

## Chapter 3. Instruments to Support Commercial Innovation

At the most basic level, an effective government policy should create an institutional base for innovation by improving the business environment, establishing effective IPR regimes, and enhancing the quality of academic and research institutions to generate the specific R&D projects that attract private investment by firms and investors. Beyond those general policies, most OECD governments have also intervened at the firm level to stimulate private funding of R&D on the basis of the arguments of market failures and the capital gap for funding innovative technology-oriented firms. In general, those types of interventions have taken two forms: (1) direct government support for firms' R&D investment, typically at the early stage of the R&D cycle, to determine commercial viability through procurement preferences, tax incentives, direct grants, or loans and (2) intervention in the market, through direct government funding or incentives for private venture capital funding, for financing innovative technology-oriented firms that are engaging in commercialization of R&D.

In countries such as the United States, Finland, Ireland, and Korea, policy packages of these types of government interventions are widely credited with stimulating private R&D investment and helping to support the technology-oriented firms responsible for high levels of innovation and growth in these economies. Many developing countries and most ECA countries have reacted to that seeming success and rushed ahead with the adoption of support programs, on the basis of their visits to OECD countries, without proper attention to the suitability of particular instruments to developing and transition countries.

Using the experience of interventions in OECD countries, we will first discuss the basic principles of instrument design and how these can be applied to ECA countries. We will review the basic type of financial instruments used in OECD countries, including grants, loans, tax incentives, and procurement preferences, and discuss their applicability to ECA countries. We will then describe in detail the recommended instruments for the ECA region, including R&D grants (minigrants, matching grants) and venture capital. Some additional aspects of instrument implementation, including complementary business support services, coordination efforts, and sequencing, will be discussed. It is important to differentiate between financial support instruments, such as matching grants or tax incentives, which are the main topic of this study, and nonfinancial support instruments, such as business support services. Both are government subsidies to private entrepreneurs, but although the nonfinancial instruments combine subsidization with the public provision of the subsidized service (e.g., government owned and run incubator), a financial subsidy allows the entrepreneur to spend the subsidy on buying the business services (e.g., from the incubator) or to invest the subsidy in, for instance, equipment (e.g., a prototype) or working capital. But clearly, both types of instruments are complementary, reinforcing each other. Although in this study we deal primarily with financial instruments to support innovation, a more in-depth analysis of nonfinancial instruments such as incubators and the provision of business support services, including the question of public versus private provision of these

services,<sup>10</sup> will be undertaken in a future study (ECAKE II).

### 3.1 Basic Principles of Instrument Design

OECD countries have been experimenting for decades with several instruments in support of commercial innovation. On the basis of a review of this experience, a number of principles have emerged as key factors for effective program design. An overarching principle for program design is the *institutional environment*, especially governance and the tendency toward state capture. Given the institutional and governance situation and the identification of corruption as one of the main constraints to the business environment in many ECA countries, it is of the utmost importance to protect projects from misappropriation by the state. Another important principle is *additionality*: any instrument needs to, as much as possible, avoid crowding out, while promoting private investment and risk sharing. The second, related principle is *neutrality*: to minimize distortions, governments should avoid sector and company targeting (“picking winners”).

#### 3.1.1 Institutional Environment: Corruption and State Capture

The design of new instruments needs to account for the existing institutional environment. Many ECA countries, especially the new EU member states and accession candidates, already operate variations of innovation support schemes. The analysis of the institutional setup needs to consider the benefits and potential for effective restructuring of existing instruments vis-à-vis the advantages of creating new institutions and instruments from scratch.

To avoid government capture and failure, instruments should be designed to be as neutral and transparent as possible. Most critically, the decision-making (selection) processes about funding allocations need to ensure that the

quality of selection is driven by true innovative and commercial potential. The continued presence in many ECA countries of corruption and capture of governmental processes by interest groups places a heavy burden on the design of successful policy instruments. The various grants and venture capital funding proposed under the project are likely to attract rent-seeking behavior, which could result in inefficient funding allocations if the institutional design cannot immunize the funding allocation from interference by political actors and other interest groups.

The design of instruments is crucially dependent on the capacity of public servants to administer them and insulate their decision-making promises from capture and rent seeking. As the Finnish case study in box 2 below shows, some of the most successful innovation support systems in the world rely heavily on the analytical and managerial skills of public servants to take good economic decisions. Although Finland is successful with this setup, it is questionable whether the model can be implemented as such in many ECA countries. Weak public service institutions might result in a lack of capacity to make informed and economically beneficial decisions.

The instrument design in ECA therefore needs to enhance the decision-making processes with sufficient checks and balances through a wide representation of private sector, academia, civil society, and foreign expertise to protect the decision-making process from rent-seeking behavior and capture by interest groups. An optimal instrument design should include the following key elements:

- The administration and funding decisions are located in an independent institution

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<sup>10</sup> This question is similar to the debate about public versus private schools in the United States, in which the vouchers could be used to subsidize schooling without necessarily using public schools.

with a clear mandate and control mechanism, separating it from other public policy goals.

- The funding decision is made by an independent investment committee. To enhance transparency it is advisable to staff the investment committee with technical experts and foreign experts that are less likely to be subject to political influence. A potential problem is the question of confidentiality and fear of industrial espionage.
- The investment policy and decision processes are instituted and supervised by a supervisory board consisting of representatives of different government institutions and international advisors.
- Technical assessments of the project proposals are based on external peer reviews involving international experts where possible.
- All project proposals and decisions are recorded, tracked, and made publicly available to enhance transparency. E-government procurement technologies should be considered to aid the process.

### *3.1.2 Additionality and Crowding Out*

The most important design question to be examined in this chapter is whether government support programs create new investment in R&D or whether they simply crowd out private investment, which is substituted by government funding. Most impact assessments of these types of programs in OECD countries are based on aggregated statistics such as the volume of financial flows, as well as anecdotal and intuitive evaluation of the relationships between policies and the subsequent economic performance of an economic sector.

