any reasonable timeline. Startups building autonomous vehicles, drones and space technologies, each with applications that could meaningfully improve people's lives, will relate to this experience.

In health, the government has recognised the funding needs of the Medicines and Healthcare products Regulatory Agency, provided a further £10 million, and set a new operating model to accelerate innovation. It still faces a daunting task – not least adapting medical device regulations, mostly designed for one-off approvals of hardware, to a world of continuously iterative software and AI-based medical devices – but it's been given the necessary support to succeed. Other regulators must now receive the same backing.

The second job, after empowering today's regulators, is both to plug the gaps between them and spot where the sectoral approach is no longer fit for purpose. Technology companies increasingly operate cross-sectorally but our regulatory infrastructure does not. So far, the Digital Regulation Cooperation Forum is a dedicated effort to share insight and resources between 'digital' regulators, but this still leaves out many others. Meanwhile, startups who cross multiple regimes still face high and often duplicative costs early on.

The recently announced AI sandbox is a strong step in this direction, but it must be a wedge into a broader, cross-sectoral effort to enable innovation and pool the risks of doing so. How too could we scale the efforts of the Regulatory Pioneers Fund? How could the Regulatory Horizons Council and Better Regulation Executive have a stronger impact on enabling innovation? These are esoteric bits of the state that few founders or investors think about, let alone voters, but their role in upgrading our innovation ecosystem is often overlooked.

Finally, no matter how quickly authorisations and regulatory reforms come forth, too often the pathway to then scale innovations across the UK state is lacking. There is a huge opportunity to be found in novel procurement methods, like the government acting as a buyer of first resort. But at a minimum, we must pick the low hanging fruit.

Take health, where regionally-tied funding and software-based delivery models continue to clash, where pilots frequently fail to scale, and where there's still enormous duplication across NHS, local authority and central government procurement. Fixing this is critical, not only to save startups and the public sector from wasted effort, but also to realise large-scale potential.

Technology and policy are the twin engines of progress, and we will need both to solve our most pressing problems.

Technology and policy are the twin engines of progress, and we will need both to solve our most pressing problems. For years, startup policy has rightly focused on setting the right ‘horizontal’ incentives and letting a thousand flowers bloom. But now we need a different capability. The next era of innovation is going deep into ‘vertical’ sectors, promising breakthroughs that could directly improve both our lives and our planet. Our regulatory state must be up to the task.

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The power of proactivity

Kirsty Innes

The business of government – determining the laws of the land, and providing services to its people – has come a long way. Over the last decade or so, digital government has become a fully-fledged discipline with a global community, a subject of academic research and an area of keen interest for NGOs.

The ethos and practices originated by organisations like the UK's Government Digital Service have been widely endorsed and replicated. Making services functional, easy to find and simple to use is now seen as central to good government.

But what if citizens didn't even have to look for services – what if services came to them?

Enter 'proactive public services' (PPS) – when a benefit, entitlement or opportunity is provided to a citizen without the need for them to apply for it. Instead, government bodies use new or existing data held about the user to determine that they are eligible for a service, and proactively issue or offer it. For instance, [in Austria](#), once a parent registers the birth of a new baby, family allowance payments are automatically paid to every eligible family.

A proactive approach (sometimes called a 'no-stop-shop') is perhaps most useful for benefits payments and other types of government financial support (the UK's energy bill support measures rolled out in 2022 is one example). But interventions such as proactively offering and even booking appointments for routine healthcare checks or vaccinations could also be considered. As the science around personalised nutrition and healthcare develops, targeted vitamins or supplements might be appropriate (for instance, many local authorities already provide free Vitamin D for babies and children, without prescription. And of course fluoridated water is a long-standing proactive public service).

Services such as driving licences and passports could become more efficient if replacements were issued automatically, much as a bank issues a new debit card before the old one expires. This would reduce the need for urgent renewal services and smooth demand for the issuing authority.

The advantages of the proactive approach are obvious: citizens don't have to spend time and energy claiming benefits, and authorities spend less time assessing applications. Fewer people miss out. Public services become more efficient and more effective.

Another aspect of PPS is the possibility of making benefits more responsive to people's circumstances, so that they receive support when they need it and stop receiving it when they no longer do. Universal Credit is an early example of an attempt to do this.

What if citizens didn't even have to look for services – what if services came to them?

Businesses stand to gain from a more proactive approach to public services in two ways: first, as users of government services themselves. Could local authorities smooth some of the admin burden of paying business rates by proactively offering support to new businesses with the registration process, or regulators nudge them by providing a pre-populated form when, for instance, a licence needs to be renewed? Second, as third-party service providers: the more the public sector is able to understand citizens' needs and differentiate its offer, the more opportunity there is for businesses to play a role in meeting those needs.

Achieving this vision in the UK requires some hefty improvements in public sector data infrastructure (both the technical systems and databases, and the surrounding policy and governance). Most crucially, we need to establish robust expectations and systems to support and govern data-sharing between different parts of government.

'Tell Us Once', a service which allows public bodies to update their records when they receive notification of a death, was a useful, if tentative, toe in the water here. Since then, numerous grass-roots level initiatives aimed at helping to better join up datasets held by different government bodies have sprung up, in many cases delivering valuable results (for instance, the LEO dataset that brings education and employment data together to provide detailed insights into young people's career prospects). The Government Digital Service's work to introduce One Log-In for Government is also a necessary but not sufficient step.

These are useful, but piecemeal advances. To fully bear fruit, a shift to proactive public services would mean opening up the full constellation of datapoints generated by citizens in their interaction with public services so that it could – when appropriate – be used to give accurate predictions as to their circumstances and needs, in a fully secure and privacy-preserving way. This is an ambitious goal, but by no means impossible. One essential element would be a properly functioning digital identity, provided by the state, and useable for both public and private services.

There is also work to do to understand and set expectations about what is an appropriate proactive intervention by the state, and what isn't; to identify the right balance between efficiency and privacy, but also to ensure people retain some sense of agency, rather than being meek recipients of what the state deems appropriate. These balances are understandably sensitive, especially where health or personal finances are concerned. But people are increasingly used to automated nudges and suggestions in their private lives, whether it's a FitBit telling you to stand up, or a bank app that automatically sweeps a certain amount into a savings account every week.

By making sure more people get what they need, when they need it, a proactive approach can help reduce longer-term costs to the state of people suffering all kinds of negative outcomes, from unemployment or poor mental health, to addiction, crime or domestic abuse. Indeed, PPS should be seen as one part of a fundamental shift to a long-term, front-loaded model of public services. In this approach, rather than stepping in only when something has already gone wrong, resources are invested earlier on.

A shift to proactive public services would mean opening up the full constellation of datapoints generated by citizens in their interaction with public services.

In this way, scarce resources can be efficiently targeted to maximise the chances of people leading happy, healthy, fulfilling lives from the outset.

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Treasuring trade

Eamonn Ives

Trade policy has been thrust back onto many countries' political agendas in a way which few can probably remember for a long time, if ever at all. At their most intense, debates around trade policy are bound up as much with geopolitical and national security objectives as they are about simple economics. But most of the time, the focus does remain on the latter. Whenever a new trade deal is struck or a new trading bloc is proposed, it's rare to read reports which don't lead on the question of how much (or, typically, how 'little') they will add to economic growth, or the impact they will have on jobs.

We should be in no doubt that international free trade has overwhelmingly been a blessing for society, and a primary driver behind the skyrocketing of living standards which has pulled billions of people out of poverty around the world. It has also allowed different societies to interact, become closer, and spread a cornucopia of goods and services from one corner of the globe to another. How many – or, perhaps more appropriately, how few – of the things do you consume on a daily basis which are made entirely within your own domestic economy?

Economists have recognised the economic importance of international trade for centuries, millenia even. As was famously noted in the eighteenth century by Adam Smith, and others that followed such as David Ricardo, free trade permits specialisation in an economy. In other words, the ability to which economies can lean into their comparative advantage – and derive the productive benefits which naturally flow from doing so – is determined by the number of people, firms, and countries which we can buy things from, and sell things to.

Access to larger markets also allows firms to grow because they can better exploit economies of scale, and, in the case of smaller businesses, it might even be a prerequisite for their existence – if an entrepreneur is in such a niche market that they can only sustain themselves through selling abroad as well as at home. This fact also permits innovation, in that having an international market as well as a national one to sell to might be the difference between developing a new and useful product making financial sense or not.

Academic evidence corroborates the theory. In a study of similar firms (in this case, rug manufacturers in Egypt), it was found that those which exported experienced a boost to their productivity of around 20% above those which did not. Other data from British firms broadly echo this finding. Studies have also shown how exporting can boost innovation and job growth among small firms.

