

Response to the Green Paper “Building our Industrial Strategy”

Mariana Mazzucato

Professor in the Economics of Innovation and Public Value
Director, *Institute for Innovation and Public Purpose*
University College London

Introduction and Summary

The process of leaving the European Union, following last year’s Brexit referendum, has significantly changed the debate on economic policy in the United Kingdom. In her foreword to the *Industrial Strategy Green Paper*, Prime Minister Theresa May declares her ambition to create “a country that really does work for everyone”. Implicit in this ambition is a recognition that the government needs to embrace a more inclusive growth model. There is a real opportunity to use this moment to recognise that **not only the rate but also the direction of economic growth is important**. It is precisely industrial strategy that can help lead to a direction for growth that is smarter (more innovation-led), more inclusive (with less inequality) and also more sustainable (catalyzing a green transition across sectors). And thus the new department for “Business, Energy & Industrial Strategy” (BEIS) can become a central pillar to implementing **an economic strategy that has innovation at its centre**—and an energy element which could be used to direct this innovation in transformational ways.

In this response to the consultation on the “Building our Industrial Strategy” Green Paper, I reflect on this opportunity by highlighting the need for a directional push that enables the sum of the parts to lead to a transformational push for the economy—driven by innovation and productivity changes across many sectors. Without a systemic approach, incremental changes and a focus on individual technologies and sectors will not create the radical change that is needed. In this respect, I believe it is key to learn from the successes and failures of past attempts to use “Industrial Strategy” to rebalance economies, and to use such lessons for the practical implementation of such a strategy. In particular, my response emphasises:

- the importance of a **systemic approach** to industrial strategy, and the problems that can result when such an approach is lacking;
- the need to see industrial strategy as an **interaction between multiple actors** in both public and private sectors;
- the need for public actors to be positioned strategically along the **entire innovation curve** (e.g. not just R&D);
- the possibilities of using **mission-oriented strategies** directed at solving concrete societal and/or technological challenges which spark innovation across a variety of sectors;
- ways in which industrial strategy could be used to **direct a green growth agenda**;
- the role a **public investment bank** can play in providing patient strategic finance to innovative companies and project

1. What definition of industrial strategy?

Questions for consultation addressed: no. 1, 2, 4, 5.

The reiterated objective of the BEIS industrial strategy, as set out in the Government's Green Paper, is "to improve living standards and economic growth by increasing productivity and driving growth across the whole country". While this statement recognises the importance of the broader economic outcomes that industrial strategy can enable, identifying more evenly distributed economic growth as the ultimate aim of general economic policy is not in itself "industrial strategy". Crucially, this high-level objective for industrial strategy does not incorporate a clearly identifiable "strategy" and makes no reference whatsoever to "industry".

This very broad objective fails to recognise that **economic growth has not only a rate, but also a direction**. The case of Spain before the housing bubble burst is an excellent example of why this matters: a "successful economy"¹ experiencing one of the highest growth *rates* in the EU, that was simultaneously heading towards an unsustainable path of financial speculation in the construction sector. The exact opposite has occurred in Germany, a country that has succeeded in becoming an industrial and innovation leader by prioritising *directional* change through a "High-Tech Strategy"² which sets explicit priorities and challenges to be addressed in a systematic and mission-oriented way. The consultation on the Green Paper explicitly calls for lessons from other countries (question 4), yet in stating that the industrial strategy "is not about the Government directing the economy", the Green Paper risks ignoring the lessons from countries that have managed to achieve innovation-led growth through directional, mission-oriented industrial and innovation strategies. **This is not about top down planning, but about providing a direction for sustainable economic growth**; i.e. the use of directed policies that can increase business expectations about future growth areas, and in the process also foster bottom up learning and exploration³.

In particular, the new BEIS Department should consider **how it can bring together energy and industrial strategy to set a coherent, economy-wide, green direction for industrial and innovation policy**⁴. A green direction is key to sustainable economic growth⁵. It does not simply concern renewable energy, but rather involves a process of transformation across the entire economy (thus affecting many of the Industrial Strategy's 10 pillars, including infrastructure, skills, science and innovation, and world-leading sectors, as well as energy

¹ The Economist (2004). "The second transition". Special report on Spain, available at: <http://www.economist.com/node/2764840>.

² Recently updated in 2014 as "The new High-Tech Strategy".

³ Rodrik, D. (2004). "Industrial Policy for the Twenty-First Century". CEPR Discussion Paper No.4767.

⁴ Rodrik, D. (2014). "Green Industrial Policy". *Oxford Review of Economic Policy*, 30 (3): 469-491.

