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Dan Breznitz¹ and Darius Ornston²

Abstract

This article challenges the long-standing emphasis in the developmental state literature on the powerful pilot agency as an essential component of industrialization. Although a pilot agency may be able to facilitate growth in mature industries, we argue that policy makers seeking to promote rapid innovation-based competition must instead rely on continuous, radical policy innovation. We argue that this kind of experimentation is more likely to occur at the periphery of the public sector, in agencies with few hard resources and limited political prestige. In addition to providing a novel interpretation of how states enter new, high-technology markets, we explain why some successful countries become less innovative over time. As agencies successfully introduce radical policy innovations, their higher profile exposes them to greater political interference and reduces their entrepreneurial capacity. The argument is supported by within-case analysis of two historically low-technology economies that successfully promoted rapid innovation-based growth, Finland and Israel.

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policy innovation, industrialization, comparative political economy of development, developmental state, innovation policy, Finland, Israel

The state features prominently in literature on economic development. The “developmental” state literature asserts that late developers require an autonomous, powerful, and centralized bureaucracy to industrialize (Chibber, 2002; Doner, Ritchie, & Slater, 2005; Johnson, 1982; Wade, 1990). Recent work on the “neo-developmental” state asserts that such agencies are more effective when embedded in multiple domestic or international networks (Ansell, 2000; Block, 2008; Evans, 1995; O’Riain, 2004). Both literatures situate developmental agencies at the center of the public sector and the economy more generally. Although such agencies may facilitate competition in mature industries with clear technological trajectories, we argue that policy makers seeking to facilitate rapid innovation-based (RIB) competition must instead rely on a very different kind of organization.

We begin with the observation that the promotion of RIB growth requires a “Schumpeterian developmental agency” (SDA) committed to a process of continuous policy experimentation (Kuznetsov, 2009). In contrast to the literatures on the developmental and neo-developmental state, we argue that this type of radical innovation is more likely to occur at the *periphery* of the public sector, in low-profile agencies with relatively few hard resources and limited political prestige. These peripheral agencies are less vulnerable to political interference and more likely to adopt experimental policies that promote RIB growth. In identifying the circumstances under which agencies are more likely to engage in policy experimentation, we not only advance a novel explanation for how late developers can promote disruptive technological innovation, but also reveal why successful agencies become less entrepreneurial over time.

We develop the argument in five stages. The first section introduces the literature on the developmental and neo-developmental state. The second section defines the SDA and explains why radical policy innovation is more likely to occur at the periphery of the public sector. The third and fourth sections illustrate the argument by analyzing how two historically low-technology late developers, Finland and Israel, assumed leadership in new RIB industries. In these two very different cases, SDAs, the Finnish Fund for Research and Development (Sitra) and the Office of the Chief Scientist (OCS) in the Israeli Ministry of Trade and Industry, played a crucial role in stimulating coevolutionary change by precipitating policy experimentation and RIB growth.¹ Within-case analysis, based on 229 interviews conducted

between 2000 and 2012, reveals that these innovative agencies were located at the periphery of the public sector and became progressively less entrepreneurial over time as increasing success exposed them to greater political interference. We conclude by generalizing the argument to a broader universe of cases.

The Developmental State: Centralization, Capital Accumulation and Catch-Up

The state has long played a central role in governing the economy. This is particularly true in capital-scarce developing countries, where economists have argued that states can promote industrialization through import-substituting industrialization, subsidization, credit rationing, and public procurement. Political scientists, inspired by East Asian industrialization, have asserted that such policies are most effective when implemented by an autonomous, coherent, and centralized bureaucracy (Chibber, 2002; Johnson, 1982; Wade, 1990). The developmental state requires a powerful pilot agency, “outside and astride” traditional ministries to mobilize and allocate capital (Doner et al., 2005, p. 334; Weiss, 1998, p. 52). Such agencies are better positioned to resist special interests and coordinate across different sectors and industries (Chibber, 2002, p. 955; Johnson, 1982, pp. 315-320; Woo-Cumings, 1999, p. 13).

These traditional pilot agencies enabled several East Asian economies to catch up to their developed counterparts in established, capital-intensive, medium-technology industries such as steel, shipbuilding, and automotives (Amsden, 1989; Johnson, 1982; Wade, 1990). These hierarchical agencies were perceived as less effective in RIB industries, however, stifling the flow of information and inhibiting experimentation (Katz, 1998; Wong, 2011). As a result, a more recent literature on the “neo-developmental” state emphasizes a different pattern of state-industry relations, in which pilot agencies are embedded within multiple domestic and international networks (Ansell, 2000; Evans, 1995; O’Riain, 2004). This multiply-embedded structure enables policy makers to more effectively gather information and coordinate action across different actors and sectors, while simultaneously reducing their dependence on special interests. This network-oriented literature thus reinterprets East Asian catch-up and proposes to explain how countries can compete at the technological frontier, and in high-technology industries in particular (Block, 2008; O’Riain, 2004).

Although the literature on the neo-developmental state enhances our understanding of state–society relations, it presents an incomplete picture of how states promote RIB growth. Even with this new emphasis on networked

governance, many scholars focus on the same, powerful, pilot agencies that featured so prominently in earlier literature on the developmental state. Although such scholars reject a command-based structure in favor of horizontal networks, they situate powerful developmental agencies at the center of those networks (Ansell, 2000, p. 307; O’Riain, 2004, p. 148; Rodrik, 2007, p. 113).² For such scholars, the biggest threat to the neo-developmental state is that it may become too fragmented, inhibiting effective policy formulation (Negoita, 2011, p. 92; O’Riain, 2004, p. 37). In practice, we claim that the opposite is true. Although a core, powerful networked developmental agency may use information to more effectively implement traditional industrial policies, its central location can hinder policy experimentation and RIB growth.³

Schumpeterian Developmental Agencies, Policy Entrepreneurship, and Rapid Innovation-Based Competition

To understand why centrally positioned agencies may hinder innovation, it is important to recognize that RIB competition confronts policy makers (and firms) with fundamentally new challenges. At the technological frontier, and in RIB industries in particular, products and industries are intrinsically uncertain and continually evolving. Indeed, if novel technology is the objective, then long-term planning based on the idea that markets and products are already known is not applicable (Breznitz, 2007b, p. 15). Successful intervention requires policy makers to launch experimental policy measures to target nonexistent industries and activities. Experimentation is also continual in that policy makers must be prepared to cull the inevitable failures and abandon even successful policy measures to create space for new ones (Rodrik, 2007, pp. 114-117). In short, RIB promotion requires an SDA charged with continually identifying radically new policy proposals to destabilize and transform the public and private sectors (Kuznetsov, 2009).