Having an international market as well as a national one to sell to might be the difference between developing a new and useful product making financial sense or not.

Despite all of the advantages associated with international trade, it is fair to say that challenges to it have been rising in recent years. Regardless of one's views on Donald Trump or Brexit, it is plain to see that they have had a dampening effect on international trade as things stand. This has been compounded by the havoc which Covid-19 put on international supply chains, and the more mercantile mindset which it seemed to inspire among many as a result. Nowadays, you are far more likely to hear people agree with the idea that it is better to locate production within domestic borders, or at least within those of our most trusted allies. Ultimately, international trade as a percentage of global GDP has been on a roughly downward trajectory ever since 2008.

If we are to have as dynamic, innovative, and successful a global economy as possible, these obstacles to trade need to be overcome. While it is possible to excessively focus on trade promotion to an unhealthy degree (a sort of 'reverse mercantilism'), it should be abundantly clear that there is still much more to reduce the burden on businesses which import and export, or on those who want to start doing so. This includes old fashioned tariff liberalisation, to harmonising or recognising different standards (and tackling other non-tariff barriers, which are generally accepted as the most pressing impediment to trade nowadays), and easing the weight of administrative bureaucracy which so often accompanies international trade.

Above all, a future agenda for international trade must be one that is crafted for the economy of today. While once upon a time most economic activity was tangible and based on goods, business is increasingly services-intensive and intangible, and therefore poses new questions to regulatory frameworks and how economies interact.

This shift also poses opportunities, should they be grasped. Most obviously, technological advancements have allowed consumers to buy and retailers sell around the world at the click of a mouse. But they also allow us to track trade flows and conduct customs and other legal operations associated with trade. Understanding how new technologies can help facilitate trade should be a primary concern for governments and bodies such as the World Trade Organization.

Trade between nations has underpinned so much of our economic success to date. It has allowed entrepreneurs to innovate and grow as they tap new markets and satisfy demands of new consumers. It will also play a vital role in spreading the sorts of new technologies – from clean tech to medical advancements – which will allow us to live healthier and happier lives. The international trade agenda might have been buffeted of late, but that doesn't alter the fundamental truth that it remains a key mechanism for delivering a more innovative and productive global economy.

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The international trade agenda might have been buffeted of late, but that doesn't alter the fundamental truth that it remains a key mechanism for delivering a more innovative and productive global economy.

Fuelling the future

Eli Dourado

Energy scarcity is one of the most salient issues of our time. Between supply disruptions resulting from the Russian invasion of Ukraine and the need to reduce the carbon dioxide emitted from fossil fuels, energy supply must now be one of the top priorities for any responsible government.

The tools for supplying energy have never been better. Wind and solar prices have plummeted over the past decade. Subsurface engineering technology – directional drilling and controlled fracking – have gotten much better, leading to opportunities in natural gas as a transition fuel and advanced geothermal technology that could turn the whole world into Iceland. Nuclear technology remains underexploited.

In innovation circles, it is common to talk about research, development, and deployment. With such an embarrassment of riches in energy technology, these elements are now reversed in priority. Deployment of new energy infrastructure must be the top priority, followed by further development of known energy technologies. Additional research is welcome in a few specific areas, but for the most part we have the tools to supply the energy we need to thrive.

DEPLOYMENT

The biggest challenge in energy production is not technology or financing but simply getting the permission necessary to create new energy facilities. Environmental reviews and community opposition can delay projects for years.

There is no perfect energy source, and therefore no energy plant that is completely without controversy. Utility-scale solar plants take over a lot of land. Windmills are sometimes considered eyesores and cause bird deaths. Nuclear facilities come with an irrational perception of the risk of meltdown. Electricity transmission lines are hated for their contribution to visual clutter. Fracking faces opposition because of overstated problems with induced seismicity and contamination of the water supply, which are non-issues when it is done responsibly, but also because of misguided climate-focused opposition to natural gas as a bridge fuel. Pipelines and LNG terminals face similar opposition. Mining for critical minerals has been outsourced to poorer countries that are more willing to suffer the local environmental effects.

It is difficult to see how we can supply enough energy for our populations to thrive if we are unwilling to bear the costs of building new energy infrastructure. We must accept that people will be inconvenienced. We must recognise that even clean energy projects come with environmental trade-offs. And we must not allow the deployment of new, socially beneficial infrastructure to be delayed because of paperwork requirements or small-minded community concerns.

In innovation circles, it is common to talk about research, development, and deployment. With such an embarrassment of riches in energy technology, these elements are now reversed in priority.

DEVELOPMENT

First-of-their-kind energy projects are capital-intensive and too risky to fund using normal project finance mechanisms. Especially for novel geothermal and nuclear applications, there is a case for government-sponsored mechanisms to fund the de-risking of novel projects.

One promising mechanism is a creative contract similar to the one used by NASA for SpaceX to initially develop the Falcon 9 rocket. [The NASA contract](#) was milestone-based, fixed-price, and only shared cost. Each of these elements is important. Milestone-based payments ensure that money does not chase after projects that cannot reach their targets. Fixed price means that the company has to operate effectively. Shared cost means that the company will only pursue the contract if they believe there is a valid business case for the final demonstrated product.

Other mechanisms like loan guarantees or advance market commitments may also be valuable for first-of-a-kind projects.

The nuclear industry may need help overcoming runaway costs. The tendency when designing nuclear plants is to make them large, necessitating many active safety features. These active safety features then require significant regulatory oversight. The regulatory burden on operation and maintenance is substantial, making individual plants unprofitable and unlikely to be duplicated.

This dynamic has made nuclear power relatively uneconomical compared to wind, solar, and gas. There is a case for the government to commission a single nuclear plant design that does not require so many active safety features and then encourage the repeated production of that single plant design. By producing the same simple plant over and over again, the cost of each plant could be driven down, making nuclear energy competitive again.

RESEARCH

Although we mainly already have the tools to produce a great deal more energy, additional research could contribute to energy abundance provided that it is focused on useful and not trendy topics. For an example of the latter, the European Union has invested a lot in the hydrogen economy, although it now seems clear that neither transportation nor energy storage is going to be hydrogen-based.

A valuable long-term need is a better way to convert thermal energy to electricity. Today, our coal, nuclear, and geothermal plants use giant, expensive steam turbines to perform this conversion. Replacing these steam turbines with thermoelectric generators or thermophotovoltaic cells would enable nuclear technology to miniaturise and – in the long-term future – shrink to the point where it could potentially power vehicles and appliances. These solid state technologies could also benefit from manufacturing learning curves, just as solar panels have come down dramatically in price over the past several decades.

There is still a lot of possibility for improvement in battery technology. A ten-fold improvement in energy density is possible while improving batteries on other margins including cost. Much denser, cheaper, and more durable batteries would change the way we design many products, including cars.

Finally, although there is a role for the government in funding fusion research, neutronic fusion seems like a dead end from a grid-scale perspective. It is an expensive way to make steam, and is unlikely to ever be cost-competitive compared to properly executed fission or advanced geothermal. Government funds should instead go toward aneutronic, direct-conversion fusion, which has a longer path to the breakeven milestone but a far brighter future on our electricity grid.

Literally and figuratively, energy is the fuel that drives the engine of entrepreneurship the world over. It is embedded into just about everything of value that we build and consume. Societies which demonstrate the capacity to most successfully harness energy are invariably those which best flourish. With a little more research and development, and a lot more deployment, we can ensure that an ever increasing share of the global population has the means to fulfil its true innovative potential.

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Errors in trials

Meri Beckwith

Imagine you've been asked to sit in on a research ethics committee meeting. The committee is discussing whether to allow a clinical trial for a new drug for Stage 3 cancer to proceed. The drug is for people who have failed to respond to other treatments, and can save lives if administered quickly. The committee meeting, which only meets every eight weeks, gets started. But instead of discussing the medical potential of the drug, the committee members spend the session complaining about the font used in various documents submitted. Minutes slip by, until the time is used up, and the clinical trial (and patients) must wait a further eight weeks before the committee meets again and patients can be enrolled.

Kafkaesque amateur short story? Stress dream? Nope. This was a real research and ethics committee meeting that I sat through as a spectator late last year. The Phase II oncology trial was delayed as a result, potentially costing lives.

The above example is one of many interactions I have had with the UK research committee system, as the founder of [Lindus Health](#). We run faster, more reliable clinical trials so patients can benefit from new treatments sooner. The world of clinical trials is beset with problems; there is an overall stagnation in output of new drugs despite exponential increase in spending on clinical trials (a phenomenon known as [Eroom's law](#)). Things are especially bad in the UK, which should be a world leader in clinical research, but is held back by a uniquely ineffective ethics approval process.

