

Policy Implementation: The Art and Craft of Innovation Policy Making

Putting in place on a large scale the foundations of innovation policy as described in former chapters is a daunting task for developing countries. They do not have the necessary resources and the educated cadres, and more generally, the institutional situation is not fit for it. Therefore to help them cope with such challenges, we will discuss two crucial points: how to develop a pragmatic innovation agenda, and how to build an institutional framework for change.

Adapting Best Practices to the Local Context: The Pragmatic Innovation Agenda

Organizational and technological innovation involves doing new things in an existing context. Even in economies with poor institutions, such as Belarus and the Islamic Republic of Iran, where the institutional and investment climate is very difficult, surprisingly dynamic, innovative, and export-driven start-ups and spin-offs are present. Their success depends crucially on the specific local context, because the instruments that can facilitate innovation (shared vision, incubation, and angel and early-stage venture capital networks, among others) work differently in the Islamic Republic of Iran from the way they work in Argentina or Ukraine, for example, which are roughly comparable middle-income economies. This critical dependence on local specifics is one characteristic of pragmatic innovation agendas. Another is the open-ended nature of the relevant

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policies and instruments. Blueprints for innovation are useful only to the extent that they can be adapted to changing circumstances. This is how China—a paragon of pragmatic innovation—introduced incremental and gradual changes that were ultimately strategic and radical into its innovation system.

The recognition that local institutional contexts are not merely important but critical requires reconsidering the familiar reliance on “best practice” and its adaptation. If the context is crucial, a successful practice in one country signifies, at best, a promising approach in another: “best practices” no longer exist, only “promising practices.” If best practice is highly contextual, no institutional recipes exist; therefore, finding a best practice requires experimenting and taking risks. A process that emphasizes a pragmatic search for solutions is called *self-discovery*—the process of trial and error through which an enterprise or entrepreneur determines what markets it can (or can become able to) serve (Hausmann and Rodrik 2002; Hausmann, Rodrik, and Sabel 2007).

Self-discovery applies not only to enterprises and private sector entrepreneurs. Just as a private entrepreneur has to discover a cost structure that will allow him or her to enter a new market, the public sector needs to seek new institutional configurations to support private self-discovery. The public sector also needs to take calculated risks, which may fail, and be accountable for the results. Self-discovery of new practices by the productive sector (with the private sector entrepreneur at the center) and self-discovery of an appropriate institutional framework to support it (with public sector entrepreneurs at the center) are two sides of the same coin.

The first section of this chapter looks at self-discovery for innovation. The second focuses on the transformation of the institutional context.

Agents and Processes of Self-Discovery

Private entrepreneurs and productive enterprises are at the center of the self-discovery process. Their risk taking and experimentation are supported by an innovation system: a network of organizations, rules, and procedures that affect how a country acquires, creates, disseminates, and uses knowledge. Key organizations participating in the private sector’s self-discovery process are universities, public and private research centers, and policy think tanks. For the innovation system to be effective, the private sector must require knowledge, and effective links between research and development (R&D) and industry are vital for transforming knowledge into wealth. Therefore, self-discovery is a collective process that takes place through networking. Interactions among the different organizations, firms, and individuals are critically important. Ireland offers a good example of the main aspects of the self-discovery process. Its recent financial and economic crisis does not make its exemplary path of the past decades any less relevant.

As is well known, Ireland demonstrated that one of the poorest members of the European Union, highly dependent on agriculture and low-end

manufacturing, could successfully turn its economy into a provider of high-technology services. Ireland's transformation is attributable to sustained and well-targeted investment in education and to a policy framework favorable to foreign direct investment (FDI), notably in the information and communication technology (ICT) sector. At 20 percent of gross domestic product (GDP), Ireland's net inflows of FDI are one of the world's highest, second only to Sweden. The country has become one of the most dynamic knowledge-based economies in Europe and is the second-largest exporter of software. With an average rate of GDP growth of 8.9 percent over the period 1995–2002, the “Irish miracle” is not attributable solely to the government's investment in education and its efforts to attract FDI. Substantial European Union (EU) assistance also helped Ireland attract investments relevant to a knowledge economy. Today, it is the headquarters of many European technology giants, and Dublin has taken advantage of its well-developed network infrastructure to become the hub for European telephone call centers. Ireland has thus come a long way from its traditional low-end manufacturing economy. Yet, while it was extremely successful in attracting major multinationals, their links to the Irish economy remained limited. To become a full-fledged knowledge economy, Ireland had to strengthen indigenous innovation. In response to this challenge, Ireland increased investments in education and innovation and made a major commitment with its National Linkage Promotion program (see box 8.1). After an initially slow start, multinationals increased local purchases significantly. This program illustrates a self-discovery process stimulated by appropriate procurement measures.

Box 8.1 Private and Public Sector Entrepreneurs Come Together: An Irish Experience

In the wake of a highly successful foreign direct investment (FDI) program, Ireland faced the challenge of how to deepen FDI involvement and how to leverage the technology then being used to develop an indigenous technological capability. In response, the Industrial Development Authority took a calculated risk by bringing together a group of multinational companies and potential suppliers through a systematic search process that came to be known as the National Linkage Promotion Program (1987–92). The key problem in developing potential suppliers is that one is “doomed to choose” (Hausmann and Rodrik 2006): that is, one must choose among potential suppliers simply because developing large numbers of them is wasteful. This process involves risk that needs to be shared by the government and the private sector. Three main groups were involved in the program:

- *Government:* Government provided the political imperative and charged various state agencies with supporting the program and cooperating. Budget lines were established, and the Department of Industry took a close interest in the program's operation and effectiveness. Input at this level was essential for

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Box 8.1 continued

maintaining political visibility and support for the program. A total of eight agencies contributed staff and assistance, in part to help small and medium enterprises (SMEs) navigate the bureaucracy when seeking the best and most appropriate assistance. Staff members from each agency had to shed familiar bureaucratic routines and behave entrepreneurially to fast-track the many applications for assistance and to fine-tune the services being offered to meet the specific needs of both the customers and their suppliers.

- *Industry, primarily MNCs (through FDI):* The principal sector targeted was electronics, since it was the largest and most dynamic and had the greatest propensity to source locally. Industry cooperation was sought, and the MNCs (multinational corporations), through the Federation of Electronic Industries, contributed to program costs in the first two years. Companies were lobbied at high levels by senior agency executives and government ministers. Incoming companies were introduced to the Linkage Promotion Program's executives so that local sourcing opportunities could be discussed and developed. MNCs were also asked to provide technical assistance, in association with state technical agencies.

- *SMEs:* A rigorous assessment procedure was used to select participating companies. It included an analysis of existing or potential capabilities against perceived supply opportunities, a detailed examination of financial management, and an assessment of existing management and of the firms' potential.

An essential part of the program was the development by linkage executives of close relationships with key MNCs. Because of the number of agencies involved in the program, a well-balanced and multifaceted team of experts in management, business development, technical issues, accounting, and banking was the key to success. This array of skills allowed the team to carry out the initial assessment and selection of suppliers (in close cooperation with the MNCs) and also to carry out early-stage development workshops with the SMEs.

- *Outcomes:* Over the five years of the program, locally sourced materials in electronics increased from 9 percent to 19 percent of MNC purchases. While the total population of MNCs in Ireland was about 900, approximately 200 proved to be effective participants in the program, both through purchases and through their support. The core group of 83 supplier companies participating in the program dramatically outperformed other similar companies on average. This outcome was partly a function of the selection process, partly a function of intensive support, but largely due to interaction with demanding customers who forced them into a competitive mode. Over the period, these companies achieved average growth in sales of 83 percent, average productivity improvement of 36 percent, and average employment growth of 33 percent.

Source: Author.

However, over the past three years, attractive wages in China, India, and Eastern Europe have weakened Ireland's competitive advantage, and many global companies have scaled back or canceled their plans for Irish operations. Ireland has had to fight hard to reclaim its status as a major destination for

outsourcing and has done so by leveraging the brainpower, productivity, and flexibility of its workforce, in short, by achieving its transformation to a fully fledged knowledge-based economy.

The success of this strategy is already apparent, and a number of large multinational companies have returned or relocated or plan to relocate to Ireland in the near future. Companies such as Dell—which employs about 4,000 people in Ireland but which also began outsourcing to India and elsewhere—have not always found the quality they hoped for. As a result, countries like Ireland, which, in parallel to strong marketing campaigns, have strengthened their knowledge base through concentrated investments in R&D and education, have seen large multinationals return, and, more important, have turned out products and services higher on the value chain. Today, investment is going into higher-level jobs in pharmaceuticals, biotechnology, and digital media. In contrast, countries like Poland, not long ago an attractive location for foreign investment, are beginning to lose their share of FDI owing to weak marketing capacities and their failure to “sell” their sources of competitive advantage.

The example of Ireland highlights three main issues of pragmatic innovation as self-discovery: the first-mover problem, the critical mass problem, and the restructuring problem.

The “First-Mover” Problem. Change invariably starts with first movers (firms and other actors), those who are the first to recognize and capture new opportunities, such as Dell in the case of Ireland. In countries with weak institutions and low knowledge endowments (low-income economies), a central problem is to find first movers able to demonstrate what can be achieved in spite of obstacles and a sometimes hostile institutional environment.

