Papers in Innovation Studies

Paper no. 2015/38

Innovation Bureaucracy:
Does the organization of government matter when promoting innovation?

Erkki Karo (erkki.karo@ttu.ee)
Ragnar Nurkse School of Innovation and Governance,
Tallinn University of Technology

Rainer Kattel (rainer.kattel@ttu.ee)
Ragnar Nurkse School of Innovation and Governance,
Tallinn University of Technology

This is a pre-print version of a paper that has been submitted for publication to a journal.

This version: October 2015

Innovation Bureaucracy: Does the organization of government matter when promoting innovation?

Erkki Karo and Rainer Kattel

Abstract

Current research on how to organize the role of government in innovation – both how governments support innovation in markets and how governments achieve innovations within public organizations for improving its market supporting activities – converges around a rather simplified single-organization explanations: innovations are driven by either (Weberian) elite expert organizations or (Schumpeterian) fluid peripheral organizations. We show that looking at history of innovation bureaucracy, a more complex picture emerges: historically we find a rich organizational variety for implementing diverse innovation policy goals. We show that historically the organizational variety is, first, driven by highly diverse public-private relationships; and second, the variety itself is an important factor in success and failure of innovation policies. Combining analytical lenses created by Weber and Mintzberg we build analytical framework based on routines and capacities to analyze organizational variety in innovation bureaucracy. We show how different kinds of public organizations are successful at delivering different kinds of innovation policy goals and impacts. Particularly important is the distinction between organizations capable of innovations in policies (instrumental performance) vs organizations supporting innovations in private sector (substantive performance). We finish with discussing the importance of organizational variety for the concept of entrepreneurial state.

Innovation Bureaucracy:
Does the organization of government matter when promoting innovation?

Erkki Karo & Rainer Kattel[1]

> The high administration of society embraces the invention, examination, and execution of projects useful to the people. The high administrative capacity thus involves three capacities: the capacity of the artists, the capacity of the scientists, and the capacity of the industrialists, whose collaboration fulfills all the conditions necessary for the satisfaction of society's moral and physical needs.
>
> Henri Saint-Simon

JEL: B15, B52, O2, O25, O30, O38, P11

Key words: innovation policy, Weberian bureaucracy, organizational varieties, policy capacities.

Abstract

Current research on how to organize the role of government in innovation – both how governments support innovation in markets and how governments achieve innovations within public organizations for improving its market supporting activities – converges around a rather simplified single-organization explanations: innovations are driven by either (Weberian) elite expert organizations or (Schumpeterian) fluid peripheral organizations. We show that looking at history of innovation bureaucracy, a more complex picture emerges: historically we find a rich organizational variety for implementing diverse innovation policy goals. We show that historically the organizational variety is, first, driven by highly diverse public-private relationships; and second, the variety itself is an important factor in success and failure of innovation policies. Combining analytical lenses created by Weber and Mintzberg we build analytical framework based on routines and capacities to analyze organizational variety in innovation bureaucracy. We show how different kinds of public organizations are successful at delivering different kinds of innovation policy goals and impacts. Particularly important is the distinction between organizations capable of innovations in policies (instrumental performance) vs organizations supporting innovations in private sector (substantive performance). We finish with discussing the importance of organizational variety for the concept of entrepreneurial state.

Introduction

Gustav von Schmoller complained more than hundred years ago that Smithian economists assume that well functioning public bureaucracy and orderly finances are a given and that this assumption leads them to numerous mistakes (1900, 292). Similarly, Richard Nelson and Sidney Winter reminded us more than 30 years ago: "If one views policy making as a continuing process, the organizational and institutional structures involved become critical. Public policies and programs, like

private activities, are embedded in and carried out by organizations. And, in a basic sense, it is the organizations that learn, and adapt. The design of a good policy is, to a considerable extent, the design of an organizational structure capable of learning and of adjusting behavior in response to what is learned." (1982, 384-385) Yet, most current innovation policy[2] debates have one thing in common: implementation of policies is often assumed to be exogenous to policies; what matters is the policy choice (e.g., what kind of R&D tax breaks work? should we have a public venture capital fund?), and not how this choice is designed and implemented, and by whom. Thus, there's an inherent *policy bias* when we typically talk about innovation and the state.[3] This is in quite a stark contrast to private sector innovation discourse where innovation is often related to implementation (e.g., how to keep creativity in an organization? how should we engage with clients, partners?). (See Lam 2006 for an overview) Such asymmetry is also reflected in research: while studying public sector organization of innovation is relatively rare even among Schumpeterian/evolutionary economists, then studying private sector organization of innovation is a venerable field of research and teaching. This essay sets out to show that public sector organization of innovation supporting activities – implementation of various innovation policies – greatly matters to society's successes and failures in trying to promote innovation and technological advance. We call these organizations *innovation bureaucracy*: public sector organizations tasked to enhance innovation and technology (via funding, regulating, procuring).

In a recent paper, Breznitz and Ornston (2013) analyze the evolution of the Israeli and Finnish innovation policies and argue that *peripheral Schumpeterian agencies* may be the sources of *policy innovations* necessary for promoting *rapid innovation-based competition,* given that these agencies have sufficient *managerial capacities* (or slack).[4] Arguably, the peripheral status (and little prestige and resources) is important to reduce the likelihood of political interference and to allow space and to create organizational need for *policy experimentation* (and innovation), but also for new forms of public-private interactions (while avoiding capture by special interests) as these agencies are unable to tap into existing political, financial and institutional resources.[5] Importantly, they claim that these findings contradict the earlier development and innovation policy research (from Johnson 1982; Wade 1990 to O'Riain 2004; Block 2008) that argued in favor of key nodal or central pilot agencies (also referred to as *Weberian agencies*) as the source of developmental/innovation

---

[2] Here and below we use innovation policy in the widest possible sense: in our view it includes all public policies that consciously aim to promote innovations and technological change. On why such usage might be justified, see Lundvall 2013.

[3] In all of the recent larger evaluations of innovation policies, implementation issues have not received any attention. Such evaluations discuss in detail the effectiveness of various policies and policy mixes, but not whether design and implementation of these policies and policy mixes plays any role in the effectiveness. See European Commission 2013 and Manchester Institute of Innovation Research 2012. OECD country studies of innovation policy typically describe implementing agencies but rarely go into analytical details (e.g., whether a success of a measure has anything to do with the agency implementing it or not).

[4] This tallies also somewhat with findings in public administration research that autonomous agencies with large managerial autonomy combined with strict performance controls – in another words, new public management style agencies emerging in 1990s – are rather innovation-oriented culture. (Wynen at al. 2013) However, this is based on self-reported (by organizations) innovativeness and thus has to be taken with some caution.

[5] They also recognize that the success of the peripheral agencies may lead them to become (politically) more central and eventually reduce their capacity for policy innovation.

policy success or impact.[6] Particularly East Asian *developmental state* scholars – Amsden (1989), Evans (1995; Evans and Rauch 1999), Haggard (1990; 2004), Wade (1990) – turned the concept of *highly capable bureaucracy* (together with a specific notion of embedded autonomy) into a crucial variable explaining the strong state-led development performance of East Asian economies and beyond.[7] This line of research has *assumed* that whatever the policy and institutional variety between specific economies, bureaucratic capacities can be best developed and best talent recruited and motivated via *Weberian means* of *meritocratic recruitment* and *career management* to make working for government either financially competitive to, or culturally even more rewarding/prestigious than working in the private sector. Evans and Rauch (1999) cemented these ideas through a more quantitative analysis that only tested the importance of some of the Weberian elements (merit-based recruitment and Weberian career systems) on a much broader sample of countries as a whole without explicitly looking at innovation/development agencies/bureaucracies as explicit cases (see also Rauch and Evans 2000).[8]

Paradoxically, it is almost never explicitly defined in any of the abovementioned research what is actually an innovation or developmental agency. Johnson (1982) looked at a *ministry*, later analysis of South Korea and Taiwan have emphasized *planning and policy coordination boards* (Cheng et al. 1998), often set-up on purpose *outside* usual career-system and examinations. Evans and Rauch's (1999) empirical study of 126 countries does not differentiate systematically between ministries, development boards and other government organizations. Neo-developmental state research has looked at a *research-funding agency* (DARPA in the US – Block 2008), *industrial development agency* (IDA in Ireland – O'Riain 2004; Breznitz and Ornston 2013 argue that peripheral agencies in Ireland have been IDA's sub-divisions, i.e. subunits within an organization). Breznitz and Ornston (2013) look at a *ministerial department,* or *office* (Office of Chief Scientist in Israel) and a *foundation* supervised by a central bank and later by parliament (Sitra in Finland). These organizations have highly diverse tasks and positions within broader public management and innovation systems; they differ in structure, size, skill-sets etc. In sum, it seems that their selection as cases to be analyzed is determined by their importance as *change agents* within specific innovation systems that have specific bottlenecks and failures that these agents have helped to overcome. In other words, their definition and selection as

---

[6] This is best captured by Chalmers Johnson and his concept of *developmental state*: a country with predominant *policy orientation towards development* supported by small and inexpensive *elite bureaucracy* centered around a *pilot organization*, such as MITI, with *sufficient autonomy* (limited intervention by the legislative and judiciary) to identify and choose best industries to be developed and to choose the best-fitting policy instruments (from administrative guidance to control over finance and regulation of competition) while still maintaining *market-conforming methods of state intervention,* and *public-private cooperation* in state-business relations (Johnson 1982, 305-320).