All clinical trials undergo ethical review before they are launched and patients are able to participate. This is reasonable, given the potential (but often necessary) risks involved. In the UK, all clinical trials need to be approved by a [public research and ethics committee \(REC\)](#). Their mission is to 'promote safe research', but in practice they do the opposite. Receiving an initial decision for any clinical study takes a minimum of six weeks, and any change to an ongoing study usually takes four or more weeks to clear. This delay disincentivises research, and the long feedback loops actually make it harder to ensure clinical trials can proceed safely; small changes are often aimed at boosting patient understanding of a trial or participation, but these are not often worth the cost of making the changes. Furthermore the quality of feedback received undermines the entire point of the review process. Here are the experiences of two companies we've worked with recently to illustrate:

1. IMPROVING INHALER ADHERENCE FOR ASTHMA PATIENTS

This clinical trial is investigating how timely reminders can improve inhaler adherence for asthma patients, and provide valuable data for their care providers. There is no risk to patients, they're just receiving reminders to take medication via an app.

After five months of repeated reviews, the ethics committee has still not cleared the study for approval, several times contradicting its own guidance (for instance, requiring all 'he/she' pronouns in study documents be changed to 'they/them' and back again). The delay itself and the hundreds of pages of documents required by the ethics committee has pushed the cost into the hundreds of thousands.

2. PUTTING TYPE 2 DIABETES INTO REMISSION WITHOUT DRUGS

This is a 200-person study for a total diet replacement and accompanying digital therapeutic for type 2 diabetes. The treatment itself is calorie-restricted soups and shakes, that have been shown to consistently put type 2 diabetes into remission. Given the nature of the intervention, there's very little risk, and clear benefits both to participants and to the wider health system.

The committee provided initial feedback after two months. They insisted on changes to language in participant-facing materials that made the documents unintelligible. When they reviewed these changes (after a further six week delay), they pointed out that the document was indeed now unintelligible and asked that it be changed back. Finally they prevented patients on the control arm of the study being offered free access to the study treatment after the study finished. This will disincentivise patients to take part, slow down study recruitment, and is clearly unethical.

There is an overall stagnation in output of new drugs despite exponential increase in spending on clinical trials.

WHAT'S GOING WRONG, AND HOW TO FIX IT

Ethics committees are typically made up of clinicians and 'laypeople'. All posts are typically unpaid, and the work is time-consuming. This means they attract a certain kind of person. Think of a local council planning committee, but opining on the minutiae of clinical trial design. As ethics committees are publicly funded (and free to apply to), there is limited funding available for training. Feedback can be wildly inconsistent, even contradicting the Medicines and Healthcare products Regulatory Agency's own guidelines. This further increases the uncertainties and costs in conducting research. Added to this, there is the usual bureaucratic inertia and preference for the status quo.

To overcome this challenge, the UK should consider two potential solutions:

1. **Pay ethics committee members.** Submitting research to an ethics committee today is free, yet the time cost of delay to starting a clinical study can run into the millions per week. Private research sponsors would gladly pay to fund adequate training and compensation for REC members, in return for faster turnaround times, more relevant feedback and a more predictable process. Of course, publicly-funded/NHS-sponsored research could be exempt from paying.

2. **Make it easier to use private ethics committees.** In the US, most ethics committees are private companies who are closely regulated by the US Department for Health and Human services. They have an incentive to deliver a reasonable, timely service, as slow or inconsistent feedback will result in research sponsors taking their business elsewhere.

The UK should be the best place in the world to run clinical research. The NHS has one of the best, most consistent longitudinal health datasets in the world, and data from UK populations is accepted by the US's Food and Drug Administration (FDA), while costs of administering clinical trials are very low. But the UK's inconsistent and slow ethics approval process disincentivises research run in the UK, handicapping the UK's otherwise excellent research output, and preventing the NHS from adopting these treatments for the benefit of all.

Recall the company providing inhaler reminders for asthma patients. They have given up on their UK expansion plans, and decided to run their trial in the US instead. Sure, getting ethical approval to run a study in the US costs \$4,000, but they can receive approval within a week and any changes to the clinical trial can be made within three days. How many more zero-cost, zero-risk interventions will we discard before we sort out our ethics committee system?

ABOUT THIS AUTHOR

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Taxing questions

Helen Miller

It has become much more common for people in the UK to work for their own businesses. Business owner-managers – who can be self-employed or running their own company – were the fastest-growing part of the UK labour market from the early 2000s until the pandemic. This growth was remarkable by international standards; within the OECD, only the Netherlands saw a larger rise in self-employment.

The UK tax system encourages people to start businesses, while simultaneously discouraging risk taking and some forms of investment. Tax should be reformed to ensure we get the right number and type of business – more is not always better.

LOWER HEADLINE RATES ARE POORLY TARGETED

Business owners' incomes are taxed at lower rates than those of employees. Specifically, overall tax rates on self-employment profits, dividends and capital gains on business assets (including both personal and corporate taxes) are lower than those on employment income. The differences can be large. A job completed through an employment contract will attract income tax and both employee and employer national insurance. Someone doing the same job but working for their own company can have a tax bill that is thousands of pounds lower if they pay themselves in dividends, and lower still if they can take their income in the form of capital gains.

These lower tax rates on the incomes of businesses and their owners are often defended as a means to promote investment, risk-taking and entrepreneurship. And there are reasons for the government to want to encourage some activities in cases where the market will generate too little activity in the small business sector. For example, some businesses may be less keen to try out risky new ideas than would be best for society as a whole, because part of the benefit flows to other firms which can learn from the new products or processes rather than to the one taking the risk. And some worthwhile activity may be constrained by a lack of access to credit.

But lower headline tax rates are poorly targeted. Some businesses are innovative, and others are facing credit constraints that we would like to alleviate. But many businesses are in neither category. As a result, reduced tax rates that apply to all businesses or business owners are not well targeted at the kinds of activities that government policies may sensibly want to promote. The benefit of lower headline tax rates accrues disproportionately to those who make high private returns on their activities – activities that are likely to be viable even without government support.

IT'S POSSIBLE TO HAVE TOO MANY BUSINESSES

At the same time, preferential tax rates create a series of unintended side effects. Aside from the unfairness (because people with the same overall income can pay very different taxes) and government revenue loss created,

The UK tax system encourages people to start businesses, while simultaneously discouraging risk taking and some forms of investment.

giving tax breaks where they are not justified can actually create too many businesses and reduce productivity. Tax policy should not, for example, encourage people to become self-employed (or encourage employers to use self-employed contractors) if they would otherwise be happier and more productive with an employment contract. The rapid growth in the number of small businesses in the UK is often hailed as a success. But this is not necessarily true and this narrative sits uneasily alongside evidence that many small businesses have very low productivity and create low incomes for their owners.

OVERALL, TAX DISCOURAGES RISK-TAKING

And despite the lower tax rates, making investments, and taking risks with the possibility of making a loss, are often *discouraged* by the tax system because of the design of the tax base – the definition of what is taxed. The tax treatment of returns to investment is a mess: incentives vary depending on the asset type, source of finance and legal structure involved and they range from large subsidies to large penalties. For example, there is a disincentive to invest money in (your own or another's) company but a subsidy for many debt-financed investments. The tax base should be reformed to remove, as far as possible, disincentives to invest and take risks and differences across different types of investment. For example, rather than try to use lower tax rates on future profits to minimise disincentives for risk-taking, it would be better to make the treatment of losses more generous. More broadly, removing problems with the tax base would be better targeted at improving investment incentives than preferential tax rates for business owners.

A BETTER TAX SYSTEM IS POSSIBLE

With a reformed tax base, there would be a very strong case for aligning the overall marginal tax rates across legal forms – an additional pound of income earned through a business should be taxed at the same overall rate that would be applied if the work had happened through employment.

If the government wants to go further and actively incentivise certain types of entrepreneurial activity, it should avoid focusing support on activities that are most likely to happen even without the support, as reduced headline tax rates do. Instead, the government should be looking to target support to activities that cannot go ahead or are only borderline-viable without support.

Promoting entrepreneurship is worthwhile, but is difficult and must be approached with care. A good starting point, however, would be to remove (as far as possible) the barriers to investment and risk-taking in the current system – and that is more readily achievable.

The tax base should be reformed to remove, as far as possible, disincentives to invest and take risks and differences across different types of investment.

ABOUT THE AUTHOR

Helen Miller is a Deputy Director at the Institute for Fiscal Studies.