⁵ Mazzucato, M. and Perez, C. (2015). "Innovation as Growth Policy" in Fagerberg, J., Laestadius, S. and Martin, B. (eds.) *The Triple Challenge: Europe in a New Age*. Oxford University Press: Oxford.
<http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198747413.001.0001/acprof-9780198747413>

systems). “Green Growth” could offer the possibility of orienting innovation across the entire economy in order to transform production, distribution, consumption and even lifestyle patterns in an ecologically sustainable way. In the UK context, it is important to recall the work of UCL Prof Paul Ekins, who has focused on the energy transition conceived in a systems framework⁶.

On the contrary, the emphasis on energy innovation presented in the Green Paper is almost exclusively on the “need to keep costs down for business” (p.20), which assumes that business already wants to invest in renewable energy, and simply needs to be incentivised to invest more. The evidence, however, is that to transform the economy to deliver green growth will require the same level of push, through directed policies that actively create new landscapes which business later follows, as can be seen in the transformation and re-orientation of the economy around the development of information technology⁷.

2. Less supporting pillars, more systemic creation

Questions for consultation addressed: no. 2, 4, 7, 8.

The second question for consultation in the Green Paper presents a particularly skewed vision of industrial strategy: “Are the 10 pillars suggested the right ones to tackle low productivity and unbalanced growth? If not, which areas are missing?”. **It would be a fundamental misconception if the whole industrial strategy were to be based on simply listing areas, sectors and technologies for intervention without considering the systemic dimension of industrial strategy.** As the BEIS Select Committee (p.3) has noted, the Green Paper provides “a long list of policy interventions but little by way of ground rules to provide a framework for future decision-making which, we would argue, should be the core of any long-term strategy”. Indeed, countries that have managed to implement successful industrial strategies – such as Japan⁸ or Germany⁹ – have always incorporated a comprehensive and systemic approach, aimed at addressing the corresponding systemic nature of the innovation process underpinning the industrial dynamic.

⁶ Skea, J., Ekins, P. Winskel, M. (2011). (eds.) *Energy 2050: Making the Transition to a Secure Low-Carbon Energy System*. Routledge: London.

⁷ Gates, B. (2015). “We need an energy miracle”. Interview with Bill Gates, *The Atlantic*, by James Bennet. Available at: <https://www.theatlantic.com/magazine/archive/2015/11/we-need-an-energy-miracle/407881/>

Mazzucato, M. (2016). “Innovation, the State and Patient Capital” in Jacobs, M. and Mazzucato, M. (eds.) *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, Wiley-Blackwell: London. <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1119120950.html>

⁸ Freeman, C. (1987). *Technology Policy and Economic Performance: Lessons from Japan*. London: Frances Pinter.

⁹ BMBF (2014). “The new High-Tech Strategy: Innovations for Germany”. Bundesministerium für Bildung und Forschung / Federal Ministry of Education and Research (BMBF). Available at: https://www.bmbf.de/pub/HTS_Broschuere_eng.pdf

Whilst 8 of the 10 pillars in the Green Paper represent typical horizontal policies, one concerns regional policy and another one traditional sectoral interventions, making it difficult to understand how the pillars interact with each other as part of a coherent strategy. As a consequence of the above-mentioned lack of directionality, the underlying thread of each of these pillars is an approach based on creating the conditions for “supporting” and “improving” existing features of the UK economy, or “encouraging” the emergence of new sectors and the transition to a low-carbon economy. However, in a modern capitalist economy, markets, sectors and technologies are created and shaped as a result of a collective interaction between various actors: businesses, employees, civil society organisations, and the government¹⁰. In fact, in several notable cases (e.g. the IT and pharmaceutical sectors in the US), the State has played a crucial “entrepreneurial” role in creating and directing the emergence of new technologies, with specific public agencies investing along the whole innovation chain in basic and applied research, as well as directly providing long-term patient finance to innovative companies¹¹. The possibility of public funds to provide **the investment of first resort** – one that embraces a clear role in reducing uncertainty, setting directions for new technological paradigms and stimulating subsequent private investment – is lacking in the Industrial Strategy Green Paper. On the contrary, it outlines a view of government as a mere facilitator for the private sector to drive the process of industrial change and innovation.

3. Rethinking the pillars of the industrial strategy

3.1. From a sectoral approach to a mission-oriented strategy

Questions for consultation addressed: no. 31, 32, 33, 34.