We argue that this experimental process is less likely to occur in powerful pilot agencies at the core of the public sector. Radical innovation is instead more common along the periphery, in agencies with relatively few hard resources and, just as important, little prestige. This peripheral location facilitates policy innovation in three ways. First, agencies at the periphery of the public sector with relatively few concrete resources and little prestige are an unlikely target for political interference by established public- or private-sector interests. Because they control fewer resources and are deemed less important, these agencies are less vulnerable to lobbying by special interest

groups. The political profile of the peripheral agency thus enables policy makers to experiment with novel and risky initiatives targeted at new activities and industries.

Second, the fact that these peripheral agencies occupy a “second tier” status within the public-sector forces them to develop novel policies as established instruments are already “taken” by others. Deprived of the resources to allocate credit or grant aid, policy makers are incentivized to develop alternative programs, often turning to private-sector partners to develop new ideas and facilitate implementation. Peripheral agencies are thus more likely to cultivate that the kinds of networks that neo-developmental state theorists celebrate. To the extent that higher profile agencies can “poach” successful projects from their less privileged counterparts, peripheral developmental agencies are forced to develop new policy initiatives in a process of continuous experimentation.

Finally, agencies with limited resources are exposed to different ideas about how to promote restructuring. Low-profile agencies with few hard resources are less likely to attract the interest or support of powerful domestic interest groups. Such agencies are thus more likely to cultivate alliances with nontraditional domestic or international actors. Although such agencies, like all public organizations, are vulnerable to capture, their nontraditional alliances encourage them to promote growth in ways that are different to the ruling paradigm.

Consequently, it is peripheral rather than core pilot agencies that are more likely to become the institutionalized loci of experimentation, pioneering radically new science, technology, and innovation policies that, if successful, become more central when economic crises challenge established policy routines and industries. In identifying the specific circumstances under which agencies engage in radical policy innovation, we advance a novel explanation for why some countries successfully enter RIB industries.⁴ We also explain, in contrast to the developmental and neo-developmental state literature, why successful countries may become less innovative over time. As peripheral agencies succeed, their increasing political profile, resources, and centrality subject them to progressively greater political interference and reduces their flexibility.

In the next two sections, we analyze the histories of two very different countries with transformative SDAs, Finland and Israel, as a theoretical framework building and elaboration exercise. Both countries represent critical cases in that they occupied a marginal position in RIB industry. It is hard to imagine, as we look at Finland and Israel today, that they were among the least research-intensive and lowest-technology economies in the early

postwar period, spending less than 1% of GDP on research and development (R&D). By 2000, however, these economies had emerged as high-technology leaders and international role models in the realm of innovation policy (Breznitz, 2007b; Ornston, in press).

In examining these two critical cases, we use most different and most similar systems analysis to increase analytic leverage. The fact that Finland and Israel differ along multiple dimensions enables us to address alternative explanations such as bureaucratic quality, the structure of the national innovation system, and the influence of large firms. In Finland, for example, one of the highest-quality, Weberian-ideal bureaucracies in the world is embedded within a centralized, neo-corporatist innovation system dominated by a handful of large firms (Ali-Yrkkö & Hermans, 2004; Kaufman, Kraay, & Mastruzzi, 2003; Ornston, in press). Israel, by contrast, rivals Greece in measures of government effectiveness and possesses a highly fragmented innovation system populated by start-ups and smaller firms (Breznitz, 2007a; Evans & Rauch, 1999; Kaufman et al., 2003; Teubal, 1983, 1993). In both cases, however, it was peripheral agencies with modest budgets and limited prestige such as the Finnish Fund for Research and Development (Sitra) and the Israeli Office of the Chief Scientist (OCS) that introduced the radical policy innovations that would later support RIB growth. At the same time, longitudinal analysis enables us to examine how SDAs evolve over time within a single national environment. More specifically, as their profile increased, Sitra and the OCS faced increasing political pressure and reduced flexibility. This development explains why these two agencies have exhibited less flexibility in recent years.

Radical Policy Innovation and Rapid Restructuring in Finland

This section explores how Finland adopted the innovation policies that helped transform it from one of the lowest-technology economies in the Organisation for Economic Co-operation and Development (OECD) into a global leader in information and communication technologies (ICT) industries. Figure 1 captures this remarkable transformation as the share of high-technology manufactured exports increased eightfold from 3.3%, less than half of the OECD average in 1980, to 26.8% by 2000 (OECD, 2011). It also illustrates the challenges that currently confront Finland, as the country faces what one minister characterized as the “most significant structural upheaval Finland has ever seen in the new technology sector” (“More Than 1,000 Nokia Employees,” 2011).

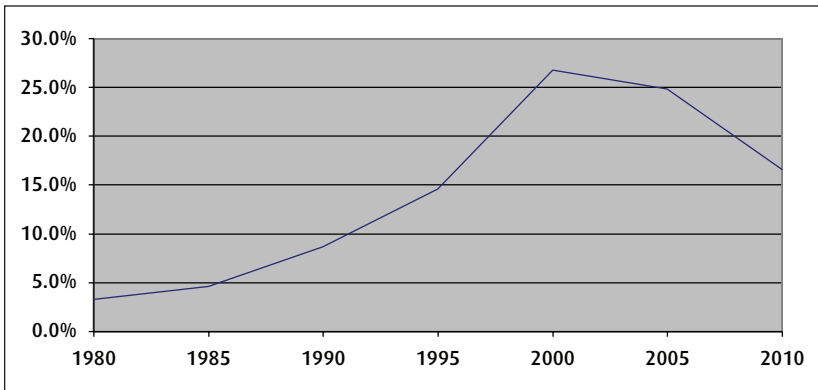


Figure 1. Share of high-tech manufactured exports, Finland, 1980–2009
Source: Data from OECD (2011).