From campuses to companies

Jonathan Simons

To grow our economy, we need there to be a clear pathway for the creation of businesses to commercialise the thousands of ideas that are generated every year in and around universities by staff, students and partner businesses. Ideally, this pathway would encompass support at three stages: creating the first micro-enterprises and startups; providing an environment for them to grow; and hosting them when they are large and sustainable businesses.

It also matters where these businesses are. Only the very biggest businesses – the Rolls-Royces et al. – can create their own supply chains and ecosystems around them. Every other organisation will seek to go where the ecosystem around them is already supportive. This ecosystem needs to encompass access to capital, talent and staff, and other businesses and organisations in a similar stage.

Unfortunately, the UK state has made it harder than necessary for these ecosystems to grow. Those that have been created – such as Cambridge, with an ecosystem around the university that is delivering billions of pounds annually just through its spinouts and partnerships – are feted, but rarely does government ask why they are exceptional.

Specifically, at all three stages of growth, the environment for our would-be unicorns and new companies is hostile:

First, spinning out. Universities take an IP share from innovations created by their staff and students and graduates, which is reasonable. But the share taken varies hugely by universities, and is high by international standards. [Research from Founder of Air Street Capital Nathan Benaich](#), crowdsourcing spinout data from across 2021 and 2022, suggests UK universities took on average a 19.8% equity share – over three times what US universities take (5.9%) and 2.8 times what EU universities take (7.3%). The same data shows that time taken for a university to move a product from idea to spin out is also cumbersome, averaging more than six months – twice as long as startup rounds.

Second, scaling up. At this stage, companies are still erratic in growth, and often not able to take out long standing contracts and pay commercial rent. They need an ecosystem which incubates them, and locates them close to other organisations like them; people who can give technical advice; and a sense of community from other founders. They also need access to technical facilities such as labs. Yet accessing this on commercial grounds is hard – and therefore the commercial imperative for universities or private funders to meet these is also hard. A suboptimal equilibrium develops. We need the creation of what we might call dedicated scale-up facilities in the UK – owned by universities but backed by non-profit maximising funders (either from patient capital, or social investors, or government) to allow organisations to scale.

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As well as lab facilities, they need a plug-and-play set of offices, technical capacity, and an ecosystem of facilities whereby founders can meet suppliers, other organisations, investors, staff, and educational providers. The oft-quoted example of Silicon Valley has this, but so too do flourishing areas such as Boston in the US (centred around Harvard and MIT) and Paris in France.

Third, growth. At this point, our large company needs facilities in order to scale beyond the university, but still wants to retain links to the ecosystem of smaller companies and innovation going on. They can pay commercial rent – including on things like lab space. And yet, in our most thriving areas of the country for scaling new enterprises, it's near-impossible to build lab space. To quote directly from a recent report:

"[D]espite estimated laboratory demand of 335,000sq ft per year across Oxford and Cambridge, new supply has been less than 150,000sq ft annually. This equates to more than 200,000sq ft of unmet demand each year. As a result, rents have soared. Laboratory space in Oxford and Cambridge costs almost £50 per sq ft, more than twice that of rival European cities like Amsterdam or even Paris. London is more expensive still, with annual rents having reached an eye-watering £92 per sq ft – 25% higher than office space in the City. Crucially, international competitors aren't standing still. In Boston alone, ground was broken on more than 3.9m sq ft of lab space last year."

Planning reform – or lack of it – stymies our highest growth sector. There is no direct train route yet confirmed from Oxford to Cambridge. House prices are exorbitant. For a large, innovative company wanting to grow, we couldn't make it harder for them to grow in our economically strongest and most innovative areas.

Ideas, money, estates, people. That's a mutually reinforcing agenda for growth, and should allow the UK to create more unicorns, as well as a long tail of companies and innovative products at all sizes. We have plenty of ideas being generated in our leading universities. But without support to grow, they may as well stay in the lecture theatre, library, lab, or pub where they were first dreamed up.

ABOUT THE AUTHOR

Jonathan Simons is a Partner, and Head of the Education Practice, at Public First.

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Passport to prosper

Bella Rhodes

The UK is a global leader in tech because it draws to it many of the world's most talented people who regard it as one of the best places in the world to start, grow and scale a business. London, especially, is the engine of our entrepreneurial ecosystem: it's not just a hub for our own domestic talent pool, it exerts a magnetic pull for the best and the brightest from across the globe.

On paper the UK's immigration system is equipped to support the talent it attracts – a system designed to welcome high-skilled migrants to come and benefit our economy. In practical reality however, this is not always the case.

Like saplings, startups are vulnerable in their early stages. Few survive to adulthood. Startups are time and cash poor making two of the most frequent startup-killers unexpected costs and unexpected delays. Both of these are things our immigration system regularly throws at startups. Compounding these stressors, startups are often innovating at the cutting-edge of what is possible – from AI to climate-tech – so this means the talent pool from which they can draw is very small. Often when a startup needs to make use of the visa system it will be for a business-critical hire. This means the practical functioning of the UK's immigration system should be regarded as a fundamental ingredient to the UK's continued tech success.

From conversations with founders, there are three main areas that need tackling.

Firstly, and most importantly, on average startups are stuck in the immigration system far too long. When a startup needs a crucial hire, they need that person quickly: startups don't have the flexibility of a large corporation with an HR department that can easily deal with reams of paperwork, nor do they have the ability to rearrange projects to accommodate long delays. The Home Office has targets for applications: 90% should be decided in three weeks, 98% within six weeks and 100% within 12 weeks – but too often we speak to startups where the decisions have been delayed by three months or more. The problem is not policy intent – it is red tape and delays within the Home Office.

Cost is also an issue startups often raise. Early-stage startups have tight cash-flows. For a standard Skilled Worker visa, the startup needs to pay £199 for registration as a sponsor, a £364 Immigration Skills Charge, up to £719 for the application itself, followed by a yearly £624 Healthcare Surcharge – then there are constant lawyer fees to ensure paperwork is in order. There are other options beyond the Skilled Worker visa that skip formal sponsorship (and its charges) but not all of these work for startups. Expanding the Youth Mobility Scheme to the US, expanding the High Potential Individual visa to include top university graduates, and reforming the Scaleup visa so that it works for the startups it was originally designed for should be urgently examined.

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Finally, awareness and understanding must be increased. While the UK's immigration system currently offers lots of options for skilled talent, that flexibility has bred complexity. When the options are different for a cyber specialist compared to a generalist, an Australian under 30 compared to an American under 30, or a graduate from the Université Paris Sciences & Lettres compared to a graduate from the Sorbonne, it is no wonder startups are confused. And like most issues in the startup ecosystem, any problems will land on the desk of the founder: early stage startups don't tend to have the back office functions more established and traditional companies have. Founders deal with everything.

Innovation in the UK relies on a well functioning immigration system that founders can rely on; but right now bureaucracy and complexity are major barriers. If startups cannot easily hire talent within the UK they will go elsewhere. The intent is all there in the Government's policy – now, we just need the delivery.

ABOUT THE AUTHOR

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Going places

Harry Rushworth

Amongst developed countries, there is a trend that as a city's population grows, so does its productivity, as residents gain greater access to education, employment and leisure, not just in scale but also in variety. Employers too have more people to choose from, meaning they can hire staff best suited to a role. These 'agglomeration' benefits are why larger cities usually have higher productivity and GDP per capita. But this correlation between city size and productivity does not hold within the UK. Though Britain may have large cities, they are not necessarily more productive than their hinterlands. Economically speaking, this is very weird.

As a city grows, the number of journeys within it increases too, placing a strain on the existing transport infrastructure. Left unresolved, a city may grow without actually improving access, and thus could be considered a collection of contiguous towns rather than a unified whole. In order to gain agglomeration benefits then, the population of a city with access to the economic opportunities at the centre needs to grow, not just the number of people tacked onto the outskirts. In order to avoid stagnation, cities need to continually invest in their infrastructure to maximise access.

Whereas a single car lane may transport just 2,000 people per hour, a right of way for trams or trains can move a magnitude higher, at anywhere between 18,000 and 90,000 people per hour depending on the technology and mode used. This much higher throughput, combined with faster average journey speeds, means rapid transport can increase the effective size of cities, thus enabling higher productivity, as well as saving people time travelling. Strong rapid transport networks in our largest cities should therefore be seen as a necessary investment to improve quality of life, and that's before considering the strongly positive environment and health benefits from increased active travel and less polluted air.

London might be renowned for having one of the best transport networks in the world, but by British standards our capital is an exception rather than the norm. The second and third cities of Birmingham and Manchester have no metro, and rather small and congested tram networks. Beyond them, provision is even more sparse, with Leeds and Bradford, a combined urban area of around two and a half million people, having to rely solely on unintegrated bus networks and slow regional rail.