Empirical evaluations using counterfactual data sets are few: Lerner (1999) studies recipients of the U.S. government's long-running Small Business Innovation Research (SBIR) R&D grant program. When comparing program awardees and a matched sample of firms

that did not receive awards during a 10-year postwar period, Lerner finds that firms receiving grants grow significantly faster than the others after receipt of the grant. His results are ambiguous in suggesting that the effect may relate more to "quality certification" by the government, enabling the firm to raise funds from private sources. Indeed, his findings suggest distortions in the award process; companies receiving multiple grants showed no increase in performance. Trajtenberg's (2000) review of a number of studies of Israel's R&D grant programs also suggests that there is evidence, although limited, of a positive relationship between the grant programs and productivity in R&D-intensive industries.

Wallsten (2000) found that the SBIR program crowds out the firm's own research spending approximately dollar-for-dollar, reversing the finding of Lerner (1999) for this same program. Branstetter and Sakakibara (2000) found that Japanese funding of research consortia increased the R&D of the participating firms. Lach (2000) found that research support of commercial firms in Israel increased the firms' total R&D expenditure by \$1.41 for every dollar of public research expenditure. Ali-Yrkkö (2004 and 2005) showed that the increase of public funding in Finland did not lead to a crowding out of private R&D funding.

Therefore, government interventions need to be carefully designed so that they do not crowd out private investment and funding sources. Although financial market failures can be identified, especially in the early stages of innovation, the smaller the distance of the innovative process from the market and the higher the probability of market success, the higher the probability of financing from mainstream financial intermediaries. It can be argued that the important principle of matching may prevent or at least mitigate crowding out. Projects closer to commercial application should be funded by venture capital or other private sources.

As much as possible, therefore, interventions should be designed to promote private risk taking and stimulate the private risk capital market. A number of design issues can be taken into account:

- *Risk sharing:* The high uncertainty about technological and commercial success in the ESTD phase not only deters mainstream financial institutions, it also represents a risk for the innovator. Often, the inherent uncertainty of success is the key obstacle in providing incentives to potential entrepreneurs to invest their own money, accommodate the opportunity costs of leaving a secure job, and last, but not least important, take commercial risks by borrowing money.
- *Preservation of incentives:* However, the design of the instruments also needs to preserve the incentives for entrepreneurs to invest their intellectual resources and time and effort in the pursuit of success. Concessional funding is prone to “moral hazard” problems.
- *Commercial orientation:* Criteria for funding decisions need to clearly distinguish between projects that are technologically interesting and the targeted group of projects that are technologically innovative and have potential for commercial success. Commercial success potential must be a criterion for project selection.
- *Instruments tailored to address specific bottlenecks:* The choice of instrument varies according to the different stages of the innovation chain. As discussed in chapter 4, in some ECA countries the most effective set of interventions will be combinations of financing instruments and measures to enhance innovative capacity and the reforms to the business environment. The optimal level and degree of subsidy should be lower, the closer the intervention target is to functioning market mechanisms.

### 3.1.3 “Industrial Policy” and Neutrality

Neutrality of government programs supporting innovation (such as matching grants) means that the government does not decide *ex ante* which technological areas, firms, or projects to support, but rather responds to the demands coming from the market. Under that approach, the government sets universal criteria for submission and eligibility (e.g., technological and commercial viability, proven business record). The entrepreneurs (i.e., the would-be innovators) submit project proposals for support, and the agency in charge supports those that best fit the criteria.

More generally, neutrality means that the program should not try to steer the grants (or any other such instrument) in any predetermined direction, but rather should try to deploy them in such a way as to maximize spillovers or social returns. The success of R&D support programs in Finland and in Israel is in large measure attributed to the fact that in both cases the policies implemented were largely neutral in that sense. There were still instances of targeting, but the thrust of the policies remains neutral. Today, Finland has established specific sector programs; however, the emergence and selection of these specific sector programs are driven by an *ex post* recognition of clusters that have emerged in a neutral and competitive policy environment.

The main critique of the merits of neutrality in this type of intervention is that, in the first place, the rationale given above for intervention is the presence of spillovers—that is, a gap between the private and social rates of return. The difference between the social and private rates of return may be more than a factor of 3 to 4 (Jones et al. 1998). Yet, this gap may not be constant across projects. Suppose we have two projects with identical private rates of return, but one has a social rate of return marginally higher than the private return, and the other has a social rate of return higher by a factor of 10 than the private rate of return. The market will be indifferent between the two although from

## Box 1 Taiwan's Experience with Targeted Research Grants

Historically, a number of Asian countries (Taiwan, Japan, Korea) have actively supported commercial R&D through grants and low-interest loans in highly targeted technology sectors. In Taiwan, for example, the Industrial Technology Research Institute (ITRI) acts as a public sector applied research center, participating and managing R&D and technology transfer in high-tech industries. ITRI conducts research directly on new technological developments in the international arena and then transfers its research to the private sector for commercial development. More recently, the government has offered direct grants and subsidies to finance private R&D in high-tech sectors (“Industrial Policy in East Asia: In Search for Lessons”, background paper prepared for the *World Development Report 2005: A Better Investment Climate for Everyone*). Most of this R&D support, however, has been absorbed by large companies and research consortiums as part of state subsidies for large-scale industrial policies. Often the subsidies were tied to FDI initiatives and technology transfer.

The approach of large and direct R&D subsidy tied into foreign technology partners undoubtedly created clusters of successful industrial activity in certain technology sectors in these countries. However, the long-term impact on the innovation system remains questionable. Noland and Pack (2003) argue (based on Wang 1998) that the impact of Taiwan's interventions has been modest: “Rather than the government's sectoral policy and preferential treatment of the strategic industries, it was the government's creation of a favorable climate and environment that contributed the most to the blossoming of Taiwan's information industry.”

a social perspective, the one that offers such a high social rate of return is preferable. If all this information is available, neutrality is not the best policy. Some countries in East Asia have taken a mixed approach—adopting project and firm neutrality while targeting certain sectors or industries in their approach (see box 1).<sup>11</sup> However, selecting projects based on their “social return” is in most countries impractical because it requires huge amounts of information about the parameters of the social benefit of each project. Moreover, because such parameters are necessarily subjective, selection based on the social benefit of each project opens a “Pandora's box” of capture and corruption possibilities. Given the limited institutional capacity, it is unlikely that many governments in ECA countries would be able to estimate the social rates of return and select projects with the highest social benefit. We can therefore, as a second-best op-

tion, opt for neutrality. The threat of capture by vested interests (e.g., old firms or organizations for whose services there is no demand but who are trying to survive from state aid for innovation) and corruption lead us to recommend neutrality as a principle of intervention. Only after a track record of excellence has been established, with several years of experience (as has happened in Israel and Finland) could the principle of neutrality be modified—but only toward sectors/industries, not toward individual

