Innovation for Growth – i4g

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Smart and Inclusive Growth: reforming the risk-reward nexus in innovation

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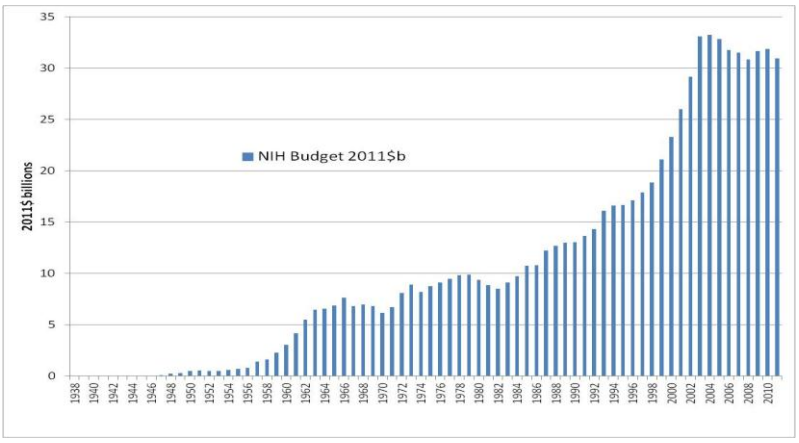
Introduction

For an 'innovation union' to emerge, 'systems' of innovation are needed so that new knowledge and innovation can diffuse throughout the European economy. *Systems* and eco-systems of innovation (sectoral, regional, and national) require the presence of dynamic links between the different *actors* and institutions (firms, financial institutions, research/education, public sector funds, intermediary institutions) as well as horizontal links *within* organisations and institutions (Freeman, 1995).

What, however, has not been given enough attention in the debate about the different actors and institutions required for innovation-led growth, is the exact role that each actor in the system plays along the 'bumpy' and complex *risk landscape* (Mazzucato, 2011). Considering these roles more explicitly, allows us to consider the degree to which the division of labour in risk taking is matched or not by a division of rewards, which one would expect if there is a *risk-return* relationship. It also helps us to better understand whether the eco-system is creating the right incentives. Is it the case that because some actors are putting in a lot, other actors have been given less incentives to do their share?

Market failure theory discusses 'risk' in terms of the 'wedge' between private and social returns, which may arise from the 'public' nature of goods (which limits the ability of private actors to appropriate returns), or different types of externalities (Laffont, 2008). This is the classical argument that justifies State spending on basic research. However, the *mission oriented* investments, which make up about 75% of public sector investments in innovation in many advanced economies, cannot be understood within the market failure perspective. Missions, such as putting a man on the moon, to developing the internet (which was done in DARPA, an agency of the US Department of Defence) involve both basic and applied research, and are driven not by the dynamics of the private/social 'wedge' but by direct objectives of the government. Indeed, the very heavy funding of the US pharmaceutical industry arises from the US government mission, through its National Institutes of Health, to " seek fundamental knowledge about the nature and behaviour of living systems and the application of that knowledge to enhance health, lengthen life, and reduce the burdens of illness and disability". The budget of the NIH has reached 400 billion over the last decade, with 31 billion in 2012 (see Fig. 1).