Contrast this to our neighbours across the Channel, and the picture is starkly different. Of urban areas in France, Germany, and the Netherlands with more than 500,000 people, over 80% have a form of fixed rapid transport. In the UK it's a meagre 50%.

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TABLE 1:

Percentage of urban areas larger than 500,000 people with a rapid transport system

	UK	Netherlands	Germany	France
Metro / U-Bahn	25%	60%	15%	38%
Light rail / tram	30%	80%	78%	88%
Either system	50%	80%	85%	94%

Functional urban areas as defined by the OECD on 2015 population.

It does not need to be this way. If you were to compare the Netherlands and the North of England, you would find many similarities: both are former industrial heartlands with a similar land area, population, and density, yet they have wildly different economic outcomes, with GDP per capita around 50% higher in the Netherlands. The most important difference in infrastructure is the quality of the public transport network, with quadruple the number of metro and tram stops in the Netherlands, and high-quality access for pedestrians and cyclists into them.

This wide gap between British and European cities isn't there for lack of trying. Leeds attempted to initiate a tram network several times in the noughties, and the regional authorities in Manchester, Birmingham, and Bristol have all touted ideas for future metro networks to no avail.

Despite the ambition to improve transport networks in their cities, however, local authorities in the UK have neither the power nor the independent revenue source to construct their own public transport systems without central government approval and financing – unlike their continental peers. This means that councils in the UK not only need to have good relations with the government of the day, but that central government also needs to be convinced that a project is a worthwhile investment, which is a problem when infrastructure projects can often take years to provide a return.

The reality of centrally managed infrastructure funding means that London is competing with Leeds and Liverpool for the same pot of cash, so when officials in the capital assess business cases for investment, they not only have a personal stake in seeing that money be spent closer to home, but often the cases themselves actively encourage that. The scale of population and economic output that London has means that the regions can't compete on an even footing. And where the central government has allocated funding for public transport around the country, it has primarily been on headline-grabbing national schemes rather than locally within cities. Projects like HS2 and the East Coast upgrade will improve connections between city centres, but the investment needed for residents and businesses to access those central stations has been neglected. A more localised approach to how we prioritise infrastructure investment is needed if we are to emulate the regional prosperity of our neighbours.

Rapid transport networks are a key enabler of higher housing densities and thus should be considered a key tool in tackling the housing shortage without needing to expand development to too much greenfield. The Bus Services Act, passed in 2017, is the first page in this new chapter, giving regional British cities the powers to manage and regulate their bus networks in the way London has exceptionally done so for decades. As of yet, only Greater Manchester has been able to navigate the red tape to do so. We need to support other cities to do the same.

Though regional British cities may underperform today, the evidence from Europe suggests that this is not inevitable. Urban rapid transport investments are one of the best tools at our disposal to boost the productivity of our cities, increase access to labour, and spur greater innovation. They should be a priority for central government and local authorities alike.

ABOUT THE AUTHOR

Harry Rushworth writes about transport and planning and is a former Chair of the Transport for London Youth Panel.

Urban rapid transport investments are one of the best tools at our disposal to boost the productivity of our cities, increase access to labour, and spur greater innovation.

A recipe for success

Hermione Dace

Many of us have enjoyed a period of eating what we want, whenever we want. But this era of cheap, abundant food – that has come at enormous cost to the planet and our health – is now coming to an end. Creating a food-secure future will require radical changes to the way we produce and consume food.

There are growing signs that our food system is broken. The latest is the lack of lettuce on our shelves. Supermarkets have been placing limits on fruit and vegetable sales due to shortages, partly because poor weather is affecting harvests in Europe and North Africa. Unfortunately, these shortages won't be a one-off event. Extreme weather from climate change poses the biggest mid- to long-term threat to our domestic food supply.

As well as suffering the consequences of climate change, the food system is also one of its major causes. It is the second biggest contributor to climate change after the energy industry. In the United Kingdom it is responsible for around 30% of emissions.

Beyond emissions, agriculture is also the world's greatest cause of environmental destruction. To zoom in on the UK specifically, agriculture takes up 70% of the land's footprint, and is the biggest cause of habitat destruction, soil degradation and biodiversity loss. What was once a green and pleasant land is now one of the most nature depleted countries in the world. Not only does all of this impose a huge financial burden on the taxpayer, but the industry is also pushing the earth's systems beyond their limits.

Much of this damage is caused by animal agriculture, which is wildly inefficient. Eighty-five percent of the farmland that feeds the UK is used to rear animals, but meat, dairy and eggs only provide 32% of the calories we eat. The opportunity cost is huge – every acre of this land is an acre we can't use for natural ecosystems, housing, or renewable energy generation.

Our health is at risk too. The Covid-19 pandemic highlighted the growing risk of zoonotic diseases – the predominant cause of which is agriculture. Overuse of antibiotics in pigs and chickens is responsible for the majority of antimicrobial resistance worldwide, threatening the future of medical care.

Despite – or perhaps because of – the scale of the problem, the food system is often neglected when it comes to policy solutions. The UK government's climate adviser, the Climate Change Committee (CCC), has repeatedly pointed out our slow progress on net zero across food and land use. Emissions from agriculture have changed very little over time compared to other sectors.

As well as suffering the consequences of climate change, the food system is also one of its major causes.

But there are reasons to be optimistic. Innovations – from cultivated meat to vertical farming, gene editing and precision agriculture – mean a different future is possible. Drawing on scientific breakthroughs, these technologies enable us to produce more food on less land, with fewer emissions. Technology can help us feed the world.

Companies are already innovating the way we make our meat. Just as the horse and cart made way for faster, more comfortable cars, animals in factory farms can make way for lower-emission, land-saving, slaughter-free meat. By scaling cultivated meat and precision fermentation technology, consumers can still enjoy eating what they want, but with less strain on our natural resources. For the government, supporting this industry would require far less political capital than implementing a highly unpopular meat tax, for example.

And thanks to technology, growing crops is no longer constrained by traditional growing cycles and weather conditions. Vertical farming enables us to produce fresh produce all year round, even as increasingly volatile weather risks conventional production. We can grow gene-edited crops that are more resilient to pests and drought. And we can use the power of artificial intelligence to improve the treatment and harvesting of crops. The CCC reckons the UK can increase crop yields by 25% through crop breeding and improved farming practices.

Not only can these technologies help fix our broken food system, scaling them also presents an opportunity for green growth. One report shows that scaling cultivated meat would unlock £2.1 billion of GDP growth, create 16,000 jobs and boost tax receipts by over £500 million.

But this food revolution is not inevitable. For it to happen at the speed and scale necessary it will require government support.

Government must invest in the technologies that will help feed the future. In the same way that public money has made renewable energy cheaper than fossil fuels, public money can help food technologies to scale so we can reap their benefits. The countries that support the food tech revolution will also establish themselves as science and tech superpowers, while attracting the best talent from around the world.

Government must also foster a supportive regulatory environment. Many new technologies like cultivated meat must be regulated. But while the pace of innovation in food tech is extremely fast, regulation is struggling to keep up. We need a regulatory framework that supports innovators while maintaining high standards.

The UK faces an opportunity to be a food technology leader, developing a domestic supply chain and exporting our tech as other countries follow our lead. But to do that we need a policy framework that enables leadership in applying and developing new food systems.

Innovations – from cultivated meat to vertical farming, gene editing and precision agriculture – mean a different future is possible.

With supportive policies, a decade from now we could have a world-leading food system, delivering sustainable and nutritious food. And we'll have benefitted from the growth, jobs and food security that it will bring.

ABOUT THE AUTHOR

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On solid foundations

Nicholas Boys Smith

In a [brilliant essay](#), economists Sam Bowman, Ben Southwood and John Myers recently expounded ‘the housing theory of everything’. A lack of homes in the right places in too many Western countries, they argued, explains not just declining living standards but sluggish productivity, stodgy innovation, regionally entrenching inequality, declining birth rates, unsustainable living patterns and even growing political extremism.

I agree. High rents decimate disposable income and benefit landowners and the few at the expense of workers and the many. It’s not for nothing that Conservative political success in the twentieth century was the success of the property-owning democracy. Inadequate housing supply destroys labour market flexibility, making it exponentially harder to slot the right person in the right job at the right time. And people who cannot earn top salaries are unable to move to higher income places at all, entrenching regional disparities. Nor can families form with no home to move to, nor any spare bedrooms in which children can live. The wrong being done to the young and the poor by an inadequate housing supply is profound. It is no exaggeration to say that it potentially threatens our stability as a society as regional towns and cities hollow out and a surfeit of overqualified, underpaid graduates compete for fewer and fewer, smaller and smaller flats in an overwhelmed South East.