[7] Johnson (1999) has argued that his original goal was to highlight the uniqueness of the Japanese development, limits to its emulation, and not to present Japan as a model. Only since the late 1990s have some studies tried to replicate the original claims of Johnson (see Cheng et al. 1998; Kang 2002; 2002b). See also Evans 1998.

[8] Their original questionnaire (available here: http://econweb.ucsd.edu/~jrauch/codebook.html) does not in fact contain any questions about institutional or organizational structures, or about their politico-administrative position in policy systems, or about capacities. This is all the more striking as the period they cover – 1970-1990 – saw in many countries arguably the deepest administrative reforms of past 100 years, namely the rise of new public management type of managerialism and copying of private sector practices. On the latter, see Drechsler 2005.

innovation agencies is determined by their *performance* on the system/policy level that is in turn determined by some level of 'success' in their particular policy task.

In the context of public sector innovations we see a somewhat similar trend where organizations tasked with innovating within public organizations or services (innovation or design labs, ilabs in short), tend to be established as at arms length institutions, with low budgets and political profiles but with highly charismatic leaders, broad independence in agenda setting and with high level of experimentation (e.g., Nesta in the UK, Mindlab in Denmark; see Puttick et al. 2014, Tõnurist et al. 2015).[9]

In what follows we aim to show that both analytically and historically the diversity of innovation bureaucracy is richer (both in function – what these organizations do –, and in organizational variety, i.e. how they work as organizations) than previous research has shown, and that it matters a great deal for the success and failure of policies how they are organized. In this paper we seek to contribute to this debate both theoretically and empirically. On the theoretical level, we show that the arguments in favor of central vs peripheral agencies are in fact not mutually exclusive, but highlight the complexity of how government organizations need to be structured and organized (and what type of performance/outcomes we expect from different organizations) to support innovations both *in* policies and also *through* policies in firms and industries.

We first build briefly a policy implementation framework; then look at the history of innovation bureaucracies and diverse functions fulfilled by such organizations; with the help of Weber and Mintzberg we then build an analytical framework for organizational variety of innovation bureaucracy; and lastly, we discuss what does the functional and organizational diversity of innovation bureaucracy mean for current debates around the entrepreneurial state.

I Policy implementation: how can we conceptualize it for the innovation policy discussion?

Typically implementation comes into innovation and technology discussions as a question about *capacity*, e.g. whether a country, a ministry or an agency has the capacity to create new policies, learn from past mistakes, take new partners onboard, etc.[10] Such discussions tend to be binary in their nature: the capacity is either there or it is not. Accordingly, our first task is to unpack the idea of capacity and show that capacity of an organization is in fact a highly dynamic concept rather than a binary on-off feature. Thus, we propose to understand capacities of an organization as systemic reflections (or results) of the day-to-day *routines* within the organization and within its context (other organizations, institutional rules).[11] Organizational routines

---

[9] We will not discuss here research around public sector innovations, see however Kattel et al 2014.

[10] We follow here a classic definition of policy capacity: "the ability to marshal the necessary resources to make intelligent collective choices and set strategic directions for the allocation of scarce resource to public ends" (Painter and Pierre, 2005, 2) Policy capacity can be differentiated from state and administrative capacities, but here we mean policy capacity to encompass also state and administrative capacities. (See also Karo and Kattel 2014 for more detailed discussion)

[11] We differentiate between the concepts of *organizational routines* and *capacities*. While in the firm and industry level research, economists tend to look at organizational routines, i.e. specific patterns of behavior that different organizations follow (as in Nelson and Winter 1982; also Chandler 1977), in the

in turn are evolutionary phenomena formed via organizational setup or configuration (how organization is structured within, its finances, external relations, etc; see Mintzberg 1989) and the particular positive feedback mechanisms or interaction channels the organization is engaged with (see also Hodgson 2008; McKeown 2008).[12]

Feedback mechanisms enforce specific types of behavior (routines) and discourage others, and thus form capacities of organizations – what tasks and with what kind of impact/outcome organizations can *deliver*. These feedback mechanisms are highly contextual: an innovation policy organization lives and breathes among legal, political, administrative, financial, technological and economical feedback mechanisms.[13] Feedback mechanisms, in other words, help us understand that organizational routines and subsequent capacities of public sector organizations are not institutionally determined in a top-down design fashion and not purely internally selected and designed either (and determined by their rationales), but are *relational,* or dynamic (see also Jayasuria 2005).

For the sake of brevity we can summarize these feedback mechanisms in the innovation arena under *politico-administrative* and *business-administrative* feedbacks.

First, *politico-administrative interactions, or feedback mechanisms*. We can think of such interactions in terms of the forms and extent of political delegation and *autonomy* (or power) of specific organizations, i.e. how much space an organization has to develop its own routines. This autonomy can be either *consciously granted* by national strategies and political elite for specific goals (i.e. innovation), or *organizationally gained* though political infighting, lack of political importance of the field, etc. In terms of key routines public sector organization are usually analyzed through (see e.g. Pollitt and Bouckaert 2011), we can list here following routines: organizational routines (e.g., how is organization set up, does it have divisions, departments), strategic management routines (e.g., who sets key targets and how, are strategies and evaluations formalized), personnel routines (e.g., what are hiring and promotion practices), financial management routines (e.g., how is budgeting formalized, what are the sources of funding) and coordination routines (e.g., with whom does the organization have to coordinate its activities). All these routines are formed in daily politico-administrative interactions and result in specific kind of politico-administrative capacities (see also Painter and Peters 2005).

---

case of public sector organizations – given its stronger institutionalist grounding and somewhat normative stance of public administration scholarship (i.e. the goal is to understand 'what works') – the focus tends to be on capacities, i.e. outcomes/impact of specific routines on some performance criteria. The closest concept to routines in public management research is that of *organizational trajectories,* but it is still looked at through an institutional lens (Pollitt and Bouckaert 2011).

[12] Pierson 2004 offers to date perhaps the most detailed discussion of positive feedback mechanisms within public sector and politics. Positive feedback is closely linked to the idea of path dependence: once certain organizational routines become dominant it also becomes costly to change to alternative ones (as it would typically mean changing organizational stucture, hiring new people, etc) and thus exitsing routines are solidified over time.

[13] It is important to note that the precise definition of all relevant routines is close to impossible, especially given that the definition and scope of innovation policy and related activities is not definite, is constantly changing, and differs between contexts (see Edquist 2011).

Second, *business-administrative interactions, or feedback mechanisms*. We can think of these in terms of the forms and extent of public-private cooperation in policy design and implementation; or, whether and to what extent there is *interest capture* of bureaucracy, which business groups have *access* to bureaucracy and how is this access formalized (the concept of 'embedded autonomy' is one of the most elaborate conceptualizations of these issues – see Evans 1998). More specifically, we can list here the following interactions that matter in innovation arena: technological interactions (e.g., how typical it is for specific public organizations to communicate with technology intensive companies, and how does it happen), production interactions (e.g., how do industrial companies gain access to policy making processes, are there sectoral or ownership differences) and financial interactions (e.g., how close are linkages with financial sector regulations and innovation policy, how are these linkages organized). All these interactions form business-administrative routines and engender in specific kind of business-administrative capacities.

In sum, capacities are not on-off phenomena, but continuously formed through daily interaction and follow from routines established through these interactions. Organizational configurations (in terms of specific routines) initiate these interactions in different forms across organizations and the routines characterizing a specific organization tell us what an organization can and what it cannot deliver.

In addition, there are two somewhat countrevailing dynamics surrounding feedback mechanisms in the public sector: *isomorphism* and *competition*. On the one hand, we can assume that forces of isomorphism are quite strong within one polity, for instance because of common legal background (e.g., civil service law), universalistic regulations and rules (e.g., procurement rules) and common principles of funding (e.g., annual budgets, fiscal rules). Accordingly, path dependencies in organizational configurations and capacities tend to be relatively strong. On the other hand, often within the same polity or even policy arena different organizations compete for the same limited resources (e.g., basic vs applied research agencies) and different policy arenas can easily have conflicting goals (e.g., research agency funding renewable energy research and energy agency subsidizing carbon based energy production).

Furthermore, both types of feedback have both local and global drivers: while businesses and their interests are increasingly driven by global competition, innovation networks and value chains, politics is similarly driven not only by the assumption of globalization of the business, but also by international politics (free trade regimes and other international agreements) and so called discursive convergence on universal management fads and common best practices. In other words, global trends can increase conflicts with isomorphic pressures and trajectories (and are often the key 'triggers' for competition).

Accordingly, conflicts within public sector are normal occurances. Such competitive and conflictual dynamics create needs for organizations to differentiate (e.g., via different strategies and/or hiring practices) in order to 'succeed', that is to legitimaze what they do, to defend their budgets, etc. Thus, both of the dynamics together – isomorphism and competition – create what can be called *punctuated positive feedback mechanisms in public sector*: tendencies towards isomorphism and similar capacities are counteracted by competitive needs to differentiate. This means that even within common rules and context, there is bound to be organizational variety

and different capacities to deliver innovation policy goals.[14] In short, we can expect that within innovation policy arena there exists organizational variety of configurations, that is various types of organizations with different feedback mechanisms, routines and capacities working towards rather similar wider policy goals.