Fig. 1 National Institutes of Health R&D funding

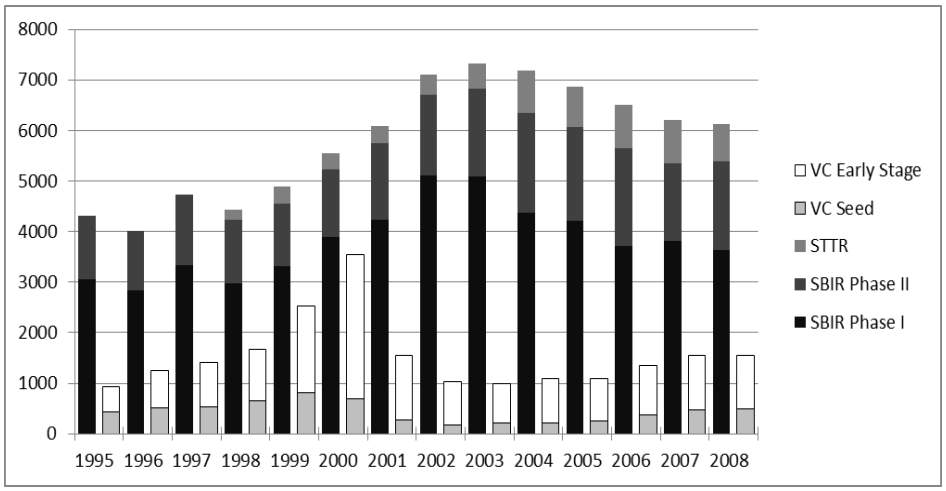


At a more micro level, Block and Keller (2011) find that between 1971 and 2006, 77 out of the most *important* 88 innovations (rated by *R&D Magazine*'s annual awards) were found to have been fully dependent on federal support, especially, but not only, in the early phases. And all the major 'general purpose technologies', from aviation to the internet, owe their core funding to the public sector (Ruttan, 2006).

These examples are important because it is often argued that what is missing in Europe is the availability of 'private' finance willing to fund the radical technologies, as well as the specific phases in which risk is highest such as the 'death valley' stage of the innovation cycle. Yet what is not said is that private finance works well especially when it rides the wave of State investments, as it has done in the USA. Indeed, all the major technologies that make the iPhone so 'smart' are funded by public sector organisations: GPS, the internet, touch screen display, and even the latest voice activated SIRI personal assistant—all owe their funding to the State (Mazzucato, 2012 forthcoming, Breakthrough Institute, 2012). 'Geniuses' like Steve Jobs, and the presence of private VC, are fundamental, but without the State funding of both basic and applied research in the core radical technologies, it is not clear whether the VC model would work at all, and whether individuals like Jobs would have much to add their 'design' talent to.

And it is not just about research. While many associate risk capital with either business angels or VC, in reality in many countries, including in Silicon Valley part of the USA, it has been public not private funds which have filled the high risk funding gap. In the USA, the SBIR programme which began in 1982, provides almost $2.5 billion annually to small firms. It is administered by 11 government agencies and divided between phase 1 ($150,000) and 2 ($1 million). And as VC has become increasingly short-termist, pursuing returns in a 3-5 year period, the SBIR programme has had to step up and often funds firms that VC is too risk averse for. As can be seen in Fig. 2, as VC has become increasingly short-termist, pursuing capital gains, and seeking early exit through an IPO, SBIR has had to step up its risk finance (Block, 2012). Indeed, Pisano (2006) has argued that the short-termism of venture capital makes it an inappropriate model to drive innovation in science-based sectors, such as biotech, nanotech and today's clean-tech, which require much longer time horizons.

Fig. 2 Number of Early Stage and Seed Funding Awards, SBIR and Venture Capital



A dysfunctional eco-system: socialized risk, privatized rewards?

Interestingly, one of the results of this eco-system in which the State plays a leading role beyond that which has been attributed to it by either the market failure perspective of the national systems of innovation perspective, in the various frameworks reviewed above, has been a fall in the investments actually made by private firms in the innovation process. As argued by Angell (2004), the NIH has been much more 'risk-taking' than private large pharmaceutical companies, with up to 75% of the most radical new drugs (new molecular entities with 'priority' rating) coming out of public not private labs. Yet, as the NIH has been spending more and more on the knowledge base that underpins the biotech and pharmaceutical industry, the large pharma companies themselves have been spending an increasing amount on repurchasing their own stock. In 2011, along with $6.2 billion in dividends, Pfizer repurchased $9.0 billion in stock, equivalent to 90 percent of its net income and 99 percent of its R&D expenditures. Amgen, the largest dedicated biopharma company, has repurchased stock in every year since 1992, for a total of $42.2 billion through 2011, including $8.3 billion in 2011. Since 2002 the cost of Amgen's stock repurchases has surpassed the company's R&D expenditures in every year except 2004, and for the period 1992-2011 was equal to fully 115 percent of R&D outlays and 113 percent of net income (source: Lazonick and Tulum, 2011).

The problem is widely diffused: in the last decade, Fortune 500 companies have spent $3billion in share buybacks. While they claim that this is due to the lack of new opportunities, the reality is that the most expensive (eg capital intensive) investments in new opportunities (with high market and technological risk) are being made by the public sector. In this sense, the problem is not one of 'crowding out' as is sometimes argued—because in fact the State is investing in areas that the private sector has chosen not to invest in.