Finnish movement into new ICT industries such as mobile communications was a complex and coevolutionary process, shaped by favorable opportunities such as the Nordic Mobile Telephone standard, skillful private-sector actors such as Nokia, and enabling innovation policies (Ali-Yrkkö & Hermans, 2004; Häikiö, 2002; Rehn, 1996). This section focuses specifically on innovation policy, where analysis has privileged national, neo-corporatist bodies such as the Science and Technology Policy Council and large, well-funded agencies such as Tekes (Moen & Lilja, 2005; Rehn, 1996). Although these peak-level bodies were integral in scaling new policies (Ornston, in press), we claim that the initiatives they adopted were actually pioneered by Sitra, a small think tank at the periphery of the public sector. As Sitra's programs were poached by more powerful actors, it launched new initiatives to transform the Finnish innovation system. At the same time, Sitra's growing prominence threatens its status as a disruptive agent.

Sitra as a SDA: From Industrial Policy to Innovation Policy

Historically, Finland possessed one of the lowest-technology economies in the OECD. Even “high-technology” companies such as Nokia derived half of their international revenue from noncompetitive, bilateral trade with the Soviet Union (Steinbock, 2000, p. 28). Public policy reinforced this reliance on low- and medium-technology industry. For example, the Bank of Finland, in close collaboration with the major banking blocs, incentivized investment in capital-intensive industries by fixing interest rates below market-clearing

levels, strategically allocating foreign exchange and repeatedly devaluing the currency (Rehn, 1996, pp. 230-231). Although governed by different actors, industrial policy exhibited similar characteristics. The powerful Ministry of Trade and Industry (KTM) used grant aid and created state-owned enterprises to successfully target mature, capital-intensive manufacturing industries such as copper, steel, and chemicals (Rehn, 1996, pp. 278-282). Public support for research was so underdeveloped that policy makers would later propose stripping KTM of its responsibilities in this space (Murto, Niemelä, & Laamanen, 2006, p. 41).

Policy innovation instead originated at the periphery of the public sector within a small foundation, Sitra. Proposed by the Bank of Finland and approved by parliament, the Finnish National Fund for Research and Development was established in 1968 to celebrate the Finnish parliament's 50th anniversary. Like many other Finnish initiatives, the idea was imported from Sweden, which had just established the Riksbankens Jubileumsfond (Murto et al., 2006, p. 30). Sitra was established with a much broader mandate to promote the competitiveness of the Finnish economy, reflecting both a growing consensus about the inflationary consequences of the devaluation cycle and continued disagreement about how to escape it (authors' interview, Finland, June 20, 2012). Sitra's budget, however, was modest, as the agency operated off the interest from its 145 million endowment (Murto et al., 2006, p. 31).

Although formally supervised by the Bank of Finland, Sitra's modest budget and unconventional mandate effectively insulated it from political interference. In the words of one former executive,

We were very free. We had a lot of leeway and a lot of space to maneuver within. . . . The central bank had other things to do. They didn't care about this small organization. As a result, the bureaucracy wasn't there. The state oversight wasn't there the same way it would later become. (authors' interview, Finland, June 14, 2012)

Sitra's peripheral position facilitated radical policy innovation in two ways. First, Sitra was forced to develop alternative strategies as larger, more powerful actors such as KTM and the Bank of Finland monopolized traditional instruments such as the state-owned enterprise and credit rationing. Inspired by his extensive international contacts, Sitra's first president, Klaus Waris, instead sought to promote entrepreneurship by using grants and soft loans to cofinance risky long-term research by private corporations (Murto et al., 2006, p. 31). Sitra's lower political profile also enabled the organization to target nontraditional, private actors. Established industries, focused on more lucrative funding opportunities at the Bank of Finland and KTM, were strikingly

underrepresented in early funding rounds. During the first 10 years, more than one quarter of Sitra's funds were allocated to electronics, far out of proportion to the industry's significance in the Finnish economy (Murto et al., 2006, p. 70).⁵

Lacking capital, the organization instead sought to raise awareness about a new, R&D-intensive developmental model by writing reports and inviting elites to participate in courses on economic policy (Moen & Lilja, 2005, p. 373). These efforts bore fruit in the early 1980s, not because of an emerging high-technology coalition (which was still in its infancy), but rather because of deteriorating economic performance and geopolitical vulnerability.⁶ The OPEC-induced oil crises of the 1970s increased bilateral trade with the Soviet Union to worrisome levels, whereas high-profile failures in electronics delegitimized traditional industrial policies (Sabel & Saxenian, 2008, p. 61). In this environment, Sitra's research program provided a proven model to promote restructuring. As described elsewhere, Finland's peak-level, neocorporatist system of interest intermediation accelerated policy implementation (Ornston, in press). Reflecting Sitra's marginalization within the Finnish public sector, however, a new actor was created to take over this domain, the Finnish Funding Agency for Technology and Innovation (Tekes). Tekes's initial budget was 4 times higher than Sitra's and increased rapidly from 40 million in 1984 to more than 400 million by 2000. By then, Finland led the European Union in public R&D spending as a share of GDP and ranked second only to Sweden in gross expenditure on R&D as a share of GDP (Eurostat, 2011).

Dramatically higher research spending in turn helped Finnish firms to capitalize on favorable opportunities such as mobile communications. For example, Tekes cofinanced the collaboration between Nokia and the Technical Research Institute of Finland that created the software protocol for the GSM (Groupe Special Mobile) digital mobile communications standard (Ali-Yrkkö & Hermans, 2004, p. 122). It did so at a time when Nokia's attention was focused elsewhere, on television (Häikiö, 2002, p. 98), and it sustained research spending as Nokia flirted with bankruptcy in the early 1990s (Häikiö, 2002, p. 142).⁷ Nokia's widely documented transformation from a medium-sized, diversified conglomerate into a high-technology giant, however, obscures the next round of experimental policies that were being developed at the periphery of the Finnish public and private sectors.

