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Publication date:
2016

Document Version
Publisher's PDF, also known as Version of record

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on
Innovation Studies
No. 20160115

Foresighting for Inclusive Development

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Abstract

We propose that foresight can contribute to inclusive development by making innovation policy processes more inclusive, which in turn makes innovation systems more inclusive. Processes of developing future-oriented innovation policies are often unsuccessful and rarely inclusive. We conceptualize such processes as foresighting. We focus on how the ex-ante design of policymaking processes affects the actual process with a focus on inclusion, and we discuss how it affects policy effectiveness and innovation system transformation. Our argument is that processes of policymaking must be inclusive to affect and transform innovation systems because a set of distributed actors, rather than ministries and innovation agencies, is the gatekeepers of change. From this perspective, inclusion is a precondition rather than an obstacle for transformation. We develop a conceptual framework and use it to study design and processes in two foresight cases in two emerging economies - Brazil and South Korea. Although the research is exploratory and the results tentative, the empirical studies support our main propositions.

Keywords:

Inclusive development; foresight, innovation systems; innovation policy; emerging economies

Highlights:

- Experiences from foresight designs in Brazil and South Korea
- Foresight can help make innovation systems more inclusive
- Distributed actors are the gatekeepers of innovation system transformation
- Among social, industrial, and territorial inclusion we focus on industrial
- We need systemic and innovation-oriented foresight to enhance inclusive development

1   Introduction

From the perspective of evolutionary economics, learning and innovation are the most important processes in development (Nelson, 2008). Including people in learning and innovation activities is thus a central part of inclusive development. The nature, extent and direction of innovation activities are strongly influenced by a set of social structures that we often refer to as innovation systems. Making such systems more inclusive will thus promote inclusive development. We propose here that foresight may help us bring about more inclusive innovation systems.

Ministries of finance, industry or science and technology in developing countries often produce ambitious plans and related innovation policies for strengthening and connecting science and technology (S&T) and industry activities to support innovation systems. Too often, such strategic initiatives fail. We suggest that one important explanatory factor behind failed policies can be found in the design of the very process of generating them. We argue that whether the process of developing future-oriented innovation policy[1] is inclusive or exclusive has important consequences for its likelihood of having an effect ex post. We conceptualize the process developing strategic innovation policy as foresight. Foresight is an important and widely used instrument for future-oriented policymaking and for "wiring up" innovation systems (Martin & Johnston, 1999).

Foresight is currently undergoing a two-tracked transformation. First, it is in a process of attaining stronger theoretical foundations as the field moves from being practice-oriented towards increasingly becoming a scientific discipline. Second, it is in a process of implementing a systemic and evolutionary understanding of innovation. In earlier work, we have suggested 'innovation system foresight' (ISF) as a tentative framework that can bring forward this dual transformation (Andersen & Andersen, 2014). ISF is a tool for strategically guiding innovation system (IS) transformations in desirable directions, e.g., towards more inclusivity. Nonetheless, such transformations are feasible only if the structural design underlying foresight adheres to the basic ideas of ISF. These include a systemic understanding of innovation, which demands a focus on context specificities and relatively broad social inclusion. Hence, our main proposition is that ISF can not only possibly ensure more

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[1] We refer to innovation policy in the "broad" sense (Lundvall & Borrás, 2005). Furthermore, we use the terms "strategic" and "future-oriented" innovation policy interchangeably.

inclusivity in innovation policymaking but also enhance the 'effectiveness' of it. From this perspective, inclusion is a precondition rather than an obstacle for transformation. To achieve transformations, governments must build and institutionalize competences for inclusive public-private dialogue around innovation policy.

The effect of social inclusion on innovation and development is an emergent research area (Heeks et al., 2014; Johnson & Andersen, 2012). The theme has hitherto largely been ignored in both innovation and development studies (Cozzens & Sutz, 2014). Thus, despite recent activity, it is empirically under-researched and conceptually under-developed (Foster & Heeks, 2013). Most empirical research on inclusion and innovation focuses on micro-level processes (for example, grassroots or frugal innovations), but the importance of broader system structures (i.e., institutions) wherein the latter processes are embedded is widely acknowledged (Andersen & Johnson, 2015; Cozzens & Sutz, 2014). In this paper, we focus on the structural features of innovation policymaking. We thus contribute to the former knowledge gap by outlining how foresight can make innovation policy, and in turn innovation systems, more inclusive. More precisely, our argument is that the design properties guiding the process of innovation policymaking (foresight) to a large extent determine whether its output (e.g., growth plan) can be implemented. The idea to combine foresight and innovation systems to study inclusive development is novel, and it emerges from the authors' respective experience with innovation studies, technology foresight and development studies.

Although most research concerns the social inclusion of poor and vulnerable communities, a recent initiative from the OECD broadens the notion of inclusion to encompass social, industrial, and territorial inclusion into innovation systems (OECD, 2013). A central point is that although aiding the poor remains at the core of inclusive development, we must acknowledge important interdependencies between the different forms of inclusion. For example, including poor people in labour markets depends on the growth of heterogeneous firms, and the workplace is often a key arena for learning. The inclusion of poor people into learning activities (as education) can help firms succeed via better equipped workers. Additionally, firms remain the key drivers of inclusive development and the main actors for up-scaling and diffusing inclusive innovations (specific products/services). We focus on industrial inclusion and thereby also contribute to research on inclusive development by exploring this novel concept empirically.

4

The paper is both conceptually and empirically explorative. We propose that a certain type of foresight thinking —innovation system foresight—is particularly conducive to inclusive development. Through the use of interviews and secondary data sources, we present indicative evidence from case studies in Brazil and South Korea.

Section two will present the conceptual linkages between foresight, inclusion and innovation system transformation. Section three presents our analytical framework and methods. Section four presents foresight cases from Brazil and South Korea and their context. Section five contains an analysis of cases. Section six concludes.

2 Foresight, innovation systems and inclusion

2.1 Inclusive and systemic policymaking

It is widely recognized that neither a universal recipe for nor a general theory of policymaking for innovation exists (Ahlqvist et al., 2012). Nonetheless, policy and strategy development are increasingly being interpreted as a continuous, reflexive, distributed, and interactive learning process (EFP, 2012). Rodrik (2006, 2010) argues that in the global learning economy, there are no simple and universal paths to economic development. Therefore, any path is necessarily unclear ex ante, which makes systematic experimentation with policy and institutions the only sensible strategy.

