

# From Market Fixing to Market-Creating:

## A new framework for innovation policy

MARIANA MAZZUCATO

Science Policy Research Unit, University of Sussex, UK

*Correspondence Address:* Mariana Mazzucato, Science Policy Research Unit,

University of Sussex, UK. Email: [m.mazzucato@sussex.ac.uk](mailto:m.mazzucato@sussex.ac.uk)

### ABSTRACT

Many countries are pursuing innovation-led 'smart' growth, which requires long-run strategic investments and public policies that aim to create and shape markets, rather than just 'fixing' *markets* or *systems*. Market creation has characterized the kind of mission-oriented investments that led to putting a man on the moon and are currently galvanizing green innovation. Mission-oriented innovation has required public agencies to not only 'de-risk' the private sector, but also to lead the direct creation of new technological opportunities and market landscapes. This paper considers four key issues that arise from a market creating framework for policy: (1) decision-making on the *direction* of change; (2) the nature of (public and private) *organizations* that can welcome the underlying uncertainty and discovery process; (3) the *evaluation* of mission-oriented and market-creation policies; and (4) the ways in which both *risks and rewards* can be shared so that smart growth can also result in inclusive growth.

**KEY WORDS:** innovation policy, mission-oriented policy, market failures, system failures, directionality, smart growth, inclusive growth.

JEL Classification: H1, L1, L2, O1, O3

## 1. Societal Challenges and opportunity driven investments

Innovation agencies around the world are increasingly considering socio-economic-technological challenges that can be tackled through innovation policies (*EC Innovation Union; OECD Innovation Strategy*). The idea is that, through such challenges, which can relate to such issues as climate change, cancer, or the demographic-ageing crisis, innovation policy should produce solutions for societal problems. The present paper argues that such challenge-driven innovation policies require the traditional *market failure* justification for policy intervention, and even the *system failure* one, to be complemented with a more active *market creating* framework. To this end, the paper draws on and advances an analysis of the role of public policy in the economy that can provide a more strategic and *mission-oriented* approach.

Societal challenges require technological, behavioral, and systemic changes and have much to learn from those *mission-oriented* feats that led to putting humans on the moon and to the emergence of new general-purpose technologies ranging from the Internet to biotechnology and nanotechnology (Foray et al. 2012). It was only possible to achieve those missions when the public and private sectors worked together to create new technologies and sectors (Mowery et al. 2010; Ruttan 2006). Crucially, the public side of such partnerships was not limited to incentivizing, facilitating, or *de-risking* the private sector. Rather, it required that (public) risks be taken through choosing a particular direction of change (Mazzucato 2013a). Such *directionality* did not occur from the top down, but through a decentralized group of public agencies, what Block and Keller (2011) refer to as a “developmental *network* state”. Given the immense risks involved in choosing to develop particular sectors (such as nanotechnology), technologies (such as GPS), and broadly defined areas (such as the green economy), the relevant public institutions had to welcome the underlying

uncertainty that such choices entail. Some options win (such as the Internet) while others fail (such as the commercialization of the Concorde airplane). Indeed, the success of innovative public organizations like DARPA in the US Department of Defense, which has been responsible for the financing of Arpanet (the seed of the Internet), has been attributed to the attention it paid to internal organizational dynamics, which nurtured experimentation and learning (Abbate 1999; Block 2008), and 'policy as *process*' (Hirschman 1967; Rodrik 2014).

Missions imply setting *directions of change*—that is, tilting (rather than leveling) the playing field to favor certain types of change more than others (Mazzucato and Perez 2015). The IT revolution was picked as was also the biotech and nanotech revolution (Block and Keller 2011). What should be the core of the policy debate is not whether policies require picking and choosing but how to enable such picking to occur in the smartest way possible, nurturing a learning and adaptation process which prevents the system from getting locked into sub-optimal circumstances. Missions should be broad enough to catalyze many different sectors (the man on moon mission required a dozen sectors to engage) but concrete enough to translate into specific problems to solve, so that progress towards the mission can be evaluated on a continual basis.

Thus limiting our understanding of the role of the public sector to one that simply 'administers', 'fixes', 'regulates', and at best 'facilitates' and 'de-risks' the private sector, prevents us from thinking creatively about how to allow public sector vision, risk-taking, and investment to lead and structure the necessary transformational changes. A general lack of faith in the power of public institutions, driven by public choice theory (Buchanan 2003), has led to a reduction in the kinds of investments that the public sector makes in building its own capabilities and competencies (with a consequent rise in outsourcing, Crouch 2016), which are essential to guide such change.

The biased view of the public sector as at best facilitating change, rather than directly creating it, has been symptomatic of not only the market failure approach to policy intervention (discussed further below), but also of the evolutionary approach that has emphasized the role of public policy in terms of fixing *system failures* (Lundvall 1992). This is because the *systems of innovation* perspective has focused primarily on the need to build horizontal linkages between actors, rather than on direct (vertical) investments, and while this has contributed important insights into the framework conditions required for innovation, it has ignored those more vertical policies required for setting the *direction* of change, and the characteristics of public agencies required to set such a direction. In other words, by viewing public sector action (regulation or investment) as the solution to a problem that arises from different types of failures, whether these be coordination failures or network failures, it has indirectly perpetuated the view of the public sector as a passive force that can only facilitate change, rather than lead it. Consequently, the systems perspective to policy has provided little guidance for the directionality that is required in a world in which different pathways of development can be chosen even within a sector (Stirling 2014), and minimal insights are provided regarding the nature of the actors required. Is a financialized private sector the same as a non-financialized one? Are public organizations that aim to create horizontal conditions for innovation organized in the same way as those directed at missions that require picking of specific firms to support, particular technologies to develop, and broadly defined sectors to create?

The key problem is that any framework that focuses on policy only in terms of fixing problems, especially (but not only) market failures, does not embody any explicit justification for the kind of market creation and mission-oriented **directionality** (and 'routes' within directions) that was required for innovations such as the Internet and

nanotechnology and is required today to address societal challenges (Mazzucato 2015). Secondly, by not considering the state as a lead investor and market creator, such failure-based approaches do not provide insights into the type and structure of public sector **organizations** that are needed in order to provide the depth and breadth of high-risk investments. Thirdly, as long as policy is seen only as an ‘intervention’, rather than a key part of the market creation and shaping process, the type of **evaluation** criteria used to assess mission-oriented investments will inevitably be problematic. Fourthly, by not describing the state as a lead risk-taker and investor in this process, the failure-based approaches have avoided a key issue regarding the distribution of **risks and rewards** between the state and the private sector.

