Legitimation and effects of mission-oriented innovation policies: A spillover perspective

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Abstract

Innovation policy has long been motivated by the objective of internalizing knowledge spillover externalities - and thereby enhancing the intensity of R&D based innovation. Within the ongoing shift towards mission-oriented innovation policies (MIP), however, also factors like the direction and accumulation of changes matter. Few attempts have been made to systematically describe on what accounts the associated policy strategies have been evolving. We address this lacuna by distinguishing and characterizing three MIP types associated with consecutive stages in the trajectory from fixing innovation-related market failures to implementing effective solutions.

Second, despite relevant advancements in both heterodox economics and innovation studies, little is known about how the evolution of policy approaches relates to the usual spillover rationale. The current paper extends the neoclassical knowledge spillover perspective by also including information externalities and coordination (or adoption) externalities.

Finally, we illustrate empirically how the MIP typology and synthesized spillover framework shed light on possible policy tensions. Data is retrieved from a survey conducted amongst 276 firms participating in Dutch examples of each MIP type. This concerns, respectively, a 'Valorisation Grant' for academic start-ups, a catalytic form of public procurement of innovation (PPI), and a direct form of PPI. Especially catalytic PPI firms report unappropriated contributions to wider diffusion of their innovations. Our findings warn against pursuing system transformations by adhering to traditional firm-level stimuli and impact measures (MIP drift), as well as against support for context-specific solutions (myopic MIP). We conclude with discussing implications for policy development and evaluation.
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Key words: spillovers, externalities, mission-oriented policy, innovative public procurement

JEL: O38 (Government Policy); O33 (Technological Change: Choices and Consequences; Diffusion Processes)

Highlights:
- An overview of different approaches to mission-oriented innovation policy (MIP)
- An integrated spillover framework capturing a wide variety of innovation externalities
- Theorizing and an empirical illustration of the spillovers associated with MIP approaches
- Discussion of MIP-related policy drift as mismatches between rationales and intervention
- Discussion of MIP-related policy myopia involving support for context-specific solutions
- Discussion of alternative routes for moving from R&D policies to MIP approaches
1. Introduction

Rooted in science and technology policy, public expenditures on business R&D are commonly legitimized by economic reasoning regarding the existence of spillover externalities (Aghion & Jaravel, 2015). The lack of possibilities to appropriate all value created through innovation activities prevents firms from investing in R&D. Across the majority of at least OECD countries, the common response has been to internalize spillovers in the economy by providing compensation – e.g. as subsidies or tax advantages (Guélec & Van Pottelsberge de la Potterie, 2003). This way of solving market failures should encourage firms to undertake R&D and innovation activities they would otherwise consider too risky.

As science, technology and industrial policy have been evolving into innovation policy, attention arose also for issues like the circulation and application of knowledge stemming from R&D. Currently, innovation policy is in turn moving towards approaches that even surpass improving just the level of knowledge production and diffusion (Mowery et al., 2010; Boon & Edler, 2018). Instead of hoping that policy-induced innovations will also have a positive impact in terms of mitigating complex societal problems, like climate change and health concerns (often resulting from earlier innovations), contributing to solutions for such challenges is becoming a key policy objective (Borrás & Laatsit, 2019; Foray, 2019). Mission-oriented innovation policies (MIP) driving the search for solutions are therefore characterized by their directionality, as opposed to the generic scope of traditional innovation policies (Mazzucato, 2018). Directionality entails collectively focusing innovation efforts on overcoming the inertia that keeps a mission’s focal problem in place (Cantner & Vannuccini, 2018).

A large body of studies on innovation systems and transitions has shown that the very amassing of a wide range of innovation activities and institutional changes is crucial for socio-economic transformations to occur – and thus for missions to succeed (Weber & Rohracher, 2012). Acknowledging the systemic and cumulative nature of change, policy makers in search of grand solutions are urged to accommodate the adaptation of knowledge creation and diffusion mechanisms, entrepreneurship possibilities, market creation, financing, regulation, competition law, public debate, etcetera (Hekkert et al., 2007). Especially in the face of ‘wicked’ unstructured and contested problems, there is no script telling who should be doing what and which moment (Wanzenböck et al., 2019). Thus, rather than executing a well-defined roadmap, finding novel answers to complex questions requires transformative innovation policies that drive entrepreneurial experimentation and respond to institutional barriers hampering the implementation of promising solutions (Schot & Steinmueller, 2019).

The rationales for mission-oriented innovation policies are markedly different from only internalizing spillover externalities. At the same time, as governing transformative change entails steering private (along public) interests in the direction of collective benefits, this almost inherently involves evoking policy outcomes going beyond the value that private firms can appropriate individually. Surprisingly little attention has been paid to the question what type of externalities this would be. Neoclassical economists have traditionally only considered knowledge spillover externalities in relation to rent spillovers and business stealing effects, all of them mostly concerned with just the level of R&D or productivity. Additionally, development economists like Hausmann and Rodrik (2006) draw attention to information
externalities and coordination externalities as a driver for economic growth and diversification. The imperative of eliciting such externalities has informed modern views on industrial policy (Stiglitz & Greenwald, 2014), but so far without also reaching the MIP debate (exceptions being e.g. Mazzucato, 2018; Foray, 2019). Coming from yet an entirely different tradition, innovation scholars point at the existence of system dynamics adding to the emergence and adoption viability of new technologies and solutions. Again, although rarely linked to spillovers explicitly, also governing firm involvement in processes like niche formation and regime contestation is essentially a matter of yielding collective returns on private investments.

The primary objective of this paper is to synthesize the range of spillovers that are relevant to consider for currently unfolding MIP policies. Advances in various literature streams shed new light on known spillovers, while also pointing at some neglected ones. We present a comprehensive framework, linking the various types of spillovers that may be at play. The framework offers a basis for reflecting on what dynamics to assess when encouraging private firms to contribute to the collective exploration of new innovation paths.

Focusing on the typically overlooked types of spillovers, we illustrate our framework with a case study on SBIR policy instruments in the Netherlands.\textsuperscript{1} The overall objective of this policy scheme is to challenge and support firms in providing innovative solutions for societal issues. The three underlying instruments consists of a ‘Valorisation Grant’ for academic start-ups, a catalytic form of public procurement of innovation (PPI), and a ‘direct’ form of PPI. Just like PPI policies have been linked to mission-oriented innovation policy before (Edquist & Zabal-Iturriagagoitia, 2012), also the Dutch national government has now positioned its SBIR policies as an exemplary instrument for solving societal challenges.

Our analysis of the spillovers targeted and observed by the Dutch SBIR policies is based on the response of 276 respondents in an online survey. Firms involved in valorisation and catalytic PPI seem to yield the newest knowledge, but the latter group systematically reports more contributions to transformative change. The catalytic PPI group also seems to generate more coordination (adoption) externalities when compared to firms developing solutions through direct PPI. These tentative investigations suggest that policy makers should be wary of using undifferentiated and possible outdated policy instruments (as well as effect measures) when pursuing mission-oriented policy goals. Apart from lurking policy drift (Howlett & Rayner, 2007; Kivimaa and Kern, 2016), our case study also points at the ‘myopia’ risk of directing firm-based innovation activity towards highly context-specific solutions. As indicated by the poor level of collective effects for direct PPI, exerting a strong demand-pull might go at the costs of the wider transformation potential of mission-oriented innovation experiments.