Yet the politics remains stuck and stodgy. Parliamentarians, councillors and local groups all concede the need for more homes in *principle* but find ever more ingenious reasons to oppose more homes in practice: newts, views, fields, shadows, wind, shops and traffic are all adduced to prevent homes. As a society we have fallen out of love with the future and stuck in a deeply inadequate present.

But here’s the rub. I don’t blame the NIMBYs. In fact, I agree with them. Too many of the developments we have created over the last 70 years are ugly and thoughtless, profligately dispersed or lumpishly over-scaled, careless of the local and heedless of the landscape. They are ugly and they encourage a systemic social resistance to new homes. Don’t agree with me? It doesn’t matter. The British public do. [Two percent](#) of the public (that’s not a typo) trust developers and 7% trust planners to create new developments without making existing places worse. Until these figures change it is impossible to fix the politics.

The revealed preference data is even clearer. When, vanishingly rarely, we manage to create new places with the walkable and humane qualities of older places they typically sell at value premiums of between 10-25%, as research from the [UK](#), [US](#), [Holland](#) and [elsewhere](#) shows.

More beautiful places are not just more popular. They are good for us as well. Many of the components that make settlements beautiful also make them healthy, happy and sustainable.

A beautiful place is a place in which people wish to walk, rather than a place that the car helps them to avoid. It is a place in which they enjoy spending time with one another. It is a place to be, to work, to live, to teach, to learn, to love and to shop. It is a traditional town, neighbourhood or village. The evidence consistently shows that such places are more popular, perform their roles as centres of productive agglomeration and commerce better and are healthier, happier and more prosperous. By contrast, streets with more traffic or faster cars are reliably and consistently associated in academic research with poorer air, fewer neighbourhood friendships, less walking, more constrained children, lower residential land values. That's why rich people tend to avoid them. They are the very opposite of the idea and belief in the importance of home. They turn our neighbourhoods from a place into no place, from somewhere into anywhere.

The best examples of new English developments are Poundbury in Dorset and Nansledan in Cornwall by HM King when he was Prince of Wales. Three critical differences between these neighbourhoods and most new housing estates are the more beautiful buildings and streets, the many spaces for local shops and commercial spaces and the ease with which you can walk about. Both sell at a premium, require less land, are more locally popular, house more jobs and have a higher proportion of affordable housing than is average. They are creating virtuous circles of places.

The English planning system now requires that new developments be popular and beautiful but many professionals remain deeply sceptical that this is necessary. The public and private sectors certainly struggle routinely to create loveable streets and buildings. But until we do, we will live less happy, less connected lives with less sense of neighbourhood. Critically, we will also continue routinely to oppose the new homes and places that we so desperately, desperately need.

ABOUT THE AUTHOR

Nicholas Boys Smith is the Founding Director of Create Streets and the Chair of the advisory board of the Office for Place.

Inadequate housing supply destroys labour market flexibility, making it exponentially harder to slot the right person in the right job at the right time.

The price of parenting

Annabel Denham

How childcare is provided and who pays is under the political spotlight. The Labour Party is promising a plan like “the birth of the NHS” and at the recent Spring Budget, the Chancellor set out a plan to expand the existing subsidy to cover children from nine months through to school age.

Until the 1990s, decisions on childcare arrangements were largely a private and charitable matter. In the intervening years, a consensus emerged that provision was a matter for the state. It now has a number of objectives: to make it more affordable; to raise the quality; to improve the educational attainment of (under-privileged) children; and to maintain parental labour market attachment, particularly among women.

With the first goal in mind, public spending on the sector has risen from the hundreds of millions in the 1990s to roughly £6 billion per year today. Much of this is spent on a childcare subsidy for three and four year olds, where all parents get 15 hours ‘free’, and most get 30. There are also additional programmes for working parents and ‘disadvantaged’ two-year-olds, subsidies through the benefits system, tax reliefs, VAT exemptions, Sure Start centres and after-school care support.

The subsidies have increased demand for childcare, which has, in turn, contributed to higher prices. Today, parents face high out-of-pocket costs: recent research from the charity Coram found the average annual cost of full-time childcare for an under-two-year old is now £14,836. The annual cost rose by 171% between 2000 and 2021; over the same period, household earnings increased by just 66%.

Consequently, childcare for many low to middle income households has been simply out of reach. And, as costs have risen, so too have demands for more state ‘investment’ in the sector. This has led the government to open up what the Institute for Fiscal Studies described as a “new branch of the welfare state” by pledging to expand “free” childcare to cover all children from nine months until they begin school, from September 2024. This will come at an additional £4 billion to the taxpayer. And it is not means tested, leaving those on lower incomes, who perhaps don’t have children, subsidising wealthier parents who would have paid for it anyway.

This reform will leave Whitehall in charge of the price of 80% of all pre-school childcare in England (up from just under 50% now). Payments go directly to nurseries and government has imposed a standard rate, which for the existing subsidy has left some providers out of pocket. This forced nurseries to raise prices for non-subsidy children (i.e. those requiring wraparound care, or those too young to be eligible). Those unable to recoup costs closed: the overall number of providers in England, for instance, dropped by around 4,000 between March 2021 and March 2022.

While government pledged to increase the amount in the latest Budget, the stakes for getting the rate right are now far higher, given cross-subsidisation will no longer be possible.

The massive increase in childcare subsidies has been welcomed in some quarters. But it does not address the underlying costs and lack of supply, because it is only part of the childcare puzzle. In order to achieve its second and third objectives, the state has imposed ever-expanding requirements, which have driven up costs, raised barriers to entry and stifled competition. Regulations include teacher-to-child ratios, burdensome record-keeping, staff qualifications and safety measures. Though the government has just loosened ratios for children over the age of two (from 1:4 to 1:5), it should really be left to individual providers to decide appropriate ratios according to the needs of the children in their care. Ours remain among the strictest in Europe.

The Childcare Act 2006 and the Early Years Foundation Stage (EYFS) was introduced in 2008 (in England). It is based on an educational model of childcare, which for many children who use nurseries for a limited period is probably unnecessary. The hours spent observing and photographing toddlers could be put to better use.

Childminders must pay to register with Ofsted or a handful of childminder agencies in a process that takes up to 12 weeks. They must follow the EYFS and are inspected by Ofsted. They can only care for a maximum of six children under the age of eight at any time, just three of whom can be below age five and just one child below age one. Matthew Lesh and Kristian Niemietz calculated that bringing regulation more in line with our European neighbours could lead to a reduction in costs of around £300 per child per month.

Female workforce participation has become an increasingly polarised element of the childcare debate. On the one hand, there are claims from some on the 'left' that more women want to work, to work more hours, and that by expanding the 'free' provision we would see greater labour market retention – leading to higher Treasury receipts. On the other, groups on the 'right' like Civitas insist more women want to stay at home with their children. Both underline the pitfalls of polling, and the ways in which it can be deployed to further a certain agenda.

Subsidised childcare didn't significantly increase parental participation in both France and the Netherlands. While more generous provision may lead to fewer women off-ramping after the birth of their children, these effects should not be exaggerated. The proportion of mothers of dependent children who are in work here in Britain is already at historically high levels. The numbers in employment with their youngest child aged 0-2 are lower than in Sweden, but well above the EU and OECD averages.

The point should surely be that parents need choice. Government has limited this by pumping up demand through subsidies and choking supply through regulation. Instead, it should deregulate in areas such as the EYFS and restrictions on childminding.

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We should place more faith in providers to establish their own educational frameworks. Where public funding is required, it should be much more targeted and involve putting top-up vouchers in the hands of parents, leaving nurseries to set their own fees to match local conditions.

In doing so, we can stem the withdrawal of many providers from the market, while lowering barriers to new entrants. We could open up the possibility of more innovation in the sector: some providers could adopt more flexible models, with parents paying on a daily or weekly basis according to their needs. This would be particularly beneficial to gig or self-employed workers. We could breathe new life into a beleaguered industry, rather than resigning ourselves to the idea that nationalisation is the only option.

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Demographic dilemmas

Ellen Pasternack

1972 was the last year that Britons had enough babies to replace themselves. It's a similar story in wealthy countries around the world: France, 1974; Germany, 1969; Japan, 1973; Canada, 1971. The United States had a brief burst of replacement-level fertility in the 2000s, but otherwise has been below-replacement since 1971.

Most wealthy countries haven't felt the full effect of falling birth rates because they have kept their populations topped up via immigration. But this may not always be possible. As countries like Mexico, India and Bangladesh have become wealthier, their birth rates too have dropped off. Many countries we may previously have thought of as crowded with large families are now also at below the 2.1 replacement rate. The last century's explosive growth in the world's population is already beginning to slow; demographers predict that within this century the total number of humans will plateau and then start to decline.