Industrial strategy requires both horizontal and vertical policies, working together systemically. Traditionally, industrial strategy in the UK has focused on (vertical) sectoral interventions. Until the end of the 1970s, this consisted of various measures ranging from indicative planning to outright nationalisation of entire industries (e.g. steel, coal, shipbuilding, aerospace and so on.). In the Green Paper, the proposed sectoral approach is much less interventionist—less vertical and more horizontal. “Sector deals” are not presented in terms of where Government might provide additional funding or overall direction, but as a private sector-led process whereby “businesses rather than the Government are best placed to identify what companies need in order to enhance their competitiveness as a sector” (p.100). In the 8th pillar, the document outlines a list of five sectors which are not considered to be “exclusive”, as the government “invites” other sectors and businesses within

¹⁰ Op. cit. Mazzucato (2016).

¹¹ Mazzucato, M. (2013). *The Entrepreneurial State: Debunking the Public vs. Private Myth in Risk and Innovation*. London: Anthem Press. <https://marianamazzucato.com/entrepreneurial-state/>

them to identify solutions for addressing, once again, very general issues related to productivity, competition, and skills.

Although certain sectors might be more suited for sector-specific strategies, there are good reasons for avoiding a sectoral approach, particularly when it is easily captured by specific interests. Not least, private lobbying interests may prevail in negotiating specific provisions with the government¹², negatively influencing the industrial strategy with short-sighted indirect measures (e.g. tax credits) that potentially waste public funds and create little if no additionality in terms of new investment. The patent box represents a typical example of these misconceived policies¹³ since there is no reason to lower tax on monopoly profits. In a country where business investment in R&D (BERD) continues to be below the OECD average, sectoral policies risk allowing the private sector to continue to ask for subsidies or support, rather than to fundamentally transforming themselves.

The case for building a modern industrial strategy on the identification of challenges, rather than sectors, is compelling and increasingly recognised. In my previous response to the Business, Innovation and Skills Select Committee¹⁴, and my oral evidence presented to the BEIS Select Committee on 22 November 2016, I suggested a more mission oriented approach that would use specific challenges to stimulate innovation across sectors. In its *Industrial Strategy: First Review*, the BEIS Select Committee has explicitly endorsed the idea that industry support should be “guided by a targeted ‘mission-based’ approach, channelling the Government’s support towards addressing the big challenges of the future.” The Committee also concludes that “It is for Government to set those missions, in discussion with stakeholders” (p.25). Through well-defined missions – focused on solving important societal challenges related to climate change and environmental quality, demographic changes, health and wellbeing, mobility issues etc. – the government has the opportunity to determine the direction of growth by making strategic investments throughout the innovation chain and creating the potential for greater spillovers across multiple sectors¹⁵. Interestingly, one of the most well known missions in

¹² Buchanan, J. M. (2003). “Public Choice: The Origins and Development of a Research Program”. *Champions of Freedom*, vol. 31, pp. 13-22

¹³ Griffith, R., Miller, H. and O’Connell, M. (2010). “Corporate Taxes and Intellectual Property: Simulating the Effect of Patent Boxes”. IFS Briefing Note 112, Institute for Fiscal Studies.

¹⁴ Mazzucato, M. and Watson, J. (2016). “Response to BIS Committee Inquiry: Industrial Strategy”. University of Sussex. <http://data.parliament.uk/WrittenEvidence/CommitteeEvidence.svc/EvidenceDocument/Business,%20Energy%20and%20Industrial%20Strategy/Industrial%20strategy/written/39044.html>

¹⁵ Foray, D., D. Mowery, and R. R. Nelson (2012). “Public R&D and Social Challenges: What Lessons from Mission R&D Programs?”. *Research Policy*, 41: 1697–1702.

Mowery, D. C., R. R. Nelson, and B. R. Martin. (2010). “Technology Policy and Global Warming: Why New Policy Models are Needed (Or Why Putting New Wine in Old Bottles Won’t Work).” *Research Policy*, 39: 1011–1023.

the history of capitalism—the Apollo man on moon mission—sparked innovation across multiple high tech and low tech sectors, including textiles.

3.2 *Green* as a new direction for innovation policy

Questions for consultation addressed: no. 27, 28, 29, 30.

