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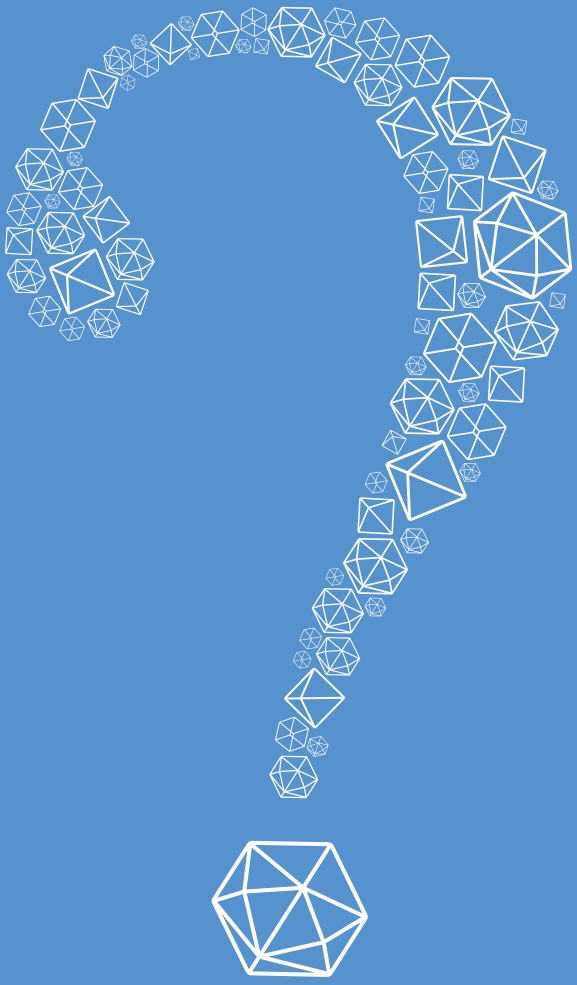
NESTA Making Innovation Flourish

State of Uncertainty

Innovation policy through experimentation

By Hasan Bakhshi, Alan Freeman and Jason Potts



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Abstract

We propose a fundamental shift in the role of the state with respect to innovation policy. The broadest barrier to effective entrepreneurial action that drives innovation processes, we argue, is good, timely information about relevant opportunities and constraints. Innovation policy would work better, we suggest, if modelled on experimental science and directed to the task of minimising the uncertainty that entrepreneurs face in the discovery of opportunities and constraints. We consider what this means for the institutions of innovation policy.

Introduction

This paper proposes a new model for innovation policy that clearly distinguishes it from industrial policy. We challenge the idea, implicit in much existing practice, that governments operate levers that affect innovation in predictable ways, and argue that innovation policy should instead be conceived as a process of discovery, required because the creation and exploitation of new ideas by entrepreneurs is by nature radically uncertain.

This calls for an institutional role we term the 'experimental state': where experimental processes are embedded in publicly supported innovative activity – without constraining the innovators within the rigid, pre-ordained coordinates of a traditional industrial 'plan' or 'growth strategy' – and where public activities are designed to ensure that the private discoveries they support are codified and disseminated, thereby reducing entrepreneurial uncertainty.

In developing a rationale for the experimental state, we draw on insights from evolutionary economics and from the reformation of industry policy proposed by Dani Rodrik (2004, 2007), who has sought to insert information and opportunity discovery as the fundamental constraint on economic development. We outline this case and suggest possible institutional changes that shift innovation policy further towards a more experimental conception of the role of the state in facilitating entrepreneurship and thereby innovation.

The rise of innovation policy

Innovation policy has become a major preoccupation of modern government. Each year more government agencies in the OECD countries are rebadged the 'Department of X, Y and Innovation'. Innovation reviews such as the Dyson report *Ingenious Britain* in the UK, the OECD's Innovation Strategy *Getting a Head Start on Tomorrow* and the Cutler report *Venturous Australia* continue to gather policy traction. Innovation is also increasingly defined as a primary, if not the primary, motive for supporting the creative industries (the UK's *Cox Review of Creativity in Business* and the European Commission's Creative Industries Green Paper *Unlocking the Potential of Cultural and Creative Industries*).