The present paper addresses these four challenges by asking the following questions:

- (1) How can public policy be understood in terms of setting the direction and route of change; that is, shaping and creating markets rather than just fixing them (**Directionality**)?
- (2) How can this alternative conceptualization be translated into new indicators and evaluation tools for public policies, beyond the micro-economic cost/benefit analysis and macro-economic appraisal of crowding in/crowding out that stem directly from the market failure perspective (**Evaluation**)?
- (3) How should public organizations be structured so they accommodate the risk-taking, explorative capacity and capabilities needed to envision and manage contemporary challenges (**Organizations**)?
- (4) How can public investments along the innovation chain result not only in the socialization of risks, but also of rewards, enabling smart growth to also be inclusive growth (**Risks and rewards**)?

While the questions may seem broad, it is their potential *connection* that can help build a *market creation* framework. Policies that aim to actively create and shape markets require indicators that assess and measure the performance of a policy along that particular transformational objective. The state's ability and willingness to take risks, embodied in transformational changes, requires an organizational culture (and policy capacity) that welcomes the possibility of failure and experimentation and is rewarded for successes so that failures (which are learning opportunities) can be covered and the next round financed.

This alternative view (policy framework) of policy making builds on the inspirational work of Karl Polanyi (2001 [1944]), an economic historian and sociologist who understood markets as being deeply embedded in social institutions, and policy as not standing on the side-lines, but within the very *market creation* process. In his epic book *The Great Transformation*, Polanyi described the way in which capitalist markets are deeply embedded in social and political institutions, rendering the usual static state vs. market juxtaposition meaningless. As Polanyi wrote: “[t]he road to the free market was opened and kept open by an enormous increase in continuous, centrally organized and controlled interventionism” (2001 [1944], 144). Polanyi's work has been revolutionary in terms of showing the myth of the state vs. market distinction: the most capitalist of all markets, the national market, was forcefully pushed into existence by the state. The market is embedded in and shaped by the state (Evans 1995). The present paper argues, in essence, that the four above questions can help govern the dynamics of embeddedness, so that policy choices are rendered more explicit (and hence also more easily debated), and the results of public policies can be measured with metrics that are adequate for a dynamic process.

The remainder of the paper is structured as follows. Section 2 briefly reviews the limits of market failure theory (MFT) in describing transformational change. Section 3 considers ways in which recent advances in heterodox economics contain the seeds of an alternative framework to MFT. Section 4 considers the four key questions that emerge from considering a market shaping framework. Section 5 considers the new research questions that emerge from considering this perspective.

## **2. Market failure theory**

*Market failure theory* justifies public intervention in the economy only if it is geared towards fixing situations in which markets fail to efficiently allocate resources (Arrow 1951; Samuelson 1954). The market failure approach suggests that governments intervene to fix markets by investing in areas characterized by positive or negative externalities. For example, positive externalities arising from public goods (which are *non-rivalrous* and *non-excludable*) will be characterized by under-investment by the private sector and will therefore require public investment. This is the case for basic research, which has high spillovers that create difficulties in appropriating private returns; consequently, basic research is characterized by too little private investment. Negative externalities, such as those created by pollution, require public measures that cause the private sector to internalize external costs, such as through a carbon tax.

A particular source of market failure comes from negative externalities that arise from the production or use of goods and services such as climate change, traffic congestion, or antibiotic resistance, for which there is *no market*. In this perspective, most societal challenges are seen as negative externalities. Such failures work at the

system level; that is, they amount to system failures. The socio-economic system as a whole results in costly outcomes that are undesirable from a societal point of view. For instance, climate change can be seen as a negative externality from carbon-intensive production methods or the burning of fossil fuels. Indeed, the *Stern Review* (Stern 2006) on the economics of climate change stated that: “Climate change presents a unique challenge for economics: it is the greatest example of market failure we have ever seen” (Stern 2006, 1). Negative externalities are not reflected in the price system: there is no ‘equilibrium’ price because there is no market for negative externalities. Many economists have called for market-based mechanisms (such as carbon pricing or carbon taxes) or neutral technology policies (such as tax breaks) to correct for this type of market failure, both of which leave the market to determine the *direction of change*.

While MFT provides interesting insights, it is at best useful for describing a *steady-state* scenario in which public policy aims to put patches on existing trajectories provided by markets. It is less useful when policy is required to dynamically create and shape new markets; that is, ‘transformation’. This means it is problematic for addressing innovation and societal challenges because it cannot explain the kinds of transformative, catalytic, mission-oriented public investments (Foray et al. 2013) that created new technologies and sectors that did not previously exist. This includes the emergence of the Internet, the nanotechnology sector, the biotechnology sector, and the emerging clean-tech sector (Block and Keller 2012). Such mission-oriented investments coordinated public and private initiatives, built new networks, and drove the entire techno-economic process, which resulted in the creation of new markets (Mazzucato 2015). This depiction is very different from assuming that the private sector

is in a space and simply needs to be incentivized to invest more or less within that space. It is the space itself that has been created by public policy, with the private sector entering only later. The imagination and vision emanated from the policy itself, which actively took risks rather than just *de-risking*.

A key characteristic of market-creating investments is that they are not limited to upstream basic research (the classic public good). Indeed, public investments that led to technological revolutions (IT, biotech, nanotech) and new *general-purpose technologies* (such as the Internet) were distributed *along the entire innovation chain*: basic research through the National Science Foundation (NSF), applied research through DARPA and the National Institutes of Health (NIH), and early-stage financing of companies through agencies like Small Business Innovation Research (SBIR) (Block and Keller 2011). This means that the kinds of innovation instruments (discussed by Martin 2016, this issue) were spread across a decentralized network of different agencies across the entire innovation chain. While such agencies might not act together in a planned way, the history of agencies like DARPA and NIH teaches us that they were often driven by a *vision* to create new landscapes (in defense or life-sciences) rather than to only fix problems in existing landscapes. In order to understand such mission-oriented policies, and to guide future ones, it is essential to develop a framework that can take into account investments that direct/steer change in particular directions, with the public sector not only *de-risking*, but also taking risks and uncertainties as lead investor. A *market-creating* framework for policy, to complement the market (and system) *fixing* role, can build on several 'heterodox' economics literatures that have emphasized the state's *transformational capacity*. We review these alternative literatures below.