Paradoxically, such countervailing dynamics also mean that in public sectors organizational configurations and capacities can prevail that are not necessarily viewed as somehow successful or creative by outsiders. If a public organization does not look and behave like Apple it does not mean it cannot be as important for innovation and technological change. This is related rather logically to the problem of performance measurement in the public sector: indicators of public sector productivity, efficiency, effectiveness, impact (i.e. impact on the treated groups of citizens, companies etc) are highly debatable and most governments and global indicators tend to emphasize also more subjective and intermediate or *instrumental performance* indicators of procedural transparency, satisfaction with public sector or trust in public sector in general (see also Pollitt and Bouckaert 2011; van de Walle 2008). In essence, we tend to substitute *substantive performance* measures with *instrumental performance* as a second-best solution.

Also in innovation policy, it seems that we really do not know whether and what elements of innovation policy work and have an impact on firms and industries (especially as different interventions of innovation policy are at the same time influencing the general framework conditions and supporting/regulating specific industries and even firms).[15] Therefore, also here we tend to substitute the substantive performance of policies with some instrumental sub-indicator of policy capacity (i.e. what type of governance structure is expected to contribute best to the policy impact) or analysis of the completeness of the policy mix or innovation system (either in comparison or against some benchmark) In sum, most of current research takes a rather simplified focus and looks mostly at how specific policy choices influence firm/industry or economy-level performance where some best-practice governance solutions are expected to be *sine qua non*. This logic can be visualized as follows:

Policy capacity (as an instrumental performance indicator) → **policy choices → firm/industry/economy performance**

Our approach is more complex, but reveals an important simplification of the analytical map above. Our key theoretical argument is that organizational variety is in fact a necessary condition for successful innovation policy: similarly to the private sector context where start-ups, contractors, or R&D or innovation units within large

---

[14] For example, on the system (of innovation) level, some political entities – countries or regions in the EU, states in the US and other federal systems, or local governments – can try to attract innovation-oriented investments and skills to their entity via tax competition, while others try to achieve the same goal via public investments into venture capital funds, research institutes etc. Logically, the governance structures and capacity needs for designing and implementing such diverse policies are highly different. Similarly, differences can be expected also on lower levels of governance, i.e. when we focus on the functioning of sectoral systems of innovation or specific policy domains where factors from technological capabilities (distance from techno-economic frontier and specific needs of businesses) to ethics of innovation (is it politically accepted to pursue GMO research and product development) may differentiate strategic focuses and related capacities.

[15] See the recent large scale meta-study, Manchester Institute of Innovation Research 2012.

corporations are expected to deliver different things than large corporations, organizational variety provides space for different instrumental outcomes or performances within public sector that in turn contribute to substantive policy performance. Whether or not this organizational variety exists and how it evolves (and can be influenced by new policy interventions) depends on the forms of feedback (how it is configured in specific countries, policy domains, or organizational environments/habitats) that in turn influence the organizational set-up and specific forms of policy capacities found in a polity or policy sector. In other words, policy capacity is embedded in organizations that function in a complex environment characterized by co-evolutionary interactions (*punctuated positive feedback mechanisms)*. We can visualize our approach as follows:

Feedback mechanisms → policy choices and organizational variety (as instrumental performance indicator) **→ firm/industry/economy performance** (substantive performance) **→ feedback mechanisms**

II History: how have governments organized innovation efforts in the past?

Historically, modern public organizations consciously aiming to support innovation and technological advancement emerge in late 18th and mostly in early to mid-19th centuries.[16] It is probably not a coincidence that such organizations coalesce concomitantly with industrial revolution and its diffusion. There are two key trends that help to explain the birth of *modern* innovation bureaucracy:

➢ The emergence of polytechnics and engineering education (related to both military and civilian needs) in Europe and the US (mostly military engineering at West Point) that created supply of engineers and technicians for both public and private sectors.[17]
➢ The emergence of professional managerial class both in private companies (e.g., in railroads, armories, and others) and in public sector (e.g., military procurement practices of Quartermaster department during the US civil war).[18]

Both of these trends can be seen as evolutionary reactions to increasing technological complexity of societies in the aftermath of the industrial revolution. From these two springs, as it were, come forth almost all forms of modern innovation bureaucracies: it is difficult to think of any such organization without engineers (and similar technical skills) working in them as it is equally difficult to imagine them without professional level of managers (or middle managers, according to Chandler 1977, 7). This would indicate that historically innovation bureaucracies resemble quite strongly the Weberian thesis proposed in 1980s and 1990s by developmental state studies: hierarchical rational (elite) expert organizations supporting mostly private sector in

---

[16] Evolution of such organizations has obviously a longer history, reaching back at least to Renaissance Italian city states, to German cameralists states and to industrial policy practices by Colbert in France, but these and other such ocurrances will not be discussed here due to space limitations.

[17] Engineers play also a crucial role in some countries in professionalizing civil service in early 19th century and helped to by-pass 'old' patrimonial structures; see comparative study by Lundgreen 1990.

[18] For our purposes is not important whether the professional managers were born in private or public sectors (for a discussion, see Chandler 1977, Hoskin and Macve 1988 and 1994); it is, however, important that in both sectors it happens around the same time. On the role of Quartermaster department in the evolution of US administrative system, see Wilson 2006.

innovations and technological change. However, the story is not as straightforward. In fact, while most innovation bureaucracies use technical experts/engineers and professional managers as key ingredients of their organizational DNA, the way these become fused with various technological, financial, political and administrative contexts (feedback mechanisms described above) opens up a much larger and colorful canvas for organizational configurations to emerge. Indeed, as we will show, it is the relationship between private and public initiative, and how these partnerships are organized and structured, that is one of the key determinants for how types of innovation bureaucracy emerge and operate – and what capacities they contain.

However, for looking at history and current practices of public sector organizations promoting innovations, it is useful to first differentiate diverse functions such organizations exercise (what policy goals they pursue) and only then we can look at what kind of organizations (with what kind of feedback linkages, capacities) there have been and are.

Innovation systems scholars (e.g. Edquist and Hommen 2008) have tried to systemize the key functions or 'activities' in the innovation system (recognizing that the state has a distinct role in most activities and this leads to complex policy mixes). Others have tried to operationalize these functions/activities through institutional complementarities (also between public and private sectors) of the social systems of innovation and production (Amable 2003; Hollingsworth and Boyer 1997) and argue that institutional complementarities may be highly diverse accross regions and economies. There are two common limitations in these streams of research. Firstly, they mostly have a snapshot perspective: what are the functions 'as of now' (in the best performing or different ideal-type systems) and little thinking in terms of why and from where have these functions emerged from. Secondly, there is no systematic organizational perspctive on how these functions are organized. It is notworthy that innovation scholarships centres around activities/functions, institutions and organizations and their interactions and we see that innovation scholars talk about *policy mixes* (mixes of public sector activities) and *institutional complementarities* (mixes of institutions), but not about organizational mixes (or organizational varieties and complementarities).

Table 1 attempts to give a birds-eye view of these functions, describing what policy goals are typically pursued and how these goals relate to innovations and technological advance; the table also brings historical and current examples of organizational configurations carrying out these functions / policy goals. It goes without saying that there can be considerable over-lap between functions and organizational forms; here they are depicted in an ideal-typical taxonomy.

Table 1. Taxonomy of Functions of Innovation Bureaucracies

Function	*Socio-economic policy goals, relation to innovation*	*Examples of organizational configurations*
Management of strategic resources	Ensure wider returns from key assets; up/downstream skill and technology development	Trading companies, state owned companies
Long-term investment	Ensure financing of future technologies and skills, upgrading of existing ones; infrastructure and public works development.	Central banks steering private finance, development banks, public venture funds
Furthering knowledge	Ensure research into basic	Research funding agencies; public

frontier	scientific questions, enable next generation of technologies	universities
Deepening technology base	Ensure widening of applied R&D, lowering risks of diversification, upgrading	Developmental and innovation agencies; IPR offices; experimental technology and policy/public service labs
Generating demand for new products and services	Generate market power for new technologies, innovations deemed socio-politically important	Procurement of innovations, public R&D laboratories; regulatory bodies (in health, environment, energy)
Diffusion of new skills, technology	Ensure wider benefits from technological advances and innovations	Industry associations, competition authorities

As we see, in many ways these are functions center around creating and/or enhancing markets for new skills and technologies. Thus, we will refrain from further discussion of the functions but will try to get somewhat better understanding of the corresponding organizational configurations, specifically their emergence and evolutionary trajectories.[19]

Management of strategic resources

Emergence of organizations: Trading companies emerge from 16th century onwards first as various East India companies, later covering wide trade and military purposes. These companies were often first private companies with high-level political support, later state-owned. (Carlos and Nicholas 1988; also Bowen 2006) Such strongly private configurations with overt political support were in some instances spectacularly successful in trade and military conquests, but less important for innovations and technology development.