This preoccupation is by no means confined to governments ideologically predisposed to intervention. Active support for innovation is a publicly-stated goal of the Conservative-Liberal Democrat coalition government in the UK as evidenced in a raft of proposals including a revamped Technology Strategy Board, funding for new Technology and Innovation Centres (*Blueprint for Technology*), and the vaunted East London high-tech hub. Yet, the focus of such proposals – collaboration, networks, experimental development, demonstrators and public-private partnerships – is different from a traditional emphasis on strategic or infant industries, and industrial or social planning.

Thinking has not moved forward to catch up with this change,[1] which also explains why policy has not been consistent (e.g. see Richard Lambert's (2011) critical discussion of the Government's sectoral growth review *The Path to Strong, Sustainable and Balanced Growth)*. The theoretical rationale for innovation policy remains rooted in a mix of traditional industrial policy and an emerging new understanding that is still, we argue, incomplete.

An effective innovation policy should work by fostering entrepreneurship in the discovery and exploitation of opportunities. The main barriers here relate to uncertainties surrounding opportunities and constraints. Policy institutions should be directed toward collaborative efforts at experimental learning about such ever-changing opportunities. Innovation policy has traditionally been modelled on the planning prerogatives and market failure presumption of industry policy. But an alternative approach is to blend a Hayekian conception of entrepreneurial actions to a Schumpeterian conception of the innovation process. This suggests a very different role for the state in the creation and facilitation of a new class of public good, namely information that is valuable to entrepreneurs.

Industrial policy and its discontents

The premise of innovation policy is usually support for private entrepreneurship and enterprise to create new industries and new markets through policy instruments and regulatory measures. The underlying presumption is that this process will fail

if left to the market alone and that an effective innovation policy suite can target and correct this (see the discussion in Hutton and Schneider, 2008). Aghion *et al.* (2009) characterise this approach as follows: *"This is the issue of… whether the institutionalised and informal processes of information and knowledge generation are optimal, or should be optimised by public policy measures so that they yield the desired long-run rate of technological innovation and productivity growth."*

Two arguments for intervention in particular underpin most accounts of innovation policy: that new knowledge, technology or ideas generate positive spillovers, or externalities, which private entrepreneurs cannot fully capture (*market failure*); or that innovation requires a systematic national or regional approach to innovation (*systems failure*). Further (not necessarily mutually exclusive) supporting arguments range from managing transitions from declining to emerging sectors, maintaining industrial diversity, supporting innovative sectors, public support for the early development and learning phase of infant industries, overcoming barriers to R&D finance (for SMEs in particular) and improving international competitiveness.

The underlying idea in all cases is to provide redress for a sub-optimal market outcome through a directed public intervention, usually involving a transfer of resources, either through direct spend or subsidy, indirect support such as training subsidies, or via reconfigured incentive structures, as with intellectual property rights and R&D tax relief.

This standard rationale is associated with high levels of targeted sectoral support (*de facto* if not explicit), fiscal policy to guide socially optimal levels of private investment and research and development, public infrastructure programmes and institutional support for business costs like skills and training. This is, in many cases, almost indistinguishable from the traditional rationale for industrial policy, from which innovation policy thus has come to differ mostly in its goals rather than the mechanisms, targets, and instruments which it proposes.

Industrial policy formed the core part of the development strategies for many developing economies through the 1950s-70s and continues to be practised by many governments today. It was instrumental to the rise of many newly industrialised countries (such as South Korea, Taiwan and Brazil). While there have been manifest failures and instances of capture (particularly in Africa and Latin America, but also in European attempts to pick 'national champions'), there have been successes too: the steel industry in South Korea; Taiwan's semiconductor industry; Chile's salmon farming and, arguably, the entire paradigm of Chinese growth. It has however fallen out of favour with many economists.

It is not our purpose to rehearse or take a position on their criticisms. Our argument, we believe, should be acceptable equally to advocates and critics of industrial intervention. Our point is a different one:

it is that innovation policy, which supports the generation and exploitation of new ideas, has desirable effects distinct from those sought by industrial policy: most notably the discovery of knowledge. Reconceived as working with businesses to reduce uncertainties, it should be immune to the critique of industrial policy to which Hayek (1945) gives the name 'knowledge problem'. For Hayek, markets are mechanisms to discover information about the local conditions of supply and demand, and thus discovery of economic opportunity (also Rodrik, 2004). Hayek conceives of relative prices as signals that carry information about change in those local and temporally specific conditions. Markets may fail if, say, there are information asymmetries between private agents, but the idea that the state can intervene to improve matters assumes it knows more than the agents.