If the government is to adopt a mission-oriented approach to its industrial strategy, it will be crucial to transform the purpose of the energy pillar, from an uncoordinated list of cost-saving measures for businesses, to a more **systemic mission-driven effort to addressing environmental and climate change, taking into account the role of energy systems**. This would also give the opportunity of setting a “green” direction to the industrial strategy, with potentially transformative effects for the economy as a whole¹⁶. Once again, it is useful to learn from the experience of competing nations, namely Germany. According to the Green Paper on industrial strategy, the UK government simply seeks to “manage” (p.90) the transition to a low carbon economy, whereas the German strategy is to “fundamentally restructure Germany’s energy supply”¹⁷. Germany’s *Energiewende* programme for energy transition constitutes a model of how to implement an integrated strategy that addresses several sectors and technologies in the economy. With its missions to fight climate change, phasing-out nuclear power, improving energy security by substituting imported fossil fuel with renewable sources, and increasing energy efficiency, *Energiewende* is providing a direction to technical change and growth across different sectors through targeted transformations in production, distribution and consumption. This has allowed even a traditional sector like steel to use the ‘green’ direction to renew itself. Indeed German innovation policy has placed pressure on steel to lower its material content through the use of a ‘reuse, recycle and repurpose’ strategy¹⁸.

Furthermore, the energy area is one that illustrates more than any other the need for both supply and demand side policies. Demand side policies are what allow new technologies (that arise from supply side policies) to be fully deployed and diffused throughout an economy. Green innovation should not be seen therefore as

¹⁶ Perez, C. (2016). “Capitalism, Technology and a Green Global Golden Age: The Role of History in Helping to Shape the Future” in Jacobs, M. and Mazzucato, M. (eds.) *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, Wiley-Blackwell: London.

¹⁷ Page 4 in BMWi (2015). “Making a success of the energy transition”. Bundesministeriums für Wirtschaft und Energie / Federal Ministry for Economic Affairs and Energy (BMWi). Available at: https://www.bmwi.de/Redaktion/EN/Publikationen/making-a-success-of-the-energy-transition.pdf?__blob=publicationFile&v=6

¹⁸ BMUB (2016). “German Resource Efficiency Programme II”. Available at: http://www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/german_resource_efficiency_programme_ii_bf.pdf.

Green Alliance (2015), “Circular Economy Scotland”. Available at: <http://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf>.

confined to low carbon energy *supply* options and smarter energy networks. Demand side policies aimed at energy efficiency are an important complement to the supply side, and a cheap and fast way of mitigating climate change in the short term, offering multiple benefits for business, households and the economy. In this sense, as stated in our¹⁹ policy brief written for the run up to the Paris 2015 COP meeting:

“Battling climate change requires efforts on multiple fronts, both on the supply side (e.g. investments in R&D, innovation) and on the demand side (changing consumption and investment patterns, and enabling diffusion and deployment). If green innovation is to be characterised by the kind of technological changes that surrounded the IT revolution, it will require not only massive amounts of private spending on R&D, piloting and deployment, but also (and especially) public sector agencies willing to take on risks in the most capital intensive and high risk areas. Crucially, we cannot assume that nudging and incentivising is enough, policies must actively push and pull.”

The submission to this Green Paper consultation by the UCL Energy Institute (and the associated RCUK Centre for Energy Epidemiology) represents a very strong and evidence based case for how an energy efficiency revolution will have to focus on the *demand-side* of decarbonisation.

3.3. Finance for an industrial strategy: long-term, patient and direct

Questions for consultation addressed: no. 18, 19, 21, 22, 26.

Industrial innovation is *uncertain, collective and cumulative*²⁰. As with any other economic activity involving production, it needs to be financed, but financial returns from investment in innovative activities are not always assured, and it usually takes time before they can materialise. It is precisely the cumulative, path-dependent feature of the innovation process that requires a particular type of patient, long-term finance²¹. In some countries this has occurred through public forms of venture capital (e.g. Israel’s Yozma), in others through funds related to procurement policy (e.g. in the US via SBIR), and still in others through innovation funds within public banks (e.g. KfW in Germany, or EIF inside the EIB).

The Green Paper has the merit of recognising the importance of long-term finance for investment in innovative firms. The launch of a new Patient Capital Review represents a welcome development that will assess the availability and propose new ways of providing long-term finance, based on international best practices. The

¹⁹ Mazzucato, M, Semieniuk, G. and Watson, J. (2015) ‘What will it take to get us a Green Revolution?’, Sussex Energy Group, (01/12/2015). <https://www.sussex.ac.uk/webteam/gateway/file.php?name=what-will-it-take-to-get-us-a-green-revolution.pdf&site=264>

²⁰ Lazonick, W. and Mazzucato, M. (2013) “The risk-reward nexus in the innovation-inequality relationship: who takes the risks? Who gets the rewards?”. *Industrial and Corporate Change*, 22 (4): 1093-1128. <http://icc.oxfordjournals.org/content/22/4/1093.abstract>