### 3. Insights on market shaping/creating from alternative theories

Policies based on building systems of innovation focus on the need for nations to build a “*network of institutions in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies*” (Freeman 1995). The emphasis here is not on the stock of R&D, but on the circulation of knowledge and its diffusion throughout the economy (Lundvall 1992). Institutional change is not assessed through criteria based on static allocative efficiency, but rather on how such change promotes technological and structural change. This perspective is neither macro nor micro, but more meso, where individual firms are seen as part of broader network of firms with which they cooperate and compete. The systems of innovation approach has been crucial for highlighting deficiencies in the market failure perspective, as it regards innovation policy (Lundvall 1992; Freeman 1995). It has emphasized the inability of MFT to tackle lock-in effects and to specific types of institutional failures that arise from feedback processes along the entire innovation chain (Verspagen 2006). As discussed by Brown (2016, this issue), key innovation institutions, such as universities, will only allow the innovation system to achieve its potential if they are lined up synergistically with other institutions in the entrepreneurial eco-system.

However, while the systems of innovation approach has been key in identifying dynamic system failures, it has not explicitly created an alternative policy framework. This is because it has been too wed to the notion of policy as fixing, rather than wholeheartedly debunking the notion of policy as an ‘intervention’ in the market process. In order to develop an alternative framework, the market itself must be redefined as an *outcome* of the interactions between different agents, including public policy makers (Mazzucato 2013c).

In order to develop a market-creating view of policy, in the spirit of Karl Polanyi's understanding of markets as outcomes embedded in policy processes, the paper draws on insights from different bodies of thought that have considered the role of the state in achieving *transformation* of the economic landscape. These are: (a) science and technology policy research on *mission-oriented* policies; (b) development economics research on the *developmental state*; (c) evolutionary economics research on shifts in *technological trajectories and the emergence of techno-economic paradigms*; and (d) my own research on the *entrepreneurial state*, which looks explicitly at the risk-taking role of different actors (Mazzucato 2013a). In section 4, I use these insights to consider new questions for economic policy that can help guide a market-creating framework. The fact that these four bodies of thought have not previously been linked, and have not been clearly positioned to critique the key tenets of market failure theory, has prevented them from having the impact they could have on our understanding of how to guide, evaluate and manage public policy.

***a) Science and Technology Policy Research: Mission-Oriented Innovation Policy***

The history of innovation policy, studied especially through the systems of innovation approach (Freeman 1995), provides key insights into the limits of market failure theory with regard to justifying the depth and breadth of investments that have been necessary for the emergence of radical technological change. Innovation policy has historically taken the shape of measures that perform the following four functions: (1) support basic research, (2) aim to develop and diffuse general-purpose technologies, (3) develop certain economic sectors that are crucial for innovation, and (4) promote infrastructural development (Freeman and Soete 1997 [1974]). The *justification* of innovation policies has changed over time. While military motives predominated in the

1950s and 1960s, the aim since the 1970s has been to improve economic and competitive positions. In the 1980s, innovation policy became increasingly justified due to market failure. Innovation policies driven by military motives have been described as mission-oriented because they have aimed to achieve clearly defined technical goals. There have been calls in recent years for a return to such policies to address 'grand societal challenges' (Mowery et al. 2010). However, Foray et al. (2012) contrasted missions of the past, such as putting a man on the moon, with such contemporary missions as tackling climate change. While past missions aimed to develop a particular technology (with the achievement of the technological objective signaling that the mission was accomplished), contemporary missions have addressed broader and more persistent challenges, which require long-term commitments to the development of technological solutions. The *Maastricht Memorandum* (Soete and Arundel 1993) provided a detailed analysis of the differences between old and new mission-oriented projects, showing that "older projects developed radically new technologies through government procurement projects that were largely isolated from the rest of the economy, though they frequently affected the structure of related industries and could lead to new spin-off technologies that had wide-spread effects on other sectors. In contrast, [contemporary] mission-oriented environmental [and other] projects will need to combine procurement with many other policies in order to have pervasive effects on the entire structure of production and consumption within an economy" (p. 50).

However, research in this literature has often failed to integrate empirical insights in order to provide a fully-fledged theory that contrasts with MFT. Consequently, these studies have resulted in ad-hoc theoretical understandings and policy advice on how to manage mission-oriented initiatives, without tackling the key justifications for

mission-oriented investments in a way that contrasts the justifications that arise from MFT. In particular, the framework has been limited to looking at agencies that focus on science, technology, and innovation policies. Doing so ignores the relationship between types of finance and innovation development. It also overlooks, for example, the rise of public financial institutions like state investment banks (such as KfW in Germany or the China Development Bank) as sources of mission-oriented finance, especially as private finance has increasingly retreated from financing the real economy (Mazzucato 2013b; Mazzucato and Penna 2014). While mission-oriented programs are intrinsically dynamic, with feedback loops between missions and achievements, the tools used to evaluate such public policies have remained static, coming from the MFT toolbox. For these reasons, mission-oriented policy research is currently confined to a small area of policy research and practice and has had minimal impact on how economists understand the role of public policy.

***b) Development Economics: Developmental Network States***

Work on the developmental state, a concept from a small group of development economists, has revealed the importance of the ‘visible hand’ of the state in industrialization and technological change (Wade 1990; Amsden 2001). More recently, this literature has also emphasized the importance of a developmental *network* state; that is, a decentralized network of different types of state agencies that can foster innovation and development. While significant attention has been devoted to the role of large agencies or institutions (such as DARPA or the NIH) in historical mission-oriented projects, it is only recently that considerable focus has been placed on the broader network of structures, actors, strategies and agencies, such as intelligence distributed amongst actors and institutions, flat organizational structures, flexibility, and customization (Perez 2002). Many successful cases of innovation and technology

policy strategies have been carried out by networks of decentralized public institutions, which have focused not on creating individual ‘national champion’ firms, but on establishing a constellation of innovative firms (O’Riain 2004). This has been the case in East Asia, Finland, Israel, Taiwan, and even in Silicon Valley in the United States (Block and Keller 2011). Such successful policies have covered a wide range of measures, including R&D support, training, support for marketing and exporting, funding programs (including early-stage venture capital), networking and brokerage services, building of facilities and clusters (so-called science parks), and fostering industrial ties.

From this alternative view, economic development is not the result of natural competitive advantages, but of the endogenous creation of new opportunities that *lead to the establishment* of competitive advantages. This process requires discovery of the cost structure of an economy in order to identify which of the types of goods and services that already exist in world markets can be produced in a domestic economy at low cost (Rodrik 2004). The state plays a central coordinating role in this discovery process and often represents a lead agent in economic development efforts. Because economic development is an endogenous process, the state provides social capital, coordinates initiatives and public-private partnerships, fosters synergies, and promotes the introduction of new combinations that create Schumpeterian rents (Reinert 2007).