This critique, however, ignores a more relevant scenario where neither the state nor private agents are perfectly informed about economic opportunities; where the private sector has clear informational advantages in certain areas, and the state has them in others. And the uncertainty does not concern just economic opportunities – it relates to the whole innovation system: how different parts of the system interact with one another, for example, and how policy levers impact on them.[2]

It also ignores the yet more fundamental problem of unmeasurable uncertainty (Knight, 1921). *"The problem is not merely that we do not have enough information to reliably attach probabilities to a given number of events. An event which we cannot yet imagine may occur in the future… This means that some relevant information cannot be known, not even in principle, at the time of making many important decisions."* (Dequech, 2000).

This presents obvious challenges for an approach based on traditional industrial policy. Imagine in the future that there will be a new sector built around a technology that we cannot yet anticipate (think of television or even the BBC from the standpoint of the mid-19th century before Maxwell, when science did not know that light was electromagnetic, let alone that such things as radio waves could exist). It is clearly not meaningful to assess whether this sector is a potential driver of growth, whether there are skill shortages or research opportunities awaiting public investment in the face of market failure, whether it is of strategic significance to the future of the nation or at risk from competition from China. But it is equally unsustainable to argue that the market can discover this missing knowledge; we simply do not know if the knowledge is there to be discovered.

This suggests, at first sight, just the traditional rationale for public involvement in basic research: a sphere of knowledge discovery prior to application, for which the future benefits are not merely unknown but as yet unknowable. However, imperfect information and uncertainty are not just endemic to basic research but innovation as such. Who, even Marshall McLuhan, could have quite foreseen the phenomenon of Facebook?

This is why failure is as much an element of successful innovation as success. As IBM founder Thomas Watson famously remarked: *"How can you double your rate of success? Treble your rate of failure."* The very fact that so many attempts at innovation fail so badly shows that, even with known technology quite far down the path to market, innovators venture not merely into the unknown but often, under current conditions, the unknowable.

Rethinking innovation policy

The recent turn toward innovation policy is grounded in the fundamental role of knowledge in economic growth and development, seeking to augment the associated drivers of innovation, specifically entrepreneurship, research and development, education and training, venture finance, supporting institutions and disruptive structural change. Like the rise of environmental policy, innovation policy also increasingly cuts across multiple domains of government intervention and with a similarly complex remit and difficulty of assessment.

The problem is that much innovation policy remains rooted in industry policy, and has inherited many of its presumptions: such as a focus on planning, targets and sectoral programmes. This opens it to well-known critiques of industrial policy: the knowledge problem, the risk that planning structures will be captured, the rigid costs associated with state bodies, the absence of mechanisms for identifying or correcting failure, and the consequent additional costs arising from overrun, irrelevance, and so on, which, it is argued, exceed the marginal social benefit deriving from the public's investment.

A more robust objective of innovation policy should be to work with business to create knowledge and wherever it can reduce uncertainty.[3] A major barrier to private sector development is the climate of generalised uncertainty that characterises the advance of knowledge. This is the reason for a long, hard look at the motives behind, and the practice of, public innovation policies.

Costs and benefits of innovation policy

Innovation is not a natural process. It is constrained in all dimensions, yet drifts easily. There is nothing inevitable about innovation-led growth. Market mechanisms and institutions are valuable precisely because they facilitate and guide this process toward adaptive outcomes. Some economists argue that any intervention will distort this market order by affecting the underlying information and incentives. If our assumption is perfect information, then we agree. But in matters of new technologies, new business models or new markets, a better analytic starting point is general ignorance. Innovation is hard because the adoption of novelty is hard (Potts, 2010a) and because most opportunities do not arrive fully labelled. There are often substantial uncertainties that make entrepreneurship more difficult, sometimes too difficult. The discovery

and dissemination of information about opportunities or constraints, information that reduces uncertainty, lowers the costs of entrepreneurship and improves its likelihood of success. This does not distort the market order, it helps create it.