Ongoing Experimentation: From Research and Development to Risk Capital

Although the decision to establish a much larger agency dedicated to research threatened Sitra, it also forced the organization to develop new policies that

would advance industrial restructuring. To identify new instruments, Sitra policy makers looked beyond the large enterprises that they had worked with in the 1970s (which were now focused on Tekes) and beyond Finland to the United States. Inspired by a visit to Silicon Valley in the mid-1980s, Sitra managers used their endowment to purchase equity in high-technology firms and support private venture capital (VC) funds (authors' interview, Finland, November 22, 2006). Like Sitra's earlier foray into research, movement in early-stage risk capital markets provoked little resistance, even as supervisory authority was transferred from the central bank to the Finnish parliament (authors' interview, Finland, June 14, 2012).

With limited financial capital, Sitra again relied on network building. For example, Sitra established the Finnish Venture Capital Association in 1990 (Luukkonen, 2006, p. 6) and worked with private-sector venture capitalists to lobby politicians, KTM, pension funds, insurance companies, and other major investors (authors' interview, Finland, November 20, 2006). By the early 1990s, Sitra had pioneered a new model that could be copied and scaled by national politicians as a severe recession and banking crisis delegitimized established policy routines and industries. The financial crisis of the early 1990s shifted attention away from large conglomerates to smaller and medium-sized enterprises, both because this sector was more heavily affected by the ensuing credit crunch and because it was seen as the principle source of employment growth. In this environment, Sitra was prepared to offer a radically different strategy to promote growth. Kera, a regional development fund, was the first to copy Sitra by launching the first dedicated public VC fund, Start Fund of Kera in 1991. In 1995, parliament established an even larger fund, Finnish Industry Investment (FII), under the supervision of KTM (Luukkonen, 2006, p. 6).

Together with a successful campaign to woo institutional investors, these initiatives dramatically increased VC investment in Finland (Luukkonen, 2006, p. 11). For example, investment in early stage risk capital climbed from 0.003% of GDP (2.8 million) in 1989 to 0.103% of GDP (135.4 million) by 2000, leapfrogging every member state for which data are available to rank first in the European Union (Eurostat, 2011). A more robust VC community in turn facilitated high-technology growth by funding the small and medium-sized enterprises that Nokia executives relied on to manufacture components and conduct research (authors' interview, Finland, November 24, 2006). At the same time, this rapid increase in VC masked significant weaknesses in the Finnish economy and the high-technology sector in particular.

Contemporary Challenges and the Limits of the Schumpeterian Developmental Agency

The Finnish VC industry was heavily affected by the dot-com crash at the turn of century. Investment in early stage risk capital plummeted from 135.4 million to 40.2 million by 2004 (Eurostat, 2011). The hazards of focusing exclusively on technological innovation were underscored by Nokia's difficulties later in the decade. Despite boasting the largest research budget in the telecommunications industry, Nokia struggled to cultivate productive, working relationships with telecommunication operators and application developers (Boutin, 2010). In challenging the R&D supply-side focused policies of the 1980s and 1990s, these shocks precipitated a significant shift in Finnish innovation policy.

Like the initial movement into risk capital, recent institutional innovations can be traced back to Sitra. The creation of FII and an increasingly vibrant private sector led Sitra to exit from the VC industry. From 1996, Sitra shifted its role from a direct provider of capital to network building, providing planning assistance to firms, launching a networking service to link firms with business angels, and matching young enterprises with experienced managers (Luukkonen, 2006, p. 9). Sitra's new role in the VC industry reflected a broader shift away from the provision of hard resources toward the coordination of various actors in the innovation process, particularly end users and citizens (Hämäläinen & Heiskala, 2007). Sitra adopted the concept of "social innovation" in 1999 and subsequently launched initiatives in areas as diverse as health care, municipal reform, and energy efficiency (authors' interviews, Finland, June 18 and 22, 2012). This more holistic approach to innovation has since been adopted by other actors in the Finnish innovation system in response to recent economic shocks. By 2008, Finland's national innovation strategy had addressed the concept of social innovation, prompting agencies such as Tekes to launch programs on public-sector reform and workplace cooperation (authors' interview, Finland, June 22, 2012).

At the same time, it is unclear whether Sitra still has the capacity to generate disruptive new ideas. Although senior-level managers conceive of Sitra as "challenging the status quo" (authors' interview, Finland, June 19, 2012), new policy innovation are scarce. Several external evaluations criticized Sitra during the 2000s, with one participant commenting, "The Finnish system lacks a funder of really radically new, innovative ideas. In my mind Sitra could be an organization that adopts that role, but now it is going in a completely different direction" (authors' interview, Finland, June 15, 2012). The apparent lack of focus and limited impact precipitated the latest change in

management in 2008, with the goal of delivering measurable results (authors' interview, Finland, June 19, 2012).

Doing so will be difficult, however, as Sitra enjoys a much more prominent position in the Finnish innovation system. Although its endowment remains modest, Sitra's increasing profile has attracted political attention. A former executive noted, "Sitra had built up a very good reputation, not only nationally, but also internationally. . . . It became prestigious for politicians to sit on its supervisory board and show to their constituents that they impact its policies" (authors' interview, Finland, June 14, 2012). Growing parliamentary inference was most visible in the appointment of former Prime Minister Esko Aho to lead Sitra in 2004, but it was reflected at lower levels as well. Commenting on the 2000s, an insider remarked, "They even started to parachute into Sitra persons who needed a political reward. [People] who had done something for a political party and were left without a job were given a room at Sitra and were given a title" (authors' interview, Finland, June 14, 2012).

Political interference affected Sitra's strategy. For example, Sitra's board has pressured the organization to focus on existing, high-profile social problems such as health care and municipal reform. One senior employee acknowledged, "We were led to understand that we cannot say no to a national problem. So, for example, we have to do something for health care, even if it is an old problem that should have been resolved, like municipal IT systems, twenty years ago" (authors' interview, Finland, June 19, 2012). Another employee remarked "We are the risk takers and we do not have to listen or build consensus in Finland. But [our leadership] says that we have to work with all political parties to do this" (authors' interview, Finland, June 19, 2012).