The remainder of this paper is as follows. Section 2 provides an overview of different types of mission-oriented innovation policies as encountered in ongoing research debates. While consensus seems to exist on where these policies are coming from (traditional R&D policy) and where they are going to, there is no comprehensive overview of the intermediate steps that have been taken in this evolution of policy approaches. We therefore first distinguish four distinct phases and corresponding types of mission-oriented policy approaches. Following up on this

\textsuperscript{1} In the original U.S.A. version, SBIR stands for ‘Small business innovation research’ as it focuses on SMEs. The Dutch adaptation of this policy is open to large firms as well. Hence, it is unusual to spell out the acronym.
distinction, section 3 introduces the aforementioned spillover framework and describes which particular spillover types can be deemed most relevant for each of the categories. Section 4 presents the case study, in which we investigate the spillover profiles of SBIR policy instruments corresponding with different mission-oriented approaches. Implications for policy makers are provided in section 5. Section 6 concludes.

2. The emergence of mission-oriented innovation policies

2.1 From policy for knowledge to policy for solutions
Recent years have witnessed a rapidly increasing interest in so-called mission-oriented innovation policies (Robinson & Mazzucato, 2019). As the name suggests, these policies are primarily marked by the objectives they set – i.e. the missions they are pursuing. Mission-oriented innovation policies (MIP) entail policy strategies aiming to provide novel solutions for specific goals with public relevance beyond or even instead of boosting economic growth (Mazzucato, 2018). This typically concerns major societal challenges like climate change, poverty, or inequality, requiring solutions combining societal and technological change. Although there exceptions, MIP are mostly focused on problems in which the developments on a wide range of factors are deemed crucial (e.g. technology, regulation, behaviour). As this requires cumbersome alignment processes and continued commitment, such problems are often also referred to as ‘grand’ societal challenges. Essential for these challenges (and addressing them through policy) their systemic nature, i.e. the problems are kept in place due to a variety of techno-economic as well as institutional factors. Policy strategies for coping with such ‘wicked’ problems have been studied extensively in the transition literature that unfolded over the past two decades.

A second key feature of MIP is that they rely on (or at least involve) mobilizing innovation as a means to provide solutions. In practice, scholars and policy makers differ in their appreciation of how important (technological) novelty really is and how novelty-based solutions can best be elicited. While some argue for starting out with spurring the development of better technologies, others point at the relevance of first disentangling the nature of a wicked problem (Wanzenböck et al., 2019). In any case, there seems to be consensus on the importance of directionality as a distinctive feature of mission-oriented innovation policies (Boon & Edler, 2018). Such policies should overcome inertia by steering entrepreneurial experimentation towards cumulative development pathways (Cantner & Vannuccini, 2018; Schot & Steinmueller, 2019). Occasionally, MIP is therefore regarded as a special variety of specialization policy (Foray, 2012; Foray, 2019).

Almost without exception, contributions on the emergence of MIP outline how such policies mark a change with respect to other types of science, technology or innovation (STI) policy (e.g. Robinson & Mazzucato, 2019; Foray, 2019). This typically also involves a discussion of dominant rationales, like solving market failures, fixing system failures or overcoming transition failures (Mazzucato, 2016). While it is common to contrast system and transition thinking against a market perspective, scholars have repeatedly stressed that the creation of markets is in fact of utmost importance for the widespread diffusion of viable solutions (Mazzucato, 2018). Furthermore, emphasis has been placed on the importance of transformative activities (Rodrik, 2004; Foray, 2019) and transformative innovation policies (Weber &
Rohracher, 2012; Janssen, 2019; Schot & Steinmueller, 2019). Originating from transition literature as well as modern industrial policy literature (Rodrik, 2004; Stiglitz & Greenwald, 2014), transformative innovation policies cover the range of interventions aimed to eliminate barriers hampering entrepreneurial exploration of new economic opportunities. These interventions have been characterized as systemic, preferential, experimental, cumulative, and adaptive (Janssen, 2019; Foray, 2019). Since offering transformation possibilities is regarded as essential for accommodating disruptive change, many of these characteristics are reflected in current thinking on mission-oriented innovation policies (Mazzucato, 2018).

Clearly, the succinct description of MIP characteristics already touches upon a broad range of changes in why, how and even by whom innovation policy is formulated and executed. A close look at the emerging literature quickly reveals different conceptions on issues like the importance of novelty, the link with specialization and industrial policy, or the different ways a mission can be framed. For instance, Wanzenböck et al. (2019) draw attention to the degrees of contestation, complexity and uncertainty characterizing a societal problem as well as its solution. Allegedly, different positions in the ‘problem-solution space’ they define demand different policy strategies.

Although the outlines of the shift towards MIP policies are widely recognized, few attempts have been made to systematically describe on what accounts the associated strategies have been evolving. In other words: the direction of policy evolution is clear, but there is no comprehensive overview of the steps taken nor of the key characteristics of each of these steps. We address this lacuna by distinguishing policy approaches associated with four consecutive stages on the continuum between generic technology push and specific market (or rather: society) pull. Critical in this respect is the main objective a policy approach aspires to, which can vary between simply boosting knowledge development and innovative economic activity in general, spurring innovative activities with wider societal impact, eliciting coordinated solution development for societal problems, and facilitating search for implementable solutions not necessarily depending on innovation.

The suggested spectrum of approaches, depicted in Figure 1, is closely associated with the hierarchy of missions and their underlying mission projects (Mazzucato, 2018). In our view, MIP policy as understood in most contemporary writings (having a transformative nature due to its directional and systemic character) particularly covers the mission-oriented innovation programs layer in the middle of Figure 1. This layer entails the alignment of various innovation projects - embracing technological, organizational and business model innovation - and institutional changes required for developing an innovation path with impact on a particular mission’s goals. Below that layer we find MIP policy merely favouring innovation in designated priority areas, while above it there is a MIP policy approach for identifying which solution directions (providing the basis for a well-defined mission) are promising in the first place.

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2 A minor exception is Soete & Arundel’s (1993) ‘Maastricht Memorandum’ describing differences between old and new mission-oriented projects, as referenced also by Mazzucato (2018) and Robinson & Mazzucato (2019).
Before addressing the role of spillovers in the four policy approaches, we describe their most prominent features in more detail (see Table 1). These features include the policy rationale, the mechanisms through which the policy objective is pursued, and the targeted stage in the process from knowledge creation to transformative change. Also, we briefly touch upon corresponding governance issues like the actors carrying key responsibility, the type of actions they perform, and the policy instruments they have at their disposal. Finally, we reflect on issues like the kind of developments that need to be monitored in order to learn from and adapt policies, as well as the key challenges encountered when implementing each of the approaches.