And unfortunately the same problem seems to be appearing now in the emerging cleantechnology sector. On the one hand in 2010, the US American Energy Innovation Council (AEIC) asked the US government to increase its spending on clean technology by three times to $16 billion annually, with an additional $1 billion given to the Advanced Research Projects Agency for Energy (ARPA-E). On the

other hand, they have together spent $237 billion on stock repurchases between 2001-2010. The major directors of the AEIC hail from companies with collective 2011 net incomes of $37 billion and R&D expenditures of approximately $16 billion. That they believe their own companies enormous resources are inadequate to foster greater clean technology innovation is indicative of the state's role as the first driver of innovation (Mazzucato, 2013 forthcoming)

But the question arises whether this heavy funding has allowed big corporations to think they can earn the same or even higher profits while themselves putting in less resources into innovation. Indeed, pharmaceutical companies have publicly announced their rethinking of whether they need to be doing basic research at all, given that most of their knowledge comes from either small biotech or publicly funded labs (or publicly funded research in private/public universities). And they react with their feet, with companies like Pfizer closing down labs in countries where there is less public R&D (eg the UK where the R&D/GDP spend it low), going to countries where there is more (US, with a 2.7% R&D/GDP and heavy NIH).

Correcting this dysfunctional system is key if we want to prevent the same dynamic in greentech that has characterized areas like biotech. The biotechnology industry is one where most of the VC backed companies remain productless, yet make much money for the venture capitalists when they exit via an IPO.

So if the State is so important for funding high risk investments in innovation, and given the commonly accepted relationship between risks and returns in finance, it could be argued that more thinking is required on whether and how the state should earn back a more direct return on its risky investments. That is, rather than worrying so much about the *picking winners* problem, more thinking is needed about how to reward the winning investments so they can cover some of the eventual losses--which are inevitable as innovation is so deeply uncertain, in the Knightian sense (Knight, 1921).

Put provocatively, had the State earned back even just 1% from the investments it made in the Internet, there would be much more today to invest in green tech. Or put another way, is it right that the National Science Foundation which funded the algorithm behind Google, received nothing back when Google made billions (Block and Keller, 2011)?

Many argue that it is inappropriate to consider direct returns to the State because the State already earns back for its investments, indirectly via the taxation system. There are three arguments against this reasoning: (1) tax evasion (legal and illegal) is common and realistically will not disappear; (2) global movements of capital mean that the particular region (which could also include the EC) funding the innovation might not reap the benefits in terms of local job creation, the taxation question remains an open question (see the case of Apple below). And (3) investments in innovation are different from spending, on say education. The former embody a great degree of risk, similar to that experienced by private venture capital, with one in 10 investments earning a return. If the State is being asked to make such investments (which it undoubtedly has been making and increasingly so), it is necessary for it to cover its inevitable losses when those arise.

Indeed, the case of Apple computers is a case in point. Apple received its early stage funding from the US government's SBIR programme, and all the technologies which make the iPhone 'smart' are also State funded: the internet, GPS, touchscreen display and the latest voice activated SIRI personal assistant. Yet Apple has used practices commonly used which have resulted in a much lower tax bill for the US government. According to Duhigg and Kocieniewski (2012), in order to avoid taxes, Apple formed a subsidiary in Reno, Nevada, where there is no corporate income or capital gain tax.

Creatively naming the company, Braeburn Capital, Apple used it to channel a portion of its U.S. sales, instead of including them in the revenues it reported in California, where its headquarters are located. Apple reportedly saved $2.5-billion in taxes with this scheme a very large number given the $9.2 billion dollar state deficit California experienced in 2009. In other words, the entire state budget deficit would have been significantly reduced (by more than 25%) if Apple had fully reported its U.S. revenues in the state where a significant portion of its value (discovery, design, sales, marketing, etc.) was created and achieved (Duhigg and Kocieniewski, 2012). These facts simply reinforce that the tax system is not one that can be relied on for recouping investments, in this case by the State of California, in risky innovation.