Evolution of organizations: They have evolved from trading (and military) organizations towards supporting industry development (e.g., Society for Establishing Useful Manufactures, founded in 1791 in US; it was meant as a new industrial town with textile production at its core; with private funding, but public leadership under Alexander Hamilton and Trench Coxe; see Cooke 1975)[20], and then towards utilities and natural resource management in the second half of 20th century. Many private sector management practices remain important features of such configurations up to late 20th century (e.g., Development Bank of Singapore is established under private law although publicly owned, in 1968); autonomy from politics and market-like discipline (e.g., through governing boards, floating shares on stock exchanges, performance management practices) become key issues for these configurations. There are success stories such as China's use of state-owned companies in industrialization.[21] As policy goals, public revenue creation and management (e.g.,

---

[19] The following descriptions are necessarily extremely simplified as we do not intend to provide here histroy of such organizations but rather tiny snapshots of their evolution; we refer readers to the references for more details. It needs to be further mentioned that organizational aspects are rarely discussed in detail in historical works, thus we have gleamed together organizational facts from various sources through extensive 'snowballing' efforts to cover historical literature.

[20] The failure of SEUM has been attributed to managers of the company who had almost no industry background: most of them were financiers looking for short-term returns. (Nelson Jr. 1979)

[21] Recently Rothstein (2014) has hypothesized that the exceptional development of China – despite the lack of rational and transparent bureaucracies – may have been based on the 'cadre' or 'missionary' type bureaucracies. These bureaucracies share some institutional similarities with Weberian

today as holding companies in Singapore) has since inception dominated over innovation and technology. (See Tõnurist and Karo 2016 for detailed discussion)

Long-term investment

Emergence of organizations: Sraffa attributes the emergence of this type of public organization that attempts to steer private finance into industrial development to late 19th century German central bank and its role as lender of last resorts.[22] (Sraffa 1930) For its organizational configuration, the *Reichsbank* was directly under the guidance of the German Chancellor, but initially it was privately owned and followed corresponding management practices. (Riesser 1911) In US we see at the same time a rather different type of financial system emerging where states created their own public banks that undertook investment functions. (Kregel 1997)

Evolution of organizations: Evolution of public organizations dealing in one way or another with steering investments towards innovations and technological change can be seen in three layers: *First*, evolution of central banks from essentially departments within ministries of finance into autonomous institutions devolved from fiscal policy during the second half of the 20th century, and de-segmentation of banking sector (e.g., diminishing role of sectoral industrial banks in Europe) during the same time through financial deregulation (that results in increasing financialization); effectively central banks change from quite strongly hierarchical industrial policy organizations into highly autonomous professional organizations tasked with financial stability. *Second*, emergence of development banks – in the US case state level development companies – first in Asia (in 1902 in Japan; Yasuda 1993) and in post-WWII era in many other countries with notable success and with direct focus on industrial development and with autonomous professional organizations configuration (Mazzucato and Penna 2015). *Third*, emergence of venture capital, private and public, in the aftermath of WWII, initially in the US, later elsewhere as well. Particularly in the US, the symbiotic co-evolution between private venture capital, new technology companies and public defense spending is well documented. (Weiss 2014) Particularly in its public form, organizational configurations that emerge use mid-level managerial autonomy and close linkages to private venture capital and technology companies. Importantly, within this function we can see strong division of labour emerging over time as central banks move away from industrial financing; financial authority over private banks is divided into multiple (auditing) organizations and venture capital looks for high risk-high return undertakings. This division of labour is reflected also in different organizational configurations and by varying impact on innovation and technological change.

Furthering knowledge frontier

---

organizational model (formal hierarchies and career models), but follow rather different policy doctrines (or missions) that frame and coordinate (through socialization, charismatic leadership etc) the activities of bureaucrats and organizations and explain China's development success (for a discussion of non-Western governance paradigms, see Drechsler 2015). In recent years we have also witnessed a re-emergence of Western discourse on mission-oriented innovation policies (see Foray et al. 2012; Weber and Rohracher 2012; Mazzucato 2013).

[22] Emulation and learning from (failed) Crédit Mobilier experiences in France were important as well. See also Gerschenkron 1962; Cameron 1953, 1961, 1967.

Emergence of organizations: Emergence of modern research university is attributed to late 19th century German Althoff system in which direct ministerial guidance of Friedrich Altoff universities were reorganized and new ones founded, chairs remodeled and also modern libraries and other research infrastructure created. (vom Brocke 1991; also vom Brocke 1996) In some way to countervail this development (to emphasis more research and to involve private funding in research), early 20th century saw creation of pure research institutions according to so-called Harnack Prinzip that gave huge (scientific, financial and managerial) power to leaders of such institutions (first called Kaiser-Wilhelm-Gesellschaft, later Max-Planck-Gesellschaft). These institutions were highly personality-oriented configurations and were initially publicly owned with significant industry funding that later diminished. (vom Brocke 1996) Post-WWI era saw also emergence of (applied) public research organizations in UK within government departments. (Gummitt 1980)

Evolution of organizations: Research funding organizations within public sector have become one of the mainstays of modern innovation bureaucracies from national research councils in charge of grant funding to (sectoral) applied research agencies within ministries and outside.[23] While typically these organizations are relatively autonomous and operate under the principles of scientific excellence and peer-review,[24] then particularly since 1980s there has been noticeable impact of neo-liberal management ideas (new public management) (Boden et al 1998). This has led to privatizations of public research organizations, to increasing the share of competitive funding in total research funding and to influx of other market-friendly of quasi-market-like managerial principles. But also we can detect rise in more fluid configurations, especially in terms of staff exchanges with industry and rise of short-term contracts (such as in Fraunhofer in Germany; Basedow 2013).

Deepening technology base

Emergence of organizations: While evolutionary economists would view Japan's MITI as somewhat archetypical public organization aimed at dealing with technological upgrading of private companies (with strong role played by technical experts), it can also be argued that the aforementioned Society for Establishing Useful Manufactures (SEUM) from 1791 that attempted to found a new town based on new industries could be seen as a forerunner of such organizations. In both cases the perhaps key ingredient of such configurations is strong public leadership and political support combined with close relationships with private investors and with private companies potentially benefiting from such activities. However, organizations configurations could not have been more different: while in the case of SEUM the organizational configuration meant management by private investors; in the case of

---

[23] The impressive ICT development of Taiwan (see Breznitz 2007) is often linked most notably with *Industrial Technology Research Institute* (ITRI, created in 1973 as a merger of existing government labs). ITRIs task has been to concentrate on R&D and technological development (as state technology-creating agent acquiring and developing foreign technologies, diffusing them to industry and supporting private R&D and development activities) to the extent of providing prototypes that can be transferred to the private sector. In most other countries we see less interventionist or market-leading agencies who mostly distribute R&D grants either on behalf of public sector (demand) or to nudge and support private sector innovation activities.

[24] However, in US such agencies as NIH and NSF combine centralized expert skills with in-sourced field-specific skills in the form of medical- and academic self-steering through mechanism such as peer-review (see, e.g., Sampat 2012).

MITI, on the hand, it meant management of private initiative by administrative guidance of industries.

Evolution of organizations: Particularly East Asian success countries used multiple iterations of such developmental agencies and councils during their rise. Such agencies with high level political support and key role played by technical experts have evolved in the second half of 20th century into innovation agencies with either narrower policy goals (such as SBIR, DARPA in US) or with rather wide brief to invest into wider set of technologies and innovations (such as TEKES in Finland).[25] In particular DARPA's unusual organizational configurations has garnered lot of attention.[26] National innovation agencies are similarly to a national research agency most visible element of modern innovation systems. Another similar feature of such agencies is the impact of new public management ideas (e.g., increasing share of competitive funding, funding projects that 'fix' market failures) that increasingly guide funding decisions and evaluation practices at such organizations. In general, organizational configurations include fluid organizations such as DARPA but also relatively stable and standardized organizations (for instance such as in charge of EU's structural funds in Central and Eastern European Countries; see Suurna and Kattel 2010; Karo 2011).

Generating demand for new products and services

Emergence of organizations: Procuring innovative – or often simply products with higher quality and new specifications – has a history in military procurement both in Europe and in US, with the Quartermaster Department in the latter being perhaps one of the forerunners of modern US bureaucracy with its activity during the Civil War and of venture capital industry with its activities during WWII. (Wilson 2006; Weiss

---

[25] In Finland two key government agencies, Sitra and TEKES, created in 1980s a division of labour emerged with Sitra providing loans to companies in early stages risk-capital markets (establishing the Finnish VC market and the Finnish Venture Capital Association in 1990) and TEKES (who had considerably larger budget) concentrating on R&D funding and incentivizing the local R&D networks. These agencies worked in complementary manner as almost all companies receiving Sitra's financing received also TEKES grants for technological innovation (Ornston 2012).

[26] DARPA (ARPA 1958-1972) was from the outset allowed to collaborate with the commercial industry in developing both military and dual-use technologies. Over the years, DARPA's programs and funding choices (it does no internal R&D) have contributed considerably (together with other agencies and programs) into most defensive and civilian innovations (see Mazzucato 2013) and the organizational model has become a blueprint for systemic changes and innovations in other fields, from homeland security (HSARPA in 2003), intelligence (I-ARPA 2007) and energy (ARPA-E in 2009). DARPA has followed a rather specific mix of organizational routines to achieve its missions: 1) *entrepreneurial managerial approach* with short-term (3-5 years) appointment of highly capable program managers (with proven technology-related track-record in military, academia, or industry) who act like *experts-on-loan to the bureaucracy* (mid-level people whether from the government, industry or academia who are temporarily on a leave from their permanent position – Fuchs 2009: 67) with budgetary autonomy to steer the direction of the funded R&D projects (indeed, it has worked as a project-based organization with some missions, or technological priorities); 2) These program managers are assessed internally through *personal feedback and peer pressure* as opposed to formal performance management and incentive systems. The Office Directors and the Director of DARPA approve the programs while following The *Heilmeier Catechism*, review the progress and make sure that the programs are scrutinized (Jordan and Koinis 2013). This system seems to also allow for failures and closure or changes of non-working projects and initiatives; *3)* Internally, it has used rather *streamlined organizational and managerial processes* as project approvals that rely on in-house expertise as opposed to peer-review.