### ***c) Evolutionary Economics: Technological Trajectories and Techno-Economic Paradigm Shifts***

Following the Schumpeterian tradition, evolutionary economists aim to “open the black box of technical change” (Rosenberg 1982) with a methodology that is led by empirical regularities and historical analysis in order to understand the process that links technical change (innovation), economic growth, and development. Key concepts

developed in evolutionary economics are those of *technological paradigms* and *technological trajectories* (Dosi 1982; Nelson and Winter 1982), which reveal the limitation of market forces in providing direction to economic development. A technological paradigm has a threefold definition: it is an *outlook* of the relevant productive problems confronted by firms (as producers of technologies or innovators); it represents a set of procedures (routines) of how these problems shall be approached; and it defines the relevant problems and associated knowledge necessary for their solution (Dosi 1982, 148).

The evolutionary focus on the co-evolution of those processes creating variety between economic agents and the competitive selection process that winnows in on that variety, means that an evolutionary perspective on policy must consider adaptation (Witt 2003, and Flanagan and Uyarra 2016, this issue). Policies should not be viewed as general a priori answers, but as being about learning and emergence. Which policy is best in which environment will emerge from experimentation and trial and error. A technological trajectory, in turn, represents the direction of learning, experimentation, and progress within a technological paradigm. Therefore, technology development is a problem-solving activity, and a technological paradigm “embodies strong prescriptions on the *directions* of technical change” (Dosi 1982, 152). This is why market signals are limited in terms of providing direction to techno-economic development; they only work within the parameters of the paradigm, which means they influence the rate of change more than the direction. When two or more technological paradigms compete, markets may influence which one is selected (the one that minimizes costs). Once established, however, paradigms have a powerful ‘exclusion effect’, whereby some technological possibilities are discarded because they are incompatible with the prevailing

paradigm and are therefore 'invisible' to agents. Thus, a techno-economic system of innovation may be locked into a self-reinforcing, path-dependent trajectory (Dosi and Nelson 1994). This becomes a problem if the trajectory being followed (or the paradigm itself) is inferior or suboptimal to what could be achieved with technologies that transgress the paradigm (or with a different paradigm).

Perez (2002) expanded the notion of technological paradigm to *techno-economic paradigm* order to account for the non-technological forces (economic and social institutions) that characterize certain periods of capitalist history and affect both the economic and social systems. Her theory of techno-economic paradigm shifts is a historical perspective on the long-waves of development that accompany technological revolutions. "A techno-economic paradigm is, then, a best-practice model made up of a set of all-pervasive generic technological and organizational principles, which represent the most effective way of applying a particular technological revolution and of using it for modernizing and rejuvenating the whole of the economy" (Perez 2002, 15). When a new technological revolution emerges, the socio-economic system remains stuck within the bounds of the previous paradigm. This renders market forces incapable of directing the system towards the new paradigm and stifles the modernizing and rejuvenating potential of the new revolution. In other words, there are mismatches between elements of the social and techno-economic systems (for example, social expectations, R&D routines, tax regimes, labor regulations). In order to overcome these mismatches, it is necessary to build new institutions that favor the diffusion of the new paradigm. In all previous technological revolutions, governments have led the process of institution-building that allowed new techno-economic paradigms to replace the old ones. Perez (2002) specifically pointed to the role that public policy plays in allowing the full deployment of technological revolutions, such as

the effect of suburbanization on the ability of the mass production revolution to diffuse throughout the economy.

This stream of research on technological and techno-economic paradigms highlights the importance of cognition when establishing the direction of technological change. Paradigms are powerful enabling and constraining institutions that favor certain directions of techno-economic development and obstruct others. In order to redirect techno-economic development on a new, qualitatively different route, a paradigm shift is required that will avoid the constant renewal of prevailing trajectories that occurs if market forces provide directionality to the system. From this perspective, the state has a crucial role to play in terms of creating a new *vision* that will coordinate cognitive efforts of different (public and private) agents and direct their action to areas beyond the existing paradigm. Green innovation can be understood as a redirection of the full deployment of the IT revolution (Mazzucato and Perez 2014). In order to effectively provide the direction of change, a vision must be created and shared. Stirling (2008) correctly focused on the role of bottom-up participatory processes to ensure directionality is taken seriously and shared amongst actors.

***d) The Entrepreneurial State: The State as Lead Risk-Taker and Investor in the Economy***

Alternative approaches to innovation policy, such as those described above, have questioned particular aspects of the economic dynamics embodied in Neoclassical theory. However, they have not questioned the underlying assumption of business being the only risk taker. The entrepreneurial state agenda has sought to challenge the notion of the entrepreneur being embodied in private business, and policy making being an activity outside of the entrepreneurial process (Mazzucato 2003). This perspective builds on studies in industry dynamics that have documented a weak

relationship between entry of new firms into industries and the current levels of profits in those industries (Vivarelli 2013). Firm entry appears to be driven by expectations about future growth opportunities, even when such expectations are overly optimistic (Dosi and Lovallo 1998). Historically, such technological and market opportunities have been actively shaped by government investment—what Mazzucato (2013a) refers to as the entrepreneurial state; that is, a willingness to invest in, and sometimes imagine from the beginning, new high-risk areas before the private sector does. Business has tended to enter new sectors only *after* the high risk and uncertainty has been absorbed by the public sector, especially in areas of high capital intensity. This has been the case with the IT revolution (Block and Keller 2011), the biotechnology industry (Lazonick and Tulum 2011), nanotechnology (Motoyama et al. 2011), and for the emerging clean tech sector (Mazzucato and Penna 2014). Indeed, Keller and Block (2013) have shown that private venture capital funds have focused on financing firms mid-stage, which had previously received early-stage financing by public programs, like the Small Business Innovation Research program (SBIR). The literature has ignored such private piggy-backing on public risk-taking, at best discussing it in terms of ‘crowding in’. What crowding in ignores, however, is the direct risk taking that such (public) activity entails, and hence the occasional failures that will inevitably result.