### 2.2 Four policy approaches

#### R&D policy

Motivated by economic growth theories, traditional R&D policy aims to enhance the amount of R&D conducted in an economy. In many countries this objective has been reduced to a target for national R&D expenditures. The rationale for policy intervention is usually the existence of market failures preventing private firms from conducting the amount of R&D that is desirable from a societal perspective. Markets for R&D can fail due to for instance information asymmetries inherently involved in innovation, or as a result from coordination problems preventing proper allocation of knowledge and R&D-based value. The five archetypical sources of market failures listed by Mazzucato (2015) cover imperfect competition, information failures, negative externalities, public goods and coordination failures. Other overviews can be found as well, be it always with a similar focus on reasons for markets to operate suboptimal.

As fixing market failures is the sole goal of R&D policy, it exerts a generic push on innovation efforts. Policies are successful whenever they result in the creation of knowledge that, once applied, yields productivity improvements. Both science and industry may be targeted, depending on who is facing which failure. The execution of the industry-oriented policy instruments, like tax reliefs for R&D expenditures, is usually in the hands of a policy execution agency. R&D policies are successful when they correct the market failure that legitimizes them.
which should be manifested in the causal chain of inputs to the R&D process (more R&D expenditures), outputs (e.g. patents), or outcomes like improved R&D-based turnover, exports, productivity or profits. Whether fixing markets for R&D truly result in higher economic performance depends on the degree of additionality the policy incurs, as well as on how and where (e.g. in which sectors) the extra knowledge trickles down in actual product offerings.

*Mission-oriented R&D policy*

The first turn towards policies for solving grand societal challenges is found in R&D policies favouring some types of innovations of others. Such ‘mission-oriented R&D policies’ take a more proactive stance when it comes to the directionality of innovation. With a preference for sustainability or health oriented innovation entering the policy priorities, the focus shifts from mere knowledge creation to novelty creation. Fixing market failures in the context of boosting e.g. ‘green technologies’ requires a particular focus on coordination failures along emerging value chains. Moreover, pushing R&D efforts in the direction of societally desirable innovations also brings to the fore new types of failures. In order to warrant that knowledge development leads to (as well as anticipates) successful product and service development, it is all the more essential that knowledge, information and technologies can flow between the varieties of actors involved in innovation processes. Drawing upon the concept of national innovation systems (NIS), policies may be legitimized by removing bottlenecks in the industry-science complex associated with societally desirable innovation directions.

The overall objective of mission-oriented R&D policies is to alter the structure and incentives in an innovation system, so that it yields more innovations fitting collective missions. In terms of governance, this requires either policy makers, scientists or industry to determine which innovation paths are feasible for solving the challenges missions are targeted at. Intervention possibilities for policy makers consist of guiding the formulation of priority areas (the number and bandwidth of selected innovation paths), as well as spurring innovation activities within these areas. The latter might entail subsidies for individual or collaborative innovation projects (research, experiments) or vouchers for transferring knowledge to actors able to translate it into market offerings. In all cases, the dominant policy logic remains to tip decisions made by actors in the innovation system towards activities falling within the priority areas. One way to assess policy success is therefore to inspect whether observed R&D and innovation efforts (within project proposals, contract research, subsidy administrations, patents, etc.) are indeed aligned with the selected directions. However, even if there is evidence of alignment, this does not guarantee that all those guided innovation efforts add up to the emergence of a promising innovation path.

*Mission-oriented innovation programs*

Whenever policies do take into account the interaction and accumulation of complementary innovation efforts, we can speak of mission-oriented *innovation programs*. This approach is probably the one best corresponding with most of the current contributions on mission-oriented innovation policy. Characteristic for coherent programs is the objective of aligning otherwise fragmented activities, in order to unleash synergies that allow potential solutions to jointly overcome the resistance of the existing order.
The approach here coined as mission-oriented innovation programs is heavily based on insights from transition studies, in particular when it comes to strategic niche management and the multilevel perspective (Weber & Rohracher, 2012; Schot & Steinmueller, 2019). Mission-oriented innovation programs are systemic in the sense that they target the entire range of problems that prevent experimentation with (and adoption of) solutions challenging the regime that is in place. As documented in the literature on technological innovation systems (TIS), system failures concern barriers in R&D-related processes like knowledge development, knowledge circulation, and entrepreneurial experimentation, but also in the mobilization of resources, formation of markets and the creation of legitimacy (Hekkert et al., 2007). How these system failures relate to market failures has become the topic of a lively debate, stressing both the complementarities and incongruences between both perspectives (Dodgson et al., 2011; Frenken, 2017). This debate is entering a new phase now that mission-oriented innovation programs are required to overcome system failures in order to create new well-functioning markets for potential solutions (Mazzucato & Penna, 2016). Regardless the theoretical paradigm one adheres to, there seems to be consensus that policies should go beyond boosting just desirable innovations (technologies together with novel business models and required organizational adaptations). Instead, innovation programs are to ensure that niche activities are aligned with each other as well as with the institutional changes necessary for them to develop into a viable innovation path. For this reason it is argued that policies should provide long-term commitment to the coupled exploration and exploitation (diffusion) of solution directions (Mazzucato, 2018; Foray, 2019). According to Cantner and Vannuccini (2018), the challenge is to nurture the formation of niches sufficiently long (but not in excess) for testing the feasibility of a particular solution direction.

Belonging still to the domain of innovation policies, mission-oriented innovation programs rely on mobilizing private entrepreneurs in the search for innovations that (together) can contribute to solving a societal challenge. Since it is usually unknown which innovation path will succeed, policy makers are advised to spur a portfolio of innovation paths (and underlying projects) rather than a single one (Mazzucato & Penna, 2016). The scope of these innovation paths is defined in a dialogue between actors across the triple helix of science, industry and policy makers. While setting the mission itself is likely to be a political issue, insights from science and industry are needed for determining the most promising paths. Bottom-up experimentation within and across a variety of sectors might advance the appraisal of which paths are worthwhile, and which ones can be aborted. One way of guiding this experimentation is via setting norms for performance levels that need to be achieved. By learning from experimentation within the boundaries of a broadly defined mission, it is also possible to develop and continuously adapt more narrowly specified innovation agendas or roadmaps (Foray, 2019). Such “top-down-bottom-up” roadmaps should specify how various lines of action relate to each other, as there might be all sorts of reinforcing or counteracting interactions between competing innovation paths (Sandén & Hillman, 2011). Another imperative is that they go beyond just R&D and innovation, and also specify which impulses will be given to other actors capable of strengthening niches (or even the technological innovation systems they might evolve in).
Actual interventions for spurring firm activity should aim to realize the intentions laid out in the collective roadmaps. Rather than encouraging firms with for example subsidies, the objective is to create circumstances making it attractive for them to engage in guided experimentation. A well-documented way of achieving this is by creating markets via ‘PPI’; the public procurement of innovations (Edquist, & Zabala-Iturriagagoitia, 2012). The sheer volume of government spending and assets offers vast possibilities for seducing firms to innovate towards goals set in the roadmaps. Possibly, financial incentives like these are combined with regulatory changes (e.g. legal exemptions) rebalancing the playing field for promising solutions. The toolbox of policy options also involves ‘soft’ measures like facilitating coordinative interactions between a broad range of parties, for instance by organizing boundary-spanning network events and appointing institutes responsible for collective agenda-setting.