The Critical Mass Problem. Scaling up and learning from the experience of first movers and pilot projects require creating critical mass by building constituencies for reform and change. This effort involves raising awareness among key groups of what is at stake and making a strong case for the need for reform. In addition, a coherent governance structure must be institutionalized to ensure coordination among the various private and public agents. Top-down vision and leadership, implementation, and follow-up are elements of success. All of these were necessary to achieve the serious investments in R&D and education in the Irish example.

Two analytical constructs drawn from management science have proved particularly useful in aggregating and scaling up first movers: clusters and supply chains, also known as value-added chains. Innovation clusters (see chapter 10) are groups of firms, research centers, and universities that conduct knowledge-intensive activities and cooperate to achieve economies of scale and scope. A value-added chain (see chapter 9) is the full range of activities required to bring a product or service from conception and design, through the different

phases of production (involving a combination of physical transformation and the input of various producer services), marketing, and delivery to final consumers. It is usually defined for particular products (automobiles, electronics, garments, pharmaceuticals), and it typically crosses industries. Each stage of production is much more closely linked with upstream and downstream industries on the value chain than with other producers in the same industry. The two concepts share the view that economic activity is not coordinated solely by means of signals generated by an impersonal marketplace but that such activity also involves direct coordination through face-to-face communication.

The critical mass problem is important for countries with intermediate knowledge endowments and institutional capabilities. It is particularly acute in large middle-income countries such as Argentina, Brazil, and Mexico in Latin America and in Eastern European economies.

The Restructuring Problem. Restructuring requires the identification of new innovation domains (innovation clusters and value chains). As many countries have discovered, successful innovation clusters (such as the forestry cluster in Finland or the garment and furniture clusters in Italy) or value chains (such as the electronics supply chain in Ireland) do not guarantee success. Even highly innovative clusters can decline as new and more successful competitors emerge. Here, this restructuring is considered in the light of a search for new innovation domains. Understood in this way, the problem is faced almost entirely by economies with advanced innovation capabilities.

Diversity of National Innovation Agendas

Because the self-discovery process considered here is closely related to specific institutional circumstances, the strength and sophistication of public and private institutions are one variable that pragmatic agendas need to take into account. Institutional endowments, however, are hard to measure, and very imperfect proxies are used. Another variable is a country's knowledge endowments, comprising education, innovation, and information technology (IT) (measured, roughly, by the knowledge economy index; see chapter 7).

In what follows, these two variables are used to arrive at a taxonomy of pragmatic innovation agendas. In the short run, a pragmatic policy agenda considers, on one hand, the country's level of technology and, on the other, the conditions of private sector development, and, based on those seeks a functional fit between a country's knowledge and its institutional endowments. For instance, Argentina and the Russian Federation have a paradoxical combination of weak institutions and relatively high knowledge endowments. To achieve a functional fit between their knowledge and institutional endowments, they may need to adopt somewhat untraditional institutions. In the long run, the pragmatic agenda becomes a self-reinforcing virtuous cycle of simultaneous enhancement of institutional and knowledge capabilities.

The Republic of Korea's transformation from a system of crony capitalism at the beginning of the 1960s (and abysmally low endowments on both counts) into an emerging innovation leader is an example of such a virtuous cycle.

The following discussion distinguishes three levels of technology development and three levels of institutional development. The evolution of technology (table 8.1, vertical axis) is reflected in the familiar distinction (de Ferranti and others 2003) between technology adoption (appropriate for low knowledge endowments), technology adaptation (for intermediate knowledge endowments), and technology creation (for the high knowledge endowments). Little technological capability exists at the technology adoption stage (Central America except Costa Rica, for example, and Sub-Saharan Africa).

Table 8.1 Diversity of Pragmatic Innovation Agendas

Level of innovation and human capital capabilities	Strong investment climate and institutions	Tolerable and improving investment climate and institutions	Poor investment climate and institutions
	Decision-making horizon		
	Long term	Medium term	Short term, survival
High Technology creation	Innovation leaders agenda: <ul style="list-style-type: none"> • Development of proprietary technology through promotion of innovation clusters • Examples: Finland; Ireland; Israel; Republic of Korea; Portugal; Singapore; Spain; and Taiwan, China 	Critical mass agenda: <ul style="list-style-type: none"> • Increase of value added of natural resources wealth and technology commercialization • Example: Russian Federation 	<ul style="list-style-type: none"> • Leveraging pockets of dynamism • Examples: Argentina (1990s), Belarus, the Islamic Republic of Iran, Russian Federation (1990s)
Medium Technology creation and technology adaptation	—	Critical mass agenda: <ul style="list-style-type: none"> • Development of innovation clusters and high value-added supply chains • Examples: middle-income economies of Latin America (Argentina, Brazil, Chile, Mexico), Asia (Malaysia, Philippines, Thailand), Eastern Europe, and South Africa 	—
Low Technology adoption	Creation of knowledge endowments: <ul style="list-style-type: none"> • Making investments in higher education and technology adoption • Examples: oil-rich Gulf countries 	"Exports as a springboard" agenda: <ul style="list-style-type: none"> • Development of nontraditional exports as entry point for institutional and technology development • Examples: Bolivia, Central America (except Costa Rica), rural regions in India and China, Kazakhstan, Republic of Korea in the 1960s, Mauritius, Mexico in the 1970s, Pakistan, Paraguay, Vietnam 	Institutional context agenda: <ul style="list-style-type: none"> • Creation of basic institutional infrastructure through a diversity of entry points • Creation of demonstration effect to show that innovation does matter, in particular in health, education, agriculture, and crafts • Examples: most of Sub-Saharan Africa and most Central Asian states

Source: Author.

In contrast, at the technology creation stage, a critical mass of national science and technology (S&T) capabilities is relevant or potentially relevant for business (the Asian Tigers and Russia, for example). Between these extremes, the technology adaptation stage is characterized by a critical mass of qualified engineers and technical staff (advanced Latin American and post-Socialist economies: Argentina, Brazil, and Mexico; Eastern European countries that recently joined the European Union; and Ukraine).

In terms of institutional endowments, a distinction can be made between strong and weak links within the innovation system, using the share of business R&D in total R&D as a proxy. In an efficient innovation system, the business sector takes the lead in R&D financing and execution (Asian high performers, for example), while in a dysfunctional innovation system R&D is performed by the public sector (such as in post-Socialist and post-import-substitution economies). Countries with extremely weak institutions, in particular public sector institutions (table 8.1, col. 4), are a special case. Here, the binding constraint is a difficult and often unpredictable investment climate (as in Belarus and the Islamic Republic of Iran, or in Argentina and Russia in the 1990s), which supersedes any other considerations.

The planning horizon of business sector actors is a good proxy for the quality of institutions. Poor institutions are correlated with a short-term planning horizon and survival. Strong links in the innovation system are correlated with a long-term decision-making horizon; concerted action—interorganizational links—rarely pays off in the short run. The medium-term planning horizon is correlated with a system that lies between the two extremes. Table 8.1 illustrates seven broad policy agendas that help show the diversity of circumstances under which countries construct their self-discovery of innovation agendas. The table simply aims to give a sense of the variety of possible approaches. The first three policy situations focus on moving exceptions, or potential first movers (which exist but are isolated), into the mainstream. The remaining situations all focus on the first-mover problem: facilitating the emergence of exceptions—pockets of excellence and dynamism in a hostile environment—to provide an example to follow, scale up, and diffuse. The specific nature of such first movers differs. When both knowledge endowments and institutions are rudimentary, the first movers are institutions of excellence in education and public service delivery. When the institutional environment is better, first movers are export-oriented firms, like those that initiated the radical transformation underway in China and Vietnam. Finally, the peculiar situation that combines a long-term planning horizon with low knowledge endowments (oil-rich Arab economies) calls for a first-mover agenda in higher education, innovation, and IT.

Critical Mass Agenda: Developing Innovation Clusters and Value Chains. The critical mass agenda applies to countries that have technical capabilities (engineering and applied research) and export-driven manufacturing

and natural resources, often as subsidiaries of multinationals. They include most of the Eastern European post-Socialist economies (such as Poland or Hungary), large Latin American economies (Argentina, Brazil, Chile, and Mexico), emerging Asian Tigers (Malaysia and Thailand), and advanced regions of China and India. In these countries, human capital costs are relatively high. They are often squeezed between the lower-cost technology adoption countries and the more advanced economies of the Organisation for Economic Co-operation and Development (OECD). The sense that they are at a turning point is strongest in higher middle-income countries such as Chile, Hungary, Mexico, and Poland. They have isolated pockets of dynamism and innovation, illustrated by the phenomenon of developing country multinationals, firms from developing countries that expand abroad on the basis of their innovation capabilities (Techint, a steelmaker in Argentina; CEMEX, a pioneer in just-in-time cement production in Mexico; and Infosys, the information processing paragon in India). While these pockets of innovation signal the country's potential, they remain exceptions. This situation makes the issue of links (value chains and clusters) a central focus of the policy agenda.