²¹ Mazzucato, M. and Penna, C. (2015). (eds.) *Mission-Oriented Finance for Innovation: New Ideas for Investment-Led Growth*. Rowman & Littlefield. <http://www.policy-network.net/publications/4860/Mission-Oriented-Finance-for-Innovation>

Government is also planning to increase the availability of funding by the British Business Bank (BBB), as well as supporting (though not with direct finance) the creation of local investment funds and the expansion of the Business Growth Fund (BGF). Nevertheless, **the scale and purpose of this key type of public finance remains fairly modest**, and furthermore are largely overshadowed by the plans to privatise the small but active and directional Green Investment Bank (GIB). The arguments used to privatise the GIB are misplaced, failing to account for the additionality that has been created through its investments in high risk and highly capital intensive areas that private finance has historically been not willing to fund²².

Another important international lesson for the UK as regards public long-term finance is the existence of national public investment banks in countries such as Germany, France, Italy, and Spain. State investment banks in those countries are primary actors involved in the provision of different types of finance, offering strategic and mission-oriented public venture capital for SMEs, along with other countercyclical and infrastructure investments²³. Their reach and scope extend well beyond the BBB and GIB in the UK combined. For example, the German *Kreditanstalt für Wiederaufbau* (KfW) has financial assets that amount to over €500 billion. In 2015 its *Mittelstandsbank* programme for SMEs mobilised €20.4 billion out of total financial commitments of €79.3 billion²⁴. KfW is also heavily involved in the *Energiewende* strategy, signalling once more the systemic approach of the German industrial strategy in coordinating its ultimate objectives with existing institutions and financial tools.

An interesting area is the way that public investment funds can help create a better balance between “risks and rewards” in innovation and industrial policy²⁵. There is an increasing awareness of the **need for establishing mechanisms that allow public investment funds to socialise not only the risks but also the rewards** so to preserve the public sector’s financial capacity for further rounds of investments²⁶. Public investment banks can, if properly structured, provide that role²⁷.

²² 'A strong industrial strategy has many benefits', *The Financial Times*, (03/08/2016
<https://www.ft.com/content/e0d05e02-54cf-11e6-9664-e0bdc13c3bef#axzz4FyU48uzW>

²³ Mazzucato, M. and Penna, C. (2016). “Beyond market failures: the market creating and shaping roles of state investment banks”. *Journal of Economic Policy Reform*, 19:4, 305-326
<http://www.tandfonline.com/doi/full/10.1080/17487870.2016.1216416>

²⁴ KfW (2015). “2015 Financial Report”. Kreditanstalt für Wiederaufbau, Frankfurt am Main, Germany. Available at:
https://www.kfw.de/PDF/Download-Center/Finanzpublikationen/PDF-Dokumente-Berichte-etc./3_Finanzberichte/KfW-Finanzbericht-2015-E.pdf

²⁵ Op. cit. Lazonick and Mazzucato (2013)

²⁶ Rodrik, Dani (2015), “From Welfare State to Innovation State” <https://www.project-syndicate.org/commentary/labor-saving-technology-by-dani-rodrik-2015-01?barrier=accessreg>

²⁷ Op. cit. Mazzucato and Penna (2016).

The Green Paper does not incorporate any plan for the establishment of a similar institution, either *ex nihilo*, or as a result of a transformation of the existing BBB and GIB. The £400 million increase in venture capital investment by the British Investment Bank adds very little to an already meagre financial endowment. Consequently, the Green Paper overlooks the possibility of establishing a properly functioning state investment bank with the task of providing the type of strategic long-term patient finance that the Government itself recognises as essential for the success of its industrial strategy.

3.3. Institutions for the National System of Innovation and Production

Questions for consultation addressed: no. 36, 37, 38.

The last pillar introduced in the Green Paper concerns the role of institutions to be involved in the industrial strategy. However, the Government's approach seems to lack a systemic vision for the role that private and public (local and central) institutions play within the national system of innovation²⁸. It is not simply a matter of creating institutions "missing in certain areas" (p.125), as the last question for consultation suggests, ranging from cultural and sporting associations to universities and airports. Innovation and industrial strategies have instead been successful when they adopted a more systemic view, not just with their programmes, but also with respect to the institutions involved in the process. It was a decentralised network of public institutions positioned across the entire innovation chain (not just upstream science or downstream intermediary institutions), combining horizontal and vertical policies in a system ways, that allowed the Silicon Valley miracle to emerge.^{29 30}