How policy makers go about when evaluating system-oriented innovation policies has recently been assessed for EU28 member states by Borrás and Laatsit (2019). So far, there is little experience with systematically analysing to what extent combinations of interventions may be held responsible for the convergence and cumulation of regime pressures, despite this being the main ambition of many innovation programs. Even if there is evidence this can be achieved via policy, a critical question is whether the reinforced innovation paths are truly the ones most suitable for yielding desirable solutions. Moreover, contributing to the exploration as well as exploitation of specific paths (i.e. the adoption of resulting innovations) might yield tensions related to market distortion.

Solution-oriented policy
The last approach we distinguish is solution-oriented policy. Its core feature is that it does not necessarily start out with the presumption that firm-based innovation is required for solving a societal challenge. Instead, of primary importance for solution-oriented policies is that they support the search for promising solution directions, which might also consist of purely institutional changes. Especially when leaning towards directions also involving innovation, the policy rationales consists of overcoming transition failures (Weber & Rohracher, 2012). These capture the variety of technological, economic and institutional (social, legal, ethical) barriers hampering the leap towards promising innovation paths that remain out of reach without policy intervention.

As Wanzenböck et al. (2019) point out, the scope and instruments suitable for solving grand challenges are dependent on the degree to which both the problem and possible solution directions are contested, complex and uncertain. In case these degrees are high, a first priority should be to disentangle the situation in such a way that suitable and legitimate directions for solutions may be envisaged. This is largely a matter of organizing debate and public discourse. Whenever the situation is less complex, policy makers can spur the exploration of solutions by awarding prizes or setting up contests targeted at the societal need they like to see fulfilled. Such an operational approach can also be an ‘open’ version of public procurement of innovation, characterized by a low degree of specification on how the solution to a given problem should look. In the situation views on both the problem and solution are converging, policy may sometimes even have the form of project management aimed at coordination the further development of the chosen solution.
Given its strong focus on ultimately solving a societal issue, rather than just making an innovative step forwards, monitoring in this MIP approach consists of tracking to which extent predefined societal goals (e.g. the amount of clean energy production, prevented illnesses) are actually met. A major tension here is that only guiding the identification of solution directions is still likely to have little direct impact, while in the longer run it might be the first step towards implementing effective instruments or regulation (possibly unrelated to innovation policy).

Table 1: Characteristics of three types of mission-oriented innovation policies, in relation to regular R&D policy.

<table>
<thead>
<tr>
<th>R&amp;D policy</th>
<th>Mission-oriented R&amp;D policy</th>
<th>Mission-oriented innovation programs</th>
<th>Solution-oriented policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objective / Policy priority</td>
<td>Boost innovative economic activity</td>
<td>Boost innovative economic activity with wider societal impact</td>
<td>Spur complementary innovative solutions to societal problems</td>
</tr>
<tr>
<td>Rationale</td>
<td>Market failures</td>
<td>Same, especially coordination failures. + System failures (NIS)</td>
<td>System failures (TIS) / directional failures</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Push: Generic innovation policy</td>
<td>Push: Targeted innovation policy</td>
<td>Pull: Demand-driven innovation policy / programs</td>
</tr>
<tr>
<td>Transformation focus</td>
<td>Knowledge creation</td>
<td>Novelty creation</td>
<td>Novelty implementation + institutional change</td>
</tr>
<tr>
<td>Responsibility</td>
<td>Industry (or science; not both)</td>
<td>Industry-science complex</td>
<td>Triple helix coordination</td>
</tr>
<tr>
<td>Governance</td>
<td>Via policy execution agency</td>
<td>Priority setting (Top-down, or bottom up)</td>
<td>Facilitate collective roadmap development (top-down-bottom-up)</td>
</tr>
<tr>
<td>Suitable instruments</td>
<td>Tax credits for R&amp;D costs</td>
<td>Subsidies (e.g. a call for ‘green’ technologies), vouchers</td>
<td>Purchasing (PPI), norms, legal exemptions, spurring broad interaction</td>
</tr>
<tr>
<td>Monitoring</td>
<td>R&amp;D expenditure, patent rate, etc.</td>
<td>Do R&amp;D and innovation efforts follow priorities?</td>
<td>Are regime pressures converging and cumulating?</td>
</tr>
<tr>
<td>Challenges</td>
<td>Trickling down of knowledge production</td>
<td>Accumulation of inventions</td>
<td>Conflicting solution paths, market distortion</td>
</tr>
</tbody>
</table>

The overview in Table 1 gives rise to the question how all elements within an approach should be aligned, and especially whether multiple ‘internally consistent’ approaches can be combined into a coherent policy mix. The answer to this question depends on what is being expected from policy interventions, and why. In the next section we address this by extending the spillover perspective underlying traditional R&D policy interventions to the various MIP approaches.
3. Spillovers as a rationale for innovation policy

3.1 Spillover types and their relation with distinct mission-oriented policies

Spillovers are often regarded as the unintended spread of results stemming from R&D investments (e.g. Coenen et al., 2015). A key element of the definition adopted here, following the standard economic view on externalities, is that spillovers concern the value R&D-investors create without being able to appropriate it (which is precisely what legitimizes policy intervention). One might thus speak of spillovers as the collection of all imaginable innovation externalities (Breschi & Lissoni, 2001). In other words, while innovation might also give rise to e.g. environmental or network externalities, we focus our discussion of spillovers only on the unappropriated production of value relevant for developing and implementing innovations.

Stemming from a market perspective, the notion of spillovers might seem fundamentally at odds with the systemic and transformative perspectives underlying the various MIP types. However, ignoring market dynamics altogether is like throwing the proverbial baby out with the bathwater – precisely the formation of new markets is an essential (yet far from the sole) condition necessary for socio-technical transformations to succeed (Mazzucato & Penna, 2016). The creation of markets is a process susceptible to market as well as non-market value creation and value exchanges, some of which will fall into the externality-based definition of spillovers. That is, in as far as MIP policies involve private entrepreneurs contributing to the emergence and strengthening of promising innovation pathways, interventions will aim to elicit benefits extending beyond the value that can be appropriated by individual firms undertaking R&D investments. Characteristic for the industry-targeted aspect of MIP policies is that they encourage firms to experiment and thereby initiate, participate and accelerate transformations also yielding returns for competitors as well as the society demanding a mission-based solution. Clearly, such external returns to firms’ private innovation efforts fit the notion of spillovers.³

Just like literature on innovation policy, research on spillovers has been evolving within different bodies of literature (notably: heterodox economics and innovation studies). Advancements therein provide a basis for reconsidering the way particular types of spillovers are of relevance for the various policy approaches discussed earlier. Moreover, they point at some spillover types so far largely neglected. Below we address which spillovers may be expected from MIP policy types targeting (or at least involving) firm-level innovation activities. Insights on this matter are retrieved from reviewing in what forms spillovers are implicitly or explicitly referred to in research on each of the policy approaches as distinguished in section 2. Generally, we find that individual studies are either concerned with investigating just a single specific type of spillover, contrasting two specific types, or with discussing spillovers without even specifying which exact types of innovation externalities are taken into consideration. Instead of presenting another narrow or overly broad view on the phenomenon of spillovers, we aim to unpack the concept into its constituent types of innovation externalities.