This policy diagnosis is not new. Virtually all these countries recognize the fragmentation of their innovation systems and their failure to develop links on the basis of innovative “first movers” as a central problem. They have tried many approaches and adopted most best practices. These practices are rich and diverse: a supplier development program to promote value chains (exemplified by the Irish program) and a variety of innovation sites (technology incubators, business development centers, innovation zones, and so on, as noted in chapter 10). A long process of policy learning and experimentation has revealed the same amount of heterogeneity and internal diversity in the performance of innovation programs and policies as in the performance of firms. A few are successful, but most do not effectively address the central problem of the fragmentation of actors in the innovation process. It is quite easy to develop sites and much more difficult to articulate innovation networks. Technology incubators—which rent office space to technology start-ups and provide business development services—are widespread, but very few succeed in developing vibrant early-stage networks that help techno-entrepreneurs develop the managerial, technical, and financial skills they need to grow their fledgling start-ups.

As a result, policy makers in these countries suffer from “recommendation fatigue”: they have seen and tried almost everything available, generally with disappointing results. They realize that copying best practices does not work and that they need to adapt “promising practices” more creatively in local institutional contexts. They are discovering that they have to embark on the self-discovery process.

Given the accumulated stock of programs and policies, a policy priority should be to recombine industrial capital, human capital, and policy assets.

The notion of recombination proceeds from an observation that a wealth of industrial assets, talent, and public programs is already present (Gu and Steinmuller 1996; Stark 1996). The priority is to make sense of what exists by recombining the viable assets into sensible programs rather than to invest in new assets and programs.

This objective implies drawing upon the variety of existing small and medium enterprises (SMEs), R&D, labor retraining, and innovation programs to make them work together toward a common goal with clear performance benchmarks. Ireland's National Linkage Promotion Program (box 8.1) is an example of such a framework program: it is not just another business development program but a program that draws upon and taps into existing programs. It encourages links among programs and facilitates changes in them by making the main actors the beneficiaries and providing clear feedback loops to detect and correct errors. If, for instance, a large share of the potential SME suppliers chosen to participate in the program fails to become actual suppliers, something is wrong both with the framework program and with the support programs on which it depends. At that point, all relevant stakeholders must come together to deal with such problems, a practice not generally adopted by SME and innovation programs. The issue of framework programs will be addressed in more detail in the section on creating a conducive framework.

The aspect of the agenda that addresses moving up the value chain and making the transition from global sourcing to proprietary knowledge presents two quite different cases. Most of the countries concerned have very dysfunctional innovation systems and a business sector that performs little R&D. They need to recombine their technological capabilities and capitalize on them to create wealth. Increased public R&D spending is valid only if it translates into business R&D. This is rarely the case. In Thailand and Malaysia, however, as in Finland and Ireland in the 1980s, innovation is fairly efficient, but knowledge creation is weak. In such a case, an increase in the public R&D budget may be advisable.

Often the agenda for reaching critical mass is purely institutional. India boasts emerging innovation clusters and vibrant equity finance; yet seed and early-stage financing for technology start-ups is in its infancy. Therefore, the government put in place an ambitious fund-of-funds program to encourage private venture funds to consider smaller projects that are more risky and involve high transaction costs. Brazil, Chile, Mexico, and Russia are also experimenting with such programs to promote techno-entrepreneurship. The general principles behind these programs are similar, but each is structured pragmatically to reflect local circumstances.

Critical Mass Agenda: Leveraging Natural Resources and S&T Endowments. While all the characteristics of the critical mass agenda described above apply to Russia, its self-discovery process, involving the construction of innovation

clusters and value chains along with the supporting institutions, is something of a special case. Russia has unusually high endowments of both natural and S&T resources. Although the latter have deteriorated significantly in the past 18 years, the federal government is attempting to enhance and restructure them. This combination is not easy to manage, because it calls for a “double transformation.” On the one hand, the country needs to commercialize its S&T capabilities in products and services valued by the market (development of clusters), and on the other hand, it needs to develop value chains to move toward greater processing capacity and more value added from natural resources. Russia is not unique in this respect. The export structure of Australia, Canada, New Zealand, and Norway is dominated by primary resources.¹ Yet each of these countries diversified backward into capital goods and higher education to become world leaders in mining and oil management, capital goods production, and higher education for the primary resource sector. Finland, with its world-class forestry cluster and a cluster of firms around Nokia, is a model of success in this respect and Russia’s neighbor. Inspiring as they are, though, these countries are of little immediate relevance for Russia’s self-discovery.

What makes Russia different is the combination of high endowments and weak institutions. The legendary success of Tekes in Finland and similar examples of focused action are irrelevant to policy action in Russia today. Rent seeking is so pervasive and so creative that coordination devices that have proved helpful elsewhere—such as interministerial innovation councils—easily degenerate into cartels or into forums where each agency defends its turf rather than developing joint agendas for action.

At a subnational level (Novosibirsk, St. Petersburg, and Tomsk), innovative start-ups and promising innovation programs and initiatives to support them do exist (see box 8.2). Yet these firms and programs remain exceptions. The federal government, which recognizes that isolation and lack of knowledge sharing by local institutional experiments are a major problem, has instituted a grant scheme to encourage drawing lessons from these initiatives and sharing promising practices at the local level.

Critical Mass Agenda: Leveraging Pockets of Dynamism. When the gap between fairly strong knowledge endowments and unusually fragile and unpredictable institutions is large, the challenge is to leverage pockets of dynamism. Countries in this situation are countries in decay, characterized (at least until recently) by the flight of both human and financial capital. In the 1990s, Argentina, Armenia, and Russia were examples of institutional instability. Today, this is the case in Belarus and the Islamic Republic of Iran.

As for innovation performance, the picture is not uniformly bleak. Some highly successful innovation-based companies are first movers. For instance, EPAM in Belarus is an information-processing firm that now boasts more than 3,000 employees, with offices in Hungary, Russia, and the United States.

Box 8.2 Turning Scientists into Entrepreneurs: Moscow University's Science Park

Moscow University's Science Park was established in 1991, as a joint venture of Moscow State University, the Russian Ministry of Science, and the private sector. More than 30 companies in software development, laser technology, and biotechnology currently work in the park. These firms benefit in several ways and are also shielded from interference by the state because inspectors harassing the firms had to deal first with the park's administration.

They also benefit from a clustering effect through their access to the university's human capital and R&D. Synergy among tenants has also been beneficial: communication between seemingly unrelated tenants has produced at least two new commercial ideas. The park also provides access to modern telecommunications, including a satellite teleprompter, and office infrastructure.

Business development services appear to be less important to park tenants. Those services are mainly available through private service providers, a practice consistent with international best practice. The park does not provide financing to tenants.

The park evolved in stages. Initially, Russian start-ups moved in. These firms generated interest among foreign investors, with whom they formed joint ventures. This foreign direct investment helped the park expand. Global companies came as both shareholders in the park and cosponsors of its expansion. The park's third office facility, for example, is being constructed jointly with Samsung, and Intel plans to cosponsor a contest for the best commercial idea.

The park's success is due to several factors, but especially strong leadership and incremental growth. Rather than beginning with a single grand project, the park's leaders started small and established credibility. Only then were they able to attract brand-name tenants and investors.

Source: Author.

It aspires to become the next Infosys and has the growth dynamics to do so in the long run. How does the firm not simply survive but grow rapidly in such an unstable institutional environment? The main reason is that it was "born global," created by a Belarussian emigrant living in New York who appreciated the creativity and problem-solving skills of Belarussian engineers and software developers. "Born global" innovation-based growth was pioneered by Israel, among others, to overcome the constraints of an inhospitable and often hostile investment climate and firms' lack of marketing skills. Under this strategy, only R&D and production are carried out in the problematic country, while marketing and access to finance take place overseas. The same strategy is now applied, or rather is being rediscovered, by nascent firms in other countries with difficult environments.

The issue for these countries is to leverage existing pockets of dynamism through science and technology parks, technology incubators, and other bridge institutions to help entrepreneurial individuals articulate their vision. These countries' policy and institutional experimentation may be quite

intense and diverse, but it is often parochial and isolated from relevant experience elsewhere in the world. Few know, for example, that the Islamic Republic of Iran boasts an early-stage venture capital program to support techno-entrepreneurship. It is a tiny but reasonably structured and quite commendable initiative; yet the relevant officials seem to be unaware of similar initiatives in almost all middle-income countries, including Armenia, India, and Russia. Thus, although self-discovery is occurring, it is strikingly isolated. Not only is the wheel being reinvented all the time (to a certain extent, that is the essence of self-discovery), but also there is little awareness that others too are reinventing the wheel. Openness to promising worldwide practice is a priority for these countries. By implication, multinational organizations can help improve the institutional environment in these countries by more actively incorporating them in South-South networks for sharing relevant and promising practices.

Emerging Innovation Leaders Agenda. Emerging innovation leaders is an agenda for countries as diverse as Ireland, Italy, the Republic of Korea, and Spain. As examples of successful and recent catch-up, these countries need to strengthen their R&D by investing more in fundamental and applied research and advanced human capital. Since an extensive literature addresses the restructuring of innovation systems in OECD economies, this subject is not addressed in detail here. Suffice it to say, the restructuring of and search for new innovation domains can be quite a daunting policy challenge. As semi-industrialized economies such as Brazil and China advance their innovation agendas, they become increasingly formidable competitors of established and sophisticated innovation clusters in OECD economies. The focus of this agenda is on restructuring and searching for new innovation domains to ensure higher value added and raise the population's standard of living.