Reaping back a (direct) return

Where technological breakthroughs have occurred as a result of targeted state interventions, there is potential for the state, over time, to reap some of the financial rewards, by retaining ownership over a small proportion of the intellectual property created. This is not to say the state should ever have exclusive license or hold a large enough proportion of the value of an innovation that it deters a wider spread of its application – the role of government is not to run commercial enterprises, but to spark innovation elsewhere. But government should explore whether it is possible to own a slither of the value it has created, which over time could create significant value and then be reinvested into growth generating investments.

For example, as discussed briefly above, three-quarters of the new molecular bio-pharmaceutical entities owe their creation to publicly funded laboratories. Yet in the past ten years, the top ten companies in this industry have made more in profits than the rest of the Fortune 500 companies combined. The industry also enjoys great tax advantages: its R&D costs are deductible, and so are many of its massive marketing expenses, some of which are counted as R&D (Angells, 2008). After taking on most of the R&D bill, the state often gives away the outputs at a rock bottom rate. For example, Taxol, the cancer drug discovered by the National Institutes of Health (NIH), is sold by Bristol-Myers Squibb for $20,000 per year's dose, 20 times the manufacturing cost. Yet, the company agreed to pay the NIH only 0.5 per cent in royalties for the drug.

Similarly, where an applied technological breakthrough is directly financed by the government, it should in return be able to extract a small royalty from its application. Again, this should not be sufficient as to prohibit its dissemination throughout the economy, or to disincentivise the innovators from taking the risk in the first place. Instead it makes the policy of spending taxpayers' money to light the innovative spark more sustainable, by enabling part of the financial gains from so doing to be recycled directly back into the programme over time.

Thus rather than worrying so much about the *picking winners* problem, more thinking is needed about how to reward the winning investments so they can both cover some of the eventual losses (which are inevitable in the innovation game) and also raise funds for future investments.

There are various possibilities for considering a direct return to the state for its investments in innovation. One is to make sure that loans and guarantees that are handed out by the State to business do not come without strings attached. Loans as well as grants could have conditions, like income contingent loans, similar to that of *student loans*. If and when a company makes profits above a certain threshold, after it has received a loan/grant from the state, it should be required to pay back a portion. This is of course not rocket science but it goes against some deep-seated assumptions. And currently, with budget deficits under so much pressure, it is no longer possible to ignore the issue.

Besides income contingent loans there is the possibility of the state retaining equity in the companies that it supports. Indeed, this does occur in many countries, such as Finland, where SITRA, one of Finland's public funding agencies, retained equity in its early stage investments in Nokia. Exactly the type of early stage investments that VC has increasingly shied away from. Yet state equity in private companies is feared in countries like the USA and the UK (and those countries copying the Anglo-Saxon model) for fear that the next step is…communism. Yet the point is that the most successful capitalist economies have had active states, making such risky investments, and we have been too quick to criticise them when things go wrong (e.g. Concorde) and too slow to reward them when things go right (egg the internet).

Other than income contingent loans, and retained equity, there is of course a more direct tool which is a state investment bank. Indeed, while many have argued the importance of a State investment bank for the needs of counter-cyclical lending (Skidelsky 2012), another reason why they are important is precisely to reap back a return in order to fund future investments. In 2012 KfW, the German state investment bank, reported £2 billion in profits, while most private banks are in the red, with many experiencing falling profits (KFW, 2011). And indeed, if/when the state institution is run by people who not only believe in the power of the state but also have the expertise around innovation, then the result produces a high reward. A perfect example is the Brazilian state development bank BNDES in Brazil which has been actively investing in innovation in both cleantech and biotechnology, and making hefty profits from the investment. In 2010 it made 21% return on equity (ROE), most of which was reinvested by the treasury into the economy (e.g. in health and education). The percentage retained by BNDES was reinvested in key new sectors, focussing specifically on the death valley stage of biotechnology in which private VC is so absent.

Conclusion

Understanding the state as lead risk-taker, opens the question about how such risk-taking can reap back a return. While many have been quick to blame the government when it fails to 'pick winners', they have been much less quick to reward it when it succeeds. It is argued here that a framework is required both for understanding the risk-taking (beyond the risk-averseness argument in the market failure approach) and for understanding how the collective system of innovation (emphasized by the national systems of innovation approach) maps also into a system of rewards. Getting the balance right will make the objective of smart and inclusive growth less about spin, and more about concrete mechanisms.

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