In the book *The Entrepreneurial State: Debunking Public vs. Private Sector Myths*, Mazzucato (2013a) describes the risk-taking role the state has played in the few countries that have achieved innovation-led growth. Ignoring the high risk and uncertainty that the state has absorbed has caused the fruits of innovation-led growth to be privatized, even though the underlying risk was socialized. It is usually assumed that the returns to the state will occur indirectly through the spillovers that are generated and/or through tax revenue. However, this type of return is based on the

assumption that the state intervention is limited to upstream areas like basic research (with high spillovers). However, the traditional assumptions break down when the intervention occurs throughout the entire innovation chain, including for applied research for technologies that get appropriated by specific firms, and on early-stage high-risk company financing. This happens because the firms in question often succeed in avoiding tax, and also because there is no reason for the firms to remain in the region/country where the public funding originated. Thus the entrepreneurial state framework implies considering both indirect and direct 'reward' mechanisms for the public policies. Such mechanisms can make it easier for public organizations to treat their investments as portfolios, able to make some return on the upside to cover the downside as well as the next round of investments. More evidence is needed from around the world regarding the challenges and opportunities related to different types of return-generating mechanisms for public investments, such as those in Israel (through Yozma), the US (through In-Q-tel) and Finland (through SITRA). This will help generate insights into the role of the state as a spender, facilitator and regulator, but also as an investor and venture capitalist (Mazzucato 2013a; Rodrik 2015). How to do this, while retaining a mission-oriented perspective (not limited by cost–benefit analysis), is a key challenge.

#### **4. Beyond market failure: Routes, organization, assessment, and rewards**

New economic thinking is required in order to build a policy framework that can be oriented towards market creating, rather than just market fixing, and can be focused on *transforming* the economic landscape rather than just facilitating it. This section brings together key concepts from the four heterodox frameworks reviewed above, drawing especially on the empirical research conducted within these perspectives, in order to provide a new theoretical conceptualization for guiding state action to tackle

transformational change. The section considers four new policy questions, which can help build a market-creating policy agenda (Mazzucato 2015).

***Directionality: Understanding the role of policy as setting the direction of change.*** Policies that aim to correct markets assume that once the sources of the failure have been addressed, market forces will efficiently direct the economy to a path of growth and development. However, markets are “blind” (Dosi 1982) and the direction of change provided by markets often represents suboptimal outcomes from a societal point of view. This is why, in addressing *societal challenges*, states have led the process and provided the direction towards new techno-economic paradigms that did not emerge spontaneously out of market forces. Governments made direct investments in the technologies that enabled the mass production and IT revolutions to emerge, and formulated bold policies that allowed these phenomena to be fully deployed throughout the economy (Ruttan 2006; Block and Keller 2011). This fact seems to point to different analytical problems facing policy makers: namely, choosing whether the correct course of action is to direct or stand back; understanding *how* particular directions and routes can be picked; and determining how to mobilize and manage activities that can lead to the achievement of dynamic social and technological challenges.

The problem is not whether to pick a direction, but how to learn from the successful picking of the past, and to enable the directions picked to be broad enough to allow bottom-up exploration, discovery and learning. This is sometimes referred to as “smart specialization” (Foray, David and Hall 2009) and is explicitly a results- and outcome-oriented agenda, not an input- or outputs-oriented one (Rodrik 2004). However, the fact that it has hitherto been based on a market failure framework means that smart specialization is, at best, considered a ‘discovery’ process with which stakeholders and

policy-designers can jointly identify bottlenecks, market failures, and missing links. Smart specialization has not addressed the way in which innovation-led growth in places like Silicon Valley *actually happened*. Doing so requires not only the identification of missing links, but the formation of concrete strategies towards producing market landscapes that simply did not exist in the past. It also requires that the playing field be *tilted* in the direction pursued, rather than *leveled* (Mazzucato and Perez 2015).

**Organization: Transforming public organizations into ones that welcome learning, experimentation and self-discovery.** If brought to its extreme, as advocated by critics from public choice theory, MFT calls for the state to intervene as little as possible in the economy, in a way that minimizes the risk of government failure, from crowding out to cronyism and corruption. This view requires a structure that *insulates* the public sector from the private sector (to avoid issues such as agency capture) and has resulted in a trend of outsourcing that often rids government of the knowledge capacities and capabilities (in relation to IT, for example) that are necessary for managing change (Kakabadse and Kakabadse 2002). Studies have examined the influence of outsourcing on the ability of public institutions to attract top-level talent with the relevant knowledge and skills to manage transformative mission-oriented policies. Without such talent and expertise it is nearly impossible for the state to fulfill its role of coordinating and providing direction to private actors when formulating and implementing policies that address societal challenges. In order to promote transformation of the economy, by shaping and creating technologies, sectors, and markets, the state must organize itself so that it has the intelligence (policy capacity) to think big and formulate bold policies. If the state is essential to the process of

transformative technological and socio-economic change, it is also essential to understand the appropriate structure of public organizations. Innovation is subject to extreme uncertainty, which creates the need for both patience (“patient long-term capital”, Mazzucato 2013b) and the ability to experiment and explore the underlying landscape (Rodrik 2004). Therefore, a crucial element in organizing the state for its market-creating role is building its *absorptive capacity* (Cohen and Levinthal 1990), a concept that has hitherto been restricted to private organizations. This absorptive capacity will enable public agencies to learn in a process of investment, discovery, and experimentation, and see policy as process (Hirschman 1967).

A key concern should be to establish skills/resources, capabilities, and structures that can increase the chances that a public organization will be effective, both at *learning* and at *establishing symbiotic partnerships with the private sector*, and ultimately succeed in implementing mission-oriented and transformative policies. Public and private organizations must re- rethink their roles when working together. Public–private partnerships have often limited the public part in de-risking the private part. This ignores the capabilities and challenges involved in public sector risk taking. De-risking assumes a conservative strategy that minimizes the risks of picking losing projects, but does not necessarily maximize the probability of picking winners, which requires the adoption of a portfolio approach for public investments (Rodrik 2013). In such an approach, the success of a few projects can cover the losses from many projects, and the public organization in question also learns from its loss-making investments (Mazzucato 2013a). Here, the matching between failures and fixes is less important than having an institutional structure that ensures that winning policies provide enough rewards to cover the losses, and that losses are used as lessons to improve and renew future policies. Research on the *developmental state* (Block and Keller 2011) suggests

that these goals are best achieved not through top-down policies, but through a decentralized structure in which the organization(s) involved remain nimble, innovative, and dynamic from within. This strand of thinking can benefit from looking at the ways in which public–private partnerships were created when seeking the joint creation of new products and services, including vaccines (Chataway et al. 2007).