Institutional Context Agenda: Nurturing Actors to Become Levers for Change. To spur growth and innovation, the countries of the "bottom billion" (Collier 2007)—that is, the poorest billion people living in mostly landlocked countries with very weak institutions, including most of Central Asia and Sub-Saharan Africa—need government intervention most. Yet these are precisely the countries in which institutions are the weakest, a context in which any intervention is likely to fail. An "infernal trap," a low-level equilibrium that blocks both technological and institutional learning, is often the consequence.

A central problem of these countries is a pervasive body of entrenched interests. To deal with this problem requires actors sufficiently well acquainted with the institutional context yet not dependent on those interests. Such actors can become levers for beginning the transformation of this difficult institutional environment in order to escape the low-level trap. Successful

diaspora members can often serve as such levers (see box 8.3). On the one hand, as natives of the country, they have a good understanding of the institutional reality. On the other, they do not depend on rents from natural resources or a government position and are consequently not dependent on entrenched interests.

Box 8.3 Diaspora Member Creates First-Mover Institution in Tertiary Education

After living in the United States for nearly 20 years, Patrick Awuah moved back to his native Ghana to start a new university to educate Africa's next generation of leaders. Awuah had left Ghana in the mid-1980s, when the country was under military rule. He graduated from Swarthmore College with an engineering degree in 1990. Soon after, he joined Microsoft, moved to Seattle, and became a millionaire before he was 30. Having achieved economic well-being, a solid reputation, and a fulfilling family life, he decided to relocate to Ghana. When asked about his motivation for returning to Ghana, he mentioned the birth of his son: "Having a son caused me to reevaluate all my priorities," he says. "This was something that was eating at me. What kind of world is it that my son is going to grow up in? And how is Africa represented in that world?"

His goal was to establish a university of Ivy League quality in his home country and train the next generation of African leaders, with a focus on ethical entrepreneurship and integrity. Awuah used his U.S. contacts and his professional knowledge to develop and assess his business plan. He found a team of University of California, Berkeley, MBA students and management consultants to conduct a feasibility study. He and his family invested more than half a million dollars in the Ashesi project and another US\$4 million more through private, U.S.-based networks, including former colleagues at Microsoft, private corporations, and foundations.

Ashesi is a private university in a leafy residential suburb of Ghana's capital city, Accra. Its campus and facilities present a stark contrast to Ghana's five public universities, where enrollment has soared to 65,000 since 1990 and where overcrowded lecture halls, substandard student residences, rising tuition fees, and poor staff salaries have led to angry protests and frequent strikes. However, tuition at public universities is also much cheaper than the US\$4,500 in fees that Ashesi charges.

Ashesi has small classes, well-trained and well-paid staff, and international partnerships with top-tier universities such as New York University and with the Council on International Educational Exchange. About 80 percent of the university's students are from Ghana. The rest are from other nations in Africa. About half the students receive financial aid. In 2005, four years after enrolling its first crop of freshmen, Ashesi issued its first diplomas to a graduating class of 20 students. Ashesi offers two four-year degrees, in computer science and in business administration, both of which also emphasize a broad foundation in liberal arts. As one student described the experience,

You're like raw gold. The school is like a furnace. The heat from all the courses, from the professors, from the projects that you undertake—you come out as a refined substance, you come out glittering. You dream beyond your world.

Source: Author.

Entry points in this situation need to be both diverse and modest: *diverse* to make up for the likelihood of many failures and *modest* to minimize the costs of failure. In this context, interventions such as export processing zones, microfinance initiatives, distance learning-based training initiatives, and the like are akin to a venture capital portfolio in which most initiatives are expected to fail. Yet development returns from those that succeed compensate for the many that fail. The low-level trap of stalled institutional learning is discussed in more detail in the later section on institutional framework.

Exports as a Springboard Agenda. Countries and regions with stable enough institutions may use exports as a springboard agenda, as they transform low unit labor costs into marketable products and services. This is a well-known strategy, owing to the highly visible successes of the East Asian Tigers and Japan. Exports and export growth are a natural benchmark for open-ended pragmatic measures and policies, and export growth provides a clear and unambiguous feedback loop between innovation policies and outcomes. Countries as diverse as Armenia, Bangladesh, and Vietnam are successfully pursuing this innovation agenda.

Export processing zones (EPZs), which provide a more stable environment than that in the rest of the country, are one policy instrument of this agenda. However, they are often ineffective and are rightly criticized for distorting incentives and inviting fraud and corruption. Yet EPZs can be designed in many ways. The traditional design is a territorial enclave whose implicit objective is to minimize interactions with an unpredictable, unstable, and corrupt domestic economy. Second-generation EPZs have been successfully piloted in African countries (Madagascar, Mauritius) and offer an incentive regime for all exporters in the country to expand the market-friendly framework to the entire economy. They include a substantially reduced tax and regulatory burden and light, nondistorting assistance. Such an incentive regime also produces a constituency for reform, consisting of first movers and others who benefit from enhanced private sector dynamism. This constituency is likely to push for further reform, including the reform of enterprises outside the EPZ.

Knowledge Endowments Agenda: Creating First-Mover Institutions. Oil-rich economies in the Persian Gulf have strong institutions (in the sense that they have a long-term strategic planning horizon for decision making), yet very modest knowledge endowments. Hence, their agenda is to leverage oil revenues to create internationally competitive higher education and R&D organizations. The first priority for Gulf countries is to build a few organizations of excellence, if only to reduce their dependence on imports of human capital (from India and other economies).

Self-discovery is very intense in these countries. New organizations are created with lavish funding, and intense knowledge transfer is underway, as some

of these new organizations are almost entirely staffed by foreign experts. However, there is too much adaptation, even replication, of best practices from elsewhere rather than true self-discovery in the sense of experimenting with novel, yet existing institutional features that reflect the local culture. The innovation agendas of these countries provide a curious mirror image of countries in self-imposed isolation such as the Islamic Republic of Iran. Whereas the latter are strikingly original in their reinvention of the institutional wheel, the oil-rich countries shun or downplay institutional experimentation. They are prepared to pay whatever price is necessary for the best experts and best global practice, assuming, at times naively, that best practice will remain just that in any context.

Table 8.2 offers Saudi Arabia suggestions of possible paths for building indigenous innovation capabilities. Saudi Arabia can buy technologies from abroad, improve domestic ones, develop joint ventures with foreign partners, or develop its indigenous R&D. Specific actions can help these different options, which are not mutually exclusive, take concrete form.

Structuring the Self-Discovery Process: The Subnational Dimension

The heterogeneity of both private and public sectors has two crucial policy implications. The spatial differentiation of economic activity, typically linked to industrial specialization, means that a focus on national indicators and institutions can obscure critical transformations occurring at a subnational level. Likewise, the state, in developing as well as in developed countries, is not a unified whole. Rather, it consists of multiple, differently organized units with varying political and economic resources, jurisdictions,

Table 8.2 Possible Innovation Paths for Saudi Arabia

Strategic option	Possible policy action
Improve: improvement of existing products by adding new features and value-added services	Put in place a multiskilled and multi-industry support group to help Saudi industrials make minor innovations that generate big rewards.
Research: support for Saudi research and breakthrough innovation through regional and national funding as well as private research conducted by Saudi industrials	Develop an innovation scheme to promote public-private partnerships and industry-university collaboration, focusing on funding of seed stage for potential niche research topics.
Venture: Saudi industrial venturing by sourcing entrepreneurship ideas providing incubation, and building innovative prototypes that could become successful products on the international markets	Support entrepreneurship through national awards, and support projects at the seed stage with appropriate grants.
Buy: purchase of corporate external venturing through capital investment (as done by the Gulf Venture Capital association within the Gulf countries and through mergers and acquisitions)	Link with global value chains through foreign direct investment, and encourage application-oriented research (e.g., the recent agreement between KACST and IBM).

Source: World Bank Institute 2008, adapted from Chebbo 2008.

Note: IBM = International Business Machines; KACST = King Abdul Aziz City for Science and Technology.

and interests. As a result, economic and institutional change begins in certain locations or domains and advances through partial and incremental (microlevel) reforms that only aggregate into larger-scale transformations over time.

Successful innovation performers are said to be sociocultural islands: homogeneous and, by implication, relatively small national economies (such as Denmark; Finland; Ireland; Israel; the Republic of Korea; Norway; Sweden; and Taiwan, China) are said to be important predictors of growth and performance (Aubert and Chen 2008). The insight here is that similar “islands,” such as Bangalore, also emerge in a highly diverse economy and that the reform process is largely a matter of building bridges from them to the rest of economy. Only by disaggregating innovation policies and their interactions with (parts of) the equally differentiated public and private sectors is it possible to see whether and eventually how these policies can rebuild institutions for economic development. This is the first of the two implications mentioned above. Incremental microreforms capable of reshaping institutional frameworks and triggering growth and reforms are the subject of the section on institutional frameworks.

A flexible, decentralized policy process that takes the diversity of circumstances into account is needed. National innovation policies often fail because they are too crude and general to be relevant to economic actors with widely different interests and capabilities. In contrast, a decentralized innovation system envisions new and varied roles for federal, state, and local authorities and for civil society.