To some, this news is reason to rejoice. Many environmentalists have long argued that such a large population of humans cannot be supported long-term on a finite earth. But while a rapidly growing population poses major challenges, a shrinking population – either locally or globally – poses challenges of a similar, if not greater, scale.

One worry is that a shrinking population will also mean an ageing one, threatening the viability of state finances. Since the state pension was introduced after World War II, the proportion of people in the UK aged over 65 has increased, from just under 11% in 1950, to 19% today, to a projected 22% in ten years' time.

This shifting age profile risks creating a vicious cycle exacerbating many of the problems Britain is already facing. Our healthcare system and social safety net – already strained enough as it is – demands higher and higher taxation to stave off collapse. Infrastructure crumbles as maintenance and upgrades are postponed, and postponed again. Increasingly squeezed working age adults, supporting more and more elderly, can afford fewer children themselves.

At a certain point, the numbers can no longer be made to add up. Will today's children be left, childless and alone, to fend for themselves in old age, after spending their working years providing for the generations that went before?

Then there's the human aspect. Take South Korea as an extreme example, where the average woman can now expect to have 0.81 children in her lifetime. This is less than half of the replacement rate – meaning that without immigration, the population would decrease by more than half with each generation: twenty grandparents could expect to have between them less than four grandchildren.

It's hard not to feel a pang of sorrow at the scale of loneliness this rapid reduction in the number of humans would represent, replicated around the world. (Another sad fact of dwindling populations is that minority cultures and languages are more likely to face extinction.)

To a large extent, fertility decreases because we choose to have fewer children. Now that women are free to decide what to do with their lives, hardly any choose to have the half-dozen or more babies that were their mothers' and grandmothers' lot in life whether they liked it or not.

But decreases in birth rate go further than personal choice. In the UK, as in many countries around the world, people on average end up having fewer children than they would like.

In many cases, this comes down to money. While it's true that we're richer than ever before, children have also become more expensive than ever before. In the past, children were an economic asset: from a young age they would help with the tasks of the home, or be sent out to earn a wage. Nowadays, child labour is – rightly – illegal, but this does nonetheless mean that children must now be constantly, and expensively, supervised.

This means that the extortionate cost of childcare holds people back from having children. Housing, too, is another major cost preventing people from expanding their families. The UK's blocks on house building reduce our GDP and systematically drain wealth from the young in particular, leaving them with less money to spare for starting families. One analysis estimates that the house price inflation in the UK prevented the births of 157,000 children between 1996 and 2014. The housing shortage also likely decreases local availability of childcare – when housing is scarce, rents will be higher and workers harder to attract – and makes everyday life more expensive and impractical for parents in many other ways, from neighbourhoods that are less walkable and child-safe, to being forced to live further from extended family.

Another reason people might not have as many children as they would like is later relationship formation. A British cohort study reports that, of people who wanted children but remained childless at the age of 42, by far the most commonly stated reason for both men and women was that they “never met the right person”. The majority of babies in Britain are born to married or cohabiting couples: taking these steps later therefore means having children later, and having fewer of them.

Social conservatives might lament that this is the fault of hook-up culture, or the unrealistic expectations of over-educated women. But less social and economic pressure to marry immediately – and the fact that women in particular can now afford to have standards – is a good thing. It does mean, though, that some people who want children won't have them, unless mitigating steps are taken to make parenthood more accessible.

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Less than half the population does paid work. If we continue to have low birth rates, this ratio will get worse, leading to ever-increasing taxes and declining public services. Innovation and economic growth needs people – and we're in danger of running out.

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Anticipating intelligently

Tom Westgarth

It is easy to look back with clarity on the pandemic. At this distance it is clear the signs were all there. Lockdowns in China, the heaving hospital wards in Lombardy. Even the exponential growth data in January and February 2020 should have pointed to one conclusion – the international community had to act and act now.

The rampant growth in AI is a similar story. GPT-3, a landmark large language model (LLM) that can predict the next sequence of words in a sentence, was produced by Open AI in June 2020. Since then, the open-source community has iterated and improved models faster than many could imagine. It is not just poems and art that the new era of 'generative AI' has produced: new tools and businesses have helped to design antibodies, produce new music, and have even become a Linux terminal. The release of GPT-4 in the last few weeks makes ChatGPT, which only went viral in December of 2022, look like the dumber, less mature younger sibling. Time moves fast in AI years.

It is worth remembering that the Covid-19 response was completely botched, despite respectable institutions being in place. The World Health Organization (WHO), all the various national health security agencies, and the Centre for Disease Control got it wrong on the initial virus risk, and even on basics such as masks and scaling up testing. Even with all those institutions in place, governments still failed to deal with the crisis.

And yet we barely have a Health Security Agency equivalent for AI, let alone a WHO. Offices for AI are not equipped to deal with the next generation of emerging challenges and opportunities that AI poses to the economy and society.

Take the UK's approach. The government's AI strategy, whilst highly regarded by experts in its aims, was not even funded. Its Office for AI, while producing policy and research, has no statutory regulatory mandate and has arguably not been given the political prioritisation it deserves in order to coordinate responses to AI.

Technologists and entrepreneurs eagerly await this year's release of the UK's 'pro-innovation' regulatory framework for AI. But with the Office for AI only staffing a couple of dozen or so employees, the team there has its work cut out if it is to anticipate and respond to emerging challenges, as well as creating an environment for markets to mature.

There are big questions that already need to be answered. We want people to be able to use AI tools for creative purposes. But how do we enable people to create AI music while also ensuring that artists' IP is protected? If someone creates original music from AI trained on web-scraping tools (tools that harvest data from the internet), have they violated copyright? This question is already on lawmakers' desks and we have no answer.

UK-based Stability AI, the latest potential AI leviathan behind [Stable Diffusion](#), is now facing a [lawsuit](#) for allegedly scraping artist's work without their consent. The outcome of this case and the subsequent regulation will be significant for the future of the British AI market. Are the relevant UK government departments going to be proactive and make legislation or will a judge decide the course of AI copyright in the UK? Technological maturity will not be brought about without institutional maturity.

Fundamentally, we require better institutional capabilities to arm Ministers and officials with information of this kind and we need new mechanisms too. As models and the dilemmas they pose increase in complexity, our institutional capacity must also.

One potential approach is that the Office for AI leads a 'whole of government' foresight approach to understanding how to benefit from AI's disruption. The Office for AI should go to every single government department, and ask them to consider all the potential ways in which public services and society could benefit from new generative AI tools, and ways in which they could cause major problems. For the highest-impact scenarios, the Office should work with respective departments and industries to develop an adaptation framework at different stages of the AI tool's development and use. A 'mitigation framework' example was [provided](#) by Stanford Cyber Policy Centre and OpenAI for dealing with emerging disinformation threats.

This tactic should be part of a suite of new responsibilities that an expanded government AI body takes on. The Office also needs to play a pivotal role in monitoring and structuring access to compute, through new resources such as the National AI Research Cloud proposed in the [Future of Compute Review](#). These are recommendations central to [our Institute's recent 'New National Purpose' for science and technology paper](#). Talk of being 'AI ready' is cheap, but if you do not have the talent, foresight, and ambition to be able to respond in an agile way to emerging risks and opportunities, you may as well stay at home.

As things stand, little of this is a political priority. 'Horizon scanning' to understand emerging AI does take place in some departments, albeit in a disparate manner. Dedicated teams within the Office for AI function need to take on this role, but that will only come if the Department for Science, Innovation and Technology gives it the backing that it deserves.

Nowhere is AI currently on a list of 'most important issues to the public'. But tomorrow, a national scandal (for example, a huge cyber hack of a public database assisted by GPT-4) would catapult the field into being a key voter concern.

Public policy is partly a game of adaptation. Good adaptation is what can separate a good government from a bad government. In the AI arena, where the stakes are even higher, the outcome of such adaptation could make or break markets, empower or control communities, playing a principal role in guiding the future of humanity.

Technological maturity will not be brought about without institutional maturity.

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Pioneering procurement

Emma Jones CBE

Despite representing a third of all government spending and a tenth of the entire economy, public procurement is not widely debated in the media or anywhere else.

Anything with a number that big attached to it is significant, but while it's widely understood to be an essential, if perfunctory activity, what is not often discussed is the fact that it's also a powerful tool that has the potential to transform the economy by investing in innovation.

Accessing public sector contracts can act like an accelerator for SMEs. Government contracts are complex – but solid and reliable.

The benefits also flow the other way, of course. Think about the impact of having some of the UK's most agile and innovative businesses solving public sector problems. By injecting investment into these types of companies, we could be delivering better services and saving taxpayers' money along the way.