***Evaluation: Transforming static metrics into dynamic ones.*** The market failure framework has developed concrete indicators and methods to evaluate government investments, which stem directly from the framework itself, usually through a cost–benefit analysis that estimates whether the benefits of public intervention compensate for the costs associated with the market failure and with the implementation of the policy (including governmental failures). The problem is that there is a mismatch between the intrinsically dynamic character of economic development and the static tools used to evaluate the role of the public policy in the process.

Failure to allow for the possibility that government can transform and create new landscapes that did not previously exist will affect the ability to measure such impact. This is evident in innovation and also for public services (Crouch 2015). This situation then leads to accusations of government crowding out business, which implies that the areas that government moves into could have been areas for business investment. Such claims are best defended through a *crowding in* argument, which relies on showing how government investments create a larger national output pie (hence higher savings for private investment to dip into). Indeed, as shown by Engel, Rothgang and Eckl (2016, this issue), public investments in R&D often crowd in further R&D investments by business.

However, this defense does not account for the fact that businesses are risk-averse and unwilling or unable to transform existing and create new landscapes, which is

about creating *new pies*, not increasing existing ones. Without *indicators* for such transformative action, the static toolbox affects the government's ability to determine whether it is simply operating in existing spaces or making new things happen that would not have happened anyway (its 'additionality'). This often leads to investments that are overly narrow or directed within the confines of the boundaries set by the business practices of the prevailing techno-economic paradigm (Abraham 2010).

Therefore, it is crucial to develop a new toolbox and indicators for evaluating and measuring the degree to which state investments open up and transform sectoral and technological landscapes, rather than tinkering with existing ones. The indicators must take into account the underlying risk and uncertainty absorbed in transforming such landscapes.

***Risks and Rewards: building symbiotic private–public partnerships.*** MFT says little about cases in which the state is the *lead investor and risk taker* in capitalist economies. Having a vision about the direction in which to drive an economy requires direct and indirect investment in particular areas, not just creating the (framework) conditions for change. Crucial choices must be made, the fruits of which will create some winners, but also many losers. For example, the US Department of Energy recently provided guaranteed loans to two green-tech companies: Solyndra (\$500 million) and Tesla Motors (\$465 million). While the latter is often glorified as a success story, the former failed miserably and became the latest example in the media of government being inefficient and unable to *pick winners* (Wood 2012). However, any venture capitalist will admit that for every winning investment (such as Tesla) there are many losses (such as Solyndra). In making its downstream investments, therefore, governments can learn from portfolio strategies of venture capitalists, structuring

investments across a risk space so that lower risk investments can help to cover the higher risk ones. In other words, if the public sector is expected to compensate for the lack of private venture capital (VC) money going to early-stage innovation, it should at least be able to benefit from the wins, as private VC does. Otherwise, the funding for such investments cannot be secured. As argued in Mazzucato and Wray (2015), even if money could be secured for public investments endogenously (through money creation), it is desirable to allow the state to reap some of the rewards from its investments for a number of other reasons. Matching this type of spending with the corresponding return would provide a measure of efficiency, holding policymakers accountable; government net spending has limits dictated by the real resource capacity of the economy; and voters will be more willing to accept the (inevitable) failures if they see that those are compensated by important successes.

The public sector can use a number of return-generating mechanisms for its investments, including retaining equity or royalties, retaining a golden share of the IPR, using income-contingent loans, or capping the prices (which the tax payer pays) of those products that emanate, as drugs do, from public funds (Mazzucato 2013). Before exploring the details of each mechanism, however, it is crucial for the policy framework to even allow the question to be asked. In a market-shaping framework, does government have the right to retain equity more than in a market failure framework? Are taxes currently bringing back enough return to government budgets to fund high-risk investments that will probably fail?

## **5. Conclusion**

This paper has considered the limitations of the market failure framework that continues to guide innovation policy. It has argued that putting innovation at the center of growth policy requires an emphasis on shaping and creating markets rather than

just fixing them and that an alternative framework must also go beyond fixing system failures. To guide a market-creating view, the paper has considered insights from alternative (heterodox) literatures on the role of the state in producing structural change and transformation. Four critical issues must be considered when building such a framework: (1) the *direction* of change promoted by policy; (2) the nature of (public and private) *organizations* that can welcome the underlying uncertainty and discovery process; (3) the *evaluation* of mission-oriented and market-creation policies; and (4) the ways in which both *risks and rewards* can be shared so that smart growth can also result in inclusive growth.

Considering the need for government policy to transform, be catalytic, and create and shape markets rather than just fix them helps reframe the key questions of economic policy from static ones that deal with crowding out and picking winners to more dynamic ones that help form the types of public–private interactions that can create new innovation and industrial landscapes. The point is not to prescribe specific technologies, but to provide directions of change around which bottom-up solutions can then experiment. As Stirling (2014, 2) put it: “*The more demanding the innovation challenges like poverty, ill health or environmental damage, the greater becomes the importance of effective policy. This is not a question of ‘picking winners’—an uncertainty-shrouded dilemma which is anyhow equally shared between public, private and third sectors. Instead, it is about engaging widely across society, in order to build the most fruitful conditions for deciding what ‘winning’ even means*”. While identifying key societal challenges is straightforward—climate change, ageing, resource security, housing, urbanization, etc.—translating challenges into concrete missions will require the involvement of an array of stakeholders concerned with sectors and socio-technical fields affected by the challenge itself. Therefore, defining the direction of investments

should be based on sound diagnosis of each challenge by the state *together* with other stakeholders.

## **Acknowledgements**

This paper has received funding from the European Union's Horizon 2020 Framework for Research and Innovation under grant agreement No. 649186 - Project ISIGrowth. Comments from Caetano Penna and an anonymous referee from the SPRU working paper series are greatly appreciated. All errors remain the author's.

## **References**

- Abbate, J. 1999. *Inventing the Internet*. Cambridge, MA: MIT Press.
- Abraham, J. 2010. "Pharmaceuticalization of society in context: Theoretical, empirical and health dimensions". *Sociology* 44 (4): 603–622.
- Amsden, A. H. 2001. *The rise of "the rest": Challenges to the West from late-industrializing economies*. Oxford: Oxford University Press.
- Anadón, L. D. 2012. "Mission-oriented R&D institutions in energy between 2000 and 2010: A comparative analysis of China, the United Kingdom, and the United States." *Research Policy* 41 (10): 1742–1756.
- Angell, M. 2005. *The truth about the drug companies: How they deceive us and what to do about it*. New York: Random House.
- Arrow, K. 1951. *An extension of the basic theorems of classical welfare economics*. Paper presented at the Second Berkeley Symposium on Mathematical Statistics and Probability, Berkeley.
- Arrow, K., and R. C. Lind. 1970. "Uncertainty and the evaluation of public investment decisions." *The American Economic Review* 364–378.