Despite its being a fundamental element of the national system of innovation³¹, the Green Paper presents the public sector simply as having a supporting role for the private sector through local authorities, universities, and government labs. The UCL institutional submission to the Green Paper consultation makes critical and excellent points on the role of universities in helping to drive and deliver industrial strategy. Other submissions will no doubt emphasise the role of the Catapult centres in creating linkages between science and industry. But universities and science industry linkages are not enough. Investment, capacity building, and the ability to experiment and learn within innovation agencies, such as Innovate UK, are critical. In this respect, the Green Paper fails to recognise the crucial role of mission-driven agencies which have been critical for some of the

²⁸ Nelson, R. R. (1988). Institutions supporting technical change in the United States. In G. Dosi, C. Freeman, R. R. Nelson, G. Silverberg, & L. Soete (Eds.) *Technical change and economic theory* (pp. 312–329). London: Pinter.

²⁹ Block, F. L., & Keller, M. R. (2012). *State of innovation: the US government's role in technology development*. Routledge.

³⁰ Mazzucato, M. (2013). *The Entrepreneurial State: Debunking the Public vs. Private Myth in Risk and Innovation*. London: Anthem Press. <https://marianamazzucato.com/entrepreneurial-state/>

³¹ Lundvall, B.A. (1992). (ed.) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.

most important global innovations of the last decades. This includes DARPA in the US Department of Defense (critical for the Internet), ARPA-E in the US Department of Energy (critical for battery storage innovations), the National Institutes of Health (critical for some of the most revolutionary new drugs), and in the UK organisations like the BBC that have been key in actively transforming the UK creative sector which today is one of the UK's most dynamic sectors with a high multiplier³². Indeed the role of such organisations has often been to actively shape and create markets, not only 'fix' them as traditional market failure theory would suggest³³.

By focussing only on the 'fixing' role of public policy, the Green Paper also ignores the importance of public investment funds which have provided the investment of first resort to industry and innovation. This includes the role of public investment banks (e.g. KfW in Germany); public venture capital and innovation funds (e.g. Yozma in Israel); or even public enterprises with respect to innovation and diffusion of renewable energy (e.g. State owned enterprises in China playing a large role in renewable energy)³⁴. These are all institutions that can operate directly and in coherence with the overall industrial strategy, creating additionality in the system by "crowding in" private investment that otherwise would not occur³⁵. They also require organizational capacity and competencies which unfortunately the trend of outsourcing government functions to the private sector, is potentially debilitating³⁶.

Without a systemic approach involving institutions in both private and public sector to pursue a mission-oriented approach defined by Government, even the proposed increase in total R&D expenditure (1st pillar) would not achieve the desired results. Indeed, **the necessity to develop an effective national system of innovation is much more pressing than achieving good results in single indicators such as R&D expenditure**, as was underlined by SPRU Professor Christopher Freeman³⁷, when comparing the cases of Japan and the Soviet Union in the 1970s. He explained the Japanese industrial and innovative success and the USSR relative failures— despite the first dedicating much fewer resources to R&D relative to GDP than the latter (2.5% against

³² The BBC has also been a fountain of technological innovations from the BBC Micro computer to the modern day iPlayer. The BBC's market creating role is discussed in: Mazzucato, M. and O'Donovan, C. (2016) "The BBC as market shaper and creator" in *Rethinking the BBC: Public media in the 21st Century*, Seth-Smith, N., et. al. (eds.), Commonwealth Publishing. <http://commonwealth-publishing.com/shop/rethinking-the-bbc-public-media-in-the-21st-century/>.

³³ Mazzucato M. (2016) "From Market Fixing to Market-Creating: A new framework for innovation policy", Special Issue of *Industry and Innovation: "Innovation Policy – can it make a difference?"*, 23 (2)

³⁴ Mazzucato, M., Semieniuk, G. (2016). "Financing renewable energy: who is financing what and why it matters". SPRU Working Paper Series SWPS 2016-12. http://marianamazzucato.com/wp-content/uploads/2016/07/2016_12_SWPS-Mazzucato_et_al.pdf

³⁵ Op. cit. Mazzucato (2013).

³⁶ Crouch (2016).

³⁷ Freeman, C. (1995). "The 'National System of Innovation' in historical perspective". *Cambridge Journal of Economics*, 19, 5-24.

4%) – through the differences between their respective national systems of innovation. Thus, the lesson for the UK industrial strategy is that the origin, integration and use of R&D matters more than its overall quantity, being it a result of how the national system of innovation is configured by the institutional setting of the country. This is a crucial element on which the Green Paper remains unfortunately silent.