But this opportunity has so far eluded successive governments. When we at Enterprise Nation talk to companies, they say that they are all too often excluded from public contracts because the bidding process is too complex, or it requires mandatory previous experience of working on government contracts and years of audited accounts.

This bureaucratic burden is far easier for big businesses and existing incumbents to cope with. For example, if an SME with ten staff members dedicates 2% of its time to procurement, it will not have any staff members working on procurement on a full time basis. By contrast, a company of 500 staff members which dedicates 2% of its time to procurement would have a ten-person team who are specialised in fulfilling procurement contracts.

To make matters worse, companies are steadily being given less time to manage these burdens, as the average amount of time a tender is posted for has decreased. This has led to fewer companies bidding for public contracts, and an increase in 'single-bid tenders' – contracts that only one company submits a bid for, meaning that they automatically win and there is no competition. Between 2012 and 2018 the number of single-bid tenders rose by almost five times.

This can exclude pioneering small businesses that are often leading the way in innovation in areas like artificial intelligence, digital delivery, and the ethics of future technology. Our economy would benefit from their input and services.

The net result of this problem is a creeping lack of competition and diversity in the range of businesses that are winning bids. This competition deficit is fiscally dangerous as it can lead to lower quality public services at a higher cost.

Despite it being a stated goal of successive governments to spend more procurement money via small businesses, we still fail to spend more than about 10% on SMEs each year. This is despite SMEs making up more than 50% of all turnover and 60% of all employment.

Solving public procurement is a big task but is of paramount importance to getting our public services right. There have already been measures taken to decrease the time and effort it takes to apply for public contracts. There have been pushes to publish all tenders on Contracts Finder so that businesses don't have to spend too long searching for opportunities. Procurement teams will host meet-the-buyer events where they can talk to companies about what they're already offering as part of early engagement and new product development.

But for the sake of Britain's entrepreneurial community, we can and should go further. For a truly modern and innovative procurement system, we need to think more creatively. Instead of being overly prescriptive when contracting for goods or services, governments should be willing to hear alternative approaches to the delivery of whatever it might be procuring – be that in education services, transport provision, or buying new technology.

If we're thinking particularly creatively, we can use policy mechanisms such as advanced market commitments (AMCs) to procure things that haven't even been dreamt up yet. An AMC is a promise to buy something, at a particular price, when it is invented. If another major pandemic were to come along, for example, we could promise to buy vaccines if someone were to produce them – derisking the R&D that goes into their development, and providing an incentive for companies to click into gear.

Under the status quo, small businesses and the government alike are held back by an inflexible and excessively bureaucratic procurement system. It is clear the government recognises there is a problem and now is the time to get procurement to the top of the agenda. With our public services under mounting pressure, and taxes higher than ever, it has never been more important to watch every penny that we spend and make sure that it's going to good use.

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Solving public procurement is a mammoth task, but is of paramount importance to getting our public services right.

Investing in ideas

Patrick Ryan

Paul Graham once said that you only need two kinds of people to create a technology hub: rich people and nerds. There is no shortage of rich people in Britain, especially close to London. What we lack is a critical mass of nerds.

Silicon Valley succeeded mainly thanks to an incredibly high density of a relatively narrow group of nerds – computer hardware and software engineers. Its gravity increased as this critical mass increased over the twentieth century, creating an insurmountable advantage. To achieve something similar, we must do something similar.

Firstly, the planned increase in the UK's public R&D budget – to £22 billion per annum by 2027 – is probably short of what is needed. The UK government spent £14.5 billion on R&D in 2021, equivalent to roughly 1.38% of our 2021 budget. For comparison, the US federal government spent \$161 billion, roughly 2.2% of its budget. Both pale into insignificance when compared to China, who spent \$441 billion on R&D in 2021, or 11.33% of the country's annual budget!

Now, we do not need to go to quite the same lengths as China, but something closer to £30 billion by 2027 would likely be more sensible. This sort of concentrated capital injection would provide the necessary momentum to drive incredible impact at scale, and could give us an insurmountable advantage in our areas of focus long into the future.

Secondly, the vast majority of any extra spending should be concentrated almost exclusively on AI, computing, and biotechnology research, and not the other verticals highlighted in recent [policy updates](#). Virtually all other policy areas are downstream from AI and biotech, and these are the industries which show the most promise to impact all other areas of human life.

Building a great British technology hub means building a hyper-dense network of experts and visionaries in AI and life sciences, and providing them with everything they need to thrive. We should focus on hiring all the world's leading experts in just these two areas, into our top five to ten academic institutions. Then we should invest heavily in their research projects.

To keep it simple, let's assume we want to hire the top 2,000 experts in these two areas into Britain's academic institutions. What will tempt them away from [top hubs](#), predominantly in the USA, but also Singapore, China, Japan, Switzerland and other places?

The most obvious answer is money. A better salary, and a better research budget, will go a long way. If we assume we give each of these experts a £2 million signing on bonus, plus a higher salary and money to spend on research, we will likely not have much problem getting them to move to the UK. But that probably means budgeting at least £10 billion more than we are currently.

We have plentiful evidence that the capital we are already spending on R&D is leading to commercial success. Our universities are European powerhouses when it comes to producing ‘deeptech’ companies – be that Deepmind, Darktrace, Benevolent AI, Babylon, or others. We’ve managed to do this with a fraction of the R&D spending of other nations – just imagine what we can achieve if we improve on the basics: money and focus.

Assume we solve R&D. Ten years from now, we are pumping out incredible AI and biotech ideas at warp speed. How do we ensure we have a thriving early-stage investor ecosystem, helping to turn today’s dreamers and weirdos into tomorrow’s titans of industry?

Again, we are already doing a pretty reasonable job here in many ways. What we need to do is double down.

The Seed Enterprise Investment Scheme (SEIS) and Enterprise Investment Scheme (EIS) are probably the best startup-focused policy initiative in the world today. They subsidise private individuals’ investment in a startup through tax relief, and investors using them don’t pay capital gains tax on the profits should the company be sold.

Recent government reforms have improved these schemes, and this is welcome. However, there is one more simple improvement that would make the schemes at least twice as effective in driving the growth of innovative companies, and it won’t cost a penny of taxpayer money.

That change is making Simple Agreements for Future Equity (or SAFE notes) SEIS and EIS compatible. This is a technical set of terms, but what it means is basically allowing investors to give money to startups now, claim their tax relief immediately, and receive the shares at some point in the future.

Early on in their journey, startups raise funding on an almost continuous basis. They need access to capital quickly in order to demonstrate traction and reach milestones. They also need to be opportunistic, securing investment as and when it is available.

What price should an early investor pay for shares? This is a very tricky question. Startups are a bet on the future, not the present. This means they are hard to value, especially before they have any commercial traction.

Building a great British technology hub means building a hyper-dense network of experts and visionaries in AI and life sciences, and providing them with everything they need to thrive.

You'd be right to say that three engineers, some code and a dog are worth next to nothing in the present day – so in theory the share price should be low. But if you invest in them based on their present value, you end up owning too much of the company, removing the incentive for the founders to build something huge.

In the USA, a clever legal structure was invented to deal with this problem. Early investors agree to invest in the company through a SAFE note. They invest money now in return for shares when a share price is decided in future, once the company has commercial traction, and a venture capitalist invests at an agreed share price. Typically, the earlier investor receives a discount on that future share price to account for their early investment, as well as agreeing a cap on the maximum possible price per share they pay.

This completely eliminates the need for investors and entrepreneurs to waste time negotiating the current share price, and better aligns their incentives (maximising the future share price). It also eradicates the need to involve lawyers in every funding round, or get consent from existing investors to raise more money.

However, SAFE notes are not compatible with SEIS or EIS, unless they are converted into shares within six months. This is because HMRC considers them debt instruments, and is an unfortunate misunderstanding of their legal structure – which is simply an agreement to pay some money for shares that will be issued in future.

SEIS and EIS are designed to help entrepreneurs at the very earliest stages – where their main backers are individual angel investors willing to take a bet on nothing but an idea. SAFE notes are the perfect investment instrument for companies at this stage. Making them compatible would be a simple, cost-effective change that will act as rocket fuel for our country's progress.

The UK has lofty ambitions to become a more innovative economy. In achieving that, it ought to be a little more ambitious, a little more focused, and also not neglect the importance of a vibrant startup ecosystem to translate R&D into commercial success.

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How do we ensure we have a thriving early-stage investor ecosystem, helping to turn today's dreamers and weirdos into tomorrow's titans of industry?

The Entrepreneurs Network is a think tank for Britain's most ambitious entrepreneurs, with an aim to make Britain the best country in which to start and grow a business.

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