The following recommendations are directed toward a clearly decentralized context in which the subnational level has sufficient autonomy and the federal government is active:

- *Subnational level.* Piloting of new innovation initiatives (entry points) at the state and regional level that (a) grow out of discussion and debate within civil society; (b) draw upon active participation of the private sector in financing, conception, and operation; and (c) build in mechanisms for evaluation and improvement in light of the state’s own experience, experience elsewhere in the country, and experience abroad.
- *Federal level.* Continuous monitoring, evaluation, and technical assistance to state-level initiatives that (a) consolidate existing programs; (b) make demand by the states and private sector clients the driver of federal programs; (c) ensure flexible federal budgeting, capable of adapting to demand and building upon experience, and mix federal funds with those of other sources; (d) build in mechanisms for evaluation, for identification of best practices at the state level and for collecting, evaluating, and disseminating international experience; (e) incorporate feedback from the states to improve federal instruments continuously; and (f) attract top-caliber

talent to promote and facilitate the planning process, to administer the operating program, and to guide experimentation and evaluation.

- *Civil society.* National process of vision building and construction of shared agenda for change that puts into practice the new decentralized incentive framework to promote innovation using altogether three approaches: matching grants, benchmarking of the business and innovation environment, and competition for federal funds.

Matching Grants. Under this principle, the central government agrees to match every dollar, up to a certain limit, that subnational governments dedicate to innovation and economic development projects, decided in collaboration with private actors, on the condition that those actors match the subnational contribution as well. The idea is simply that if the regional government and economic actors are willing to put their own money at risk in financing the projects they define together, the national government can assume that their choices are well considered and should back the project as well. The advantage of this method is to impose some discipline on project selection with little or no increase in red tape. The regional economic actors, public and private, have an incentive to sort through their priorities—and identify potential problems—and the national government acts only to ratify their provisional decisions as they emerge.

Benchmarking of the Business and Innovation Environment. This approach also aims to discipline project selection while holding bureaucracy and the politics of clientelism generally in check. But it does this not by ratifying actors' decisions but by providing information on economic performance that causes them to reflect on their possibilities in new ways. The provision of this crucial information can take place through the creation of a so-called league table of regional economic performance that covers several topics:

- *Business registration*—costs (for all areas, including time, formal and informal types of payments and contributions, including bribes), procedures required, delays
- *Business licensing*—numbers and types of licenses required, cost, time, and payments required
- *Acquisition of business premises*—procedure, costs, constraints, and delays
- *Business inspections*—types (and agency responsible), costs, number, and process followed.

Competition for National Funds. The main feature of this approach is competition among subnational entities for national funds for innovation and economic development. The entities would receive the funds based on the quality of their proposals, so that excellent proposals would have more funding than

less compelling programs. A national public-private innovation council would grade the quality of the proposals. Proposals would share their strategies so that even losers would gain knowledge. Administration of such a competition may require the ability to make impartial project selection that may not be readily available. In this case, this would not be an immediate option but a possibility to consider for the future.

Promising and best practices that have emerged recently tend to be a combination of these three approaches. For instance, sectoral funds for innovation receive government funding for research on the basis of matching-fund contributions from private sector and subnational government and, of course, on the basis of the quality of the proposals. Funding for science proposals is administered as a contest, in which the main criterion for winning is demonstration of interorganizational links, such as university-industry connections. Such contests can be quite elaborate. An initiative to establish innovation and technology zones in Russia, for example, started with a contest between subnational entities that took into account all three criteria (matching contributions, prior performance, and quality of the proposal). The selection process was difficult, as only four proposals were chosen out of dozens submitted; yet as long as decisions are transparent and credible, such procedures stimulate local creativity while working to meet national innovation objectives.

How to Create a Conducive Institutional Framework: The Virtuous Cycle

Creating an institutional framework conducive to innovation is not, in general, something that can be made through a clear blueprint rigidly prepared in advance and then closely followed. It is more a search process that begins with microreforms—well designed and conducted—that lead progressively to virtuous circles.

Reshaping an Institutional Framework as a Search Process

Conventional economic development focuses on endowments: with an appropriate endowment (good institutions, good investment climate, cultural dispositions, property and trade laws, rule of law), economies grow. Those that lack such endowments do not grow. But the surprising frequency of spontaneous growth episodes in “poorly” endowed economies, the sharp disparities in regional development within national economies subject to the same general rules, and the periodic successes of economies that change their institutional endowments by growing (China) rather than by fixing endowments to grow, all strongly suggest fundamental flaws in this all-or-nothing view of endowments.

This section develops an alternative view, according to which the institutional framework is necessarily changed through the implementation of innovation programs and policies. The challenge is to monitor this institutional change on a microlevel and scale it up.

In the case of countries at the advanced technological frontier (such as Finland or the United States), reaching that frontier improves an industry's prospects if subsequent development builds on that frontier. However, a general result of what is loosely called the information revolution—the widespread diffusion of powerful computers and telecommunications networks—is the increasingly unpredictable direction of technological development. The easier it becomes to explore technological frontiers and to survey results across these frontiers, the greater the chances of multiple, competing solutions to any given problem, each better on some dimensions than the others, but none dominant on all. Hence, one good solution cannot be expected to lead, by a natural progression, to another. In other words, the more knowable the world as a whole becomes, the less confident one can be about the kind of knowledge that will prove useful in engaging its parts.

By the same token, the more development depends on applying knowledge from domains traditionally unrelated to an industry's core activities, the less meaningful the very idea of a technological frontier—it *is everywhere and nowhere*—and the less confident one can be that leadership today guarantees leadership tomorrow. In these circumstances, it may well be more important to be able to search effectively across domains than to dominate the generation of ideas and technologies in any one of them. The decline of the centralized corporate research laboratory (in which stable project groups could pursue a line of research for a decade or more) and the rise of the ad hoc research consortium (which brings together expertise from previously separate domains) is one widely noted result of this transformation. This transition is one example of a changing institutional framework for innovation in advanced settings.

At the other end of the spectrum are countries with highly dysfunctional institutions and low knowledge endowments. Most are in Sub-Saharan Africa, where almost nothing works effectively. Interventions and policies tend to fail because of interlocking institutional traps: pervasive problems with security (strife and civil wars), high costs of access to ports, and other binding constraints. Here again, finding solutions requires cutting across several domains and thinking outside the box, experimentally, and innovatively. Even then, as Collier (2007) notes, most policies are likely to fail, simply because the institutional environment is so difficult and the constraints are so numerous and interlocking. Few interventions succeed; the institution of higher education in Ghana described in box 8.3 is one that did. In a dysfunctional environment, what is needed is a venture capital perspective on institutional formation: a search for ideas in different domains, innovation and experimentation, and an understanding that most projects will fail yet the few that succeed will provide a development payoff that counterbalances the failures. As Collier (2007) remarks, governments and development businesses are extremely risk averse, failure is discouraged and perceived as a mistake, and learning by experimenting is alien to the development bureaucracy culture. Yet the required search and

experimentation processes needed in advanced settings (near the technological frontier) and in “the bottom billion” are strikingly similar.

In such risk-averse contexts, change comes often from members of diasporas who are not linked to established domestic institutions but have experienced innovation and newness in the course of building a new life in the countries to which they have immigrated. Therefore, members of diasporas can be very effective change agents, as illustrated by Chilean and Taiwanese examples (see box 8.4).

A pragmatic agenda for change often implies focusing on bottom-up entry points (the immediate policy agenda), scaling them up to ensure coordination

Box 8.4 Members of the Diaspora Trigger Changes in Innovation Systems

In 1997, Ramón L. García, a Chilean applied geneticist and biotechnology entrepreneur with a PhD from the University of Iowa, contacted Fundación Chile, a public-private entity charged with technology transfer in the area of renewable resources. García is the chief executive officer of InterLink Biotechnologies, a company based in Princeton, New Jersey, which he cofounded in 1991. After jointly reviewing their portfolios of initiatives, Fundación Chile and Interlink founded a new, co-owned company to undertake long-term R&D projects. These projects are focused on the transfer to Chile of technologies important for the continuing competitiveness of its rapidly growing agribusiness sector. Without García’s combination of deep knowledge of Chile, advanced U.S. education, exposure to U.S. managerial practice, and experience as an entrepreneur, the new company would have been inconceivable.

The fact that skilled expatriates can create enormous benefits for their countries of origin has gained attention in recent years, owing to the conspicuous contributions that the large, highly skilled, manifestly prosperous and well-organized Chinese and Indian diasporas have made to their home countries. García’s collaboration with Fundación Chile, however, suggests that diasporas do not need to be large to produce an impact: 10 similar initiatives could transform entire sectors of the economy in relatively small countries like Chile. Moreover, García’s collaboration with Fundación Chile suggests that even small, informal diaspora networks linking small home countries with their talent abroad have some important institutional resources and may prove capable of developing more.

As of January 2008, García had created three biotechnology firms with Fundación Chile. ChileGlobal, a network of about 100 high achievers of Chilean origin, was established in 2005 to institutionalize contributions that similar efforts can make to the Chilean innovation system. The story does not end here, but rather begins. ChileGlobal recently organized a workshop to promote mentoring between innovation start-ups in Chile and Chilean high achievers abroad. As a sign of recognition of both ChileGlobal and the Chilean diaspora, key participants of the workshop were received by Alejandro Foxley, then foreign minister and vice president. Somewhat unexpectedly, the intricacies of establishing an early-stage venture capital industry became a focus of the discussion. Foxley requested members of

continued

Box 8.4 continued

ChileGlobal participating in the meeting to lead an informal working group that involved public agencies active in this area. The working group is examining issues that need to be addressed in Chile's institutional environment: the focal point is a low-key and highly focused reform effort.