2014) However, military procurement has often had close linkages to civilian inventors (e.g., Eli Whitney); another important strand of procurement is public works. In general procuring innovative products emerges in strongly hierarchical administrative (military) configurations. This is, however, quite different to regulatory and standardization efforts where the evidence is much more mixed. For instance, while railroads where initially developed by private initiatives, later standardization was led by *Verein Deutscher Eisenbahnverwaltungen* in Germany that became dominant force for technical standards in Europe's railway system – but it was initially also a private association (Kaiser and Schot 2014). Similarly, in many emerging industries in the US in the middle of 19th century, private networks were creating and maintaining standards, with armory industry being the key exception. (Thomson 2009)

Evolution of organizations: Post-WWII era up to 1980s is the golden age of procurement of innovations with various US agencies leading the way and being spectacularly successful. To lesser degrees, similar success stories can be observed also in Europe and in emerging Asian Tigers as well. (See Lember et al. 2014 counrty studies) Since 1980s and later with the emergence of WTO's regulations procurement agencies focus increasingly on efficiency and creating level playing fields (Kattel and Lember 2010). This tendency has started to change since 2000s. One of the key obstacles in wider use of procurement of innovations are the organizational routines of many procurement agencies that are oriented efficiency of markets. (Lember et al 2015) Regulatory agencies (such as FDA in US), but also large public service providers (in health, environment, energy grids, infrastructure) have become also important in generating demand for new products and services via regulatory efforts; here configuration are rarely oriented towards innovations directly, but it is often a secondary policy goal.

Diffusion of new skills, technology

Emergence of organizations: Private sector business interest associations and cartels have origins in medieval guilds and later in town management of markets (limiting competition). (Schmoller 1900, 313-315) However, perhaps the most prominent case of publicly supported private cartels is the late 19th and early 20th century German industrialization efforts, later emulated in UK and many other countries.[27] Typically organizational configurations are very loose in the sense that public sector's role is that of coordinating various public policy fields and organizations (from competition and intellectual property to forging linkages with research institutions and applied education institutions).

Evolution of organizations: While private cartels have become effectively outlawed in modern economies, in post-WWII era management of competition was a crucial function of developmental agencies in East Asia. Anti-trust agencies of today deal mostly with investigating price collusion and fixing, rarely dipping into innovation arena (with some notable exception, e.g. the EU vs Microsoft court case). Today's equivalents of cartels are variety of cluster organizations, technology parks, business incubators and accelerators, etc. In all of these organizations, their configurations

---

[27] For instance, see Murmann (2003) on chemical industry in German and UK. See also Fear (2008) on the importance of cartels in early 20th century, and Lanzalaco (2008) on business interest associations and the role of governments in supporting such organizations.

public leadership and organizational resources are secondary and private funding, initiative and management practices dominate, although with highly varying degrees of success.

Summary

From these very brief descriptions of what kind of organizations have fulfilled various innovation policy functions, we can draw following preliminary discussion points:

> - Both innovation policy functions (policy goals) and organizations fulfilling them change considerably over time; next to new technologies and related changes in economic structures that necessitate changes in policies and organizations, policy and management fashions and ideologies have strong influence both on organizations and functions.
> - There is strong evidence that multiple organizational configurations co-exist in innovation systems, and that indeed such diversity itself might be part of the success. This is perhaps even more visible if one analyses snapshots of organizational variety in different innovation systems: i.e. DARPA in the US works closely with the Department of Defense (that signals the general demand and is the main lead-user of DARPA-supported technologies), universities and other research institutes, private firms and others; in the energy sector ARPA-E that has been modeled based on DARPA has a somewhat different organizational set-up and system of actors to work with, (i.e. diverse private users and producers are much more important for the success of its innovation efforts) (see Bonvillian and van Atta 2011).
> - Complexity of innovation bureaucracy is increasing over time as new functions are added and organizations change, or new forms of organizations emerge, and not only with positive track record; old ones with positive track record (at least partially) in turn vanish (e.g. cartels for industrial competition management).
> - Policy failures can be often connected with misguided choices for organizational configurations either for the reasons emerging from wider socio-economic context (e.g., many technology parks have little to do with innovations and technology often because there are not that many technology intensive firms around) or with sector specific challenges (many applied research agencies rely on industry-university cooperation funding schemes, yet without significant industry demand being codified into agencies routines, such schemes are bound to be relatively ineffectual).
> - There seems to be relatively strong relationship between what functions (policy goals) an organization is tasked with and what kind of configuration it has and what kinds of feedback mechanisms influence this organization. That is, policy function (e.g., long term financing of technological change) drives feedback linkages (e.g., how financial regulations and nature of investments by private banks are taken into account) and this in turn influences initial organizational choices (e.g., creating public development bank using regulatory framework for private banks vs ministerial department).
> - At the outset, policy functions are often created by private demand for them, that is innovation bureaucracy organizations seem to emerge because there are dynamic technological developments within private sector. Thus, these organizations are furthering what can be called Schumpeterian rents from

innovations (e.g., creating a central bank as lender of last resort and enabling private banks to invest into long term projects, that is diversify their investments and at same time create for industrial companies option to raise capital for long term investments).[28]

  ➢ However, in time, most innovation policy functions become socialized in one form or other (public sector role becomes more dominant than private initiative) and organizations fulfilling them more bureaucratic (in the sense of feedback linkages from politico-administrative system become dominant over other feedbacks: mainly because what we call instrumental performance is easier to trace, legitimize and measure than substantive policy impact; and because politico-administrative feedback tends to be more horizontal/universal compared to diverse business needs and experience that differ between sectors, markets, regions etc). This tendency can be, in turn, followed by push back of public initiative (such as privatizing organizations and/or functions). As new functions emerge, this leads to either creation of new organizations (e.g., current trend to create innovation labs in public organizations) or to reform attempts of the existing ones (e.g., merging organizations).

  ➢ It is clear that further research is needed to understand better specific trajectories and how especially levels of economic development, technology/sectoral trajectories and techno-economic paradigms have influenced the evolution of organizational variety.[29]

  ➢ One of the issues not discussed above but that is important in the development context is the influence of foreign and international funders on domestic innovation bureaucracies.[30]

III Innovation bureaucracy: analyzing organizational variety

---

[28] Of course, one can also think of plenty of 'critical' reactions to private and technological progress where politically powerful private interests in fact demand policy actions to limit/control these procsses (i.e. use of ICT by Uber to restructure taxi-business has in some countries led to deregulation of the taxi industry and in other to stricter regulation of technology industry). Yet, from an historical perspective these conflicts lead to mutual adjustments and some compromises will persist as policies and organizational configurations.

[29] Techno-economic paradigm theory developed by Perez assumes that paradigms have a strong influence on public sector organizational variety as they have on private sector (Perez 2002).

[30] For instance, during the early post-WWII period, Taiwan created numerous *US aid based economic planning agencies:* Industrial Development Council (IDC, 1953–58), Economic Development Board (EDB, 1953–58), Council for US Aid (CUSA, 1959–63) and Council for International Economic Co-operation and Development (CIECD, 1963–73). These provided policy input for regular ministries of finance and industry and it matters a lot in policy and organizational design how such organizations understand the local context or are subject to donor pressures and organizational blueprints. Cheng et al. (1998) show that these agencies were constructed outside the normal bureaucracy to have flexible coordinating roles and allow for less strict bureaucratic rules (higher salaries, flexible recruitment etc). An early evaluation by Jacoby (1966) argued that these agencies were in fact rather 'local' and while they took-up many policy ideas proposed by the US experts, the organization of these policies/functions tended to remain more local and customized than the US would have preferred. Wu (2004) claims that their short life span (as they were mostly abolished by political choices of the ruling elite) is indicative of their dependence on the policy and person-based relations with the ruling elite; and the elite had much closer personal ties and trust in the financial as opposed to economic planning bureaucracy. Similary, in Eastern Europe, European Union has played major role in creating and funding innovation agencies with mixed success mostly because both functions/tasks and organizational designs were exported to the local context without much adaptations, see for a discussion Suurna and Kattel (2010), Karo and Kattel (2014).