³ One might maintain that inter-organizational learning is a more useful concept in the context of collective complementary innovation efforts. Our stance here is that learning is in fact one the mechanisms that might cause other parties to respond to results stemming from MIP-induced firm behaviour. Spillovers occur whenever these responses seize value that was created but not fully appropriated by the firm originally involved in the MIP policy instrument. Given the scope of this paper, we are particularly interested in the form these spillover-responses might take. Note that third parties might also respond without learning taking place.
Spillovers with relevance for generic R&D policy

As many R&D policies are motivated by an externality rationale, an extensive body of literature is dedicated to assessing investment and productivity improvements encountered beyond policy beneficiaries (Griliches, 1992; Aghion & Jaravel, 2005; Hall et al., 2009). Of key importance here are the knowledge or ‘technology’ spillovers, which allow others to learn about new technologies and their workings. Due to knowledge often having a public good nature, R&D firms are limited in preventing knowledge from leaking away. For codified knowledge some legal protection might be enforced, notably via intellectual property policy, while the spread of tacit knowledge (e.g. via skills and labour mobility) is harder to control. Not being able to appropriate all value created captured in R&D-based knowledge can lead firms to refrain from conducting the R&D in the first place, hence the need for policy (Arrow, 1962). Particularly challenging for implementing and evaluating the wider effect of such policies is the variety of mechanisms affecting the total societal returns. Third parties may increase their R&D expenditures and performance either because of the spillovers they enjoy, or because of the ‘product rivalry effect’ urging them to keep up with R&D firms (Bloom et al., 2013). Disentangling these mechanisms requires insight in which firms would be competing, and which firms are using the same technologies – the two of them not necessarily overlapping (Lucking et al., 2018).

R&D policy ideally helps to resolve the tension between a R&D firm’s private interest (appropriating all value it creates) and the public interest of enhancing the stock of available knowledge. However, innovation externalities can also cover possibly unaccounted advantages for the R&D firm itself. Collaboration, investment and trade activities allow firms and economies to access external stocks of knowledge. To effectively make use of that knowledge, a sufficient level of absorptive capacity is required (Cohen & Levinthal, 1989). Firms may develop absorptive capacity and an advantageous network position by engaging in R&D themselves. Thus, engaging in R&D might not just yield novel knowledge (potentially spilling over), but also allows the R&D firm to incorporate value embodied in the spillovers generated by others. Bye et al. (2011) refer to absorption spillovers as positive internal knowledge externalities warranting R&D policy as well as export promotion.

Moving from the R&D process to commercializing products or services it brings forward, another type of spillover entering the picture is the rent spillover. Rent spillovers occur when firms can not appropriate all R&D-based value in market transactions, for instance due to market competition prohibiting them to process quality improvements fully into market prices. Alternative explanations include the existence of coordination failures and information asymmetries between R&D firms and clients (or investors). Since R&D is inherently uncertain, it is only natural that third parties - an even the R&D firm itself - cannot properly assess the market value of R&D results. This holds especially in case of what innovation scholars call ‘exaptation’: the phenomenon when an innovation turns out to be useful in an entirely different context then the one envisaged by the developer (Bonifati, 2010). For policy makers and evaluators this implies it may be hard to determine the scope of a policy’s potential spillovers from the outset. Being somewhat like the opposite of rent spillovers, business stealing takes place when firms appropriate more value than they created. Market power can be one of the circumstances allowing R&D firms to do so, which makes this also belong to the policy domain.
of competition law. Contrary to knowledge spillovers, rent spillovers and business stealing typically form side-effects of innovation rather than legitimization for policy intervention.

**Spillovers with relevance for mission-oriented R&D policy**

Targeting R&D support to a specific range of challenge-based topics is only a relatively small step away from generic R&D policy. From a knowledge spillover perspective, the difference that matters is the extent spillovers are taken into account when defining the desired direction of innovation. A typical aspect to consider in mission-oriented strategies is the degree of novelty the supported R&D activities render. Highly novel knowledge is commonly believed to have a higher application potential, which makes it more eligible for policy support than context-specific knowledge. Moreover, how far knowledge can spill over is subjected to several proximities, one of them being cognitive proximity (Boschma, 2005). Building also on the notion of (technological) relatedness, contemporary contributions on targeted rather than neutral innovation policies occasionally stress the importance of spurring R&D activities resulting in knowledge spillovers which can truly be absorbed by other parties in the economy (e.g. Foray, 2012). Indeed, even when still focusing on knowledge spillovers and absorption, the act of defining a mission direction already offers a possibility for taking an ‘intelligent’ approach to maximizing policy impact. This fits with the policy rationale of not just eliciting as many spillovers in a priority area as possible, but precisely the ones most likely to bring a mission forward.

In as far as mission-oriented R&D policy is also concerned with the diffusion of knowledge throughout the innovation system, a categorically different type of spillover needs to be taken into account as well. Besides knowledge and skills in the technological sense, third parties can also learn about the existence of unfulfilled demand. So-called *information externalities* consist of the unappropriated spread of valuable market intelligence. Especially in the literature on development economics and industrial policy we find claims that there might be substantial social returns from spurring entrepreneurial experimentation, i.e. encouraging firms to explore new possibilities for commercializing the capabilities and knowledge they can mobilize (Hausmann & Rodrik, 2006). Competitors might not only learn about how to do deliver a certain product or service, but also that it is feasible to do so in the first place. This type of spillover, informing actors on the demand and potential for a certain type of (innovative) offering, comes into play when mission-oriented R&D policies aim to steer the innovation system as such more towards spawning promising solutions. Innovation systems will be more inclined to do so when the lessons of experiments (successful or not) reach parties who might crowd-in or decide to explore alternative paths. To prevent misalignment and duplication, there is a policy rationale for ensuring that valuable market intelligence is not entirely confined to the firms undertaking policy supported experimentation.

**Spillovers with relevance for mission-oriented innovation programs**

Looking at research on what we called mission-oriented innovation programs, yet another set of spillovers can be added to the spectrum discussed so far. Fundamental for this MIP approach is the imperative of spurring transformative activities resulting in the convergence of private and public efforts required for exploring and exploiting promising innovation paths. Following heterodox economists again, the policy challenge regarding firm involvement pertains to evoking *coordination externalities*. The unappropriated value involved here consists of
impulses policy supported firms or projects give to the emergence and strengthening of solutions as well as the markets in which they can flourish. Besides knowledge spillovers and information externalities already covered earlier, this is also a matter of putting in place proper infrastructures and institutions. While policy supported R&D firms likely benefit from this themselves, it is also of value for potential second-movers. As these third parties will not (fully) reimburse the activities paving the way for them to enter, they are enjoying value not appropriated by the policy supported R&D firms. The resulting coordination externalities are similar to network externalities, be it that the synergies in this case concern the supply side rather than demand side. In that sense they are more like a club good, with the exception that they do not necessarily have to result from deliberate sharing agreements. In fact, the rationale for mission-oriented innovation programs precisely consists of overcoming the lack of coordination and alignment that prevents from complementary factors to accumulate. Setting agenda’s and providing specific public goods and infrastructures might be powerful ways to wet directional change in motion (Foray, 2019), provided that they attract follow-up efforts from firms and clients enjoying the associated externalities. Because this might lead to further strengthening of the innovation path, coordination externalities may also be referred to as ‘adoption externalities’.