The systemic and distributed character of innovation has implications for inclusion (or participation) in the policymaking processes. It has been recognized that the effectiveness— here understood as the implementation of policies, which is indicated by behavioural changes in actors—of policy depends to a large extent on the involvement of a broad range of actors in addition to those formally in charge. Due to the complexity of the learning economy, policy formulation relies on the knowledge, experience and competence of different stakeholders. Because policymakers cannot be understood as perfectly informed social planners, distributed policymaking via the inclusion of key stakeholders emerges as a necessary and integral part of innovation policy. International experience shows that involving key stakeholders and the public in dialogue and decision-making processes is essential to making socially robust solutions for new technology (Gibbons, 1999; Mallett, 2013).

In this respect, policymaking is to a large extent about aligning expectations and building shared visions of the future that can enable the coordination of interdependent actors. Public policy thus plays a catalysing role in this perspective, which implies that the process of formulating innovation policy and the benefits related to it (process benefits) might be more important than actual tangible outputs, such as reports, list of priorities and regulation (product outputs) (Ahlqvist et al., 2012). Hence, broad inclusion has a strong instrumental value for innovation policy, and policymaking needs to be both systemic and participatory.

The direction of innovation policy development activities should not be understood as 'blind'. It is directed by the dominant vision of the future—of what a desirable future would be—and resolving what are identified as problems in that optic. The influence of the perception of the future on the direction of learning and innovation is strong, whether it is explicit or implicit. It is not possible to rationally invest in a business, study for a career, save money or even send our children to school without making some assumptions about the shape of the future—it is thus inherent to decision making (Wehrmeyer et al., 2003). The process of policy experimentation should be guided by a deep understanding of current problems and by a systematic understanding of what the future might be.

2.2 Foresight

Foresight can be understood as a dynamic and systemic planning tool with participatory and inclusive elements. It is an activity that aims to build medium- to long-term visions, aimed at influencing present day decisions and mobilizing joint actions (Havas et al., 2010). The purpose of foresight is thus to imagine different futures and their consequences and, on that basis, to engage in informed decision making. It is perceived as a process where new insights emerge and capabilities are built rather than a tool for prediction. Foresight thus rests on two key assumptions: (i) that the future is not laid out (ii) and that decisions made and actions taken today can affect the future. Foresight often functions as a knowledge input to formal innovation policymaking (e.g., legislation) that goes on in ministries and parliament. It can thus be thought of as an early stage innovation policymaking. A look at the roots of foresight gives us a deeper understanding of the concept.

2.2.1 Roots of foresight

Foresight is often considered an area of practice based on three more established traditions: technology forecasting, futures studies and technology assessment.

Technology forecasting is predicting a future technological development. This tradition has its roots in the aftermath of World War II, when the American military needed a systematic method for making informed judgement regarding the rapid technological development and its significance for military defence. In the 1940s and 1950s, large American enterprises developed systematic decision-making methods for technological strategic development based on such disciplines as strategic planning, operation analysis and econometrics. During the 1950s and 1960s, forecasting was developed as a tool broadly accepted by large enterprises, international organizations and many countries' governmental administrations (Jantsch, 1967). The fact that these methods did not predict the oil crises of the 1970s generated significant scepticism about the usefulness and validity of forecasting (particularly in periods of radical change), which in turn stimulated the development of other approaches (Miles, 2010).

According to Miles (2010), foresight is also rooted in a European tradition of futures studies established in the 1960s and 1970s (Bell, 2003, 2004). The field of futures studies tends to be dominated by professionals from social sciences and the humanities and is seen as an art involving creative and imaginative thinking and acting (Martin, 1995). Moreover, the early futures studies tradition was characterized by a pessimistic and critical point of view on the future and on technology, which partly formed the foundation of the tradition of technology assessment. Compared to forecasting, an instrument for concrete decision making, futures studies were more focused on stimulating public debate (Miles, 2010).

Through their point of departure in technology criticism, future studies have formed the basis for a third tradition, technology assessment (Miles et al., 2008; Miles, 2008), which involves a systematic assessment of the consequences for society and human beings of the introduction and use of new technology. Technology assessment has especially contributed to foresight with participatory methods. In this context, the participatory method means the broad inclusion of citizens in the discussion and assessment of the future development of technology and of the challenges to society. In this respect, the technology assessment tradition differs from both technology forecasting and future studies, both of which are expert-oriented and elitist.

The inspiration for the first formulation of foresight partly came in approximately 1980 from Japan, whose 'technological forecasting' was markedly different from what was going on elsewhere. Martin (2010) characterizes technological forecasting as follows: (i) It involves not a few experts but thousands of scientists, industrialists, governments officials and others; (ii) it considers the demand side of future economic and social needs; (iii) it combines top-down and bottom-up elements; (iv) and it emphasizes process -benefits. This led Irvine and Martin (1984) to propose the term foresight as a strategic forward-looking technology analysis to be used as a public policy tool in priority setting in science and technology. They define it in opposition to 'hindsight', understood as analysis of the historical process and the origins of certain important technological innovations.

The roots of foresight illustrate a major dividing line between forecast and foresight. According to Wehrmeyer et al. (2003), the forecast tradition has failed as a policy development tool for a number of reasons. First, it has limited ability to predict discontinuities. Second, we cannot predict the social, economic and environmental consequences of technical change with any certainty because our systems of knowledge co-evolve with the world. The weather does not react to a weather forecast, but the economy does. Third, the accuracy of predictions tends to decrease as time horizons grow, partly because the probability that the period of analysis will include one or more significant discontinuities increases as a function of time. These differences illustrate what foresight is not.

2.3   Recent developments: Innovation system foresight

Since Irvine and Martin (1984), foresight has been established as a field of practice in both public policymaking and in corporate strategic planning and more recently as a scientific discipline. It has been characterized by increasing conceptual broadening and diversity. The latter reflects experimentation with and application of diverse rationales as foundation for foresight. It has become more participatory and complex and is applied at multiple levels across numerous sectors. Despite the growing diversity, recently, parts of the foresight academic field have adopted the innovation system approach as its main rationale under the notion of innovation system foresight (ISF). This 'recent' and more participatory form of foresight is a relevant instrument for inclusive development regarding the poor and vulnerable (Ely et al., 2010).

ISF was formulated in response to a lack of theoretical underpinnings and analytical coherency in the area of foresight research and to accommodate the changing perception of innovation from a linear to an evolutionary systems perspective. ISF is defined as a systemic, systematic, participatory, future-intelligence-gathering and medium- to long-term vision-building process aimed at present-day decisions and mobilizing joint actions with the purpose of transforming innovation systems in desirable directions, e.g., inclusivity or growth (Andersen & Andersen, 2014). ISF essentially reflects the acceptance of an evolutionary and systemic understanding of innovation. Consequently, innovation policy cannot be developed or implemented in a top-down manner.