In this endeavor, the Chileans can study (but not copy) the well-known experience of Taiwan, China, with creating an early-stage venture capital (VC) industry. When the Taiwanese government decided to promote a VC industry in the beginning of the 1980s, it had neither the capacity nor a blueprint for doing it. Many were opposed to the idea because the concept of venture capital was foreign to traditional Taiwanese practice, in which family members closely controlled all of a business's financial affairs. Entrenched interests wishing to maintain the status quo were strong. Through intense interaction with the Taiwanese diaspora in Silicon Valley new institutions such as the Seed Fund (with an initial allocation of NT\$800 million, later complemented by an additional NT\$1.6 billion) provided matching capital contributions to private VC funds.

Two American-style venture funds—H&Q Asia Pacific and Walden International Investment Group—were created in the mid-1980s. They were managed by U.S.-educated overseas Chinese who received invitations to relocate to Taiwan, China. Once the first venture funds proved successful, domestic IT firms created their own VC funds. Once those started to pay off, even the conservative family groups began investing in VC funds and the IT businesses.

A search network consisting initially of dynamic and forward-looking members of the Taiwanese government and leading overseas Chinese engineers in Silicon Valley was central to the emergence of a modern VC industry in a country dominated by conservative and risk-averse business groups.^a This network did not have a blueprint; yet it had a role model (Silicon Valley) and a clear idea of what to do next. By defining each step along the road, the network became wider and eventually incorporated skeptics and opponents.

The extension of diaspora entrepreneurs' projects from cofounding joint firms in home countries to cocreating the institutional infrastructure that allows these firms to flourish is a natural progression. The initial objectives of Ramón García and his Taiwanese peers were both modest and specific: to advance their professional interests by setting up technology firms in their home countries. Yet as the constraints of the home country institutional environment became apparent to them, they worked to advance institutional reform to remedy some of the constraints. The successful growth of knowledge-based firms and the creation of an appropriate institutional environment became two sides of the same coin. Innovation entrepreneurship blossomed into institutional and policy entrepreneurship.

Source: Author.

a. A search network is defined as a network for identifying successive constraints and then the people or institutions that help mitigate, at least in part, the difficulties associated with these constraints.

and focused action (the medium-term policy agenda), and then moving on to major reforms (the longer-run policy agenda). The art and craft of policy making are to sequence the various horizons of a policy agenda to achieve a virtuous circle of growth and reforms. A pragmatic agenda is needed to get

around the institutional rigidities faced by many developing economies and to create momentum for change by fostering stakeholder awareness, gaining a consensus on tackling some key obstacles at the national level, and strengthening demand for institutional change. It is then possible to move ahead with concrete, manageable, bottom-up approaches that can serve as demonstration projects to advance the larger agenda. The process starts with microreforms. A framework program can then be used as a vehicle to scale up microreforms to a critical mass. Finally, it may become possible to reshape even national institutions.

Using Microreforms as an Entry Point

As the first section of this chapter argues, the heterogeneity of private and public sectors in developing economies is crucially important yet often overlooked. Also discussed is the considerable spatial differentiation of economic activity. Economic and institutional change therefore begins in certain locations or domains and advances through partial and incremental (microlevel) reforms that are aggregated to become larger-scale transformations only over time. A small example from India illustrates how a microlevel reform can facilitate the matching of collaborators and how reform can diffuse.

In the early 1990s, Indian products were generally suspect because they were considered to be of low quality. Quality problems in software were an important obstacle to collaboration between local suppliers and customers in world markets. In software, the problem was not specific to India. Anticipating this problem, an Indian engineer from the Software Engineering Institute (SEI) at Carnegie-Mellon University traveled to Bangalore to speak to software firms about the institute's recently introduced Capability Maturity Model (CMM) for software engineering process improvement. The core of the model was a process of periodic peer review of development "pieces" to ensure, by ongoing clarification of specifications, that the rate of error detection was higher than the rate of "error injection." Many firms immediately picked up the idea and sponsored conferences and consultations on the topic. By the end of the decade, virtually all large Indian software companies had adopted the CMM. Today, India is widely recognized for its high-quality software development processes; it has more SEI-CMM Level V (the top level) certified companies than any other country (Saxenian and Sabel 2008).

The development of a globally competitive software services and technology industry in Bangalore involved a multiplicity of similar microlevel reforms, both within the cluster and outside it. Such changes occur incrementally, without any guarantee that they will continue. But as the Taiwanese example illustrates, when changes endure, they have the potential to alter the institutional fabric of the economy.

Since microreforms may not continue and may not necessarily be scaled up, they often escape the notice of policy makers. Yet such entry points are

ubiquitous, particularly in countries with a difficult institutional environment. The “born global” start-ups in Belarus and the Islamic Republic of Iran discussed above are examples of such microreform. Born global firms create a search network that adapts global best practice to a local and often hostile environment and involves government along the way. The Belarussian government, for instance, is creating an ambitious IT park as a platform for such firms in the IT area to grow. The Islamic Republic of Iran has more than 100 science park and technology incubators, all providing a micro-environment for start-up firms. The number of such establishments suggests an intention to promote and scale up nascent microreforms.

Such parks and incubators have very heterogeneous performance and quality, and they may remain enclaves in an otherwise unfriendly institutional environment. But, as the example of the Moscow University Science Park in box 8.2 indicates, the best-performing are more accurately described as *exclaves*—extensions of the world economy. Such parks can become a demonstration case for others to follow, but, of course, this does not happen either automatically or necessarily.

Providing an Environment for Microreforms to Flourish: Framework Programs

How can diverse but fragile microlevel reforms be scaled up to the level of clusters and value chains? Economists call this the “mezzo level,” between change at the microlevel and solid reform at the national level. Framework programs provide an environment for microreforms to continue and scale up (World Bank 2001). The Irish National Linkage Promotion Program and the Taiwanese program to create a venture capital industry discussed above are examples of framework programs. Unlike typical government programs or initiatives, framework programs have two distinct features.

First, they start from existing institutions and programs. By linking better-performing segments of private and public sectors, they alleviate institutional constraints and allow the advocates of change to institutionalize their agendas. Both the Taiwanese reform and the Irish linkage efforts were initially viewed with skepticism. Yet they drew on existing organizations and programs and created sustained dynamics (in backward links with SMEs and venture capital funds), which eventually won over the skeptics. What started as a microreform went on to create national change.

Second, by searching for outside-the-box solutions to familiar problems, the institutional framework itself is reshaped. There appeared to be no institutional space for a venture capital industry in Taiwan, China, in the 1980s, so tight was the grip of established large actors (large firms and banks). The institutional framework for venture capital emerged on the organizational periphery as several venture funds. The institutional framework for a venture capital industry and the venture capital industry itself emerged simultaneously, in a dynamic virtuous circle.

Development of China illustrates how framework programs can lead to deep institutional reform. By 1980, China had developed a massive but largely incoherent R&D system. The reform program initiated in 1985 consisted of two framework programs to encourage microlevel reforms and experimentation. On the one hand, “technology markets” were established to align R&D institutes with industry needs. On the other, operational subsidies from the government were gradually reduced. Various forms of autonomy were introduced in R&D institutes (in terms of personnel, research projects, and acceptance and use of contractual fees). The technology markets, which were central to the initial programs, have largely failed. Both buyers and sellers had difficulty engaging in market transactions. Buyers were not able to absorb the transferred technology, and sellers of technology could not earn enough to secure their R&D institutes because the market was too small.

In response, in 1987 policy reform began to promote the merger of R&D institutes with existing enterprises or enterprise groups. This effort was again largely a failure. Huge gaps between the disparate parties, owing to differences in work culture and administrative affiliations, were hard to overcome. Yet budget constraints arising from the drastically reduced subsidies to R&D institutes (the second prong of 1985 reform) opened a policy space for a variety of spin-offs. First, individual scientists and engineers created spin-offs from their parent R&D institutes. These ventures were later followed by organizational spin-offs. In 1988, the Torch Program was launched to encourage spin-off enterprises, called NTEs (new technology enterprises), from existing R&D institutes and universities. NTEs became an institutional vehicle for bringing together the most dynamic segments of the R&D establishment: R&D institutes, universities, S&T staff, and local governments. Local governments invested in new and high-tech industry zones as support institutions for NTEs. Scientists and engineers, often with the support of their parent institutions, developed commercial applications of their inventions and expertise.

The Chinese strategy simultaneously freed up a policy space for dynamic new elements to emerge (from this perspective, the draconian reduction of subsidies was the key, as it created a motivation to search and experiment) and took explicit measures to encourage diverse pilots and organizational spin-offs. This strategy worked well because it was almost ideally suited to leveraging the tremendous heterogeneity of the Chinese economy and innovation system.