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<sup>11</sup> The role that government intervention played in the success of several East Asian economies has been questioned recently (Pack and Saggi 2005). It is argued that such targeted interventions are likely to fail, even more so taking recent developments into account (the liberalization of trade and finance flows as well as stricter rules internationally, e.g., at the World Trade Organization).

firms or projects. Moreover, neutrality does not imply lack of choice criteria: the authority in charge of administering the program will choose among competing projects, using certain criteria. The question is what criteria guide the choices and what the information requirements of such criteria are (e.g., the authority administering the program could choose those projects that maximize spillovers, although information requirements may make this criterion difficult to implement and open the door for unwanted influence).

## 3.2 Basic Types of Instruments

### 3.2.1 Grants versus Loans

With that in mind, it is useful to evaluate the two most basic types of instruments for government intervention to promote investments in innovation and R&D: direct subsidies (grants) and instruments with mandatory repayment (loans). In the next section we will review indirect support instruments such as procurement preferences and tax incentives. These types of instruments can be applied to different levels of activity—whether to companies or investors—and to achieve different program objectives.

One form of subsidies is grants, which typically require some share of matching investments by the grant recipients. Grants have two clear advantages over loans for the promotion of innovation. First, providing funds through matching grants reduces the entrepreneur's risks, which is typically the most important constraint in providing incentives to innovators to pursue commercial applications. In the case of technological or commercial failure, the loss to entrepreneurs is limited to their own matching investment, and they do not have to pay back the grant.

Second, R&D and innovation activities require high up-front investments that may generate positive cash flow of an uncertain level at some point in the future. Grant instruments

(like the equity provided by private risk capital investors) can support this investment profile by providing the needed up-front investment without crippling the company or project with mandatory payments before the positive cash flow can support them. Many of the most successful grant programs are designed specifically to mimic the positive cash flows with royalty payments on successful programs.

Instruments with mandatory repayments such as commercial loans or even loans with interest rate subsidies provide neither the crucial risk-reducing feature nor the cushion of support for the cash flow. Mandatory repayments may starve a potentially successful project of internal financing to invest in later stages of development and commercialization. In the case of technological or commercial failure entrepreneurs not only lose their own investment, but they also have to repay the loan in full. The implications of this at the level of the entrepreneur are very significant. An entrepreneur is very unlikely to consider engaging in already risky innovative activities when this risk is compounded by the high prospect of business failure from loan foreclosure, potentially leading to bankruptcy.

The mandatory payment structure of loans makes them unsuitable instruments for ESTD projects with uncertain cash flows and unknown ex ante prospects of success. Still, loans can play a role at later stages of the innovation process in which the risk to the entrepreneur declines with a greater probability of success and reduced distance to market. When looking at best-practice examples implemented globally, it is important to look at the economics of the instrument employed. A variety of instruments can be found that are nominally classified as loans; however, they contain provisions that forgive the loan repayment in case of project failure or convert the loan into an equity participation, thereby reducing the ex ante risks and disincentives to the entrepreneur and effectively assuming the economic advantages of a grant mechanism combined with a “tax on success.”

### 3.2.2 Procurement Preferences and Tax Incentives

It is useful to evaluate a number of other instruments that have been used internationally to promote investment innovation and R&D. Rather than directly allocate government funding for projects, these instruments attempt to indirectly stimulate investments through procurement preferences and tax incentives. Because they act indirectly, however, they require efficiency in response to the preferences and incentives on the part of both public and private actors to achieve the required response. They are therefore a more complex policy lever. In the ECA region, with weaker institutional contexts, they are likely to be difficult to implement effectively.

*Tax incentives* have been widely used, especially in Europe, for a general encouragement of R&D investment across a wide range of firms. Broadly, tax incentives encourage investors or companies to invest in R&D or new companies through tax credits or lower tax rates. Tax incentives can come in several forms: (1) up-front tax credits for investments, (2) reductions in capital gains taxes or tax rates on investments, and (3) tax credits to offset losses from investments in small and medium-sized enterprises (SMEs) or equity funds. Tax incentives are in principle neutral—they do apply to all qualifying firms equally and therefore would uphold one of the key principles in instrument design. Moreover, in the United States, a study by Hall and Van Reenen (1999) suggests that a dollar in tax credit for R&D stimulates a dollar in additional R&D.

Tax incentives, however, have a number of weaknesses that make them less applicable to the ECA region. First, tax benefits would help existing enterprises that can use profits from related products to take advantage of the credits or offsets. However, tax incentives do not help start-ups that have not yet accumulated sufficient profits and therefore cannot offset tax li-

abilities. Innovative start-ups may have very low profits for a long time. Thus, tax benefits would provide no funding at the critical initial period when commercialization takes place.

Second, in countries with a weak tax enforcement system, tax incentives may promote distorting tax avoidance behavior rather than productive investment. There is a risk that companies will reclassify expenditures without justification by presenting regular expenses as R&D expenditures. Coping with such tax avoidance or evasion requires a highly sophisticated tax inspectorate, which is unavailable in most ECA countries. Lack of specificity and poor design of the tax code can also limit the impact of tax incentives because some firms are able to benefit from reduced taxes without having significantly altered their behavior.

Third, because tax incentives are indirect, the fiscal cost of the support is not fully apparent in the budget and thus hidden from policy makers, while financial support in direct programs is easily observable in the budget.

Fourth, tax incentives cannot be used like grants to promote the creation of networks and linkages between the private sector and universities and research institutes, which lie at the heart of this type of instrument.

Procurement preferences are a variation on a direct grant program in which a portion of existing government research budgets are earmarked for small innovative firms, as in the SBIR Program evaluated by Lerner in the United States (see box 2). This type of program is most effective in large economies with significant government-sponsored, commercially oriented research budgets and transparent procurement processes, conditions that are unlikely to exist in most ECA countries.