Sitra's commitment to pressing social problems is admirable, and the organization performs a valuable consensus-building function, but increasing prestige has clearly made it more difficult for the organization to offer radically innovative solutions.⁸ Although the shift to parliamentary supervision unquestionably heightened political interference, intervention only increased once the ICT boom raised Sitra's profile. Furthermore, parallel dynamics exist in other agencies that are not subject to direct parliamentary supervision. For example, early directors argue that Tekes has failed to maintain its early focus on emerging sectors and enterprises (authors' interview, Finland, November 1, 2005), and the organization recently revised its strategy to "recapture" its initial focus on "radical innovation" (authors' interview, Finland, June 13, 2012).⁹ Such efforts are complicated by the fact that the organization is now under pressure to tackle similarly high-profile and politicized topics such as public-sector reform and workplace cooperation. To demonstrate that these dynamics

are not unique to Finland, we now turn to another agency operating in a very different political and bureaucratic environment.

Israel: “Science” as an Anchor of Radical Policy Experimentation

Today Israel is considered an ICT powerhouse, with more companies listed on the NASDAQ than any other country bar the United States. The Israeli ICT industry is based on an R&D-intensive, novel-product-based, export-oriented business model.¹⁰ Looking at this impressive record raises a question: How did Israel, a country that as late as 1965 (Katchalski, 1968) had one of the lowest R&D expenditure as percentage of GDP in the world (standing at less than 1%), develop such an R&D-intensive ICT industry and become a global leader in R&D expenditure at 4% of GDP? The rest of this section follows Israel’s industrial science and technology policies, showing the critical stimulating, seeding, and sustaining role played by an SDA, the OCS in the Ministry of Trade, Industry and Employment, in this coevolutionary transformation. It analyzes how the OCS, with very limited resources and starting from an extremely peripheral position, managed to play such a key role, as well as its decreased ability to do so since 2000.

OCS as a SDA: Conceptualizing “Science-Based Industry”

Similar to their counterparts in Finland, most financial institutions in Israel until the mid-1990s were unwilling to sponsor new technology-based firms. As in Finland, experimentation was precipitated by geopolitical vulnerability and dependence on foreign countries. In the Israeli case, a French military embargo led policy makers to channel large investments and R&D into military high-technology efforts.¹¹ Similar changes followed in civilian industrial policy. The most important was the establishment of the OCS in the then Ministry of Commerce. It might be hard for followers of current Israeli innovation policies to imagine, but in the beginning the OCS was so marginal that the position was filled by a university professor who came to the office only twice a week.¹² Only in 1974 did the minister appoint a full-time director, Itzhak Yaakov. Although Yaakov had an extensive personal network from his prior positions as head of the armament development and R&D in the military, the OCS budget, even after the increase promised to lure him, was barely 15 million Israeli liras (2% of the annual budget Yaakov had under his control in his military role; authors’ interview, United States, September 28, 2000).

Nonetheless, Yaakov's extensive domestic networks, his educational background as engineer with an advanced degree in technology management from MIT, and his international connections with the World Bank and other actors made him uniquely able to bring new policy ideas to Israel.¹³ His first action was to define the OCS's objective as the maximization of industrial R&D without targeting any specific sectors or technologies. This conceptualization led the OCS to embark on a long series of horizontal technology policies (HTPs), a novel policy idea at the time (Teubal, 1997). The first program, which continues to this day, provides conditionally repayable loans covering part of the cost for any approved industrial R&D project originating from the private industry that is aimed at developing a new exportable product. The loan is payable only if the R&D project ends with a profitable product. These royalties have assumed an increasing percentage of the OCS's annual operating budget, reaching 20% during the 2000s.

Many of the earlier employees of the OCS, however, described its actions as intensive networking aimed at broadly infusing an R&D-based development ideology into private industry. Like Sitra, the OCS's limited resources meant that its only hope to infuse industrial transformation as a peripheral agency was by educating and mobilizing more central actors into action. The resources given to the OCS were so small that Yaakov commented in an interview,

The small budget had a few reasons, most importantly was that nearly everyone in the Ministry did not understand what is it that they were supposed to be doing. *Most of the Ministry personnel thought that industrial R&D is a waste of money.* Money that can be used to buy meat in Argentina, it was, don't forget, the ministry of commerce and industry. (authors' interview, United States, September 28, 2000)

To change this situation the OCS embarked on intensive and repeated meetings with decision makers in private industry, educating them about the value of R&D and technological innovation. One of the first employees of the OCS described the early years,

During the early period we tried to create a dynamic of R&D activities. We wanted the industry to routinely conduct R&D and to create a dynamic that will infuse the idea that R&D is something that should be done throughout the industry. To create a sort of paradigmatic change in the way businesses thought about what they are doing. We did not

really care who, what, why, when, we just wanted to create an R&D dynamic. (authors' interview, Israel, May 2, 2002)

The OCS's new policies received full political support only in the 1980s, after a hyperinflationary crisis, 109,187% between 1978 and 1986, decimated traditional industry. A new R&D law in 1984 stipulated that the OCS would have an "unconstrained" annual budget for its main R&D fund, so all approved projects suggested by private industry to develop high-technology products would be supported. This was possible because the overall demand for R&D funding in Israel was still miniscule. As soon as the industry grew and become successful a budgetary limit was reintroduced.

Many of these new projects proved to be successful in international markets, as evidenced by the rising amount recouped by the OCS as payment for successful projects: from a mere \$8 million in 1988 to \$139 million in 1999. These payments were immediately injected into the industry, continuing this growth cycle until the mid-1990s. Figure 2 below shows the rapid growth of the OCS annual budget from both governmental allocations and royalties in this period. The influence of the OCS's extended activities on industrial sector innovative outputs is well documented (Trajtenberg, 2000, 2001).