A foresight can be described as consisting of three main phases: pre-foresight (design of foresight), foresighting (process of foresight) and post-foresight (implementation and dissemination of the outputs and outcomes of foresight), with each phase containing a number of steps, as seen from figure 1. ISF directly affects the pre-foresight phase, and due to interdependency between the phases, it indirectly affects the foresight and post-foresight phases. Below, we outline how ISF differs from foresight in general on four points (see more detail in Andersen & Andersen, 2014).

(1) **The goal of foresight**. In the literature, several goals are mentioned such as setting priorities in S&T, guiding innovation systems, shop window for competences, enrolling new actors in the S&T debate, and network building (Barré & Keenan, 2008). The main goal of ISF is to 'strengthen' the innovation system. The aforementioned goals are seen as inputs to this principal goal.

(2) **System definition/boundaries**. There seems to be no agreed-upon method for setting system boundaries and thus classifying factors as external or internal. Boundary setting influences the choice of methodology, data collection and stakeholder involvement in subsequent steps in the foresight process. ISF suggests following the definition of an innovation system as the organizing principle for setting boundaries. The system should "*include the elements and relationships which interact in the production, diffusion and use of new and economically useful knowledge*" (Lundvall, 1992).
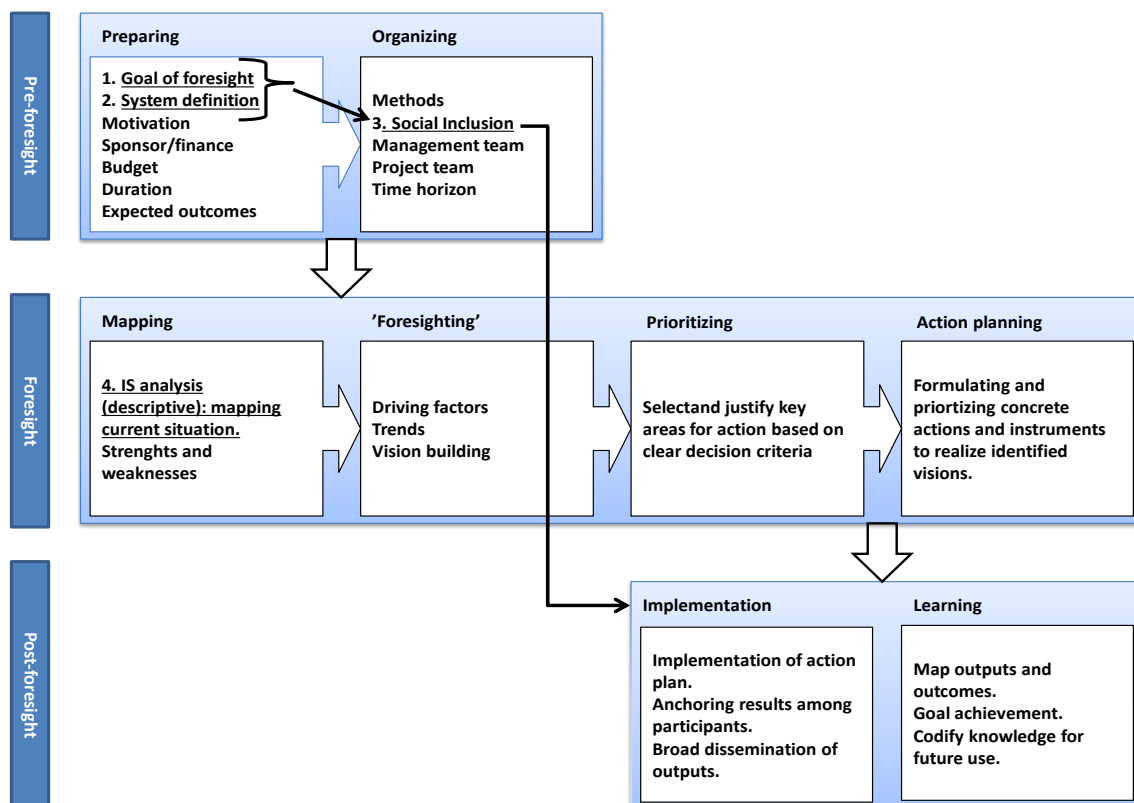
Figure 1: Phases and steps in foresight – based on Andersen and Rasmussen (2012)

(3) **Inclusion**. Innovation system transformation requires distributed policy, which in turn requires (meaningful) participation of all key stakeholders (representing, e.g., actors, networks, infrastructure, institutions). This point is closely related to system definition. A systems approach will tend to favour broad inclusion/participation because actors are seen as the primary agents, or gatekeepers, of change. Despite being in principle a participatory policy instrument, the process of foresight can be more or less inclusive. Actually, so far, broader participation in foresight has been limited. Instead, the focus has been on expert groups. One can distinguish between narrow and broad foresight. Narrow foresight is based on a forecast tradition where only a few key experts are involved, whereas broad foresight includes a much wider set of stakeholders. Narrow foresight tends to assume that all new technology is beneficial and progressive, whereas broad foresight includes a discussion of the desirability, costs, benefits and direction of innovation (Loveridge, 2005). ISF is, in other words, inclusive foresight. There is a crucial link between inclusion and the implementation of foresight results in the post-foresight phase, which is essential for the usefulness of the exercise. In this sense, the initial system definition and the identification and enrolment of key stakeholders partly define implementation possibilities. It reflects a systemic interdependency between pre- and

post-foresight because if those required to make decisions (gatekeepers) have not been included, there is little chance that they will act in accordance with the foresight action plans (Cagnin, 2011).

(4) **Mapping the present**. There is no widely agreed-upon method for analysing the present system situation. The quality of any foresight will depend on the quality of the mapping exercise because it will serve as a basis for the following foresighting steps. We suggest an IS framework for such analysis.

2.4 Innovation system foresight and inclusive development

Foresight adhering to the points outlined about can potentially promote inclusiveness in innovation systems through multiple channels:

1. *To manage, support and build interactive learning spaces*. This involves supporting, reorienting and creating new networks and linkages within and across technologies, sectors and markets and around problem-solving (Smits & Kuhlmann, 2004). These interactive learning spaces can aid communication, understanding and collaboration across boundaries, be they geographical, organizational or disciplinary in nature, and thereby increase understanding and build trust between participants. Consequently, they can improve policy implementation through increased transparency, legitimacy and ownership. (Barré & Keenan, 2008).

2. *Stimulating the identification, articulation and translation of the needs of the poor into demand for knowledge*. This is an often overlooked but critical component of successful interactive learning and innovation (Laestadius, 1998, 2000). Hence, there is a need for spaces that can facilitate these activities across subsystems.

3. *Capability building* in participants and on a system level with a focus on enhancing responsiveness to change and on strategic thinking by developing language and practice for thinking about the future (Barré & Keenan, 2008).