As noted, the research community engaged with transitions has been influential in defining the type of transformative innovation policy underlying this MIP approach. Although the concept of spillover externalities is largely absent in their idiom, many of their statements point in the direction of evoking the abovementioned coordination or adoption externalities. Policies involving firms in building niches and pressuring regimes are to a large extent doing precisely what we just described in economic terms (nurturing the alignment of complementary public and private factors). From a spillover perspective it is important that such policies do not just target firms and projects fitting a niche, but especially the ones breaking grounds for followers.

**Spillovers with relevance for solution-oriented policy**
The last MIP approach to consider is solution-oriented policy. By not necessarily belonging to the sphere of economic and innovation policies, this approach is much less associated with firm-based innovation and corresponding externalities. Especially when focused on achieving alignment between problem interpretations and appropriate solution directions, the issue of yielding social returns by spurring private investments is hardly relevant. This only starts to be of importance when policies become instrumental in selecting and accelerating innovation paths that lend themselves for mission-oriented innovation programs. In case firms take part in exploring novel opportunities to solve societal needs (e.g. via contests), this should be aimed purely on eliciting knowledge spillovers directly feeding into the solution, or on information and coordination externalities facilitating its adoption. How the contributing firms perform business-wise is irrelevant: a genuine solution-oriented approach dictates that in principle it is fine when competitors (even foreign ones) absorb these spillovers for taking the desired solution forward.

**3.2 An integrated spillover framework**
Based on our review of the fragmented literature on spillovers, Figure 2 synthesizes the findings in an integrated spillover framework.
R&D policy as we traditionally know it is usually concerned with eliciting knowledge spillovers and absorption processes associated with conducting R&D. Besides assessing how policy beneficiaries enhance their performance over time - by appropriating the results of the supported activities - , a major question is what influence is exerted on the R&D activities and business performance of third parties subjected to knowledge spillovers (as well as rent spillovers and business stealing). The scope extends if we move to mission-oriented R&D policies. Besides deliberately targeting particularly promising knowledge spillovers, policies fitting this MIP approach may also consider the information externalities that emerge when experimenting with the actual implementation and commercialization of innovations. Information externalities provide valuable demand signals that may favour an innovation systems’ capacity to explore innovation paths fitting a mission.

As we enter the domain of mission-oriented innovation programs, the business performance of policy beneficiaries is increasingly less of a concern. Instead, policies fitting this approach are expected to strengthen the exploration and exploitation of solution paths by encouraging activities that lead firms to bring about coordination/adoption externalities (in addition to information externalities and knowledge spillovers). More than convincing firms to undertake R&D that is risky due to technological uncertainties, mission-oriented innovation programs should spur innovation that is risky due to the required range of complementary factors. Supporting activities that contribute to factor alignment might help to lead the way for further strengthening of the niches around promising innovation paths. To what this extend such coordination externalities matter for solution-oriented policy largely depends on whether such policy is already catalysing the development of selected solution paths, or whether it is still aiming to disentangle complex contested problems and solutions.

4. Spillovers in Dutch SBIR schemes

From a theoretical perspective, the spillovers evoked by a MIP approach and its policy measure(s) are ideally in line with the rationale for why that policy was implemented. Due to some spillovers being largely neglected in existing bodies of literature, however, little is known about how they are manifested in actual policy implementations. In this section we provide an illustration by examining the case of Dutch SBIR schemes.
4.1 The case of the Dutch SBIR schemes

SBIR is probably best known as the United States Government’s Small Business Innovation Research awards-based program for encouraging small businesses to take part in R&D activities. Inspired by this example, various countries have implemented a version of their own (Siegel et al., 2003). For the Dutch SBIR the overall goal is to challenge and support firms in providing innovative solutions for societal problems. The scheme consists of three policy measures, each of them taking a different place in the spectrum of MIP approaches.

The ‘Valorisation Grant’ is executed by the National Science Foundation NWO and provides grants for the further development of academic inventions with commercial potential as well as societal relevance. As it not guided by criteria focused on particular priority areas, this way of pushing societally desirable innovations falls somewhere between regular R&D policy and mission-oriented R&D policy.

Apart from the Valorisation Grant for academic spinoffs, there is also a SBIR line directly targeted at existing business. This line is executed by the Netherlands Enterprise Agency (RVO.nl) and is highly similar to the UK SBRI policy measure based on of public procurement of innovation (PPI). Taking government challenges as a starting point, firms are invited to participate in open competitions. Per challenge, up to about 15 firms can receive a subsidy for assessing the feasibility of an innovation meeting the challenge’s criteria. In a second round, about 6 firms may obtain an additional subsidy for conducting an experiment in practice. Although this SBIR line is formally one singly policy measure, a distinction can be made between two types of challenges.

Following the PPI literature, ‘catalytic’ challenges are the ones governments use when supporting innovative projects that (when successfully implemented at a sufficiently large scale) reduce the need for public services. Exemplary is the call by the Ministry of Economic Affairs and Climate, asking for innovative ways for transporting and using synthesis gas (fuel gas mixtures). It is unlikely for the Ministry itself to purchase resulting solutions, but possibly the adoption of these solutions by others lowers the necessity to intervene more drastically on the energy market. Eliciting challenge-led exploration and supporting diffusion arguably is going more towards mission-oriented innovation programs than only providing R&D grants for desirable spin-offs.

There are also ‘direct’ challenges in this SBIR line. In these cases governments issue calls for innovations that improve the quality of the public services they themselves provide. Characteristic is that these challenges are less focused on supporting the wide-spread commercialization of a desirable innovation, and more on developing innovations the challenging government might purchase (hence the label ‘direct’). An example here would be a call for solutions that reduce nuisance of construction works by the Department of Infrastructure. Due to this focus on societal rather than economic relevance, direct challenges are to be regarded as positioned even closer towards the solution-oriented MIP approach.

4.2 Mapping spillovers

As the literature on mission-oriented policies emerged partially from contributions on demand-side innovation policies, much has been written about the potential of PPI to spur the development of societally desirable innovations and innovation paths (e.g. Edquist & Zabala-
Iturriagagoitia, 2012). It has also been established that PPI may induce spillovers to user firms (Rocha, 2017). However, which spillovers this would be remains again largely neglected, just like the question to what extent their nature and size match with the grounds on which the PPI intervention was legitimized.

To give an impression of the spillover effects of the PPI SBIR lines as well as the Valorisation Grant, we draw upon survey results acquired as part of the policy’s evaluation over the period 2012-2016 (Dialogic, 2017). Out of a population of 1495 policy beneficiaries with known contact information, 276 (18.5%) provided usable answers in an online survey. This concerns 170 users of the Valorisation Grant, 65 firms involved in catalytic SBIR, and 41 firms involved in direct SBIR. The survey questions covered the nature and output of the respondents’ innovation project with SBIR support. Questions on the wider spread and impact of the output are based on the development and face-to-face pre-testing of new survey items. As this section is limited to illustrating spillover profiles of distinct policy measures, only response to the three most relevant survey questions are shown here. Together, the questions provide insight in the novelty, crowding-in and niche building effects of innovation projects with SBIR support.