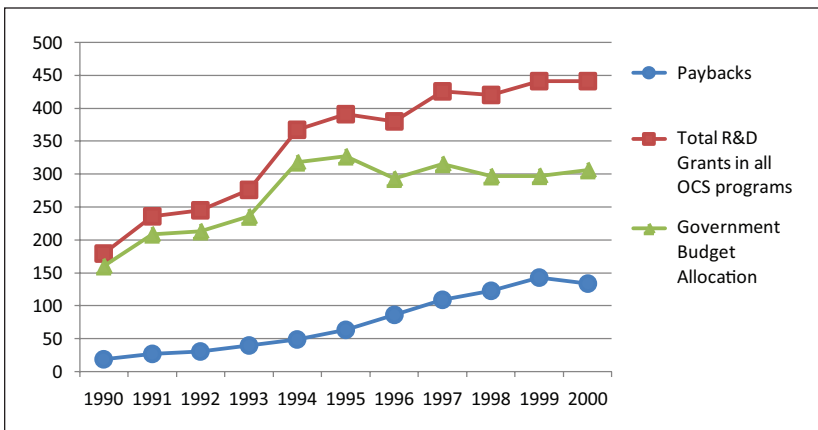


Figure 2. Annual rise in the OCS budget 1990 to 1999 (2000 U.S. dollars, in millions)

Source: Data from OCS (2012).

Paybacks are the total amount the OCS injected back into the budget from the royalties gained on past grants; government budget allocation is the total sum of approved annual budget allocation to the OCS from the Ministry of Finance.

By the late 1980s and continuing at a higher rate in the 1990s, a transformation became apparent: The high-technology industry grew, whereas agricultural, traditional, and mixed industries lost ground. By 1988, 59% of Israel's industrial exports were high-technology products, and by 1998 this was more than 71%. This transformation continued—as early as 2000, according to Israel's Central Bureau of Statistics (2001), the ICT industry accounted for more than 70% of GDP growth. During the second half of the 1980s and the beginning of the 1990s, many Israeli ICT companies expanded their activities to penetrate foreign markets. In this period OCS grants proved to be critical in the decision of the founders of key companies, such as Mercury Interactive and Comverse, to come back to Israel to establish their companies (Breznitz, 2007b).

Rapid Growth and Ongoing Experimentation From R&D Grants to the Creation of Risk Capital

In 1989 the Soviet Union started to break apart, and Jews who had been previously unable to emigrate started moving to Israel in large numbers. This wave was perceived to bring the best and the brightest technologically educated workforce from the Soviet Union and, together with the thousands of engineers who were made redundant by the defense industry, raised the question of how to tap this body of knowledge.¹⁴ Although this convergence was a historical accident, the OCS's two decades of patiently developing and introducing policies using an HTP framework established an alternative model that shaped Israel's S&T policies. The large injection of U.S. financial aid aimed at helping supposedly technologically savvy new immigrants to settle in Israel had created a window of opportunity for the OCS.

In an almost ideal example of how a peripheral agency with an arsenal of ideas can utilize its network to get small amounts of capital to start programs that proved critical in stimulating private industry change, the OCS pushed forward three programs that for years it had been arguing for. The OCS's peripheral status was the main reason why it had multiple innovative policy programs ideas, since it led it to link with diverse groups of heterogeneous and less mainstream social scientists, economist, industrialists, and like-minded civil servants from around the world. Indeed, the ideas for the three programs came from as far away as the United States and Japan. Many of these ideas, especially the MAGNET research consortia program, came from a group of academics facilitated by the Jerusalem Institute of Israel Studies that has been working closely with the OCS to develop new policy tools based on international comparison of best practices (Brodet, Justman, & Teubal, 1990; Justman, Zuscovitch, & Teubal, 1993).

In 1991, the Technological Incubators Program commenced operation. It was presented as a solution to two problems, equipping first-time technological entrepreneurs with management skills and assisting technologically skilled Russian immigrants in integrating into a capitalist society. It established a network of technological incubators managed by local public-private joint ventures across Israel.¹⁵

The second program, Yozma, started operations in 1992 and kick-started the Israeli VC industry. This time, the OCS decided that the necessary skills and knowledge did not exist in Israel and that, to succeed, the VC industry needed strong networks with foreign financial markets rather than the Tel Aviv Stock exchange. Accordingly, Yozma was created as a government VC fund of \$100 million that had two functions. The first was to invest \$8 million in 10 private venture funds, which would be 40% or less of the total capital—the rest was provided by other private limited partners. To get this financing, the funds' managers had to secure investment and partnership from at least one local and one established foreign financial institution (authors' interview, Israel, August 21, 2000).

The last initiative designed by the OCS in 1991 was MAGNET, which started operations in 1992. MAGNET, which stands for Generic Non-Competitive R&D, addressed two problems crucial for the development and maintenance of the long-term competitive advantage of high-technology companies. The first problem was that a large number of companies in Israel existed in the same technological space and each was too small to compete against bigger MNCs in cutting-edge infrastructural research activities. The second problem was the underutilization of academic research. To solve this, MAGNET created consortia to develop generic technologies. MAGNET consortiums were created for a period of up to 3 years, and all IP outputs were shared among the consortium members, who also had to agree to license this IP to Israeli companies at a cost that did not reflect monopoly status.

The success of these policies and the rapid rise of the ICT industry moved high-technology industry to the center stage of Israel's economy. Yozma proved to be so successful that it became a model (with only limited success) for VC policy worldwide. Today the Israeli VC industry is considered the most advanced and sophisticated in the world outside the United States, with many top U.S. and global funds starting operations in Israel.¹⁶

However, this success and the growing centrality of the high-technology industry to the Israeli economy also made it the center of political interest and severely limited the ability of the OCS to introduce new policy innovation. Beginning in 1991, the OCS was allowed to launch only one new program to target a new policy domain, traditional industry, and this new program did not get new budget allocation but needed to be self-financed from the OCS's

diminishing resources. As in Finland, although there are excellent reasons to build on a country's existing strengths, this incremental strategy and orientation toward established firms nonetheless encapsulates the OCS weakened capacity as an agent of radical policy innovation.