## 3.3 Financial Instruments for ECA

As can be seen in figure 4 in chapter 2, about 60 percent of ESTD funding in the United States comes from “angel investors” or corporate ven-

## Box 2 The U.S. Small Business Innovation Research (SBIR) Program

To support the commercialization of early-stage technology start-ups, the U.S. government established the Small Business Innovation Research (SBIR) program in 1982 (renewed in 1992 and 2001) to more directly affect the process of commercialization of government-backed research. The SBIR grants support research in scientific and engineering areas that will encourage the conversion of government-funded R&D into technological innovation and commercial application. The program is intended to fund projects that transform a research-based idea into a prototype, the type of research that many SMEs and venture capital companies are unable to support. Small businesses must meet certain eligibility criteria: they must be for-profit, American-owned, and independently operated; the principal researcher on the project must be employed by the company; and company size is limited to 500 employees.

Small businesses receive awards or grants in three phases. Phase I is the start-up phase, with awards of up to \$100,000 for approximately 6 months to support exploration of the technical merit or feasibility of an idea or technology. Phase II awards of up to \$750,000 support expanded R&D work that allows the developer to evaluate commercialization potential. Phase III moves the technology from the laboratory into the marketplace. No SBIR funds support this phase

*Source:* Wessner (2004)

ture (internal financing by corporations), and 34 percent comes from federal and state governments (SBIR, etc.). In ECA, as mentioned above, because of the low capital accumulation before 1990 and the shortage of entrepreneurial capacity in corporations, the funding gap presented in chapter 2 is more severe. Accumulation of retained earnings in Russian corporations has recently given rise to nascent corporate ventures. It is important that state intervention in this environment deal with the bottlenecks in all stages of the innovation chain from the generation of ideas to commercialization. It is important to stress here that the supply of ideas (the pipeline of projects) is endogenous: potential inventors and entrepreneurs need to be confident that if they create projects there will be funding available for them. Why else would they invest resources in innovation? Therefore, funding programs cannot wait until ideas appear by themselves, but rather all stages of the innovation chain need to be dealt with in parallel. Taking these design principles and possible

instruments into account, there are three types of instruments that are most useful for the region: minigrants, matching grants, and early-stage venture capital support. Business support services are necessary to develop projects that would be acceptable for funding. However, it is important that business support services be viewed not as a stand-alone policy lever but a complementary support to the core instruments that provide financing for innovation and R&D. Finally, the design of such a program will also have to play a coordinating role in the number and types of instruments that a country puts in place to support commercial innovation. As will be shown in the next sections, there is a certain sequencing of instruments that matches the innovation process—researchers and entrepreneurs have to be aware that these instruments are available for the entire innovation process and that the support system has been designed in a comprehensive and coordinated manner. Not only will that ensure the availability of support for the entire process, but it will also help curtail

### Box 3 TEKES—The Case of Finland

In 2004 most (82%) of the support funds administered by the Finnish agency TEKES were in the form of neutral grants. By 2004 TEKES provided 42 percent of all its funding through *technology programs*, totaling €171 million. In total, TEKES has been funding 26 technology programs focusing on a broad variety of technology sectors ranging from public health care technologies to nanotechnology and business and management technology. The economic rationale of the technology programs is to enhance R&D cooperation between different companies, public R&D institutes, and international actors and to transfer knowledge and skills among the participating entities. Internal evaluations of initial programs find positive returns to the promotion of R&D cooperation and coordination. However, the success of the programs relies equally heavily on the quality of public administration in identifying and deciding on relevant program areas. The decisions to launch specific technology programs are based on strategic decisions within TEKES. In interviews conducted by World Bank staff TEKES decision makers emphasized that TEKES relies heavily on information feedback mechanisms and coordination with local R&D institutions and industry in formulating the technology strategy. Although the process is not formalized, the cooperative model of public policy formulation in Finland fosters a bottom-up approach to developing the technology program priorities, thereby avoiding some of the risks of top-down industrial policies.

TEKES represents international best practice in the support of innovation through grants and other soft funding instruments. The diversified approach to different project stages, the maturity of companies, and the emphasis on grant funding for start-ups and projects with high technological and commercial risks are of direct relevance to the ECA region. However, the decision-making process, project selection, and formulation of programmatic priorities are heavily dependent on the quality and capacity of public servants, as well as the Finnish governance model with the virtual absence of corruption and capture and a transparent and cooperative approach to public policy formulation. The absence of most of the latter implies that the TEKES model cannot be transferred as is to many ECA countries. ECA governments should focus on adopting the funding instruments but complement the decision-making processes with independent, external control and oversight through peer reviews, foreign experts, and so forth. In regard to programmatic priorities, ECA governments should be encouraged to emphasize neutrality in the early stages of the development of funding programs and to focus on technology policies based only on ex post patterns occurring over time.

inefficient duplication of efforts by several agencies. (More on coordination in the discussion of the NIS in chapter 4.)

These three types of instruments address in particular weaknesses at different segments of the innovation value chain in the ECA region, with limited distortions and clear objectives.

Minigrants provide small grants directly to support precompetitive R&D, and matching grants require companies to match the investment. Finally, government leverage of private venture capital support promotes the risk capital market, which will eventually become the long-term driver of innovation investment.

### 3.3.1 Minigrants

Minigrants are small grants designed to support the identification of commercially viable ideas and scientific work as well as encourage entrepreneurship among the scientific and SME community. The objective of a minigrant is to provide an initial financing grant to support entrepreneurs/SMEs in transforming basic ideas for innovative commercial activities into a business plan format that can be presented for consideration under a matching grants program and, if and when the project matures, to potential investors (angel or venture capital).

Minigrants are the first phase of funding and focus on the commercialization of a given innovation. The purpose of a minigrant program is twofold: (1) to stimulate the initiation of entrepreneurial activities in the field of innovation by providing small grants to help *potential* entrepreneurs take their existing ideas and determine whether these ideas can evolve into commercially viable ventures and (2) to help scientists and entrepreneurs who have limited experience in building successful companies obtain technical assistance and consultancy services that can help them conceptualize the business functions that would be needed to take their products to market.