16

Perhaps one of the key observations from history of innovation bureaucracies is the oscillation between new fluid (often with substantial input and leadership from private sector) and rational expert organizations; that is Schumpeterian vs Weberian organizations as we described in the introduction. We can make this juxtaposition more theoretical using Weber's own work. In fact, calling small fluid agencies Schumpeterian is evocative but hardly justifiable through Schumpeter's own work. While Schumpeter argued that "new men" can bring forth innovations in all walks of life (from ecomomy to arts), he did not discuss organizational underpinnings in detail. (Schumpeter 1912, 142-157) However, Weber's taxonomy of domination or power (traditional, charismatic, rational) and corresponding organizational forms offers a way describe what Schumpeter attempted to show in a analytical way. That is, Weber offers *theoretical* reasons why different types of innovation bureaucracies can deliver different policy goals and how. In essence we can argue that in the history of innovation bureaucracy we can detect two ideal-typical Weberian organizations:

➢ *First*, historically most forms of innovation bureaucracy start as one type of Weberian organizations – what we can call Weber I: charismatic, dynamic organizations[31] innovating often in emerging policy areas proposing new policies and regulations, standards, or cooperation forms, and reside often outside of typical government operations (but can have high level political support or enjoy societal prestige), and

➢ *Second*, with time move (or rather 'grow') in to another type of Weberian organization – what we can call Weber II: professional, centrally governed organizations that are stable and predictable, manned with high level experts and are strong in delivering innovations in private sector during rather stable conditions of technological maturity, or conversely during catching-up or mission dominated periods (i.e. the instrumental performance of these organizations is related to long time horizons, predictability and cost-efficiency that allows for patient regulation and public investment in long-term and complex activities necessary for industrial development and catching-up; see more in Evans and Rauch 1999), and

➢ *Third*, with new functions and/or ideologies emerging, can be pushed towards more charismatic form again (often under the pretense of market-friendly ideology while the instrumental performance of these organizations focuses on change, breaking existing routines that have become obsolete – e.g. the market has found efficiencies in these processes and taken them over – or inhibit private experimentation with new productions, service, or marketing or other methods).[32]

We can see in Weber I and Weber II organizational archetypes of innovation bureaucracy from which formation of hybrid forms is possible. While the Weberian dichotomy – and inherent conflicts and dynamics it captures – seems to fit well with historical developments, diversity and fluidity of changes of innovation bureaucracy seems to be governed by a wider set of organizational variety than simply Weber I

---

[31] This form is succinctly summarized by Samier: "A charismatic organization is consistent with its own principles, that is a new organization with its own language, mores, myths, and roles derived from the personality and belief system of the charismatic founder, affecting staffing, working patterns, social behavior, and the material environment." (2005, 71)

[32] Weber argued that new organizational forms (or change from one form to another) emerge through conflicts between old and new leaders and staff (Weber 2009, 154-155).

and Weber II. While this dichotomy seems to gives us an easy way to differentiate between organizations dealing with innovations in policy and with innovations through policy impact, it seems too linear to assume that organizations – or even policy arenas, let alone countries – move from Weber I to II and back.[33] Indeed, as we aim to show, there is a more complex organizational variety of hybrids beneath Weberian dichotomy. We use Mintzberg to unlock this diversity.[34]

Mintzberg (1989) differentiates between five key organizational configurations or forms – entrepreneurial, machine bureaucracy, diversified, professional, innovative organizations – that can co-exist and exhibit – depending on the contextual factors – either cooperation (ideology and missions) or competition (politics) tendencies. According to Mintzberg (1989), different organizational configurations embody different routines and capacities (i.e. forces towards specific behaviors), i.e.: "*The entrepreneurial organization can certainly innovate, but in relatively simple ways. The machine and professional organizations are performance, not problem-solving types, designed to perfect standardized programs, not to invent new ones. And although the diversified organization resolves some problems of strategic inflexibility found in machine organizations, as noted earlier it too is not a true innovator.*" (Mintzberg 1989, 198)

Similarly to Weber's theoretical argument, Mintzberg (1989) looks at these configurations also from the perspective of an evolutionary life cycle (i.e. organizations emerge in the entrepreneurial configuration and grow to other forms until potentially declining through political forces) where organizations can make good or bad internal choices on configurations, but are mostly affected by the external competitive environment. Based on the historical overview of innovation policy organization and their evolution, we can argue that organizational variety – as a proxy for the variety of routines and capacities – may be a necessary condition for maintaining the potential for policy innovations and efficiency (as instrumental performance criteria) and innovation policy impact (as substantive performance).

We can build (Table 2) a more elaborate analytical taxonomy that combines two aspects of the organizational variety: organizational configurations and their specific routines and capacities. Mintzberg provides key characteristics – in terms of routines and capacities – of these configurations, but he has elaborated them mostly from the perspective of private sector organizations. Yet, he also recognizes that almost all organizational configurations may be also present in the public sector: most commonly machine bureaucratic, diversified and professional configurations. While in the private sector context, these would mostly be competing organizations, in the public sector we often expect these organizations to coordinate and cooperate between themselves and contribute to common public policy goals (which does not mean that there are no competitions or conflicts, as we argued above). As machine

---

[33] There are two stylized logics here that we can also find in innovation policy thinking. First, catching-up stages and more mature stages of technological life cycles require managing visible risks and implementing efficiently established and known policy solutions that can be done through more established and institutionalized (bureaucratic) routines and capacities (stability, patient capital, long-term orientation). Second, progress at the techno-economic frontier is about dealing with uncertainty and coming up with policy innovations that require more flexible and adaptable forms of organizations and governance.

[34] Lam 2006 uses Mintzberg to discuss private sector organizatinonal innovations.

bureaucracies or diversified configurations (the most common configurations in the public sector), public sector organizations may attempt (at least temporarily) to maintain different configurations and routines even in single organizations; or create separate organizations to carry out specific tasks, such as innovation (or some professional roles).

Thus, for analyzing public sector organizations and organizational variety, we have extended Mintzberg's framework by adding (in Table 2) specific organizational routines that are considered as the most important in the functioning of public sector organizations (see Pollitt and Bouckaert 2011).

Table 2. Taxonomy of organizational variety and capacities

	Entrepreneurial	Machine	Diversified	Professional	Innovative
Organizational routines	Simple; informal; flexible; little staff or middle-level hierarchy	Centralized bureaucracy; formalized; specialized work, division of labor	'Divisions' loosely coupled together under headquarter	Bureaucratic, decentralized; pigeonholes' for professional autonomy	Fluid, organic, selectively decentralized 'adhocracy' (multidisciplinary task forces)
Strategic management routines	Visionary, flexible, leadership based	Planning that is strategic programming	'Corporate' portfolio strategy and divisions with individual strategies	Stable and also many fragmented strategies by professional judgment and collective choice	Largely emergent, evolving through a variety of bottom-up processes
Personnel management routines	Limited personnel, no systemic routines, needs based development	Standardized work and skills and recruitment processes	Divided between headquarter and autonomous divisions	Dependent on training to standardize the skills of its professionals	Variety and mix of skills, openness to learning and experimentation
Financial management routines	Flexible; emergent	Efficiency and process oriented	Autonomous divisions, output oriented	Mixed; based on professional autonomy	Flexible, not efficiency oriented
Coordination routines	Direct supervision	Standardization of work processes	Standardization of outputs	Standardization of kills	Mutual adjustment
Location in the policy system	Peripheral or within machine and/or diversified organizations	Central policy implementation units with public accountability	Central/core policy units (whole policy fields)	Specialized service providers (between core and periphery)	Peripheral or in new domains, or as parts of machine/diversified organizations
Capacities	Simple/initial developments and changes	Efficiency, transparency, Accountability	Concentration of different focuses	Professional proficiency	Learning and complex innovations
Trade-offs	Responsive, with mission VS vulnerable, restrictive, unstable	Efficient, reliable VS obsession with control, no initiative, autonomy	Autonomy, diversity VS costly, reluctance to innovate, requires measurable goals	Democracy, autonomy VS professional discretion, reluctance to innovate (unless collective action)	Innovative, effective VS inefficient (communication, coordination)

Source: Our elaborations based on Mintzberg (1989).

In terms of politico-administrative feedbacks, innovative (and to lesser extent entrepreneurial) configurations – being most flexible and ad hoc – can be linked or integrated (temporarily and before they become assimilated) into different organizational configurations (as separate units, contractual partners, foundations etc). Thus, these type of organizations can be also treated as the key change or design instruments (as is visible in the current iLabs popularity). Further, machine bureaucracies where policy and implementation are often separated can be (temporarily) made more dynamic by shifting roles, i.e. policy formulators implement and implementers formulate policies (Mintzberg 1989). The same way innovative configurations can be made to work on behalf of other organizations, or policy domains i.e., operating adhocracies (or operating innovative configurations) concentrate on 'contract' project work while administrative adhocracies (or administrative innovative configurations) work for own internal projects/goals.

We can summarize our discussion above in Table 3 that depicts organizational variety (and corresponding variety of capacities) according to Weber and Mintzberg.

Table 3. Synthesis of Weber and Mintzberg

	Weber I	**Weber II**
Key Weberian features	Charismatic leadership	Expert knowledge
Key organizational configurations of Mintzberg	- innovative organizations - entrepreneurial organization	- machine organizations - professional organizations - diversified organizations
Key organizational Capacities	Experimentation, fast learning, ability to quickly change, innovation	Different forms of expertize (from efficiency management to professional details), stability, predictability

Source: Authors.