Figure 3: Response to survey questions on the wider impact of innovation projects with SBIR-support (n=276).
According to the upper graph in Figure 3, respondents involved in valorisation and catalytic SBIR are equally inclined to rate their innovations as ‘frontier experiments’ yielding novel knowledge. The 89% of respondents stating this qualification is to a reasonable or even large extent applicable is significantly higher than the 71% amongst respondents engaged in direct SBIR challenges. Important to know in light of possible common method bias is that the distinction between catalytic and direct SBIR was not known to the survey respondents.

Moving to the second graph, it turns out that the direct SBIR group reports about just as often as valorisation grant users that their innovation-based products and services are already being offered by other parties as well. This percentage of 43%-47% is significantly lower than the 67% amongst respondents participating in catalytic challenges. Moreover, the middle group also draws attention in the question on contributions paving the way for such follow-up activities by others, possibly due to information externalities. Consistent with the first graph, there is no difference yet (with valorisation grant users) when it comes to driving knowledge development. On the other items in this question catalytic SBIR respondents increasingly stand out. At least in their own view, these respondents contribute more often to adaptations and pressures like creating legitimacy or removing legal barriers. Assuming the respondents cannot privately appropriate all the possibilities these impulses provide (as also suggested by the second graph), the findings suggest catalytic SBIR challenges are in this case yielding the highest range of coordination externalities.

5. Discussion and policy implications

5.1 (In)consistencies between rationales and spillover effects within each MIP approach

Roughly corresponding with the three MIP approaches, the survey responses on the SBIR policies’ wider innovation and adoption impact shed some light on tensions coming into play when implementing mission-oriented innovation policies.

First, policies on the solution-oriented side seem to face a trade-off when specifying the scope of the solution they like to see fulfilled. Although a strong demand-side focus may open possibilities for innovations to truly take off, there is a risk that a narrowly formulated challenge in fact elicits solutions with only a minor potential for being implemented at a larger scale. This caveat of responding to incidental problems by developing ‘local’ solutions is widely known to innovation strategy scholars (Danneels, 2003; Henderson, 2006). Yet, overseeing the literature on mission-oriented policies so far, few authors have warned for stepping into the pitfall of specifying myopic MIP policies. Our tentative case illustration suggests it is worthwhile to make a careful ex ante assessment of the extent a new policy’s scope evokes advantages for non-beneficiaries - via spillovers -, rather than only spurring the development of context-specific solutions (mostly advantaging the policy beneficiaries themselves).

A second remark concerns the variation in the reported impact of policy-supported innovation projects. Apparently, the SBIR policy approaches differ in their ability to drive innovation dynamics extending beyond the activities of directly participating firms. As far as stated in policy documents and the publicly available evaluation of 2017, there are no clear indications that specific measures have been taken in order to prioritize policy support or accelerate the diffusion of spillovers. Much of the attention has been devoted to examining whether SBIR
firms themselves increase their business performance in terms of turnover and profits. In that respect it is striking how the Dutch national government is increasingly presenting SBIR as a major element of its ambition to move towards a mission-oriented innovation strategy. This becomes evident both from the coalition agreement (Dutch Parliament, 2017), as well as a letter to parliament from December 2018 (Ministry of Economic Affairs, 2018). While there are indications of some SBIR lines indeed offering possibilities on this account - albeit with significant differences amongst them -, one would perhaps expect a more explicit plan on how to leverage the instrument for setting transformations in motion. Such apparent reframing of existing policy goals without altering its mechanisms is in many ways reminiscent of policy drift as encountered also in the context of sustainability policies (Howlett & Rayner, 2007; Kivimaa and Kern, 2016). Given the relatively sudden renewal of interest for mission-oriented policies, it is possible that also other governments might overstep by updating their ambitions without adjusting the policy instruments they have in place. Resulting inconsistencies in the overall policy arrangements are likely to limit policy effectiveness. Again, to most innovation scholars this is far from an unknown phenomenon. The claim made here is only that a more detailed focus on spillovers and MIP approaches unveils innovation dynamics otherwise remaining out of sight.

5.2 The relation between MIP approaches

MIP policies are emerging out of a growing preference for innovation policies yielding ‘broad’ social returns, beyond economic welfare only. Picking up on the discussion on policy drift, a pertinent question to elaborate on in the light of policy implications is how the various MIP approaches should be regarded (and governed) in relation to each other. Drawing upon literature on the evolving composition of instruments in policy mixes (Howlett & Rayner, 2007), we recognize two ways of looking at how policy strategies themselves develop over time.

Upgrading of innovation policies

The first point of view is to consider the rise of MIP policies as a new generation of strategies replacing the traditional ‘neutral’ approach to spurring R&D. This view applies when the core objective of innovation policy shifts from economic impact to societal impact. The initial steps on the ladder from traditional R&D policies to mission-oriented programs can be made according to various routes, essentially boiling down to the question when and how to incorporate directionality and a systems perspective. In the figure below this is explained on the basis of a framework with the distinction between technology push and societal pull on the horizontal axis, and the distinction between knowledge-based policy and systemic policy on the vertical axis. One evident route consists of first introducing R&D policies fitted to societal topics (‘mission-oriented R&D policy’), and then developing mission-oriented innovation programs that do more than just providing R&D support in priority areas. An alternative route is to start with turning generic R&D policies towards systemic innovation policies, followed by the step in which these specific policies are replaced by (or tuned into) coherent programs for major societal topics like the grand challenges. The intermediate step, in the upper left corner of Figure 3, can be characterized as modern industrial policy (Rodrik, 2004) aimed at guiding and facilitating industry and science in their joint exploration of new innovation paths. Policy evolution following this route first integrates insights and policies related to developing and
strengthening innovation systems around certain technologies, and then considers the transition dynamics relevant for driving the adoption of potential solutions. A striking example is found in the Netherlands, where the government first introduced transformative innovation policies for its Topsectors, which currently are re-oriented towards also contributing to societal challenges (Janssen, 2019).

When arrived at mission-oriented innovation programs, a next stage in the policy evolution would be the step towards solution-oriented policy (which we deemed a domain beyond the boundaries of just innovation policy). Note however that a reverse route is possible as well. Starting out with introducing solution-oriented policy could fuel the definition of mission-oriented innovation program, i.e. the focal innovation paths and scope and temporality of underlying projects, as its key focus is the disentangling of wicked problems into actionable missions (Wanzenböck et al., 2019).

Figure 4: Alternative routes for moving from generic R&D policy towards mission-oriented innovation programs.

**Extension of innovation policies**

Instead of stages in policy evolution, the MIP approaches can also be regarded as offering an additional set of interventions that can enhance the impact of generic R&D policies, and thereby the overall policy mix. In this view coordination and alignment efforts come on top of R&D support, without one being inherently better than the other. As reflected in our spillover framework, the complementarity between the various approaches resides in the fact that mission-oriented and solution-oriented policies have an eye for the wider movements set in motion, while the R&D-oriented approaches lend themselves for driving novelty. Policy strategies aimed at mobilizing entrepreneurial experimentation by private firms might choose to combine policies from different categories. Such policies should be individually consistent (in terms of rationales and pursued spillovers) and evaluated on their own objectives, while also looking at how the policies reinforce other. For instance, tax credits should drive innovation, and coordination should yield commitment for joint agendas, the two of them together leading to more private innovation activities targeted at collectively desired directions.
**Revisiting failures as a ground for policy intervention**

Taking the extension (complementarities) perspective, it is worthwhile to revisit the longstanding debate on the relation between different types of failures innovation policy should respond to (Mazzucato & Penna, 2016; Foray, 2019). The description of the respective policy approaches in section 2.2 already indicated how each of them corresponds to a distinct way of legitimizing policy intervention. The apparent contrasts can be reconciled by taking a fundamentally different position on how failures feature in the process of policy formulation.