The Price of Success—Political Interference and Interagency Encroachment in the 2000s

If the 1990s was the decade in which the OCS received praise and elevated social stature for its important coevolutionary role in transforming the Israeli industry, the 2000s saw the OCS suffer the political consequences of this success. The OCS was curtailed in its ability to experiment on two fronts. First, as shown in Figure 3 below, its already limited resources were steadily and significantly cut. By 2005, the budget allocation from the government of \$123 million was barely above a third of what it was in 2000. Although the budget allocation has since increased, political interference has also subtly assumed control over significant portion of the budget and removed it from the OCS's discretion. For example, the OCS's obligation to partly sponsor

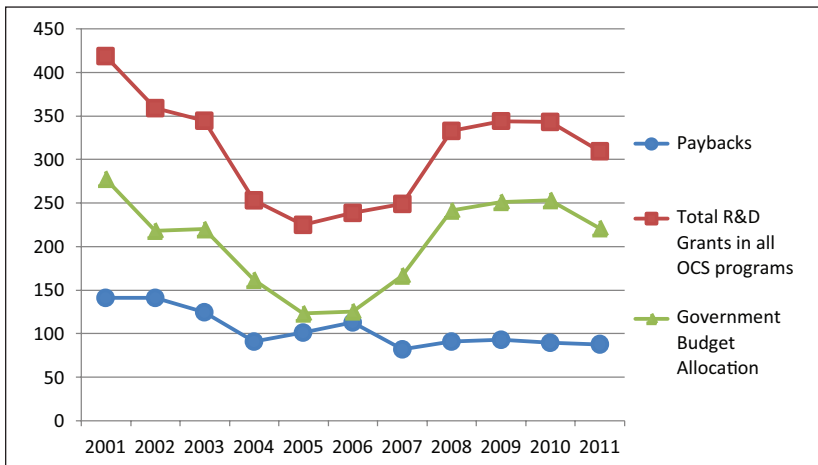


Figure 3. The painful fruits of success—OCS's budget 2000–2011 (2000 U.S. dollars, in millions)

Source: Data from OCS (2012).

Paybacks are the total amount the OCS injected back into the budget from the royalties gained on past grants; government budget allocation is the total sum of approved annual budget allocation to the OCS from the Ministry of Finance

Israel's involvement in the EU S&T frameworks mushroomed from 2% of the annual budget in the early 1990s to 25% in 2013, without a corresponding growth of the overall budget. As a result, the OCS's ability to finance new programs has been effectively curtailed.

Second, and at least as important, is the continuous erosion in the autonomy of the OCS, as well as the growing political interference in its decisions. The short and rocky tenure of Carmel Vernia as chief scientist and the recent decision by the Ministry of Finance (MoF) to restrict R&D support to small and medium-sized enterprises illustrate the impact of interference by politicians and other agencies. In May 2000, Carmel Vernia, the former COO of Converse, was appointed as a chief scientist. Vernia quickly discovered that one of the main promises he received when agreeing to take the job—that the OCS would become an independent unit and released from the direct control of the Ministry of Trade and Industry—was vehemently opposed by the new minister and her director general. Both viewed control over what by then was the most important sector of the economy, the high-technology industry, as crucial to their political power, and as such they viewed the OCS as a key tool in their political arsenal. After 2 years of increasing political interference in the daily work of the OCS, and shortly after the minister, Dalia Itzik, decided to transfer 14 million shekels from the OCS budget to help “distressed” companies without even informing him, Vernia resigned (Editors, 2000; Peretz, 2002; Rolinik, 2002).

More recently, in July 2010, the MoF inserted a regulation to the annual state budget that would have prevented the OCS from sponsoring any R&D activities conducted by “large companies,” where *large* was defined very modestly as companies with more than \$100 million in annual sales (Grimeland & Coren, 2010). Whether that proposition would become a permanent law or not was less important than the fact that this was just another indication of the constant interference of other units not only in the OCS's decisions but also in the basic professional judgments the OCS is allowed to use to fulfill its mission statement. It is becoming clear that in its old domain, new technology-based companies, the OCS's ability to act as an SDA was reduced as this sector became economically important and politically salient.

The OCS has responded to these limitations by experimenting in new domains. Several top officials, together with some leading academics, such as Manuel Trajtenberg, have started to argue that there is an overfocus of the Israel industry on ICT, with very low spillovers and linkages between the ICT R&D-producing sector and the rest of the economy (Breznitz, 2007b; OCS, 2010; Trajtenberg, 2001). To foster these linkages and maximize R&D across

the business sector, starting in 2005 the OCS allocated its internal budget to a new program focusing on a new set of private actors, traditional industry. The program tries to tackle these issues from both the demand side (educating firms on how to conduct and utilize R&D) and the supply side by offering incentives and grants for both graduate-level science, technology, engineering, and mathematics students and R&D engineers, to work in or conduct research on small and medium-sized enterprises in traditional industries. The program has grown steadily in the past 5 years and has led a significant number of firms from traditional industries to apply for OCS grants for the first time (OCS, 2010). Although the OCS has thus successfully engaged traditional industry, it has nonetheless proven less successful in targeting emerging RIB industries. Furthermore, with a steadily declining budget and constant political interference from both politicians and other (more powerful) agencies, the OCS has found it more difficult to scale its initiatives.

Conclusion: The Future of the Developmental State

In describing how Finland and Israel entered new, high-technology industries, we have highlighted how reform-oriented policy makers can facilitate RIB competition. We argued that such initiatives are most likely to emerge not from commanding or centrally positioned agencies but rather from more modest organizations at the periphery of the public sector. This observation can be generalized beyond Finland and Israel to other economies. In the United States, for example, some of the most flexible and innovative agencies, such as DARPA, have also occupied a relatively low political profile (Whitford & Schrank, 2011, p. 279). In Ireland, a paradigmatic neo-developmental state (O'Riain, 2004), virtually all of the policy innovations that supported the indigenous high-tech sector were developed and originally implemented by two marginal divisions, the Enterprise Development Program and the International Service Program (both run by the same personnel) and a small but highly entrepreneurial subagency, the National Software Directorate (NSD) within the powerful Industrial Developmental Authority (O'Riain, 2004; Sterne, 2004). Ironically, strengthening these innovative agencies proved deeply problematic. Contrary to neo-developmental theory (O'Riain, 2004), the creation of a central, high-profile agency, Enterprise Ireland, dedicated to the promotion of indigenous industry stifled policy innovation after 1998 (Breznitz, 2007b, p. 169). Although for some years thereafter the NSD was permitted to expand established grant-making programs as well as its VC development initiative, policy experimentation ceased, negatively affecting

the growth of the Irish software industry (Breznitz, 2012, p. 106). Although the financialization of the Irish economy unquestionably affected Irish policy making and industry, it is worth emphasizing that these developments predated the real estate bubble and occurred during an era of unprecedented public investment.