- Aschauer, D. A. 1989. "Does public capital crowd out private capital?" *Journal of Monetary Economics* 24 (2), 171–188.
- Atkinson, A. B., and J. E. Stiglitz. 1980. *Lectures on public economics*. London: McGraw-Hill Book Co.
- Auerswald, P. E., and L. M. Branscomb. 2003. "Valleys of death and Darwinian seas: Financing the invention of innovation transition in the United States." *Journal of Technology Transfer* 28 (3–4): 227–239.
- Bator, F. M. 1958. "The anatomy of market failure." *The Quarterly Journal of Economics* 72 (3): 351–379.
- Block, F. L. 2008. "Swimming against the Current: The Rise of a Hidden Developmental State in the United States". *Politics and Society* 36 (2, June): 169–206.
- Block, F. L., and M. R. Keller. 2011. *State of innovation: The U.S. government's role in technology development*. Boulder, CO: Paradigm Publishers.
- Breznitz, D., and D. Ornston. 2013. "The revolutionary power of peripheral agencies. Explaining radical policy innovation in Finland and Israel." *Comparative Political Studies* 46(10): 1219-1245.
- Brown, R. 2016 (this issue). "Mission Impossible? Entrepreneurial Universities in Peripheral Regional Innovative Systems." *Industry and Innovation* [insert volume and page number].
- Buchanan, J. M. 2003. "Public choice: The origins and development of a research program." *Champions of Freedom* 31: 13–32.
- Cantner, U., and A. Pyka. 2001. "Classifying technology policy from an evolutionary perspective." *Research Policy* 30 (5): 759–775.
- Chataway, J., S. Brusoni, E. Cacciatori, R. Hanlin, and L. Orsenigo. 2007. "The international AIDS vaccine initiative (IAVI) in a changing landscape of vaccine

- development: A public/private partnership as knowledge broker and integrator.”  
*The European Journal of Development Research* 19 (1): 100–117.
- Chiang, J. T. 1991. “From ‘mission-oriented’ to ‘diffusion-oriented’ paradigm: The new trend of US industrial technology policy.” *Technovation* 11 (6): 339–356.
- Coase, R. H. 1960. “The problem of social cost.” *Journal of Law & Economics* 3 (1): 1–44.
- Cohen, W. M., and D. A. Levinthal. 1990. “Absorptive capacity: A new perspective on learning and innovation.” *Administrative Science Quarterly* 35 (1): 128-152.
- Crouch, C. 2016. “The Paradoxes of Privatization and Public-Service Outsourcing,” in *Rethinking Capitalism*, ed. M. Jacobs, and M. Mazzucato. Wiley Press.
- Dosi, G. 1982. “Technological paradigms and technological trajectories: A suggested interpretation of the determinants and directions of technical change.” *Research Policy* 11 (3): 147–162.
- Dosi, G., and D. Lovallo 1998. “Rational entrepreneurs or optimistic martyrs? Some considerations on technological regimes, corporate entries, and the evolutionary role of decision biases.” In *Foresights and oversights in technological change*, ed. R. Garud, P. Nayyar, and Z. Shapiro, 41–68. Cambridge, England: Cambridge University Press.
- Dosi, G., and R. R. Nelson. 1994. “An introduction to evolutionary theories in economics.” *Journal of Evolutionary Economics* 4 (3): 153–172.
- Engel, D., M. Rothgang, and V. Eckl. 2016 (this issue). “Systemic Aspects of R&D Policy Subsidies for R&D Collaborations and Their Effects on Private R&D.” *Industry and Innovation* [insert volume and page number].
- European Commission. 2011. *Horizon 2020: The framework programme for research and innovation (2014–2020)*. Brussels: European Commission.

- Flanagan, K., and E. Uyarra. 2016 (this issue). "Four dangers in innovation policy studies – and how to avoid them." *Industry and Innovation* [insert volume and page number].
- Foray, D., P. A. David, and B. Hall. 2009. "Smart specialization: The concept." In *Knowledge for growth. Prospects for science, technology and innovation*. Selected papers from Research Commissioner Janez Potočnik's Expert Group, 20.
- 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 (10): 1697–1902.
- Freeman, C. 1995. "The 'National System of Innovation' in historical perspective." *Cambridge Journal of Economics* 19 (1): 5–24.
- Freeman, C., and L. Soete. 1997 [1974]. *The economics of industrial innovation* (3rd ed.). Cambridge, MA: MIT Press.
- Friedman, B. M. 1979. "Crowding out or crowding in? The economic consequences of financing government deficits." *Brookings Papers on Economic Activity* 3: 593–654.
- Givazzi, F., and M. Pagano. (1990). "Can severe fiscal contractions be expansionary? Tales of two small European countries." In *NBER macroeconomics annual 1990* (Vol. 5), ed. O. J. Blanchard, and S. Fischer, 75–122. Boston: MIT Press.
- Haegger, B. 2010. "Strategic foresight in public policy: Reviewing the experiences of the UK, Singapore, and the Netherlands." *Futures* 42 (1): 49–58.
- Hirschman, A. O. 1967. *Development projects observed*. Washington DC: Brookings Institution Press.
- Kakabadse, A., and N. Kakabadse. 2002. "Trends in outsourcing: Contrasting USA and Europe." *European Management Journal* 20 (2): 189–198.

- Keller, M. R., and F. Block. 2013. "Explaining the transformation in the US innovation system: the impact of a small government program." *Socio-Economic Review* 11 (4): 629–656.
- Keynes, J. M. 1926. *The end of laissez-faire*. London, England: Prometheus Books.
- Klepper, S. 1997. "Industry life cycles." *Industrial and Corporate Change* 6: 145–182.
- Kreger, A. O. 1974. "The political economy of the rent-seeking society." *The American Economic Review* 64 (3): 291–303.
- Lazonick, W., and O. Tulum. 2011. "US biopharmaceutical finance and the sustainability of the biotech business model." *Research Policy* 40 (9): 1170–1187.
- Lazonick W. 2014. "Profits without prosperity." *Harvard Business Review* 92 (9): 46–55.
- Lazonick, W., and M. Mazzucato. 2013. "The risk-reward nexus in the innovation-inequality relationship: Who takes the risks? Who gets the rewards?" *Industrial and Corporate Change* 22: 1093–1128.
- Lundvall, B. A. 1992. *National innovation system: towards a theory of innovation and interactive learning*. Pinter: London.
- Martin, B.R. 2016 (this issue). "R&D Policy Instruments – a Critical Review of What We Do and Don't Know." *Industry and Innovation* [insert volume and page number].
- Mazzucato, M. 2013a. *The entrepreneurial state: Debunking the public vs. private myth in risk and innovation*. London: Anthem Press.
- Mazzucato, M. 2013b. "Financing innovation: Creative destruction vs. destructive creation." *Industrial and Corporate Change* 22 (4): 851–867.
- Mazzucato, M. 2013c. "Debunking the market mechanism: a response to John Kay." *Political Quarterly* 84 (4): 444–447.
- Mazzucato, M. 2015. "Innovation Systems: From Fixing Market Failures to Creating Markets." *Intereconomics* 50 (3): 120–125.