It is a paradox of both planning theory, and the criticism it attracts, that interventions, motivated by the desire to create additional *private* value from the industrial success and growth thus generated, ignore the *public* value created by eliciting and discovering the very information which obstructs effective industrial policy. Most notably, they pay scant attention to identifying *opportunities* – novel applications, processes, or solutions – and *obstacles* – assumptions that were embedded in the initial planning which experience has revealed to be either false, or in need of modification. This information is highly valuable when made public. To assume that it already exists is to undercut a major rationale of the state in the innovation process as an information aggregator and processor.[4]

Innovation policy, we argue, will be improved if its main focus is information discovery rather than resource reallocation. Our proposal adapts the arguments of Dani Rodrik on economic development as *self-discovery*. It also builds on contributions by Bresnahan and Yin (2010), Nill and Kemp (2009) and Witt (2003) that seek to integrate Hayekian, Schumpeterian and evolutionary economic insights into innovation policy. The core of our suggestion, also based on evolutionary economics, is that the most important constraint on innovation is information. Innovation policy should focus on this.

Rodrik proposes an industry policy model of intervention targeted at the specific points where information failures and coordination failures occur as opposed to the standard market failures addressed by traditional industrial policy.[5] This requires a pragmatic, process-based and experimental approach to policy due to uncertainty of outcomes, and a role much closer to providing information and brokerage about growth bottlenecks (Bresnahan and Yin, 2010). For Rodrik, industrial policy should aim at facilitating industrial diversification by working with the private sector to identify various information problems and coordination failures that inhibit entrepreneurial discovery. A core proposition (2004: 3) is that: *"The task of industrial policy is as much about eliciting information from the private sector about significant externalities and their remedies as it is about implementing appropriate policies."*

This leads to a primary focus on *activities*, associated with the exploration of new technologies and the discovery of opportunities, rather than on *sectors*, associated with maintenance of jobs and regions. Evolving in response to the limitations of traditional industrial policy in developing countries, we argue that it provides the key to a reconceptualisation of innovation policy in the developed world.

This idea also sits well with approaches to industry policy issuing from evolutionary

or innovation systems theory (Edquist, 2001; Edquist and Chaminade, 2006). While such approaches acknowledge the political economy criticisms made against industrial policy by the 'public choice' school, they also recognise the significant problems caused by the gap between the private and social costs and benefits associated with opportunity discovery and coordination. They emphasise the barriers to investment and entrepreneurial development imposed by the radical uncertainty associated with any technological frontier or search space of opportunities. Herein lies, we suggest, the scope for an experimental approach to innovation policy.

This argues for a significant shift toward information discovery, networking and brokering activities through a more collaborative and ultimately experimental engagement with the private sector. Innovation policy can then be conceptualised as a more *efficient* process for eliciting, discovering, and disseminating information about the constraints and opportunities associated with new technologies, activities or ideas. It can turn up knowledge of opportunities faster, it can spread this knowledge faster, and it can dramatically reduce the social cost of repetitive failure. This approach affords particular attention to the specific local conditions of these constraints and opportunities, and would ideally seek to identify such information and coordination failures in as close to real time as possible.

The argument for innovation policy as public intervention in the economic order thus turns not on its capability to change the 'rules of the game' for innovation investment (and thus the profitability of firms undertaking it), but on its effectiveness as a partner agency in eliciting, brokering and disseminating information about the costs and opportunities that attend any new idea, thereby supporting entrepreneurialism.

Obviously, the market does provide information and coordination services through trade media, business networking, consultancy and lobbying services, for example. But there are good reasons for thinking that the market produces fewer of these services than is socially desirable: the benefits accrue to many but the costs of providing them fall on the few. This suggests an information discovery and coordination role for government agencies.

The experimental state

The starting point for our reconceptualisation of innovation policy is a rejection of a dichotomy between state and market, centred on market failure.

In traditional innovation policy thinking (Nelson, 1993; Freeman and Soete, 1997), micro failures occur at the level of weak price incentives for individual business to engage in research and development, leading to sub-optimal investment in innovation. An alternative approach begins by addressing barriers to innovation which do not fall into the category of weak incentives for particular forms of investment but *missing information*, *uncertainty* and even

ignorance of the actual constraints and opportunities facing entrepreneurs as associated with any new idea, technology or activity.

For any particular innovative opportunity, there will be barriers to market outcomes. These may be due, for example, to limited entrepreneurial knowledge of this opportunity, or institutional or legislative constraints, or due to coordination difficulties involved in realising the opportunity. In such cases, (which are instances of market failure over and above technology externalities) the resolution can arise simply from better information that may then lead to various forms of entrepreneurial action, whether as market, technological, political, or even socio-cultural entrepreneurship (Potts, Foster and Straton, 2010).