This is not, of course, to suggest that all peripheral agencies engage in radical policy innovation. On the contrary, the preceding analysis has highlighted other variables that influence entrepreneurial capacity. For example, both Sitra and the OCS enjoyed excess managerial capacity, beyond what was needed to fulfill routine operations, under competent and well-connected leaders such as Klaus Waris and Itzhak Yaakov. “Managerial slack” is especially important for peripheral agencies, as this enables them to develop and implement innovative policies with limited resources (Nohria & Gulati, 1997; O’Toole & Meier, 2010). Agencies with limited slack are less likely to capitalize on their peripheral position. Similarly, successful agencies vary in their ability to safeguard their entrepreneurial capacity. For example, the decision to shift supervisory authority from the Bank of Finland to the Finnish parliament accelerated the politicization of Sitra (although parallel developments at Tekes suggest it would have happened in any case). On the other hand, other successful agencies such as DARPA maintained significant flexibility by relying informal working relationships (Fuchs, 2010).

It is also worth noting that Schumpeterian strategies impose costs even where they are most successful. Although Finland and Israel stimulated RIB growth, restructuring exposed Finland to adverse economic shocks and Israel to distributive conflict. For policy makers seeking to promote rapid restructuring, however, this article contains some clear policy implications. Instead of strengthening established developmental agencies at the core of the public sector or embedding them more tightly within public- and private-sector networks, policy makers may be better off turning to peripheral low-profile agencies, giving them a mandate to engage in continuous policy experimentation, imbuing them with managerial slack, and shielding them from political encroachment.

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Notes

1. Our argument thus supports recent literature on endogenously generated institutional path change (Schneiberg, 2007). Unlike Schneiberg, however, who describes how “failed” battles leave behind alternative models that change the flow of the dominant path by acting as flotsam and jetsam, we view Schumpeterian developmental agencies (SDAs) as a seeding source. SDAs propose and test models in the “shadows” that later enter the mainstream (in ways that ultimately hinder the experimental capacity of these agencies).
2. This emphasis on pilot agencies is true in all case studies of emerging economies, although in the specific case of the United States, some scholars have suggested that lower profile agencies may be more insulated from “market fundamentalism” (Block, 2008). We argue that this is not unique to liberal economies, but extends to other forms of political interference as well.
3. Some neo-developmental scholars have specifically argued that decentralized political systems are more conducive to experimentation (Sabel & Saxenian, 2008; Whitford & Schrank, 2011). We advance a different argument about individual agencies, however, and, in so doing, highlight a surprising capacity for radical policy innovation, even within highly centralized political and economic systems such as Finland.
4. It is important to note that we do not argue that rapid innovation-based (RIB) development is state planned. Our argument is that public agencies can play a crucial role in stimulating and sustaining the coevolutionary development of public policy and private industry that characterizes RIB growth and that peripheral public agencies are more likely to play that role.
5. Nokia’s small electronics division was an early beneficiary of these funds in the 1960s and 1970s. This occurred at a time when the company’s top management was still focused on exporting low- and medium-technology products to the Soviet Union (Murto, Niemelä, & Laamanen, 2006, p. 70; Steinbock, 2000, p. 28).
6. High-technology firms were still politically marginalized at this time, with one industrialist famously declaring that Finland should export nothing “smaller than a horse” (authors’ interview, Finland, November 10, 2005).

7. As recently as 1991, Nokia was in such dire straits that its owners famously offered to sell the conglomerate to Ericsson for one dollar. Ericsson declined to purchase the firm, precisely *because* of Nokia's troubled consumer electronics division, which would later lead Nokia into mobile telecommunication (Häikiö, 2002, p. 142).
8. Although some scholars fault the centralization of the Finnish innovation system (Sabel & Saxenian, 2008), this viewpoint obscures the fact that Finnish economic policy was always centralized and, by virtually all accounts, is far more pluralistic today.
9. Since Tekes is also considerably younger than Sitra, this suggests that experimental capacity is not simply a function of "newness" or the life cycle of an agency.
10. For more on the history of the ICT industry in Israel, see Avnimelech and Teubal (2004), Breznitz (2006, 2007b), and Teubal and Spiller (1977).
11. France was Israel's main source of armaments and research collaboration until de Gaulle became president. Israel's supposedly historic alliance with the United States did not fully commence until the 1973 war.
12. The view at the time was that industrial R&D was the domain of the public research institutions. Indeed, the official mission of the Katchalski committee, which is credited with creating the OCS, was to improve those institutions.
13. Yaakov was also a protégé of Katchalski, who was then serving as the president of Israel. After leaving the OCS, Yaakov served as a special advisor of the World Bank to Taiwan and South Korea at the time they went through their rapid high-technology industrialization period.
14. Although the wave of immigration from the former USSR created the pretext with which the OCS was able to secure finance and political agreement to start these four programs, the Russian immigrants themselves have not, thus far, become successful technological entrepreneurs, and seem to play the important but more minor role of providing highly skilled labor (Abouganem & Feldman, 2002, pp. 27-28; Breznitz, 2007b).
15. Interview with the director of the incubators program (Israel, February 8, 2000), Trajtenberg (2000), and the incubation program web site (<http://www.incubators.org.il>). For two thorough reviews of the Israeli incubator program, see Economics (2001) and Shefer and Frenkel (2002).
16. For more on Yozma and the growth of the Israeli VC industry, see Avnimelech and Teubal (2004, 2006) and Breznitz and Zehavi (2010).

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