4. *Informing policy decision making processes,* which concerns generating insights decision making regarding the dynamics of change, future challenges and options, along with new ideas, and transmitting them to policymakers (Costa et al., 2008).

5. *Facilitating policy implementation* via inclusion, which enhances the capability for change within a given field by building a common awareness of the current situation and future challenges (Costa et al., 2008). A clear benefit of participation is that stakeholders often

are much more committed to a plan that they have contributed to designing, which facilitates the implementation of decisions. It also implies translating the collective visions into specific policy initiatives and a timely plan for implementation.

6. *Embedding participation in innovation policymaking.* This corresponds to an institutionalization of ISF, which can facilitate the inclusion of civil society and industry in the policymaking process, thereby improving its transparency, legitimacy and effectiveness (Costa et al., 2008).

It is important to note that these benefits are exclusively 'process benefits' that are not possible with limited inclusion (narrow participation). Because policy must be distributed and actors are seen as the primary agents of change, innovation system foresight must be 'inclusive' to be transformational. Moreover, ISF places particular emphasis on the micro foundations of the innovation system approach, which is interactive learning between users, producers and suppliers (Johnson, 2011). These actors require a shared vision to engage in successful interactive learning. Vision building can here be understood as bridging/closing 'distances' (e.g., cognitive, cultural) between users and producers to ensure better communication. In this way, ISF can enhance the quality and quantity of couplings between actors in the economy, which augments the 'effectiveness' of innovation systems (Fagerberg et al., 2009). In addition, ISF has the potential to strategically affect the direction of innovation activities through its function of vision building and influencing actors' behaviour. This led Georghiou (2007) to argue that inclusive forms of foresight may not only make successful innovation more likely but also shape the direction of innovation towards solutions to problems related to sustainability, poverty, or exclusion.

3 Analytical framework and methods

The main line of argumentation in this paper, which is illustrated in figure 2, is that to include firms in learning and innovation, we must first include them in designing policies for innovation-led development. We suggest that one promising way of doing this is to further pursue the ideas embedded in ISF. However, inclusion is only one parameter in ISF. It is thus necessary but not sufficient for reorienting innovation systems. We operationalize the four points that distinguish ISF from foresight more generally. We propose as the design of a foresight more strongly adheres to these points, its likelihood of succeeding in transformative change and development due to the process benefits accumulated increases. In the empirical

12

analysis, we focus primarily on how foresight design affects the foresight process; see the dotted area at the bottom of figure 2. We have little data on how the latter relates to actual policy impact. In the analysis, we thus compare two cases of how foresight design (inclusive or not) affects foresight processes, and from that, we make tentative inferences about policy effectiveness. Measuring the effect of foresight is generally complicated due to counterfactuals and an uncontrollable and complex environment affecting the study object.

Figure 2: Degrees of ISF and innovation system transformation – analytical framework
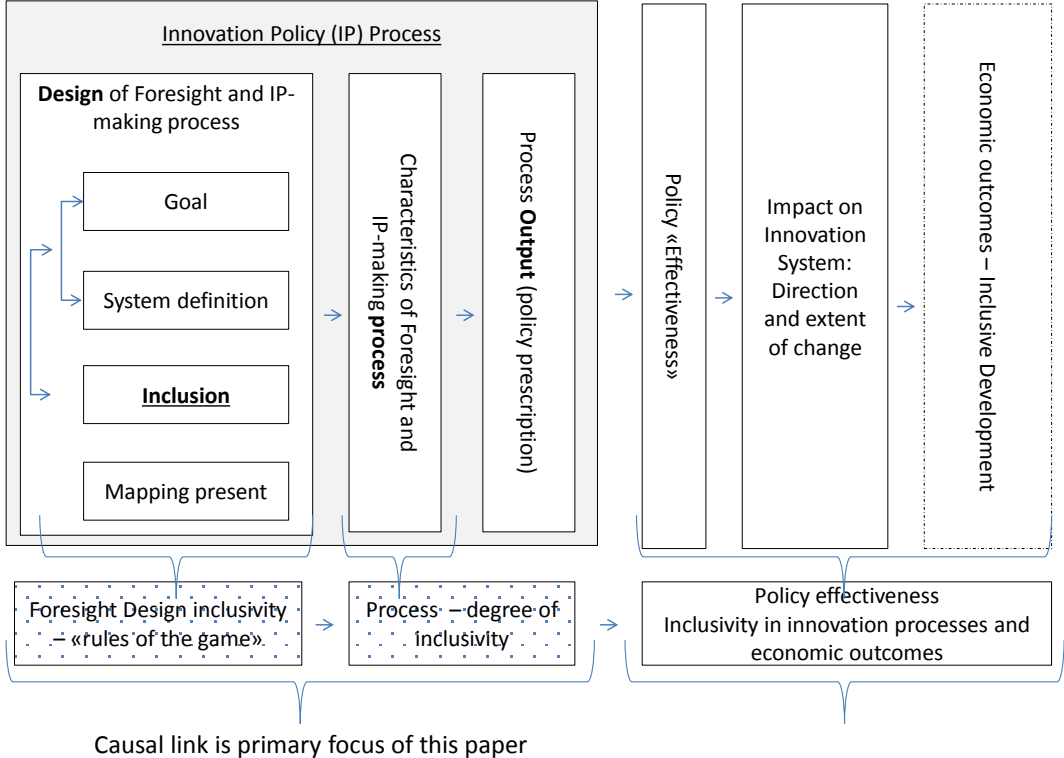
We analyse two cases of sector foresight from Brazil and South Korea, respectively. The countries were chosen for four reasons. First, both have extensive foresight activities and programmes targeting innovation and development. Second, both countries struggle to support innovation system transformation using foresight and innovation policy. Third, both are emerging economies that hold many lessons for other developing countries. It has been argued that exchange of the experiences from emerging economies (such as in Asia and South America) could be one way to speed up policy learning in other emerging innovation systems (such as several African economies) (Lundvall & Lema, 2015). Fourth, the foresight cases differ greatly between the countries, which make them interesting for comparison. In the following sections, we analyse and compare foresight practice in an organization (South

13

Korea) and one foresight programme (Brazil) involving several actors. We study these apparently incomparable entities by focusing on the analytical dimension of foresight design. The empirical material builds extensively on Andersen, Andersen, Park, & Cagnin (2014).

The case analysis will contain three main elements. First, we present a selective description of the innovation policy context. Second, we describe the foresight environment and earlier experiences. These descriptive parts presented in section four constitute the context wherein the individual foresight cases unfold. The third part of the analysis is to assess ISF content in the design of selected foresights and how this relates to the foresight process. Our foresight cases focus on the level of industrial sectors embedded in a wider national foresight culture. We focus on the period from approximately 1990 to 2010 where foresight activities for innovation policy took hold. Our data consist of academic publications, foresight reports and eight interviews with main actors in Brazil and South Korea conducted in June and July 2012; see table 2 in appendix. In the following sections we use numerous abbreviations. The reader can find an overview of these in table 3 in the appendix.