Because many of the most innovative ideas evolve through the process of scientific research and because the focus and objectives of scientific research differ significantly from the processes involved in establishing and running a business, there is often a disconnect between accomplishments that are achieved in the laboratory and successful innovations emerging in the product and consumer marketplace. This disconnect is compounded in the ECA region, in which most countries have emerged just during the past 15 years from a centrally planned economic system and, as such, do not have a long-standing tradition of entrepreneurship. Consequently, the minigrants tool is designed to help stimulate the evolution of an entrepreneurial mind-set and

provide an incentive for scientists to innovate by offering them access to a vehicle that can help them gain commercial success following their success in the lab.

An additional feature of minigrants that increases their overall value to an innovation finance program is that they maximize the likelihood of success of given innovators by matching them up with additional skills and resources to which they likely would not otherwise have had access. That is because most innovators in this context expend whatever limited resources they have in developing and building the technological value of their ideas, that is, working toward proving that their ideas are in fact technologically feasible. That results in a knowledge gap, whereby insufficient time is afforded to assessing and documenting the commercial feasibility of their ideas. Furthermore, given that many of these individuals are likely to be inexperienced in taking on the tasks needed to help assess commercial viability (i.e., market analysis, marketing plan, financial plan, etc.), giving them access to this expertise helps improve the quality of the analysis concerning the viability of their ideas.

A drawback of minigrants is the high degree of “business support services” required in the form of advice, knowledge, and technology transfer to achieve success at this stage of the innovation. Administering such a program, especially in which the capacity of the bureaucracy is low, will be challenging because of the need to involve technical and business support in both the selection process and the implementation of the grant.

In many ECA countries, the level of private business support services, such as consultants, training, business mentors, entrepreneurial networks, and even infrastructure services, is low. However, generally public provision of business support services has proved ineffective. There are a number of potential solutions to this challenge that we discuss below in the section on business support services (including incubators). It is

worth noting here, however, that to be effective the financial instrument of minigrants must be combined with some way of providing business support .

A possible solution to the problem mentioned above would be to design a combined system of minigrants with “virtual incubators.” Recipients would receive the money only in conjunction with subscription to services of a virtual incubator. That would ensure that they receive the appropriate advice and mentoring, plus it would reduce the moral hazard problem of such a system. Virtual incubators are incubators without a physical infrastructure, which prevents the incubator from developing into a real estate business, a result that occurs only too often. It also would put more emphasis on providing business support services. This solution does not come without problems (entrepreneurs having to provide their own location and infrastructure might be a problem in some ECA countries), but it is an option to consider.

### 3.3.2 Matching Grants

Although the more traditional approach to R&D support to firms has been through tax incentives or subsidized loans, since the 1980s there has been an increasing awareness among OECD countries of the benefits of matching grants in encouraging firms to share and manage risk. A number of historically successful grant programs, such as Australia’s R&D Start Program and the U.S. SBIR Program, have an implicit matching component in that firms are expected to support a portion of the research budget. In countries such as Finland and Israel, more formal matching grant programs are helping to create a seedbed of precommercialization activities out of which the most promising innovations can be generated for follow-on investment by private sector investors, such as venture capital (VC) firms.

A matching grants program works by encouraging risk sharing with firms, and it orients

the selection process toward R&D programs that are most likely to generate innovations that can be commercialized. Qualifying firms, or consortia from academic institutions, will submit grant applications for specific R&D projects that are reviewed by an independent research committee. If approved, the applicants receive a grant from 50 percent to 70 percent of the stated R&D budget for the project. Successful projects (i.e., those leading to sales) will be required to repay the grant, as a royalty from revenue, up to the dollar-linked amount of the grant. The sharing of risk with the firm alleviates, although it does not eliminate, the negative consequences of “picking the winners” by the public sector. The royalty scheme also orients the selection process toward picking projects mainly to achieve sales and profitability targets.

There are two critical aspects of a matching grant program that make it useful in the ECA context. First, firms are required to invest a dollar of their own funds for every dollar they receive as a grant. Proof of the private expenditure of a dollar is required before the government reimburses the entrepreneur for the dollar it invested. The importance of matching stems from the fact that its effect is to reduce the marginal cost of research to the firm. *A firm facing a downward sloping marginal research returns schedule will always increase total expenditure when the marginal cost falls, precluding the dollar-for-dollar crowding-out result.*

Second, the administration of matching grants must involve an independent and effective selection process whereby the projects most likely to generate commercial innovations are chosen. That factor is crucial. In the ECA region the selection mechanism will face the risk of excessive administrative burden and corruption. As much as possible, industry experts and private sector players who are familiar with commercialization of innovations should be involved in the selection. It is also important that the criteria for selecting projects and using grant proceeds are

clearly laid out and that they are adequate to the country environment.

Another critical component of matching grants (as well as minigrants) is the potential they have to create and foster linkages between the private sector and universities and research institutes by favoring consortia. Cooperative schemes between the private and public sector have been at the heart of many programs in OECD countries. Given the dissociation between the private and public sector, it is important that these instruments be used to promote schemes between the two. Because the main aim of these instruments will be to promote commercial innovation, it is also important that the private sector be in the driver's seat of these consortia. This topic will be studied under ECAKE II.

### 3.3.3 Venture Capital Support

Although matching grants support ESTD, venture capital (VC) plays an important role in the commercialization phase of the innovation chain. VC targets projects that have passed the early stage; these projects may or may not have been supported by a grants program to reach the stage at which they are mature enough to be of interest to VC. It is important to note, as described in chapter 2, that typically purely commercial VC funds avoid the uncertainties connected with early-stage companies. To achieve the high commercial returns expected by their investors, they seek out companies that have successfully developed their innovation, proved its technical capability, and identified probable commercial applications and markets. At that stage, venture capital provides the funds to expand production and develop markets and the customer base and plays a critical role in supporting the later (and most visible) stages of commercialization.