In this view of innovation policy, the role of the state is to facilitate and enable a broad spectrum of entrepreneurship by seeking to elicit, gather, and even create information with businesses (by conducting experiments, for example).[6] This is a model of a learning state that sees its mandate in the gathering and dissemination of information, the sort of information that can be turned into the entrepreneurial action that drives innovation. The innovation goal of the state is to learn, not to produce.

How governments learn

When dealing with any open complex system about which there is missing information and substantial uncertainty, the best way to discover what works and what does not is to probe and experiment (Popper, 1963; Potts and Kastelle, 2010). Experimental learning thus offers an excellent model for this reconception of innovation policy and the role of the state.

This idea also makes it clear why the industrial planning model, couched in terms of goals and targets, is a poor fit for innovation policy. Any experiment is a hypothesis test, which necessarily takes place in a context of uncertainty about what is or is not true. It starts with a presumption of ignorance and seeks to reduce this by eliciting information (the experiment) and, in the case of publicly motivated experiments, making the results public. The point is not to prove that something is correct, a criticism also made of models that require picking winners, but rather to discover what was not known, and then to use that new knowledge for further exploration. This is first and foremost a conception of innovation policy as a process, not as a targeted outcome. It is a process in the most elemental sense of being open-ended and in the practical sense of being governed by methods, rather than targets and promises. The process works when it generates knowledge that changes the space of opportunities, and not otherwise.

This model requires a different institutional relation between government, business and entrepreneurs. It is first of all much closer, because of the mutual need to discover, as it were, what it is that is known and unknown. This has long been understood as the prime challenge

for the strategic behaviour of the knowledge-based firm, and one that is resolved though better communication and organisational learning. This same principle extends to government involvement in this process. It will necessarily require closer collaboration and information exchange.

This does not, however, involve coercion. It is, as Rodrik (2004) dryly puts it: *"A process of embedding with, not getting into bed with"* the private sector. The state in this way seeks to maintain a horizontal relationship with innovating agents in which it is 'next to' or in a peer-to-peer relationship with them, but not seeking to direct or bureaucratically organise them. Examples of this may include collaborative R&D, innovation networks and clusters, efforts to discover the sources of constraints and the extent of bottlenecks in various systems, including demand, and the experimental discovery of opportunities and their immediate constraints to realisation.

Two aspects should be further noted. First, this new approach to innovation policy will require the development of different government capabilities. In particular, it will require it to have stronger business networks, officials that have direct experience of business, deeper research and evaluation skills and connections to the academic sector, and a culture more oriented towards learning. A second aspect concerns the political economy of this policy. Any endeavour at closer relations may be seen to invite rent seeking, cronyism and moral hazard. It also risks crowding out private sources of such information and coordination. And furthermore, there are implications in relation to the shift in power this would cause, in effect toward entrepreneurs and weakening existing organised coalitions. These are all challenges and require robust governance arrangements to tackle them, but they are not *ipso facto* sufficient to dismiss the model of innovation policy because it relies on closer embedding.

Embedding is necessary because learning is social. It is society that needs to learn, not only individual agents and not only a hypothetical 'information-privileged' government. Government is present in this picture because the learning process is social, involving emergent networks, communications which have public good characteristics, and changed economic patterns of specialisation, which can be affected through other parts of economic policy. The dissemination of creatively-acquired knowledge is a transmission process that also involves creativity; it is a process of learning 'how to', not simply learning 'that'. This involves interpretation and re-interpretation. There is no fixed pre-codified body of knowledge of which most implications and uses are known or knowable, as for example with computer data or basic industrial processes. Furthermore, many of these constraints and opportunities to be revealed and discovered are localised and require local inquiry (hence the importance of clusters).

Reforming the institutions of innovation policy

What might reform look like? The guiding principle here is experimental learning: innovation policy needs to be directed to the facilitation of experimental learning. The institutions of experimental learning are thereby the foundational institutions of an 'experimental state' conception of innovation policy.

What does this imply? A first and obvious point is that the goals of innovation policy will need to be led by research and learning priorities and initiatives. They should not be politically driven. But it is also to recognise that the goals will be risky, and this in effect mandates that simple *ex post* indicators of success should have little place in such policy (even the most successful experiments can fail).