About the author: [Mariana Mazzucato](#) is Professor in the Economics of Innovation & Public Value, at University College London (UCL), where she is founding and directing the [Institute for Innovation and Public Purpose](#). She joined UCL in March 2017 from the Science Policy Research Unit (SPRU, University of Sussex) where she held the prestigious RM Phillips Chair in Science and Technology Policy. She is author of [The Entrepreneurial State: debunking public vs. private sector myths](#) (Anthem 2013) and winner of the 2014 [New Statesman SPERI Prize in Political Economy](#) and the 2015 Hans-Matthöfer-Preis. Professor Mazzucato advises policymakers around the world on how to deliver ‘smart’, inclusive and sustainable growth. In 2013 she was named as one of the '[3 most important thinkers about innovation](#)' in the New Republic. Her new book [The Value of Everything](#) will be coming out in September 2017.

Institute for Innovation and Public Purpose (IIPP): The UCL *Institute for Innovation and Public Purpose* (IIPP) will be launched in Autumn 2017. Its teaching programme, research platform and policy partnerships aim to fundamentally rethink how public value can be created, nurtured and evaluated in the 21st century, and operationalise this through a framework rooted in *public purpose*. It will work closely with global policy makers to create a broader view of policy based on co-creating and shaping markets, not (only) fixing them. IIPP will work directly with the UCL’s Grand Challenges agenda, offering a new way to view complex challenges facing society—from climate change to crises in social care—that require social, technological, financial, organisational and institutional innovations. The Institute, directed by Professor Mazzucato, will be formally launched in Autumn 2017 and is part of The Bartlett, UCL’s global faculty for the built environment and home to radical thinking and teaching about space, design, sustainability and innovation. IIPP will work closely with other institutes in the Bartlett, including the *Institute for Sustainable Resources*, the *Energy Institute*, and the *Institute for Global Prosperity*.

References

BEIS Committee (2017). “Industrial Strategy: First Review”. HC 616, 3 March 2017.

BEIS Department (2017). “Building our Industrial Strategy”. Green Paper, January 2017.

BMBF (2014). “The new High-Tech Strategy: Innovations for Germany”. Bundesministerium für Bildung und Forschung / Federal Ministry of Education and Research (BMBF).

BMUB (2016). “German Resource Efficiency Programme II”. Programme for the sustainable use and conservation of natural resources. Available at:

http://www.bmub.bund.de/fileadmin/Daten_BMU/Pool/Broschueren/german_resource_efficiency_programme_ii_bf.pdf.

- BWMI (2015). “Making a success of the energy transition”. Bundesministeriums für Wirtschaft und Energie / Federal Ministry for Economic Affairs and Energy (BMWi).
- Buchanan, J. M. (2003). “Public Choice: The Origins and Development of a Research Program”. *Champions of Freedom*, vol. 31, pp. 13-22
- CDP (2015). “Piano Industriale Gruppo CDP 2020”. Linee guida strategiche, Conferenza Stampa, 17 Dicembre 2015. Available at: <http://www.cdp.it/Cosa-Facciamo/Attivita/Piano-Industriale/Piano-Industriale-2016-2020.kl>
- Crouch, C. (2016). “The Paradoxes of Privatisation and Public Service Outsourcing” in Jacobs, M. and Mazzucato, M. Eds (2016), *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, Wiley-Blackwell, London, ISBN: 978-1-119-12095-7.
- Foray, D., D. Mowery, and R. R. Nelson (2012). “Public R&D and Social Challenges: What Lessons from Mission R&D Programs?”. *Research Policy*, 41: 1697–1702.
- Freeman, C. (1987). *Technology Policy and Economic Performance: Lessons from Japan*. London: Frances Pinter.
- Freeman, C. (1995). “The ‘National System of Innovation’ in historical perspective”. *Cambridge Journal of Economics*, 19, 5-24.
- Gates, B. (2015). “We need an energy miracle”. Interview with Bill Gates, *The Atlantic*, by James Bennet. Available at: <https://www.theatlantic.com/magazine/archive/2015/11/we-need-an-energy-miracle/407881/>
- Green Alliance (2015), “Circular Economy Scotland”. Available at: <http://www.green-alliance.org.uk/resources/Circular%20economy%20Scotland.pdf>.
- Griffith, R., Miller, H. and O’Connel, M. (2010). “Corporate Taxes and Intellectual Property: Simulating the Effect of Patent Boxes”. IFS Briefing Note 112, Institute for Fiscal Studies.
- Jacobs, M. and Mazzucato, M. (2016). (eds.) *Rethinking Capitalism: Economics and Policy for sustainable and inclusive growth*. Wiley-Blackwell: London. <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1119120950.html>
- Keynes, J.M. (1926). *The end of laissez-faire*. Prometheus Books: London.
- KfW (2015). “2015 Financial Report”. Kreditanstalt für Wiederaufbau, Frankfurt am Main, Germany.
- Lazonick, W. and Mazzucato, M. (2013) “The risk-reward nexus in the innovation-inequality relationship: who takes the risks? Who gets the rewards?”. *Industrial and Corporate Change*, 22 (4): 1093-1128. <http://icc.oxfordjournals.org/content/22/4/1093.abstract>
- Lundvall, B.A. (1992). (ed.) *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*. London: Pinter.