Although VC plays a role in financing the commercialization of innovation and the expansion of innovative firms,<sup>12</sup> it does *not* provide,

a solution to the market failure in ESTD. This observation is of great importance for policy formulation in ECA because of the misguided discussion by ECA governments about the virtues of VC in ESTD. Although there is certainly a shortage of VC provision in ECA, it is important to put the role of VC in context. VC does not address the market failure in ESTD, and yet the success of VC funds depends on having a “deal flow” of attractive companies coming out of the ESTD stage. *Therefore, any intervention supporting VC needs to be preceded or complemented by interventions addressing the early funding gap through matching grants or by other means.*

Therefore, for a VC instrument to work effectively, a pipeline or deal flow of companies with commercial potential is required. A VC program is therefore likely to work best in situations in which support for R&D through a grants program provides the critical funding at the earlier stages to advance companies to the level at which they can be supported by VC firms. Similarly, minigrants and matching grants programs are likely to work best in circumstances in which support for later stages of the innovation process is available. Entrepreneurs will be able to plan better, and their incentives for engaging in commercial R&D will be greater if they know that there are adequate support instruments available after the initial stages of the innovation process. VC measures should also be coupled with specific reforms to improve the conditions for developing a VC industry, including further revisions to the VC legislation and capital market reforms to increase the liquidity of the stock market. It is useful to note that

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<sup>12</sup> Venture capitalists act as the first step of formal commercial financing for innovative, high-growth firms. They often play a similar role as angel investors in providing critical technical assistance and managerial support. Venture capitalists also support firms in accessing later rounds of financing, including initial public offerings VC.

the countries with some of the most robust VC industries (United States, Israel, Canada, Australia) have active programs at all stages of the innovation life cycle: from grants through VC support programs. For example, Australia has the R&D Start Program to provide grants for the commercialization of innovations by SMEs, which is complemented by its Innovation Funds Program to encourage VC investment in innovative SMEs.

It is also important to emphasize that VC cannot be relied on to provide all of the financing necessary for innovation. Only 1 in 200 SMEs in emerging markets (compared with 1 in 100 in the United States) is able to secure VC financing (Nastas 2005). In fact, large multinational corporate investors (e.g., Shell, General Electric, IBM, for example, in Russia), rather than VC investors, are often best suited to provide access to finance for innovation in middle-income countries. Multinational corporations (MNCs) can co-invest to form public-private funds locally, particularly to finance projects in sectors of the economy in which MNCs are interested in developing new start-ups to strengthen the supply chain. The latter may be of particular relevance for countries rich in natural resources, such as Russia, Kazakhstan, and Ukraine. Corporate venture will become an increasing source of ESTD financing if and when local corporations accumulate sufficient retained earnings to allow them to engage in risky ventures that may be only tangential to their core business. Ideally, such new ventures will be spun off to establish more flexible and entrepreneurial SME start-ups. This development depends critically on the availability of farsighted entrepreneurial owners in these private companies, either privatized or de novo companies.

The success of the most prominent venture capital funds in OECD countries relies, therefore, on three characteristics:

- *Investment expertise:* VC investment analysts are highly specialized, with a strong

understanding of different technology fields and their markets. If a venture capital fund invests in a company, it typically gains high levels of control and influence over the management decisions of the company. The VC fund manager brings management and commercialization expertise to the company and exercises control to ensure commercial success.

- *Risk Profile:* VC investment strategies are formulated such that they can absorb a high number of failed investments. Typically, the VC fund aims to earn very high returns from 1 or 2 of 10 investments it makes, which compensates for the expected failure of the rest of the investments (cross-subsidization).
- *Deal Flow:* Venture capitalists rely on a supply of high-potential companies emerging from the earlier stages of business, technological, or innovation development. Therefore, VC works best in economies (such as the United States and Israel) in which the early stage of technological development is financed by internal funding, angel investors, and/or government-supported grant financing.

These three characteristics of VC constrain the possibility of government intervention. Misperceptions of the role of VC have led to a number of failed interventions in the risk capital markets.<sup>13</sup>

State-owned and state-managed VC in particular, have proved to be especially prone to failure. Government officials usually do not have the crucial technical expertise and risk-taking mind-set to support innovations at their commercialization stage. Thus, caution is advisable

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<sup>13</sup> Because efforts to promote the emergence of a VC industry have failed in at least one reform-oriented country (Chile), a careful analysis of the reasons for this failure and any design problems that may have caused the failure is needed.

in the latest Russian government's initiative to establish "Private–Public Early Stage Regional VC Funds." As in fact is planned, the participation of the private sector is critical to the success of this program.

Typically, in many cases in which so-called VC funds managed by government entities are operating with commercial success, the risk profile does not display features of VC and the funds are not being invested in innovative ventures, but rather in small, more mature companies with less-risky product lines. Capture and rent seeking are prevalent and problematic because these types of fund set-ups are prone to be dominated by political interests (patronage).

However, there are a number of successful examples, in Taiwan and South Korea, in which government support for the development of a private VC industry has played a significant role in the development of a dynamic innovative sector (see box 4). In these cases, the government has "seeded" the VC industry through investing in privately managed funds.

In these public–private partnerships, governments mitigate some of the risk inherent in technology-oriented SME start-ups, and the venture capitalist provides commercial and managerial expertise. In time, funds graduate from using government support to avoid the restrictions placed on the fund by government. This type of instrument can take many forms:

- *Direct cofinancing:* By participating in a privately managed VC fund, the government lends credibility to the fund and acts as a catalyst for other investors to participate. This works well if the VC industry is experienced and there are attractive opportunities. Israel's Yozma Fund is an example of this approach. In 1992 the Israeli government provided U.S.\$100 million divided among 10 private funds. Each fund manager raised a matching amount of private funding. The funds made investments of U.S.\$300,000 to U.S.\$750,000 in hundreds of companies.

By 1997 the government felt that it had achieved its goals and sold the Yozma Fund through privatization.

- *Leveraged returns:* In this scheme the government, either by subscribing for ordinary equity shares or providing grants, co-invests with private investors but takes only a small part of the return, thus "leveraging" the upside potential for private investors. The Australian Innovation Investment Fund Program, for example, provides up to two-thirds of the capital for the VC funds but takes only 10 percent of the return with the remaining 90 percent allocated to the private investors and management. In exchange, fund managers are required to invest a portion of their fund in SMEs and early-stage companies. Israel's Yozma Program and the U.S. Small Business Investment Company (SBIC) Program have variations on this basic approach. These programs have proved very successful in countries in which there are opportunities to achieve very high returns.
- *Guarantees.* Guarantees against losses have been successfully used to promote investments in VC funds but tend to be most useful for countries with financial systems capable of sophisticated risk evaluation. By guaranteeing a certain return to investors and/or taking a subordinated position in the distribution of the funds' profits, the government protects investors against major losses of principal (downside risks are capped). Although guarantee programs can mitigate risk and attract commercial capital, they sometimes distort investment decisions. Facing limited losses, venture capitalists tend to be less rigorous in assessing the downside of deals.