Gradually reducing subsidies to existing players freed up policy space and motivated dynamic segments of the system to search for new solutions and approaches. Explicit measures to promote spin-offs created and institutionalized search networks—networks of diverse individuals and organizations looking for new solutions. In the case of NTEs, search networks brought together federal government officials (who monitored the results of the experiment), industry, R&D institutes, and local governments, which

contributed critical resources such as high-tech industry zones but also reaped rewards of high growth. The result was “double transformation”: high growth due to self-discovery and diffusion to new segments of the economy and reform of the established institutional structures. A double transformation generates a diversity of gradual step-by-step reforms that can lead to extraordinary changes.

Another example of double transformation, taken from the other end of the heterogeneity spectrum, is the transformation of rural industry and the role of the Spark program (see box 8.5). The cascade of institutional changes begins in the 1970s with an agricultural reform that recognized peasants’ control over the plots they currently worked and permitted them to sell, at market prices and for their own account, any surplus above target levels. The result was a sustained increase in agricultural productivity and a rise in rural incomes. In the 1980s, another wave of reform allowed for investing the proceeds of agricultural improvement in town and village enterprises (TVEs): manufacturing firms, owned by municipalities or co-owned by them and private parties, that produced for both domestic and export markets. Again, proceeds in excess of tax obligations to higher authorities were retained by the enterprise and available to its stakeholders. The TVEs continued to expand through the mid-1990s, competing with state-owned firms and adding to modest pressure exerted by the central state for their reform. TVEs unleashed creativity at the lower end of the heterogeneity scale in China’s rural industry. Measures to promote search networks to bring together dynamic segments from diverse areas were important (box 8.5).

Further up the heterogeneity scale, these changes were accompanied and accelerated by partial reforms of the financial system and the opening of export-processing enclaves to foreign firms and joint ventures (another example of a framework program to promote microreforms). At the high end of the productivity spectrum, reform of the innovation system through recombination, described above, resulted in a dramatic change.

The outcome of these framework programs to promote self-discovery and experimentation is a profusion of new institutions that create incentives for investment and efficiency-enhancing behavior in domain after domain, without ever creating traditional institutional preconditions such as stable property rights, the rule of law, and the like. China is privatizing state firms very haltingly, has only recently recognized private corporate property as a distinct legal category, and makes little pretense of an independent judiciary.

Creating Frameworks for Change: Strategic Incrementalism

Can other countries learn from China’s experience in harnessing its heterogeneity and creating new institutions, promoting growth, and undertaking reforms?

Box 8.5 A Framework Program to Promote Experimentation in a Rural Setting: The Spark Program

With the emergence of a rapidly growing and dynamic rural nonstate enterprise sector in the early 1980s and with the Chinese government's determination to make more productive use of science and technology developed in China, the Ministry of Science and Technology initiated the nationwide Spark program in 1986. Its overall objective was to transfer technological and managerial knowledge from more advanced sectors to rural enterprises to support continued growth and development in the nonstate rural enterprise sector, mostly town and village enterprises (TVEs), and to help increase output and employment. The program has since spread to virtually every province in the country and has helped develop 66,700 projects and many more individual enterprises within them. Some 20 million people have found employment in rural areas. Possibly the greatest impact has been the increase in annual per capita income of the rural population in the areas where the program has been active. In a TVE in Jingyang County in Shaanxi, for example, per capita income increased almost threefold in five years.

Under Spark, training courses were conducted, and modern training centers were established with up-to-date computer equipment, video production facilities, and language and scientific laboratories. The TVE sector demanded training for rural enterprises, and the Spark training program responded with appropriate teaching methodologies, such as instructional packages and materials, curriculum, and audio and video productions. A computerized technical information system was also set up, with thousands of technical databases for rural enterprises. These networked systems provide technical, economic, marketing, and sales channel information to TVEs. Broadcast-quality videos of Spark science and technology programs were also developed for TVEs and farmers. To evaluate Spark projects in a systematic way, the project offered technical evaluation training to staff in national, provincial, and local program offices and equipped them with analytical techniques and sources of information to allow them to offer quality help to rural enterprises. Another major objective of the program was the diffusion of technical and managerial knowledge from successful projects to nonproject beneficiaries.

The most dynamic segments of China's rural industries are drawn to the program because it increases their productivity and helps them expand. Spark's most successful projects have become pillar industries in their respective "Spark-intensive areas" and have led to vertical and horizontal integration of related industries either in their own localities or in other provinces. The program provides a way to diffuse and scale up local success stories. It found a way to leverage the tremendous heterogeneity of China's rural economy. Spark not only amplifies its better-performing segments but also connects them by assembling packages of managerial, marketing, and technical services.

The Spark Program has also become a focal point for leveraging the best and the most relevant outcomes of China's massive but not particularly efficient agricultural research system, so that the system provides incentives for staff to carry out research programs that serve the needs of rural clients.

Source: World Bank 1998; Huang and others 2004.

Most countries have many examples of microreforms of their institutional framework that emerge in unexpected settings or proceed in unanticipated ways. Various means of scaling up microreforms into changes in the national institutional framework for innovation can be proposed:

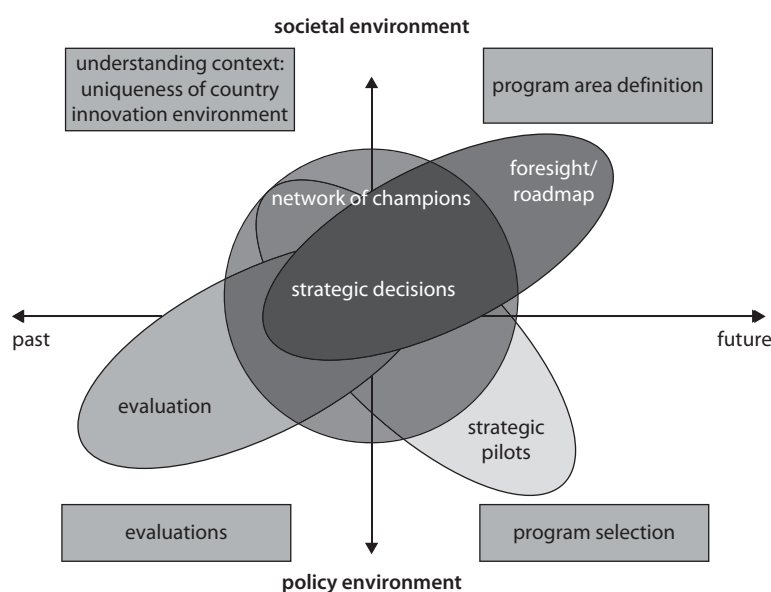
- Institutionalizing search networks of leading actors, including continuous monitoring of the progress of reform and benchmarking to determine what is feasible
- Systematically evaluating programs and projects
- Designing and implementing a portfolio of strategic pilots that probe the economic potential of projects and establishing benchmarks for action
- Initiating an innovation foresight process.

Scaling up microreforms is strategic incrementalism (see figure 8.1): change proceeds gradually, step by step, but its long-term outcome is dramatic. Each of the components mentioned in the list above is considered in turn.

Institutionalization of Networks of “Champions”

Change is driven by individuals (champions) who are willing to risk their reputation on the results of reform. The first priority for this group is to conceptualize, in a series of focused discussions on the “next steps,” the nature of the reform they are collectively promoting. The second priority is to include important decision makers from key national decision-making bodies in these deliberations.

Figure 8.1 Elements of Strategic Incrementalism



Source: Author.

Systematic Evaluation of Programs

Evaluation is a management tool that links the impact of programs to budget allocation decisions. Key issues in the design of a national evaluation program include cost-effectiveness criteria. It is important for the evaluation criteria to be transparent, for objectives to be clear, and for the application of the criteria to be measurable. The cost effectiveness of the process must also be factored in in the design of an evaluation process. Incorporating widespread use of ICT could be a step toward greater cost effectiveness.

The monitoring and evaluation processes should be separate to avoid potential conflicts of interest in implementing a national procedure for program evaluation. While monitoring and ex post reviews should be carried out by a neutral third party, ex ante evaluation can be carried out within the program itself to facilitate linking the program's key financial decisions to evaluation. International projects should be evaluated and monitored in the same manner as national projects, bearing in mind national benefits, objectives, and demands.

Optimally, 3–5 percent of the program budget should be allocated to evaluation. While evaluation is ideally a management tool, as mentioned above, this amount for evaluation may initially prove difficult. Programs found to be inefficient through evaluations will resist regular review procedures. This resistance raises the problem of managing entrenched interests. Making the feedback public will help resolve the problem. The mere fact of public access to impartial evaluation results will provide a strong disciplinary element and pressure actors to change established procedures and improve performance.

Portfolio of Strategic Pilots

Strategic pilots should examine new organizational models, test their feasibility, and in this way harness the unique features of the innovation system. These pilots are strategic because they introduce the features of a reformed innovation system: accountability for results, built-in incentives for collaboration, and structures of governance. All those are important for the continuous redesign of the pilots.