4 Context and case descriptions

4.1 Policy for Innovation

4.1.1 Brazil

In the 1990s, initiatives on innovation policy were crowded out by strict macroeconomic policies. Governments abstained from proactive innovation policy which, instead, was left to the 'market forces'. In this period, the Ministry of Science and Technology (MCT) had marginal influence (Koeller & Cassiolato, 2009). Innovation policy gradually returned during the 2000s, but competences for public-private dialogue on policy development had deteriorated. To restore industrial policy, resources allocated to innovation activities (both public and private) increased significantly.[2] In this context, foresight was seen as a tool for restoring such dialogue.

An important initiative in this context was the Industrial, Technological and Foreign Trade Policy (PITCE) launched in 2004 by the Ministry for Development, Industry and Trade

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[2] In 2000, Brazil invested approximately USD 8,327 million in 'scientific and technological activities', which grew to USD 23,453.37 million by 2008 (1.43% of GDP) (RICYT, 2010).

(MDIC). At the core of the PITCE was stimulating technological innovation and disseminating a pro-innovation discourse through the various ministries. This novel policy initiative lacked coordinating organizations and institutional support. Consequently, the government created the National Council for Industrial Development (CNDI) to support the formulation, implementation and monitoring of the PITCE. The CNDI aimed to give coherence to actions and proposals and to strengthen the dialogue between the public and the private sector on innovation policy. The Brazilian Agency for Industrial Development (ABDI) was created as an executive secretariat for the CNDI. In addition to contributing to policy implementation and monitoring, the ABDI also functions as a strategic think tank that interacts with industry via institutionalized channels of communication with most Brazilian industries in the form of competitiveness forums, trade chambers, sectoral chambers and working groups (MDIC, 2010). The ABDI articulates and diffuses the interests of industry in the CNDI. The mission of the ABDI is to develop strategic plans for industrial development by promoting investment, employment, innovation and competitiveness in Brazilian industry (ABDI, 2012). The ABDI occasionally engages in foresighting with the participation of industry to develop such plans. It is part of a continuous dialogue that has generated trust between all actors (Filho, 2012).

4.1.2   South Korea

OECD has recently argued that South Korea faces a challenge of moving from a 'catching-up' to a 'creative' innovation system. South Korea has reached the technological frontier in several sectors (particularly ICT) and must now increasingly stimulate innovative and creative technological development (OECD, 2009). One challenge is that innovation policy is primarily focused on technology-push strategies rather than the diffusion of knowledge and interactions among actors (systemic policy). Additionally, the innovation system tends to overly favour the incumbent sectors of ICT and machinery manufacturing. Hence, the development model of South Korea is changing. Its approach to innovation policy must also change (Oh, 2011).

According to OECD, South Korea must develop a systematic and evolutionary approach to the promotion of innovation to support the dynamics and efficiency of innovation processes (2009). There is, in other words, a need for *systemic policy tools* for innovation (Smits & Kuhlmann, 2004) required for achieving system transformation, which hinges on distributed

innovation policy and inclusive processes, as argued by OECD (2009: 185): "*clearly, governments alone cannot implement national innovation systems; the form and functioning of the latter tend to depend upon the actions of and linkages between a constellation of actors, both public and private*". Nonetheless, innovation policy in South Korea is hierarchical and centralized (Schlossstein & Park, 2006). Such top-down policy has been effective during the catching-up period but is now less suitable. Consequently, there is a growing need for inclusive innovation policy in South Korea. In this context, foresight at both national and sector levels has been an instrument for addressing the challenges outlined.

4.2 Foresight experiences

4.2.1 Brazil

The first explicit foresight (national) in Brazil was Brazil 2020 (1998), which was the first real attempt at 'integrated governmental planning'. The foresight did not explicitly aim to produce guidelines and priorities for public investments, and it can best be understood as an early reflection exercise that has contributed to developing the capacity in Brazil for long-term thinking (Santos & Filho, 2007). The second foresight exercise was the Prospectar Programme (2000-2003), which was managed by the MCT, focused on science and technology trends and their potential effects on Brazilian industry and society. The programme achieved a remarkable mobilization of researchers (over 10,000), which helped raise awareness of Brazil's future challenges and interest in long-term thinking. Problem identification and formulation was the main outcome (Popper & Medina, 2008).

Nearly simultaneously, the MDIC launched the Brazilian Technology Foresight Program (2000) with support from UNIDO. The motivation was to assess future challenges and opportunities of sectors (production chains) of strategic importance with the goal of contributing to industrial competitiveness through technological innovation supported by public policies (Santos & Filho, 2007). Several reports were published from the exercise, but policymakers struggled to implement the results (Castro & de Castro, 2001; MDIC, 2002). According to Aulicino & Kruglianskas (2008), this was because the underlying foresight processes did not include important industrial actors. They conclude that the pre-foresight process must be more inclusive and involve the key stakeholders to improve their understanding of and participation in the process. In 2004, the Nucleus of Strategic Issues of the Presidency launched the foresight programme called Brazil 3 Moments project: 2007,

2015 and 2022. The programme aimed to define long-term national strategic objectives but was not particularly focused on innovation (Popper & Medina, 2008; Santos & Filho, 2007). It was created to build an inclusive dialogue between the State and the Brazilian society on the values, methods and desirable solutions for reaching strategic goals (Santos & Filho, 2007). From these foresight activities has emerged the insight that broad inclusion is increasingly important for policy and strategy impact.

4.2.2 South Korea

In South Korea, foresight is central to innovation policy, which is predominantly managed in the form of laws and national plans that coordinate policies and allocate resources to STI. These traditional policy instruments have been complemented and informed by development of national visions and roadmaps (OECD, 2009). One of the earliest initiatives for spurring this transformation was the formulation of 'Vision 2025' in 1999, which involved several far-reaching proposals. As a part of realizing Vision 2025, the government launched the 'Science and Technology Framework Law' in 2001. It aims at promoting S&T more systematically by inter alia developing mid- and long-term strategies and implementation plans, improved rules for inter-ministerial coordination, and broad support for R&D activities, S&T agencies and an innovation-driven culture. Moreover, based on the Framework Law, the government formulated the first '5-Year Science and Technology Plan' and a 'National Technology Road Map', which were instruments for realizing Vision 2025. The first 5-year plan set out priorities for S&T investment, national R&D, and human resource development (MEST, 2012). The law made it mandatory to carry out a national technological foresight as a basis for formulating the 5-year plans. The Korean Institute of Science and Technology Evaluation and Planning (KISTEP) manages these foresights (Park & Son, 2010). Foresight is thus formally linked to innovation policy in South Korea (STEPI, 2012).