- Mazzucato, M. (2013). *The Entrepreneurial State: Debunking the Public vs. Private Myth in Risk and Innovation*. London: Anthem Press. <https://marianamazucato.com/entrepreneurial-state/>
- Mazzucato, M. (2016). "Innovation, the State and Patient Capital" in Jacobs, M. and Mazzucato, M. (eds.) *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, Wiley-Blackwell: London. <http://eu.wiley.com/WileyCDA/WileyTitle/productCd-1119120950.html>
- Mazzucato, M. and Penna, C. (2015). (eds.) *Mission-Oriented Finance for Innovation: New Ideas for Investment-Led Growth*. Rowman & Littlefield. <http://www.policy-network.net/publications/4860/Mission-Oriented-Finance-for-Innovation>
- Mazzucato, M. and Perez, C. (2015). "Innovation as Growth Policy" in Fagerberg, J., Laestadius, S. and Martin, B. (eds.) *The Triple Challenge: Europe in a New Age*. Oxford University Press: Oxford. <http://www.oxfordscholarship.com/view/10.1093/acprof:oso/9780198747413.001.0001/acprof-9780198747413>
- Mazzucato, M. and Penna, C. (2016). "Beyond market failures: the market creating and shaping roles of state investment banks". *Journal of Economic Policy Reform*, 19:4, 305-326 <http://www.tandfonline.com/doi/full/10.1080/17487870.2016.1216416>
- Mazzucato, M., Semieniuk, G. (2016). "Financing renewable energy: who is financing what and why it matters". SPRU Working Paper Series SWPS 2016-12. http://marianamazucato.com/wp-content/uploads/2016/07/2016_12_SWPS-Mazzucato_et_al.pdf
- Mazzucato, M, Semieniuk, G. and Watson, J. (2015) 'What will it take to get us a Green Revolution?', Sussex Energy Group, (01/12/2015). <https://www.sussex.ac.uk/webteam/gateway/file.php?name=what-will-it-take-to-get-us-a-green-revolution.pdf&site=264>
- Mazzucato, M. and Watson, J. (2016). "Response to BIS Committee Inquiry: Industrial Strategy". University of Sussex. <http://data.parliament.uk/WrittenEvidence/CommitteeEvidence.svc/EvidenceDocument/Business,%20Energy%20and%20Industrial%20Strategy/Industrial%20strategy/written/39044.html>
- Mowery, D. C., R. R. Nelson, and B. R. Martin. (2010). "Technology Policy and Global Warming: Why New Policy Models are Needed (Or Why Putting New Wine in Old Bottles Won't Work)." *Research Policy*, 39: 1011–1023.
- Nelson, R. R. (1988). Institutions supporting technical change in the United States. In G. Dosi, C. Freeman, R. R. Nelson, G. Silverberg, & L. Soete (Eds.) *Technical change and economic theory* (pp. 312–329). London: Pinter.

Perez, C. (2016). "Capitalism, Technology and a Green Global Golden Age: The Role of History in Helping to Shape the Future" in Jacobs, M. and Mazzucato, M. (eds.) *Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth*, Wiley-Blackwell: London.

Rodrik, D. (2004). "Industrial Policy for the Twenty-First Century". CEPR Discussion Paper No.4767.

Rodrik, D. (2014). "Green Industrial Policy". *Oxford Review of Economic Policy*, 30 (3): 469-491.

Skea, J., Ekins, P. Winskel, M. (2011). (eds.) *Energy 2050: Making the Transition to a Secure Low-Carbon Energy System*. Routledge: London.

The Economist (2004). "The second transition". Special report on Spain, available at:

<http://www.economist.com/node/2764840>.