In the case of the ECA region, VC leveraging may be the most effective approach. VC in the ECA region is still very limited. Therefore, the government may need to provide incentives

## Box 4 Government Support for VC Funds in Korea, Taiwan, India and Chile

The Korean government has a long history of support for the VC industry through co-investment with private investors in VC funds (starting in the 70s and 80s with the Korea Technology Advancing Corporation and the Financial Assistance to New Technology Businesses Act in 1986). The government has been and continues to be the largest supporters of VC funds in Korea, contributing over 30 percent of the capital in new VC funds in 2004. The Korean strategy for promoting VC firms includes multiple instruments—tax incentives; participation as a limited partner; credit guarantee program (less successful); and establishment of a bank, later privatized, specialized in R&D loans. Both the establishment of VC firms and the investment resources in the VC pool increased dramatically after 1997, after the adoption of the act on Special Measures for the Promotion of Venture Businesses. The government co-investment approach is viewed by many as a critical catalyst to the development of the VC market (Baygan 2003 and Koh 2005).

The Taiwan government has also actively supported the VC industry by using tax incentives, including through tax credits or lower tax rates, to encourage investors to invest in equity funds. Taiwan allowed investors in qualified VC funds a credit of 20 percent of their investment to offset tax liabilities, proportionate to actual investments by the VC companies. Taiwan's tax incentive was very effective in encouraging domestic investors, especially large companies, to invest in VC funds, resulting in the establishment of a number of local VC funds. Eliminating the tax incentive, however, has had a very negative effect on the VC industry in Taiwan, with an immediate decline in funding through VC. Companies now prefer to invest directly rather than through VC funds.

The Indian experience in supporting VC through government was the least successful of the four presented here. The government program was initiated with the assistance of the World Bank, based on guidelines issued by the government of India in 1988. Government regulations that were adverse to the development of the VC industry (geographical as well as instrumental limitations were imposed) and the lack of managerial skills ensured that the first VC firms achieved very low returns on their investments. A second phase saw a greater participation of the private sector (foreign, local and, more important, the IT Diaspora). Their managerial expertise brought some successes, but these were to a large extent hindered by continuing government regulations adverse to VC development (e.g., nonneutrality of portfolio, adverse selection). The private Indian VC industry emerged out of the boom in the IT industry *despite*, rather than because of, the government's involvement (Dossani and Kenney 2002). The latter positive developments have been aided both by a better-defined role in the past few years for the government of India, which has been very active in gradually removing both the regulatory and the legal bottlenecks, and by the fact that previous efforts, although less successful, provided a good training and learning ground for all people involved.

Chile tried to replicate the Israeli Yozma Program through the CORFO "Capital de Riesgo Program". The Chile program has had mixed results, mainly owing to low uptake by firms (World Bank "Chile New Economy Study" [2004]). The fact that the CORFO Program was not successful, although its design was consistent with international best practice, points to the need to assess country-specific conditions, both on the supply side and on the demand side.

for private investors beyond merely cofinancing VC funds. However, guarantee programs are more complex to implement, and ECA governments are unlikely to have the capacity to effectively evaluate the guarantee risk associated with the funds.

### 3.4 The Role of Business Support Services

Even if researchers or inventors have the capacity to innovate, they may lack the skills, knowledge, and business acumen to develop a project that would be acceptable for funding, not to mention the ability to engage in the business planning and implementation necessary to commercialize their innovations. In that case, the deal flow and utilization of the instruments may be constrained by the lack of project/business development capacity.

Many OECD and developing country governments implement business support services, especially incubators, as an instrument to promote the commercialization of innovation. Their rationale is that innovators and nascent entrepreneurs cannot be expected to manage all parts of the commercialization process—from launch strategy to financial planning, to IPR, to basic logistics. By providing logistical support and technical assistance, incubators are meant to help entrepreneurs transition from a supportive institutional environment of universities or large companies to the more challenging environment of a new company or R&D project.

Incubator programs have not received high marks for effectiveness, either in their success in promoting businesses or in their cost-effectiveness. This is in part because many incubator programs have developed poor reputations as they devolved from the high goals of business support to the provision of real estate and office support services. But incubators and technical assistance programs in OECD and developing countries alike tend to suffer from poor utilization and poor track records in creating successful

companies. Though there has been remarkably little analysis or impact assessment of these types of programs, the reasons for the perceived lack of success include the following:

- *Necessity for specialized skills and knowledge.* The technical advice or market knowledge required by inventors and entrepreneurs is often highly specialized, whereas most technical assistance programs are designed to reach a range of business needs and therefore are general in nature. The type of business advice needed, however, is from seasoned, experienced businesspeople who are unlikely to be consultants to these types of programs. Therefore, the skills and knowledge required by an entrepreneur in a specific context rarely match the technical assistance provided by a program.
- *Government allocation of resources.* These types of programs tend to be highly subsidized by government and designed and managed by government agencies (supply driven)—without necessarily taking into account inventors' needs. As noted above, government officials are ill-suited to evaluating the paradigm of inventors or entrepreneurs and effectively allocating resources to support them.
- *Incentives for entrepreneurs.* It can be argued that part of the seasoning process of becoming an entrepreneur is overcoming the challenges of commercializing an innovation and setting up a company. The entrepreneurs who are most likely to be successful, therefore, do not have a need for “incubation” because they have the wherewithal to mobilize needed resources. Therefore, there is a self-selection process whereby weaker candidates access incubation services and are unable to graduate from those services.

Most of the existing business incubators and industrial parks in transition countries, including Russia, are little more than custodial care

centers and, in the worst case, tax havens. A recent study argued that “elements of infrastructure such as technological parks and innovation and technology centers (ITC) are considered by managers of small companies more as nice premises, with subsidized rents, rather than structures enabling to promote small enterprises renting these premises” (Gaidar et al 2005). They are primarily controlled work premises designed to help start-up firms survive in the midst of a hostile environment. There is a logic to some form of infrastructure support in hostile environments in which land is difficult to rent, utility and communication connections are difficult to organize, and petty harassment (or worse) from bureaucratic inspectors is an unfortunate but common fact of life. But these real estate services should not be confused with the proactive value-added support and the tools, information, education, contacts, advice, and resources critical to success in the ESTD of a business.