A second point is that where relevant information is distributed across many agents, and where actions depend on the uncertain sequential outcomes of many others, decentralised and networked institutional structures are generally preferable (Mulgan, 2008).

A third related point is that the extent and scale of the scope of the experimental inquiry may need to be open to, perhaps significant, upward or downward revision, depending on findings. Good examples of this can be found in the flourishing models of policy experiments, both in economic development (Duflo *et al.*, 2006) and in the use of, for example, innovation vouchers (Bakhshi *et al.*, 2011).[7] An analogous point is that this implies a far more 'project-based' conception of innovation activities than would be implied under an industrial policy model (where what matters is the industry or sector being targeted). A project-based conception also naturally suggests the routine instigation of sunset clauses at the completion of projects (Goodstein, 1995).

This last point may seem innocuous but it actually speaks to a significant institutional shift away from endeavours to make policy into law (such as tax breaks for investors or long-term commitment to particular programmes, such as space exploration), but instead to internalise the notion that the policy ends when the learning ends. This also requires policymakers to overcome opposition from established actors who have vested interests in maintaining policies (Unruh, 2002).

Obviously too, the institutional and governance form of such innovation policy will need to recognise that it is attempting to form peer relationships with, and interact meaningfully with, something that is not actually a thing, but a complex network. Dodgson *et al.* (2005) discuss the fifth generation model of innovation that underpins this recognition for business strategy, but the same point also applies to government agencies. This can be difficult; for example, practical problems will invariably attend to suitable governance models and technology interfaces, as well as attracting staff with suitable backgrounds and skills, both in the public sector and at points of contact

in the private sector. Interacting with a complex network is harder than with an organised representative body (NESTA, 2011), as in the model carried over from industry policy, but that model, we argue, is simply unsuited to the modern innovation context.

As points of discussion, three particular institutional models can be suggested. One is the idea of strategic innovation funds. Large private or charitable funds are a common model for allocating resources to science projects as well as social entrepreneurship.[8] A public *strategic competitive fund* may be created in several ways, perhaps from establishing an independent endowment (such as from Lottery revenues for example). Another is to attach it to existing funds, such as public pensions, unclaimed banking assets or so-called 'future funds'. Such funds could be used to directly support collaborative business experiments which test propositions of wider business and/or social interest.

A second institutional model would be if the state provided 'testbed' environments for businesses, in which they can conduct, and evaluate, collaborative experiments that in the absence of the testbed might not take place.[9] A testbed environment might be imagined as a public science research laboratory in the form of an experimental marketplace, for example. An alternative model might be the equivalent of micro versions of 'special economic zones', or Paul Romer's notion of 'Charter Cities'. These would suggest special experimental zones (as a kind of micro-federalism) that would offer, within a defined space, perhaps different rules or laws, or different bundles of public services. If effectively designed, councils or regions might be expected to compete to host these experiments, with the possible reward of an emerging cluster of new economic activity. Undertaking experiments in different settings is valuable because this helps to learn about conditions for success (Hoogma *et al.*, 2002).

In both cases the state might opt to exploit economies of scale in innovation funding and create a super-fund, with a remit to take risks, to seek out and explore innovation constraints and possibilities and to make these findings public, while seeking close collaboration with those at leading edges of innovation practice and seeking to facilitate sharing of information to help resolve coordination problems. The need for a strong research capability and learning culture in all these scenarios should be obvious.

Along with the strategic innovation funds model and the experimental testbed model, both of which may work best when coupled together, a third model is suggested as a kind of business 'forensics laboratory' for the study of particular entrepreneurial, business or regional industrial failures, seeking to discover what lessons about opportunities and constraints they may hold. In part, this is already supplied by business media, consultancies, and research institutes. But such information gathering and analysis may be best done at scale, and as a public good. This might be modelled on national

science institutes, with a mandate to map the space of entrepreneurial opportunity and failure much as observatories map, and make public, research about the physical universe. Economics departments in universities used to do this. They don't do that so much now. And government economic agencies and treasuries are usually too stretched. There is a gap in the market for information and analysis of entrepreneurial opportunities and failures.[10]

Conclusions

The purpose of this provocation has been to propose a new model of innovation policy that focuses on the information problems that envelop and constrain the innovation process. The policy works, under this model, to the extent that the process of discovery and coordination can subsequently entrain the many forms of entrepreneurial action. This, we suggest, is the proper benchmark of good innovation policy.