In terms of foresight design, South Korea found inspiration in Japan for its first foresight in 1993. It was based on three rounds of Delphi surveys with thousands of experts. The focus was on identifying future key technologies without taking into account a social dimension. The second South Korean technology foresight was initiated in 1998. The design and methodology were similar to those of the first technology foresight (Schlossstein & Park, 2006). Schlossstein & Park (2006) conclude that these first two national technology foresights failed to produce explicit policy implementation as a result of the exclusion of key

stakeholders in the South Korean national system of innovation and weak government commitment.

The third South Korean technology foresight was initiated in 2003. It built on the previous two but also contained new methodological elements. It went beyond S&T and R&D priority setting and set out to match future societal needs and appropriate technological developments. Although the matching exercise was a novelty in South Korea, the Delphi technique remained the main tool. The foresight consisted of three phases, and the general public (1,000 persons) participated only briefly in the first phase. Thus, the exercise was dominated by experts that were asked about the future needs of society. The move towards a more 'inclusive' methodology made the foresight more transparent and useful for policymakers and resulted in the direct policy uptake of foresight results for the first time in South Korea (Schlossstein & Park, 2006). According to Park & Son (2010), this third technology foresight reflects a movement, although limited, towards a systemic understanding of foresight and innovation due to the increased focus on social aspects and broader inclusion (policymakers, social scientists and citizens were involved, in comparison with earlier reliance on only natural scientists and engineers) that was intended to overcome the limited impact of the previous foresights (Park & Son, 2010). In addition to the national technology foresights, 'technology road mapping' is widespread in South Korea. It is the main form of foresight at the sector level in South Korea. It is used as strategic and analytical tool by several private actors and think tanks.

In general, foresight activities are confined to being exercises made within ministries with participation of academics and experts. This characteristic complicates impact and system transformation. Currently, the legacy of top-down policymaking and S&T bias in innovation policy are barriers for developing a systemic, inclusive and innovation-oriented type of foresight. The national technology foresights and most technology road mapping activities tend to be non-systemic, technology-focused, non-inclusive, hierarchical and centralized. In accordance, Park & Son (2006) argue that although there are variations in methodology, foresight activities in South Korea are oriented towards output products such as scenarios, Delphi survey results, and future technology lists, whereas attention to process outcomes such as building collective visions and strategies and sharing knowledge is low.

4.3 Foresight case description

4.3.1 Plano Estratégico Setorial

In Brazil, we focus on a particularly interesting sectoral foresight programme called 'Plano Estratégico Setorial' (strategic sector plan – PES). It was managed in a collaboration between the ABDI and the Center for Strategic Studies and Management in Science, Technology and Innovation (CGEE) between 2004 and 2008.

PES was launched under PICTE to analyse and support sector-specific needs and competitiveness in a production-chain perspective with a 15-year time horizon (ABDI, 2012). PES contained three steps. First, a panorama analysis (what is the current situation?) was performed for each sector. Second, on the basis of the trends, the issues and perspectives relevant to a (selected) segment of the sector were identified. Third, building on the first two steps, a sector competitiveness agenda (roadmap) was developed to support the formulation and implementation of public policies to strengthen competitiveness and innovation (Arcuri, 2009). PES was partly initiated and managed by the ABDI. It resulted in 11 sectoral foresights for sector development strategies that were used as inputs to the discussions in the CNDI. These foresights were in turn used to formulate the Productive Development Policy programme launched in 2008, the aim of which was to improve long-term competitiveness. The foresights were used as inputs to discussions with the private sector to identify and develop the necessary actions to build competitiveness. The ABDI contracted the CGEE to carry out the foresights in PES.

4.3.2 Korean Institute for Advancement of Technology

The main public policy foresight actors in South Korea are the Ministry of Education, Science and Technology (MEST) and the Ministry of Knowledge Economy (MKE). Each ministry has several affiliated research agencies that perform foresight activities to varying extents. The MKE's mission is to achieve future-oriented industrial development, to strengthen the competitiveness of key industries, and to promote new growth engines (OECD, 2009). These tasks involve strategy development and implementation, to which foresight is central. The MEST is concerned with setting priorities for the long-term direction of S&T development. Hence, whereas the MEST is oriented towards S&T (non-industry focus), the MKE is closer to industry and more concerned with innovation. In practice, it implies that the MEST focuses

on long-run S&T priorities, and the MKE focuses on technology development in the short and medium run (KIAT, 2012a).

We focus on the MKE, under which two agencies, the Korea Institute for Advancement of Technology (KIAT) and the Korean Evaluation Institute of Industrial Technology (KEIT), manage the majority. Here, we focus on the KIAT, which is the main actor. Foresight in the MKE primarily takes the form of technology road mapping, which is currently performed yearly for 35 sectors, covering nearly all sectors in South Korea; of those, the KIAT is responsible for 20 (KIAT, 2012a). The KIAT aims to develop and coordinate sectoral innovation systems and to facilitate interactive innovation processes among key actors (KIAT, 2012b). The conceptual model used to manage foresight in the KIAT has an explicit focus on technology development. The framework contains an analysis of the sector's strategic environment (phase 1), an analysis of sector-internal issues (phase 2), setting goals on basis of SWOT analysis (phases 3 and 4), and developing a strategy plan (phase 5;) (KIAT, 2012c; Kim, 2012).

5 Case analysis

5.1 Goal of foresight

5.1.1 Plano Estratégico Setorial

The Plano Estratégico Setorial was intended to increase competitiveness, but more notably, the ABDI and the CGEE acknowledged the distributed character of industrial and innovation policy, particularly of strategy development for the longer term. This reflects the idea that industrial performance is a systemic phenomenon and that the success of (innovation) system transformation hinges on the acceptance from key stakeholders. From this perspective, top-down policy is thus insufficient. Industrial actors must be enrolled in the strategy-development process. PES thus goes beyond both setting research agendas and expert-based foresights to focus on realizing structural change via inclusive processes. Consequently, the main goal of PES can be said to be near ISF.

5.1.2 Korean Institute for Advancement of Technology

The overall goal of foresight activities in the KIAT is derived from the overall visions of the MKE, which, as mentioned, pivots around the creation of new industries, competitiveness and

productivity (KIAT, 2012a). However, the KIAT suffers from the institutional structure of being delivery agencies for the MKE in the sense that neither of them is much concerned with pre-foresight or post-foresight phases but merely performs the foresighting exercise. Their objectives are given by the MKE, which expects only a foresight report. This is an institutional weakness from the perspective of innovation system foresight.