Innovation Foresight Process

The foresight process attempts to identify potential future opportunities for the economy or society arising from innovative science and technology and considers how future technology can address society's key challenges. Early efforts to use this type of foresight approach were carried out in the United Kingdom in the 1990s but have now been widely adopted throughout the EU and elsewhere. They have proven particularly useful in defining longer-term needs and helping develop the creative links from which innovations emerge. The process includes several elements:

- A steering group comprising leaders from the three main constituent communities—government, academia and business

- A secretariat to identify the main participants (usually through some variant of a co-nomination exercise), to initiate and shape discussions (writing initial position papers, arranging and orchestrating working groups) and to draw together, in conjunction with the working groups, individual contributions into an integrated summary
- An organized program of semi-autonomous working groups, by topic lines (which reflect a mixture of key needs and strategic technologies) to undertake analysis, evaluate evidence, reach conclusions regarding the time-frame, and produce a summary report on their evidence, findings, and prognosis
- An integrative effort, usually conducted by chairpersons of the working groups and the secretariat, to integrate the groups' efforts and develop a conclusion, which usually suggests lines of action and priorities for resource use over the shorter term.

In parallel with the written papers, the collaborative process leads to cohesion and broad, although not necessarily universal, ownership of the strategic lines and priorities for future action. It provides government, academia, and business with a point of reference for their future efforts. In some cases, for example, the exercise has addressed the regional level rather than the national level. These exercises are repeated, and the analyses and conclusions are updated using the same procedures—sometimes reduced in scale and scope, for example, in cycles of three to five years—to ensure that they remain relevant and take into account intervening scientific progress and changes in the needs of society.

Promotion and dissemination efforts are then initiated to ensure widespread awareness of the findings and conclusions of the reports. This process adds to the shared vision of goals and reduces information asymmetries across target audiences. It also enables the findings to be incorporated into public policy and budgetary cycles and into strategic decision making in the enterprise sector. Academic bodies have also used the reports to determine allocations and priorities for selective efforts in research and teaching.

With the foresight reports as a guide, the steering group may use its prestige and influence with the concerned executive agencies to direct resources toward programs that are recognized in the findings of the reports. Monitoring and evaluation would follow, along the cyclical lines described earlier.

One of the consequences of the foresight process is the articulation of poorly structured issues of concern to everyone. For instance, the first foresight process in the United Kingdom unexpectedly identified the widespread ramifications of an aging population in its conclusions. In India, a nationwide foresight process might start by focusing on the country's thematic challenges, such as access to clean water or road congestion.

Let us now come back to the agents of change—search networks of champions. These networks are consolidated through the deliberative evaluation

of projects and programs, the next-step discussion that takes into account the lessons emerging from the implementation of projects and relevant international best practices. Nokia, a leading multinational, can serve to illustrate this principle. Many of its labs (called *labelets*, a term borrowed from Intel, which pioneered them) are co-located at major research universities. Their success is judged by the impact they produce in attracting talented young graduate students. But that cannot be the only criterion for evaluation: it is possible that talent is being attracted to the selection of topics, rather than to the opportunity for conducting potentially interesting research for the private sector in general and for Nokia in particular. Indeed, if such applied research is conducted, a discussion of how it could be relevant for Nokia and how to attract relevant graduates to Nokia needs to take place. What is usually expected from a formal evaluation is not a set of figures but dialogue: a mini-innovation foresight on its own, combining both an appraisal of individual talents and interests, and an assessment of the relevance for the firm.

Each strategic pilot (like the innovation foresight process itself) should be regularly evaluated. Uncoordinated and isolated programs can be drawn into the process, and these programs can be coordinated into an overall strategy. Ideally, a body should exist to pool information and draw lessons from specific pilots and projects from different domains of innovation.

Summary of Policy Principles

Analysis of policy making and policy implementation is only now entering the literature on innovation. The following is a summary of the main principles underpinning the present analysis and recommendations:

- *Rely on better-performing segments of existing institutions to leverage reform and change.* Institutions in developing countries may be dysfunctional, but they are not uniformly so. Within a given ministry, some segments or individuals perform better than others. These can be leveraged to transform a difficult institutional environment.
- *Use search networks to link better-performing segments of the economy.* Search networks are networks of individuals and institutions that solve complex problems by finding individuals who already are working on the solution to (part of) the problems. Strategic pilots make it possible to institutionalize emerging search networks to bring together champions from private and public sectors and (possibly) the country's talent abroad. Search networks encourage change and reform by linking together the better-performing segments of national economies.
- *Pursue the goal of "double transformation."* Double transformation involves the creation of an appropriate context for reform. Reforms that start from

the better-performing and more entrepreneurial segments of the economy are more likely to succeed. The demonstration effect makes the diffusion of reform to other segments of the economy easier. It also neutralizes the resistance of vested interests. Growth is more likely to provide space for self-reinvention at least among some segments of the entrenched interests and define their position in a new reform scenario.

- *Impose top-down measures to free up policy space.* Programs, policies, and projects cannot be multiplied ad infinitum. The introduction of new pilots means cutting down on existing programs, not only to provide budget space to trigger piloting and experimentation but also, and more important, to provide the correct incentives for players to perform. Underperforming projects are scaled down, and released resources are reallocated to test new approaches.
- *Follow the bootstrapping approach, at once humble and ambitious.* This approach involves a bold vision and strategic change in the long run through a gradual process of implementation of incremental bottom-up changes in which a favorable balance of risks and returns encourages initial steps at many entry points. In this process, each move increases the chances of initiating a virtuous cycle of institutional reforms and private sector development. Policy makers considering bootstrapping need to be prepared for the emergence of unexpected coalitions for reform.

The prevailing view of reform starts with the design of a blueprint for change, a blueprint with a known outcome. In the “strategic incrementalism” approach advocated in this chapter, the institutional outcomes are open-ended, and attempts to create a blueprint are viewed as outdated central planning. To detect problems and errors, policy makers should constantly monitor and benchmark the process of reform and restructuring.

Note

1. In Australia, New Zealand, and Norway, the share of the processing industry in overall exports ranges from 22 to 28 percent. The average for OECD economies is 82 percent.

References and Other Resources

- Aubert, Jean-Eric, and Derek H. C. Chen. 2008. “The Island Factor as a Growth Booster: A Mental Advantage Econometrically Revealed.” *Journal of Intellectual Capital* 9 (2): 178–205.
- Chebbo, Maher. 2008. “Corporate Innovation: The Engine for Economic Growth in Knowledge Economy.” Presentation at the First Annual Conference of the Arabian Knowledge Economy Association, Jeddah, Saudi Arabia, January 12–13.
- Collier, Paul. 2007. *The Bottom Billion: Why the Poorest Countries Are Failing and What Can Be Done about It*. New York: Oxford University Press.

- de Ferranti, David, Guillermo E. Perry, Indermit Gill, J. Luis Guasch, William E. Maloney, Carolina Sánchez-Páramo, and Norbert Schady. 2003. *Closing the Gap in Education and Technology*. Washington, DC: World Bank.
- Gu, Shulin. 1996. "The Emergence of New Technology Enterprises in China: A Study of Endogenous Capability Building via Restructuring." *Journal of Development Studies* 32 (4): 475–505.
- . 2006. "Policy Process and Recombination Learning: China in the 1980s and 1990s." Draft prepared for the Asia Innovation Forum. May 18.
- Gu, Shulin, and W. Edward Steinmueller. 1996. "National Innovation Systems and the Innovative Recombination of Technological Capability in Economic Transition in China: Getting Access to the Information Revolution." UNU/INTECH (United Nations Institute for New Technologies) Discussion Paper 2002–3, Maastricht, the Netherlands.
- Hausmann, Ricardo, and Dani Rodrik. 2002. "Economic Development as Self-Discovery." NBER Working paper 8952, National Bureau of Economic Research, Cambridge, MA.
- . 2006. "Doomed to Choose: Industrial Policy as Predicament." Draft for presentation at the Blue Sky Seminar, Harvard University Center for International Development, Cambridge, MA, September 9.
- Hausmann, Ricardo, Dani Rodrik, and Charles Sabel. 2007. "Reconfiguring Industrial Policy: A Framework with an Application to South Africa." Center for International Development Working Paper 168, Harvard University, Cambridge, MA.
- Huang, Can, Celeste Amorim, Mark Spinoglio, Borges Gouveia, and Augusto Medina. 2004. "Organization, Program, and Structure: An Analysis of the Chinese Innovation Policy Framework." Economics Working Paper 17, Department of Economics, Universidade de Aveiro, Aveiro, Portugal.
- Rodrik, Dani. 2007. *One Economics, Many Recipes*. Princeton, NJ: Princeton University Press.
- Saxenian, Anna Lee. 2002. *Regional Advantage*. Cambridge, MA: Harvard University Press.
- . 2006. *The New Argonauts: Regional Advantage in a Global Economy*. Cambridge, MA: Harvard University Press.
- Saxenian, Anna Lee, and Charles Sabel. 2008. "Venture Capital in the 'Periphery': The New Argonauts, Global Search and Local Institution Building." *Economic Geography* 84 (4): 379–94.
- Stark, David. 1996. "Recombinant Property in East European Capitalism." *American Journal of Sociology* 101(4): 993–1027.
- World Bank. 1998. "China: Rural Industrial Technology (Spark) Project, Implementation Completion Report." Report 18126, World Bank, Washington, DC.
- . 2001. *Think Globally, Act Locally: Decentralized Incentive Framework for Mexico's Private Sector Development*. Research Report. Washington, DC: World Bank.
- World Bank Institute. 2008. "Establishing a Knowledge Economy in Saudi Arabia." Draft policy note, World Bank Institute, Washington, DC.