This suggests a reformation of innovation policy focused on Hayek's problems of missing information and radical uncertainty, all in Schumpeter's context of continual change in information about opportunities and constraints due to creative destruction. This model of innovation policy differs from the traditional model, itself closely related to industry policy, which is focused on positive externalities in the discovery of new ideas, and practised with resource transfers and planning targets. Our proposal, instead, emphasises a learning-focused, network-brokering and information-discovery role for innovation policy, focused on the opportunities for, and constraints to, entrepreneurial action. This might, for example, be operationalised with collaborative experiments, innovation vouchers, innovation networks and clusters, public-private funds, micro-federalism, and related institutional designs. It would seek to achieve the goals of innovation policy by whenever possible reducing uncertainty for entrepreneurs.

The basic problem that constrains innovation, and the main resource that propels it, is uncertainty and its resolution. This should be the focus of innovation policy. Our proposal suggests both a more powerful strategy and potentially also a more cost effective one than the traditional approach. But it will require that innovation policy be introduced, and applied, in a scientific (learning-focused) rather than political (influence-based) frame of mind.

Why should we do this? There are multiple considerations. The big reason is that the experimental method generates valuable knowledge about immediate entrepreneurial opportunities. But another is that economic policy should always focus where it has the greatest benefit for the least cost. The experimental method is likely to be much less costly than extant methods based on claimed market failures and corrective resource transfers. It requires large changes in methods, not in bank accounts. We should do this because it might be a solution to the problem of how to better support

entrepreneurialism and innovation. And we should do this because it is likely to work: experimentation underpins our modern civilisation; it should be the basis of innovation policy too.

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Endnotes

1. The more recent emphasis on collaboration, networks and demonstrators in innovation policy can itself be understood as reflecting evolutionary forces, as policymakers have tended to learn over time what does not work (Witt, 2003; Nill and Kemp, 2009).
2. Milliken (1987) distinguishes between 'state uncertainty' (what is happening out there?), 'effect uncertainty' (how will it impact me?) and 'response uncertainty' (what am I going to do about it?). In an experimental study McKelvie *et al.* (2011) find that response uncertainty is a greater barrier to entrepreneurship than state uncertainty. The implication is that policymakers may more efficiently support entrepreneurship through collaborative experimentation with businesses which reduces response uncertainty, rather than through reducing state uncertainty through unilateral experimentation.
3. A related point is that innovation policy should not – through unpredictability – give rise to business uncertainty itself.
4. As Aghion *et al.* (2009) put it: "Treating new findings as tantamount to being in the public domain fully exploits the 'public goods' properties that permit knowledge and information to be concurrently shared in use and reused indefinitely, and thus promotes faster growth of the stock of knowledge." (pp 685.)
5. Note a similar argument was made by George Richardson (1960, 1972) in relation to the coordination problem of competitive and complementary investment.
6. In their paper on experimentation in science policy, Huang and Murray (2010) argue that: "Experimentation should focus not only on generating information about the best technical path but also determine the best organizational or institutional approach" to creating scientific knowledge (pp.568). Their thesis is that government can support diversity in early-stage research and innovation by experimenting with the organisation of research.
7. Potts (2010b) proposes experimental elimination as a way of discovering which policies do not work.
8. See, for example, Bakhshi, Desai and Freeman (2009) in a cultural industries context.
9. A good example is the Korea Advanced Research Network which was used to promote broadband services (Atkinson *et al.*, 2008).
10. Nill and Kemp (2009) describe this as: "Learning about a variety of options (which requires a wide playing field instead of a level playing field)." pp 673.

Hasan Bakhshi

Hasan is a Research Fellow at the ARC Centre of Excellence for Creative Industries and Innovation at the Queensland University of Technology and Director, Creative Industries in NESTA's Policy and Research Unit. He is also Honorary Visiting Professor at City University.

Alan Freeman

Alan is a Research Fellow at the ARC Centre of Excellence for Creative Industries and Innovation at the Queensland University of Technology and Visiting Professor at London Metropolitan University.

Jason Potts

Jason is a Research Fellow at the ARC Centre of Excellence for Creative Industries and Innovation at the Queensland University of Technology and at the School of Economics, University of Queensland.

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NESTA

1 Plough Place
London EC4A 1DE
research@nesta.org.uk

www.nesta.org.uk

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