5.2 System boundaries

5.2.1 Plano Estratégico Setorial

The ABDI initially selected industries to be analysed. Each sector foresight had a steering committee with representatives from all stakeholders, including BNDES, the MCT, FINEP, sectoral organizations (national-level industry unions), the CGEE, the ABDI, and others. Committees decided guidelines and followed the process closely. Committees decided industry boundaries and who would be relevant actors to include (Campanhola, 2012). In the pre-foresight phase, the ABDI insisted on using private business consultants to avoid the CGEE's usual reliance on only university researchers. Consultants would be more pragmatic and focus more on 'market aspects', it was believed (Campanhola, 2012). The ABDI wanted to reorient the CGEE towards a more industrially inclusive approach to foresight. Thus, there was no systematic methodology or underlying theory for setting boundaries. Nonetheless, the negotiation process reflects that the ABDI insisted on avoiding an (top-down) expert-based foresight.

5.2.2 Korean Institute for Advancement of Technology

The KIAT does not have an explicit methodology for setting sector boundaries (Kim, 2012). The MKE decides such boundaries, often via industry codes (KIAT, 2012a).

5.3 Inclusion

5.3.1 Plano Estratégico Setorial

The identification and enrolment of actors to participate in foresights was a crucial aspect of the PES studies. The ABDI carefully chose key stakeholders from each industrial sector to be part of the project. The ABDI's major goal was to persuade and to gain commitments from the committee representatives who could help organize the sector while improving its global competitiveness (Nehme et al., 2011: p. 5-6). The process was complicated, though. Firms

insisted on solving short-term problems regarding interest rates and infrastructure and were not interested in or accustomed to long-term strategic thinking. The ABDI invested significant resources in gradually trying to convince them (and government officials) about the usefulness of foresight via training and workshops. The ABDI succeeded due to three factors.

First, the ABDI was created to fill a vacuum in industrial policy in Brazil, and together with other policies (e.g., the PITCE), it reflects the determination in the government to pursue economic development through industrial policies that should pivot around science and technology. Industry perceived the latter as a business-friendly agenda and as a window of opportunity for actually influencing the political agenda (Alvarez, 2012). Second, as a new organization, the ABDI was determined and eager to prove itself by committing industry to programmes focusing on long-term policy and development strategies instead of indulging industry's obsession with short-term problems (Alvarez, 2012). Moreover, according to the ABDI Director Clayton Campanhola (2012), the ABDI had a 'good name', i.e., is an actor respected and trusted by industry. Third, simultaneously with the foresights, the ABDI launched a number of consultancy projects focusing on short-term problem-solving for industries. Seen in the total budget of the PES, these short-term investments were insignificant, but they reflected a compromise between short- and long-term issues. These projects were used as 'bait' for industry commitment and made industrial actors experienced that they had influence, which in turn earned the ABDI and PES legitimacy (Alvarez, 2012).

Hence, PES intentionally crafted broad inclusion from industrial actors to facilitate industry transformation. Although it does not appear explicitly from our data, we may say that the design of PES had strong links between the pre-foresight and post-foresight phases. The ABDI/CNDI's mandate ensured political awareness and the extensive inclusion of industry actors facilitated their cooperation.

5.3.2 Korean Institute for Advancement of Technology

The number of persons participating in the KIAT's technology road mapping has been increasing. Now, approximately 700 experts participate in the 35 yearly mapping exercises. They are organized in expert groups consisting of approximately 20 persons each and come equally from universities, research organizations and industry (KIAT, 2012a). However, according to Professor Karpsoo Kim, the increasing number does not change the fact that technology road mapping is generally a top-down method for strategy development, whereas

foresight is a bottom-up method (Kim, 2012). According to Kim, the KIAT's technology road mapping is essentially expert-driven and technology-focused without any broader inclusion of stakeholders.

5.4 Mapping the system

5.4.1 Plano Estratégico Setorial

Mapping the system created challenges for the CGEE because sectors differed significantly, forcing the CGEE to develop its own sector foresight model (Filho, 2012). It looks at each sector in six dimensions (general views) of society (Market, Social, Economic, Technological, Innovation, Competitive Strategies). The external and general trends are combined with a sector-specific analysis, where the focus is put on new players, main competitor countries and leader companies in the production chain. The production chain analysis looks at talent, infrastructure, investments, policy and institutions, design, and other 'specific' dimensions. It furthermore emphasizes the relationships between suppliers, producers and users in the chain as important for understanding needs (Filho, 2010). The dimensions are chosen based on SWOT, STEEPV, or general experience. Although the CGEE ad-hoc model is not linked to innovation system thinking, it reflects a systemic approach to both foresight and innovation.

5.4.2 Korean Institute for Advancement of Technology

There is no overarching theoretically anchored method for mapping the sectors (Kim, 2012). The models illustrated apply standard foresight instruments such as SWOT, STEEP, patents/scientific papers and quantitative value chain analysis.

6 Concluding remarks

The Plano Estratégico Setorial and previous foresight activities in Brazil can be seen as attempts to develop systemic innovation policy tools and to institutionalize them. The main lesson from PES is that systemic and inclusive foresight design generates inclusive policymaking processes that, in turn, increase the likelihood of significant policy impact. The successful inclusion of industrial actors is an interesting feature of PES. It is a general challenge for foresight to achieve this. We can draw five lessons from PES on this topic.

First, meaningful inclusion requires that industry representatives have knowledge of foresight and strategic innovation policy and consider it important, which implies training and dialogue.

The ABDI and the CGEE organized training in the pre-foresight phase. Second, PES indicates that trust and dialogue between industry and government is a premise for enrolment and in turn meaningful participation. Industry must also be convinced that there is a real opportunity for influence. Third, a unique feature of PES was the management of trade-offs between short-term problem solving and strategy development for the longer term. This may hold a key lesson for sector foresight in general. These three points all concern the inclusion of firms that initially wanted to be excluded. Fourth, during PES, the CGEE experienced that firms changed perception of the project from disbelief to engagement. Hence, included actors learned new things during the processes. Fifth, PES indicates that both the institutionalized dialogue that the ABDI had with industries and the dialogue taking place during PES were very important for identifying and articulating the needs of industries and for building trust.

PES was an experiment in identifying and formulating future needs for 11 industries. The companies alone would not have initiated such an experiment (Filho, 2012). The ABDI thus functioned as a 'bridging organization' (see Boon, Moors, Kuhlmann, & Smits, 2011) between industry, government and research. Such organizations seem indispensable when going beyond expert-based foresight. PES indicates that a continuous public-private dialogue about what constitutes current problems and a desirable future is a central part of managing innovation system transformation. On basis of our analysis, we evaluate the foresight design of PES to be reasonably similar to what we have identified as ISF; see table 1.