- Mazzucato, M., and C. C. R. Penna. 2014. "Beyond market failures: State investment banks and the 'mission-oriented' finance for innovation." *SPRU Working Paper Series* 21.
- Mazzucato, M., and C. C. R. Penna, eds. 2015. *Mission-oriented finance for innovation: New ideas for investment-led growth*. London, England: Pickering & Chatto Publishers. Rowman & Littlefield.
- Mazzucato, M., and C. Perez. 2014. "Innovation as growth policy." *SPRU Working Paper Series* 13.
- Mazzucato, M., and R. Wray. 2014. "Financing the Capital Development of the Economy: A Keynes-Schumpeter-Minsky Synthesis." *Levy Institute Working Paper* No. 837.
- Motoyama, Y., R. Appelbaum, and R. Parker. (2011). "The national nanotechnology initiative: Federal support for science and technology, or hidden industrial policy?" *Technology in Society* 33 (1–2): 109–118.
- Mowery, D. C. (2010). "Military R&D and innovation." In *Handbook of the economics of innovation* (Vol. 2), ed. B. H. Hall and N. Rosenberg, 1219–1256. Amsterdam: Elsevier.
- 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 (8): 1011–1023.
- Nelson, R. R., and S. G. Winter. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Belknap Press.
- O'Riain, S. 2004. *The politics of high tech growth: developmental network states in the global economy*. Boston: Cambridge University Press.

- Perez, C. 2002. *Technological revolutions and financial capital: The dynamics of bubbles and golden ages*. Cheltenham, England: Edgar Elgar.
- Perez, C. 2010. "The financial crisis and the future of innovation: A view of technical change with the aid of history." *TUT Ragnar Nurkse School of Innovation and Governance Working Paper Series 28*.
- Polanyi, K. 2001 [1944]. *The great transformation: The political and economic origins of our time* (2nd Beacon Paperback ed.). Boston, MA: Beacon Press.
- Pollitt, C., and G. Bouckaert. (2004). *Public management reform: A comparative analysis* (2nd ed.). Oxford: Oxford University Press.
- Reinert, E. S. 2007. *How rich countries got rich and why poor countries stay poor*. London, England: Constable.
- Rodrik, D. 2004. "Industrial policy for the twenty-first century." *John F. Kennedy School of Government Working Paper Series rwp04-047*.
- Rodrik, D. 2013. "Green industrial policy." *Princeton University Working Paper*.
- Rodrik, D. 2014. "From Welfare State to Innovation State," *Project Syndicate* <http://www.project-syndicate.org/commentary/labor-saving-technology-by-dani-rodrik-2015-01> (accessed 3/3/15)
- Rosenberg, N. 1982. *Inside the black box: Technology and economics*. Boston: Cambridge University Press.
- Ruttan, V. W. 2006. *Is war necessary for economic growth? Military procurement and technology development*. University of Minnesota: Department of Applied Economics.
- Sampat, B. N. 2012. "Mission-oriented biomedical research at the NIH." *Research Policy* 41 (10): 1729–1741.

- Schumpeter, J. A. 2002 [1912]. "Seventh chapter of the theory of economic development." *Industry and Innovation* 9 (1–2): 93–145.
- Soete, L., and A. Arundel. (1993). *An integrated approach to European innovation and technology diffusion policy: A Maastricht memorandum*. Luxembourg: Commission of the European Communities, SPRINT Programme.
- Stern, N. H. 2006. *The economics of climate change (Stern Review)*. HM Treasury.
- Stiglitz, J. 1974. "Growth with exhaustible natural resources: The competitive economy." *Review of Economic Studies* 41 (5): 139–152.
- Stiglitz, J. 1991. "The invisible hand and modern welfare economics." *NBER Working Paper* 3641.
- Stiglitz, J., and A. Weiss. 1981. "Credit rationing in markets with imperfect information." *American Economic Review* 3 (71): 393–410.
- Stirling, A. 2008. "'Opening up' and 'closing down' power, participation, and pluralism in the social appraisal of technology." *Science, Technology & Human Values* 33 (2): 262–294.
- Stirling, A. 2014. Making choices in the face of uncertainty. *Themed Annual Report of the Government Chief Scientific Adviser*, Chapter 2 (June). Draft mimeo.
- Tullock, G., A. Seldon, A, and G. L. Brady. 2002. *Government failure: A primer in public choice*. Washington, DC: Cato Institute.
- Verspagen, B. 2006. "Innovation and economic growth." In *The Oxford handbook of innovation*, ed. J. Fagerberg, D. C. Mowery, and R. R. Nelson, 487–513. New York, NY: Oxford University Press.
- Vivarelli, M. 2013. "Is entrepreneurship necessarily good? Microeconomic evidence from developing and developed countries." *Industrial and Corporate Change*, 22 (6): 1453–1495.

- Wade, R. 1990. *Governing the market: Economic theory and the role of government in East Asian industrialization*. Princeton, NJ: Princeton University Press.
- Witt, U. 2003. "Economic policy making in evolutionary perspective." *Journal of Evolutionary Economics* 13 (2): 77–94.
- Wolf, C. 1988. *Markets or governments: Choosing between imperfect alternatives*. Cambridge, Mass.: MIT Press.
- Wood, R. 2012. Fallen Solyndra won bankruptcy battle but faces tax war. *Forbes*, 11 June. <http://www.forbes.com/sites/robertwood/2012/11/06/fallen-solyndra-won-bankruptcy-battle-but-faces-tax-war/> (accessed 29/6/2014)
- Wright, B. D. 2012. "Grand missions of agricultural innovation." *Research Policy* 41 (10): 1716–1728.