Weberian types I and II characterize extremes that flank various types of organizations (innovative and entrepreneurial organizations verging towards Weberian charismatic organizations; and machine and diversified organizations towards professional organizations). All of these organizations exist within politico-administrative and business-administrative interactions that in turn determine what kinds of capacities and routines exist within these organizations.[35]

IV Discussion: innovation bureaucracy and entrepreneurial state

In her recent paper, Mazzucato argues that one of the crucial questions for the innovation research is to understand "how should public organisations be structured

---

[35] Take for instance the US case: one can argue that the key public institutions of the US innovation system have been in fact defense-oriented *core federal departments* (from defense to health and energy, i.e. DoD, NIH, DoE) and the *networks of agencies* (NASA, CIA, Office of Naval Research, DARPA, NSF) and *federal laboratories* created for implementing policy through the hybrid networks between public and private actors (to steer private R&D, negotiate support and leverage resources for state-directed defense-oriented projects). See Block and Keller 2011, Weiss 2014.

so they accommodate the risk-taking and explorative capacity, and the capabilities needed to envision and manage contemporary challenges?" (2014, 8) Further, "key concern should be to establish which skills/resources, capabilities and structures are useful to increase the chances that organizations will be effective both in learning and establishing symbiotic partnership with the private sector – and ultimately succeed in implementing mission-oriented and transformative policies." (Mazzucato 2014, 17)

In this paper we have argued that the current debates on how to organize government actions to support innovation have over-concentrated on single-organization research (different 'agencies' and iLabs) and single-variable explanations (Weberian nodal agencies vs peripheral Schumpeterian agencies). We argue that instead of single-form explanations for how to organize government actions to support innovation, we might gain greater understanding of these questions by focusing on organizational variety in the context of public policy-making and implementation. Indeed, understanding public organizations in their respective politico-administrative and business-administrative feedback context, and what kinds of routines emerge from these, should be the first task towards more entrepreneurial state. We can even argue that lack of entrepreneurial activity (as discussed by Mazzucato) is itself a result of existing routines: public organizations operate in politico-administrative context where risk taking, long-term thinking, etc, are not simply frowned upon, but other routines have become to dominate over these routines and switching to new ones comes at a considerable cost (both politically and administratively). History tells us that under such circumstances new functions/policy goals and new organizational forms emerge to deal with pressing challenges. It depends greatly on whether challenges are brought forward by private actors or by political leadership as this plays an important role in what kind of organizational configurations will be chosen to deal with new challenges or in rejuvenating existing organizations. Our research shows that organizational variety is perhaps important in itself, as it allows for some functions of innovation policy to be fulfilled in relative stability (e.g., basic research funding under peer-review) but in other areas more experimental solutions could be sought (e.g., active industry participation in applied research evaluations).

Thus, one of the lessons from our research is that entrepreneurial state requires diversity of public sector organizations dealing with innovations and technological change. Second lesson is that there is a crucial difference between initiating new policy goals vs changing existing policy goals and organizations, that is, the crucial difference between policy innovations and policies supporting innovations. Third lesson is that in innovation policy arena there are multiple public organizations and these organizations compete for funding and political support, thus conflicts between policy goals and organizations are bound to be numerous. Accordingly, one of the key issues is how to coordinate the activities and capacities of various public organizations. This would typically call for political leadership to proactively address coordination issues.

As for further research, if governments want to be effective in supporting innovation policy, as scholars we should not only recommend better policy mixes, but also pay attention to the organizational mixes. Further, there is a need for systemic research what role technology and techno-economic paradigms play in evolution of innovation bureaucracies, what are country-specific and the sectoral differences; and how does globalization of innovation and production networks, and of policies and of policy

elites under WTO and multilateral agreements, influence evolution of innovation policy capacities. It would also be important to understand whether non-Western contexts (with viable alternatives to Western modernization paradigm and with different cultural-religious contexts) play a role in how innovation bureaucracies evolve.

References

Amable, B. (2003). *The diversity of modern capitalism* (Oxford: Oxford University Press).

Amsden, A. (1989). *Asia's Next Giant: South Korea and Late Industrialization* (Oxford: Oxford University Press).

Basedow, A. (2013). 'Technology Transfer.' Fraunhofer Center for Central and Eastern Europe, May 9th, Prague/ CZ, 1-36.

Block, F. (2008). 'Swimming against the current: The rise of a hidden developmental state in the United States', *Politics & Society*, 36(2), pp. 169-206.

Block, F. and Keller, M.R. (eds.) (2011). *State of Innovation: The U.S. Government's Role in Technology Development* (Paradigm, Boulder & London).

Bonvillian, W. B. and Van Atta, R. (2011). 'ARPA-E and DARPA: Applying the DARPA model to energy innovation', *The Journal of Technology Transfer*, *36*(5), pp.469-513.

Breznitz, D. (2007). *Innovation and the State: Political Choices and Strategies for Growth in Israel, Taiwan and Ireland* (New Haven: Yale University Press).

Breznitz, D. and Ornston, D. (2013). 'The Revolutionary Power of Peripheral Agencies: Explaining Radical Policy Innovation in Finland and Israel', *Comparative Political Studies*, 46(10), pp. 1219-1245.

Boden, R., P. Gummett, D. Cox, K. Barker (1998). 'Men in white coats … men in grey suits', *Accounting, Auditing & Accountability Journal*, 11(3). pp. 267-291.

Bowen, H. V. (2006). *The Business of Empire: The East India Company and Imperial Britain, 1756-1833*, Cambridge: Cambridge University Press.

Brocke, B vom. (1996). 'Die Kaiser-Wilhelm-/Max-Planck-Gesellschaft und ihre Institute zwischen Universität und Akademie. Strukturprobleme und Historiographie', in B. vom Brocke and H. Laitko (eds.), *Die Kaiser-Wilhelm-/Max-PIanck-Gesellschaft und ihre Institute. Studien zu ihrer Geschichte*, Berlin: de Gruyter, pp. 1-34.

Brocke, B vom., ed. (1991). *Wissenschaftsgeschichte und Wissenschaftspolitik im Industriezeitalter. Das "System Althoff" in historischer Perspektive*. Hildesheim: Lax Verlag.

Cameron, R. (1953). 'The Crédit Mobilier and the Economic Development of Europe', *Journal of Political Economy*, 61 (6), pp. 461-488.

Cameron, R. (1967). *Banking in the Early Stages of Industrialization*, Oxford: Oxford University Press.

Cameron, R. (1961). *France and the Economic Development of Europe, 1800-1914: Conquests of Peace and Seeds of War*, London: Routledge.

Carlos, A. and S. Nicholas (1988). '"Giants of Capitalism": The chartered trading companies as modern multinationals', *The Business History Review*, 62(3), pp. 398-419.

Chandler, A. (1977). *The Visible Hand. The Managerial Revolution in American Business*, Cambridge, MA and London: The Belknap Press of Harvard University Press.

Cheng, T.J., Haggard, S. and Kang, D. (1998), 'Institutions and Growth in Korea and Taiwan: The Bureaucracy', *Journal of Development Studies*, 34, pp. 87-111.

Cooke, J. E. (1975) 'Tench Coxe, Alexander Hamilton, and the Encouragement of American Manufactures', *The William and Mary Quarterly*, 32(3), pp. 369-392.

DARPA (2013), Driving Technological Surprise: DARPA's Mission in a Changing World.

Drechsler, W. (2005). 'The rise and demise of the new public management', *post-autistic economics review* 33, 17-28.

Drechsler, W. (2015). 'Paradigms of Non-Western PA and Governance', in A. Massey and K. J. Miller (eds.), *The International Handbook of Public Administration and Governance* (Cheltenham: Edward Elgar Publishing), pp. 104-132.

Edquist, C. (2011). 'Design of innovation policy through diagnostic analysis: identification of systemic problems (or failures)', *Industrial and Corporate Change* 20 (6): pp. 1725-1753.

Edquist, C. and Hommen, L. (eds.). (2009). *Small country innovation systems: globalization, change and policy in Asia and Europe* (Cheltenham: Edward Elgar Publishing)

European Commission (2013). *Lessons from a Decade of Innovation Policy. What can be learnt from the INNO Policy TrendChart and The Innovation Union Scoreboard*, Brussels: European Commission.

Evans, P. (1995), *Embedded Autonomy: States and Industrial Transformation* (Princeton: Princeton University Press).

Evans, P. (1998), 'Transferable lessons? Re- examining the institutional prerequisites of East Asian economic policies', *The Journal of Development Studies*, 34(6), pp. 66-86.

Evans, P. and Rauch, J. E. (1999), 'Bureaucracy and growth: a cross-national analysis of the effects of 'Weberian' state structures on economic growth', *American Sociological Review*, pp. 748-765.

Fear, J. (2008). 'Cartels', in G. Jones and J. Zeitlin (eds.), *The Oxford Handbook of Business History*, Oxford: Oxford University Press, pp. 268-292.

Gerschenkron, A. (1962). *Economic Backwardness in Historical Perspective*. Belknam Press.

Gummitt, P. (1980). *Scientists in Whitehall*, Manchester: Manchester University Press.

Fuchs, E.R.H. (2009), 'Cloning DARPA Successfully', *Issues in Science and Technology,* pp. 65-70.

Haggard, S. (1990), *Pathways from the Periphery: The Politics of Growth in the Newly Industrializing Countries* (Ithaca, NY and London: Cornell University Press).

Hodgson, G.M. (2009). 'The concept of a routine', in Becker, M.C. (ed) *Handbook of Organizational Routones* (Cheltenham: Edwards Elgar), pp. 15-38.