The design of foresight in the KIAT seems to be primarily top-down, expert based, not theory-based, short term, product oriented, technology focused, and non-systemic. In this context, it is interesting to observe that the KIAT identifies the poor diffusion of results, a weak industry impact, and the analysis of contextual factors as their main challenges. The KIAT tries to diffuse results through hearings, meetings and engagement with industry, but the impact remains weak (KIAT, 2012a, 2012c). Moving towards a systemic, inclusive and innovation-oriented foresight style might alleviate the KIAT's challenges. A potential barrier for directly including more diverse actors can be found in South Korea's industrial structure. According to Sarpoo Kim, the multinational enterprises (Chaebols) are too strong to be bothered with what the KIAT and the MKE do, whereas the small and medium-sized enterprises (SMEs) are too weak to benefit from the results (Kim, 2012). According to the KIAT, it is difficult to establish contact with industry, particularly SMEs. South Korea does not have capable industry associations (potential bridging organizations). Most of them have

only 4-5 employees and are weak in terms of resources and capabilities (KIAT, 2012a). In contrast to the PES case, there seems to be a lack of 'bridging organizations' such as the ABDI and representatives for industrial actors that are able to proactively participate in foresights. The KIAT's foresight design and associated policymaking processes are not very inclusive and are thus far from the ideas of ISF; see table 1. Hence, by negative example, the KIAT's foresight activities suggest the same conclusion as PES, which is that foresight has potential as an inclusive and systemic innovation policy tool. This potential is exploited only when foresight is designed according to the insights of ISF. This is because foresight (and innovation policy, more generally) must be inclusive to be transformational, which implies that the actors in the system of innovation are the principal agents of change—the gatekeepers, so to speak.

This conclusion lends support to the broader propositions of this paper, i.e., including (often uninterested) firms in learning and innovation activities requires that they first be included in collective public-private strategy development processes leading to innovation and development strategies to feel ownership of policies, to have influence on them, and to understand and learn about them. Moving towards such practices in innovation policymaking is one way of making innovation systems more inclusive and thus to promote inclusive development. Accepting the argument implies that governments should invest in inclusive public-private dialogue about future-oriented innovation and development policies guided by a systemic understanding of innovation. Moreover, governments should focus more on the process benefits of inclusion and support the formation of bridging organizations in industry.

National investment priorities in innovation, which significantly affect the direction of innovation and thus the transformation of IS, are often selected in a relatively top-down manner. Its principal methodology is expert-based working groups (with academic bias) and questionnaires surveying thousands of experts. The underlying logic and perception of innovation is informed by the so-called linear model of innovation, which is a problematic practice because we know that innovation is predominantly a systemic phenomenon. We have argued here that innovation system informed type of foresight (i.e. ISF) can support better decision making in and the impact of such investments. This is particularly true in developing economies, where innovation systems are often fragmented (Szogs et al., 2011). Such countries are in need of systemic, forward-looking and inclusive tools for 'wiring up' and transforming their embryonic systems of innovation. This paper constitutes a first tentative

step towards finding a way forward. To build on and further explore this potential requires more conceptual work and empirical studies in developing countries.

Table 1: Summing up case studies

	Plano Estratégico Setorial		Korean Institute for Advancement of Technology	
	Characteristic	*ISF "Score"**	*Characteristic*	*ISF "Score"**
Goal of foresight	Effective industrial policy; transforming industrial system System transformation focus is important. It makes you identify actors as gatekeepers.	(++)	New industries and technologies by setting priority lists for investment in S&T rather than generating change This type of expert-based screening for future technologies must be seen as only one input to actual foresight and not end product	(+)
Defining system	Ad hoc and weak innovation focus but with systemic understanding of performance Illustrate that absence of explicit method for delimitating system of interest leads to ad hoc solutions	(++)	The MKE decides sector boundaries via industry codes. Non-systemic understanding of performance and innovation Illustrate that absence of explicit method for delimitating system of interest leads to ad hoc solutions	(+)
Inclusion	Broad inclusion Illustrate necessity of enrolling industry and how to do it (short- vs. long-term trade-off, trust)	(+++)	Narrow inclusion, expert-based Delphi 700 experts organized yearly in expert groups. Nonetheless, top-down, expert-driven and technology-focused method for strategy development without broader participation of stakeholders from the Innovation System. Shows necessity of enrolling industry though by negative example.	(+)
Mapping	Ad hoc design based on SWOT and STEEPV but with significant systemic features	(++)	Standard foresight instruments such as SWOT, STEEP, patents/scientific papers Ad hoc and S&T focused (linear understanding of innovation)	(+)

* The number of (+) indicates the degree of similarity with ISF; (+) weak, (++) moderate, (+++) strong

Acknowledgements

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Appendix

Table 2: Overview of interviews

Name	When (2012)	Where
Lèlio Fellows Filho Senior Foresight Manager and researcher Cristiano Cagnin Senior Foresight Manager and researcher	June 4	CGEE, Brasilia
Roberto Alvarez International Affairs Manager	June 6	ABDI, Brasilia
Clayton Campanhola Director (at the time)	June 6	ABDI, Brasilia
Byeongwon Park Future Strategy Team Research fellow Former Director Technology Foresight Center KISTEP	July 10	STEPI, Seoul
Karpsoo Kim, Professor, KAIST	July 11	KAIST, Daejon
Moonjung Choi Director of Technology Foresight Division Office of Future Strategy	July 12	KISTEP, Seoul
Ilgu Cho Technology Planning Team Leader	July 13	KEIT, Daejon
Yeong Cheol Seok Department of Technology Strategy KIAT Vice President Kee Nyeong Lee Technology Planning Team Team director	July 16	KIAT, Seoul

Table 3: List of abbreviations

Abbreviation	Full name	Country
ABDI	Brazilian Agency for Industrial Development	Brazil
CGEE	Center for Strategic Studies and Management in Science, Technology & Innovation	Brazil
CNDI	National Council for Industrial Development	Brazil
KAIST	Korea Advanced Institute of Science and Technology	South Korea
KEIT	Korean Evaluation Institute of Industrial Technology	South Korea
KIAT	Korea Institute for Advancement of Technology	South Korea
KISTEP	Korean Institute of Science and Technology Evaluation and Planning	South Korea
MCT	Ministry of Science and Technology	Brazil
MDIC	Ministry for Development, Industry and Trade	Brazil
MEST	Ministry of Education, Science and Technology	South Korea
MKE	Ministry of Knowledge Economy	South Korea
PES	Plano Estratégico Setorial' (strategic sector plan)	Brazil
PITCE	Industrial, Technological and Foreign Trade Policy	Brazil
STEPI	Science and Technology Policy Institute	South Korea