Especially for market failures, the dominant logic is to take such failures as the starting point for determining on what accounts policy intervention is required for restoring desirable economic mechanisms. Adopting Martin’s (2016) drug prescription parallel, the failures are commonly regarded as illnesses in need of a medicine. Extending the scope from enhancing R&D intensity to setting innovation directions and adoption foregrounds a whole body of other types of failures, like the system and transition failures discussed earlier. Such failures are much less a starting point for intervention; they rather are the diagnostic explaining why a desired improvement of the current conditions is not coming about. A notorious weak aspect of the alternative perspectives on innovation is that, by concentrating on systems and regimes, they often lack a critical assessment of the place of firm behaviour within observed inertia. Occasionally this stems from the active rejection of taking market failures as a legitimate basis for formulating transformative policy (Mazzucato & Penna, 2016). From a complementarities perspective, however, it also seems possible to give the market failures a similar status as the other failures. That is, rather than regarding market failures themselves as an illness, they can be thought of as a diagnostic as well; see the figure below.

Whenever a certain transition is insufficiently taking off (the illness that needs to be ‘cured’), policy makers may contemplate the urge of intervening by considering to what extent the ensemble of market, system, and transition failures together can indicate which forces are hampering progress on a particular trajectory. Such stance towards failures potentially prevents them from exclusively focusing on the one kind (e.g. restrictive regulation) while overlooking barriers of the other kind (e.g. information asymmetries surrounding the financing for and adoption of a solution).

![Diagram of traditional and alternative ways of legitimizing policy](image-url)

**Traditional way of legitimizing policy**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Intervention selection</th>
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<tr>
<td>Market failure</td>
<td>Innovation policy instruments</td>
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</table>

**Alternative way of legitimizing (MIP) policy**

<table>
<thead>
<tr>
<th>Problem</th>
<th>Diagnose: explanation for problem</th>
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<tr>
<td>Market failures</td>
<td>Innovation policy instruments</td>
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<td>System failures</td>
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<td>Transition failures</td>
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6. Conclusions

Contributions

Earlier research on mission-oriented and transformative innovation policy has pointed at the imperative of maximizing spillovers (Rodrik, 2004; Janssen, 2019; Foray, 2019), without clearly specifying which kinds of spillovers this would concern. We have taken up this challenge by elaborating what spillovers types can be associated with particular MIP approaches. Adhering to fine-grained typologies on these accounts brings to the fore various policy tensions overlooked so far.

A first contribution of this paper is a comprehensive overview of emerging approaches to mission-oriented innovation policy. In our view there is no such thing as MIP theory; the literature on this account is merely a theory-informed characterization of a topic rapidly gaining interest amongst policy makers. As the hype unfolds, more and more concepts and actual instruments are being labeled as being characteristic for ‘the MIP framework’ (Cantner & Vannuccini, 2018). To structure the debate and encourage productive communication, we suggested a distinction between three types of MIP evolving out of ordinary R&D policy. With each type having its own objective and rationale, also governance, implementation and monitoring issues are markedly different between the various MIP types.

Second, we have sought an answer to the question what variety of spillovers is relevant to consider when facing different approaches to spurring (mission-oriented) innovation. Our review of distinct literatures acknowledges spillover categories normally hardly captured in a single study. Spillovers often remain regarded as belonging to the sphere of market logic, despite the claim that creating markets is key for solving grand challenges by (also) mobilizing industry efforts. Moreover, taking the definition of spillovers as innovation-induced benefits not entirely appropriated by the originator, also pressures on socio-economic systems are essentially manifestations of innovation externalities.

Building on the first two contributions, we presented an integrated spillover framework as a basis for prioritizing what effects policy should achieve (given their rationale and thus MIP approach). The consistent account of spillovers and resulting framework also serve to bridge various literatures relevant for mission-oriented innovation policies, which might help overcome the limitations of adhering to individual perspectives only (e.g. when seeing failures as competing paradigms, rather than complementary diagnostics).

Finally, the empirical illustration based on Dutch SBIR schemes suggests it is not evident that MIP policies are coherent in their rationales and interventions. Being an adaptation of the original (U.S.A.) SBIR program targeted at enhancing the innovation capabilities of SMEs, the initial Dutch SBIR was dedicated to pushing solutions. Currently it is increasingly regarded as a genuinely mission-oriented approach. Meanwhile, as the objectives and rationales have been shifting, the design of the intervention and associated monitoring has remained largely unaffected. Valorisation is organized as generic push, despite the ambition to especially facilitate the development of innovations contributing to societal welfare. Also the direct SBIR is unlikely to deliver on this account, given the finding that a solution-oriented MIP approach might steer R&D and experimentation towards myopic innovation rather than scalable
solutions. Furthermore, catalytic and direct SBIR implemented in an identical way (as the analytical distinction is hardly made in practice). These findings, although stemming from an anecdotal case, point at the risk of drift in the context of mission-oriented policies (Howlett & Rayner, 2007; Kivimaa and Kern, 2016). We echo the importance of aligning measurement instruments with actual policy goals (Arundel et al., 2019). Also, we have sketched different archetypical ‘upgrading’ and ‘extension’ routes for moving from R&D policy to advanced MIP forms. In reality it is possible that different alternatives will be deployed simultaneously. At all times, however, it remains imperative to be consistent in articulating the types of spillovers that are envisaged per underlying instrument.

Limitations and further research
Featuring in a mostly conceptual paper, the empirical analysis presented here merely serves as an illustration of the tensions that might surface when differentiating in more detail between varieties of MIP as well as different spillover types. Our case study on Dutch SBIR schemes, which in no way pretends to be a sound quantitative test, suggests it might indeed be fruitful to extend innovation surveys with questions on the broader impact of innovation activities. The sketched spillover profiles were based on readily available and imperfect survey data. Follow-up research is required for developing more rigorous methodologies to gauge characteristics like the scope, speed and intensity of various types of spillovers, in particular when it comes to information and coordination externalities. A clear limitation of the survey-based approach, although not uncommon (Feldman & Kelly, 2006), remains that it the innovating actors themselves might have the best look-out, but still a very limited view of the changes they help set in motion.

Another line for additional inquiry consists of more research into the respective merits of the various MIP approaches. Selecting an upgrading or extension route for fitting existing policy mixes to new policy goals requires more insights into the trade-offs involved, as well as more contextualization. Highly relevant in this respect is also the question how various national and regional policies may be combined, as there is currently no consensus over the degree of (de)centralization that is appropriate for implementing mission-oriented policies (Robinson & Mazzucato, 2019).
References