Hollingsworth, J. R. and Boyer, R. (eds.) (1997). *Contemporary capitalism: The embeddedness of institutions* (Cambridge: Cambridge University Press).

Hoskin, K. W. and R. H. Macve (1988). 'The genesis of accountability: The west point connections', *Accounting, Organizations and Society*, 13(1), pp. 37–73.

Hoskin, K. W. and R. H. Macve (1994). 'Reappraising the Genesis of Managerialism', *Accounting, Auditing & Accountability Journal*, 7(2), pp. 4-29.

Jacoby, N. H. (1966). *US aid to Taiwan; a study of foreign aid, self-help, and development* (New York: Frederick A. Praeger)

Jayasuriya, K. (2005). 'Capacity Beyond the Boundary: New Regulatory State, Fragmentation and Relational Capacity', in M. Painter and J. Pierre, eds, *Challenges to State Policy Capacity: Global Trends and Comparative Perspectives*, pp. pp. 19-37 (Basingstoke: Palgrave Macmillan).

Johnson, C. (1982), *MITI and the Japanese Miracle: The Growth of Industrial Policy* (Stanford: Stanford University Press).

Jordan, L. K. and Koinis, K. (2013). 'Flexible Delivery: Organizations that Can Fail and Still Succeed', *Competitive Industries Note*, 3, pp. 1-4.

Kaiser, W and Schot, J. (2014), *Writing the Rules for Europe. Experts, Cartels, and International Organizations*, Basingstoke: Macmillan.

Kang, D.C. (2002), 'Bad Loans to Good Friends: Money Politics and the Developmental State in South Korea', *International Organization,* 56(1), pp. 177-207.

Karo, E. (2011). 'The evolution of innovation policy governance systems and policy capacities in the Baltic States', Journal of Baltic Studies, 42(4), pp. 511-536.

Karo, E., and Kattel, R. (2014). 'Public Management, Policy Capacity, Innovation and Development', *Brazilian Journal of Political Economy*, 34(1), pp. 80-102.

Kattel, R.; Cepilovs, A.; Drechsler, W.; Kalvet, T.; Lember, V.; Tõnurist, P. (2014). 'Can we measure public sector innovation? A literature review'. LIPSE Working papers, 2, 1-45.

Kattel, R., and V. Lember. 2010. "Public Procurement as an Industrial Policy Tool: An Option for Developing Countries?" Journal of Public Procurement 10 (3): 368–404.

Keller, M. R., & Block, F. (2012). Explaining the transformation in the US innovation system: the impact of a small government program. *Socio-Economic Review* 11(4): pp. 629-656.

Kregel, J. (1997). *The Past and Future of Banks*, Roma: Ente Einaudi.

Lam, A. (2006). 'Organizational innovations', in J. Fagerbert, D. Mowery and R. Nelson, *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, pp. 115-147.

Lanzalaco, L. (2008). 'Business interests associations', in G. Jones and J. Zeitlin (eds.), *The Oxford Handbook of Business History*, Oxford: Oxford University Press, pp. 293-315.

Lember, V., R. Kattel, and T. Kalvet (eds.) (2014). *Public Procurement, Innovation and Policy: International Perspectives*. Heidelberg: Springer.

Lember, V., R. Kattel and T. Kalvet (2015). 'Quo vadis public procurement of innovation?, *Innovation: The European Journal of Social Science Research*, DOI:10.1080/13511610.2015.1043245.

Li, K.-T- (1995). *Evolution of Policy Behind Taiwan's Development Success* (World Scientific).

Lundgreen, P. (1990). 'Engineering education in Europe and the U.S.A., 1750–1930: The rise to dominance of school culture and the engineering professions', Annals of Science, 47(1), pp. 33-75.

Lundvall, B.-A. (2013). 'Innovation Studies: A personal interpretation of "the state of the art"', in J. Fagerberg, B. R. Martin and E. S. Andersen (eds.), Innovation Studies. Evolution and Future Challenges, Cheltenham: Elgar, pp. 21-70.

Manchester Institute of Innovation Research (2012). Compendium of Evidence on the Effectiveness of Innovation Policy Intervention. London: Nesta.

Mazzucato, M. (2014), 'A mission-oriented approach to building the entrepreneurial state', A 'think piece' for the Innovative UK: http://marianamazzucato.com/wp-content/uploads/2014/11/MAZZUCATO-INNOVATE-UK.pdf

Mazzucato, M. (2013), The Entrepreneurial State: Debunking Public vs. Private Sector Myths (Anthem Press).

Mazzucato, M. and C. Penna (2015). "Beyond Market Failures: The Market Creating and Shaping Roles of State Investment Banks". Levy Institute of Bard College Working Paper no 831.

McKeown, T.J. (2008). 'Organizational routines in political science', in in Becker, M.C. (ed) Handbook of Organizational Routones (Cheltenham: Edwards Elgar), pp. 31-51.

Mintzberg, H. (1989). Mintzberg on Management: Inside our strange world of organizations (Simon and Schuster).

Murmann, P. 2003. Knowledge and Competitive Advantage. Cambridge: Cambridge University Press.

Nelson, Jr., J. (1979). 'Alexander Hamilton and American Manufacturing: A Reexamination', The Journal of American History, 65(4), pp. 971-995.

Nelson, R. R., and Winter, S.G. (1982), An evolutionary theory of economic change (Harvard University Press).

O'Riain, S. (2004), The Politics of High Tech Growth: Developmental Network States in the global Economy (Cambridge University Press, Cambridge).

Ornston, D. (2012), When small states make big leaps: Institutional innovation and high-tech competition in Western Europe (Cornell University Press).

Perez, C. (2002), Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages (Cheltenham, UK: Edward Elgar).

Pierson, P. (2004). Politics in Time. History, Institutions, and Social Analysis, Princeton and Oxford: Oxford University Press.

Pollitt, C., & Bouckaert, G. (2011), Public Management Reform: A comparative analysis-new public management, governance, and the Neo-Weberian state (Oxford University Press).

Puttick, R., Baeck P. and Colligan P. (2014) The teams and funds making innovation happen in governments around the world (Nesta): http://theiteams.org/system/files_force/i-teams_June%202014.pdf.

Rauch, J. E. and Evans, P. B. (2000), 'Bureaucratic structure and bureaucratic performance in less developed countries', Journal of public economics, 75(1), pp. 49-71.

Riesser, J. (1911), The German Great Banks and Their Concentration in connection with the Economic Development of Germany, Washington: Government printing office.

Rothstein, B. (2014), 'The Chinese Paradox of High Growth and Low Quality of Government: The Cadre Organization Meets Max Weber', Governance, doi: 10.1111/gove.12128.

Samier, E. (2005), 'Toward a Weberian Public Administration: The infinite web of history, values, and authority in administrative mentalities', Halduskultuur, 6, 60-94.

Sampat, B. N. (2012). 'Mission-oriented biomedical research at the NIH', Research Policy, 41(10), pp. 1729-1741

Schmoller, G. von (1900) Grundriß der Allgemeinen Volkswirtschaftslehre, Teil 1, Leipzig: Duncker&Humblot.

Schumpeter, J. A. (1912), Theorie der wirtschaftlichen Entwicklung, Berlin: Duncker&Humblot.

Sraffa, P. 1930. Lecture notes on Continental Banking. Trinity College. Unpublished.

Suurna, M. and Kattel, R. (2010), 'Europeanization of innovation policy in Central and Eastern Europe', Science and Public Policy 37(9), pp. 646-664.

Thomson, R. (2009). Structures of Change in the Mechanical Age. Technological Innovation in the United States, 1790–1865, Baltimore: The Johns Hopkins University Press.

Tõnurist, P., Kattel, R., & Lember, V. (2015), 'Discovering Innovation Labs in the Public Sector', Working Papers in Technology Governance and Economic Dynamics, 61: http://technologygovernance.eu/files/main//2015062509192727.pdf.

Tõnurist, P. and E. Karo (2016). 'State owned enterprises as instruments of innovation policy.' Annals of Public and Cooperative Economics, forthcoming.

Van de Walle, S. (2008). 'Comparing the performance of national public sectors: conceptual problems', *International Journal of Productivity and Performance Management*, 57(4), pp. 329-338.

Wade, R. (1990), *Governing the Market: Economic Theory and the Role of Government in East Asian Industrialization* (Princeton: Princeton University Press).

Weber, M. (1922/2009) Economy and Society. (edited by Gross, G. and Wittich, C.) (University of California Press)

Weber, K. M., & Rohracher, H. (2012), 'Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive 'failures' framework', *Research Policy*, *41*(6), pp. 1037-1047.

Weiss, L. (2014), *America Inc.?: Innovation and Enterprise in the National Security State* (Cornell University Press).

Wilson, M .(2006) The Business of Civil War. Military Mobilization and the State, 1861–1865, Baltimore: The Johns Hopkins University Press.

Wu, Y. (2004), 'Rethinking the Taiwanese developmental state', *The China Quarterly*, *177*, pp. 91-114.

Wynen, J., K. Verhoest, E. Ongaro, S. van Thiel (2014). 'Innovation-Oriented Culture in the Public Sector: Do managerial autonomy and result control lead to innovation?', *Public Management Review*, 16(1), pp. 45-66.

Yasuda, A. (1993). *The Performance And Roles of Japanese Development Banks*, Graduate Thesis, Department of Economics, Stanford University.