Given these historic problems in incubator programs and government provision of support services, it is necessary to critically evaluate direct subsidies for these types of programs and to be more creative in developing solutions to the real challenge of delivering effective managerial and technical business support to ESTD companies.

It can be argued that the most successful models for incubation and business support services for new companies are the “angel investors” and early-stage VC funds that operate primarily in the U.S. market. Typically, these “angel investors” are seasoned businesspeople with experience in the industry who provide business advice and contacts for specialized skills and knowledge. Because they are investors in the business, they resolve the failures noted above by having the incentive to do rigorous due diligence on the capabilities of the entrepreneur, to critically evaluate the needs of the business and direct it toward necessary resources, and to remain involved in the company, “hand holding”, over an extended period of time.

Unfortunately, “angel investors” are not prevalent in the ECA region. Nonetheless, a number of best practices can be taken from the model and applied to the provisioning of business support services:

- *Business support services linked with investment activities.* Business support services should be a paired component of an investment (such as a matching grant or VC investment). The entrepreneur is therefore screened as part of the investment selection process, and the investment capital helps the company execute its business plan.
- *Private allocation of support services.* Rather than having government set up ponderous technical assistance schemes, entrepreneurs articulate and determine the type of assistance they need as part of their application for a grant or VC. A portion of the investment budget is allocated specifically for business support services.
- *Private provision of technical skills and knowledge.* Entrepreneurs are empowered to seek out the skills and knowledge they need from private consultants—it is therefore a demand-driven supply of business services.
- *Seasoned business expertise.* As much as possible, the successful businesspeople in a country or region should be involved in the design and selection process of innovation programs. Even though they are unlikely to become intimately involved in the selected businesses, their advice and perspectives can be diffused throughout the program.

Let us stress that under this flexible approach, *business* support services are viewed not as a stand-alone policy lever but as a complementary support to the core instruments that provide financing for innovation and R&D. Business support services should be supplied in a demand-driven way, with financial assistance for business support services being offered to

*firms*—who in turn will use the financial support to purchase business support services.

Clearly, however, government support for knowledge and technology transfer and business support services remains a challenging topic. It is further limited by the lack of a critical evaluation of programs and the proliferation of programs. ECAKE II will provide a more in-depth analysis of knowledge and technology transfer in the context of a discussion of absorption of innovation.

### 3.5 Monitoring and Evaluation

An effective monitoring and evaluation (M&E) framework should be a component of the deployment of policy instruments mentioned in this chapter targeted at the enhancement of innovation. M&E should provide information about the program's progress on three levels: (1) the project level in regard to the success of individual projects; (2) the program level in regard to the uptake of funding and overall portfolio performance trends; and (3) the economy level in regard to changes in the technological capabilities, productivity, and growth and in regard to the role of the program in stimulating those changes. Jaffe (2002) explores the possibility of producing more compelling empirical evaluations by having the grant agencies anticipate the need for such evaluation and build certain features into the grant process to facilitate later evaluation. The proposed design of the grant-making process that may facilitate ex post evaluation is discussed below.

An M&E framework for innovation policies must be flexible enough to take into account the organic nature and unpredictability of innovation policies. There is likely to be a significant amount of uncertainty about key variables (e.g., pipeline of project). There may be time lags because the policies change the incentives related to innovation activity. The dynamic nature of the political and business environment will also affect the uptake and performance of the

program. Innovation-support programs must therefore be designed with sufficient flexibility to allow their mechanisms and tools to continue to evolve with changing conditions.

The role of the M&E system is to identify how a program is performing relative to its objectives to allow correction or cancellation of the program midcourse, for example, as a result of low uptake (pipeline lower than expected). Specifically, an M&E system should (1) follow up on whether the program is overfunded and unnecessarily tying up resources and (2) evaluate the overall success of the program on an ongoing basis to help determine when and if the program should be discontinued or restructured. Problems with the program may stem from a lack of demand for resources or a lack of appropriate output resulting from the investments made and, in some cases, from the sufficient evolution of other funding vehicles, thereby making the existing program no longer necessary.

To fulfill that role, M&E vehicles must effectively provide data about the program's progress on the three levels mentioned above—project, program, and economy.

#### *M&E at the Project Level*

The M&E framework should provide feedback on whether the tools being deployed are making a significant impact on the projects being financed in regard to increasing their individual likelihood of success and their access to follow-on financing.

At the project level, therefore, projects must be evaluated in regard to their success on two dimensions: technological success and commercial success. This process begins with ensuring that projects submitted for evaluation for funding clearly state, and distinguish between, the technological and commercial objectives. These objectives should be approved by the evaluation committee/authority and should be amended in conjunction with the applicant where necessary. In doing so, each project begins with specific, measurable, time-bound benchmarks that can

be evaluated to assess the overall success of the project.

Although measuring how a project performs relative to its benchmarks makes it possible to determine whether or not the project has been a success, it does not effectively convey whether the program itself has had a significant contribution to the success or whether the program merely identified which projects were most likely to succeed. In other words, were these projects successful because the tools made available in support of innovation facilitated this success, or were these projects successful because the selection process identified the best projects, with these projects likely to produce a successful outcome independent of the support provided by the program itself?

Jaffe's "regression discontinuity design" (Jaffe 2002) can be a very effective tool in helping to answer that question. The regression discontinuity design is an econometric tool that focuses on evaluating projects at two stages: the selection stage and the assessment stage. The tool requires that projects be ranked in relation to their likelihood of success at the selection stage (a process that needs to take place in any event to enable the selection of projects for funding) and at the assessment stage, to include not only those projects that were selected for funding, but also those projects that were not selected for funding. Essentially, the evaluation team will keep track of projects that were not selected for funding (this can be done by making it a requirement at the application stage) and apply the regression discontinuity design to assess to what extent the provision of funding and innovation support contributed to the increased success of the selected projects.

#### *M&E at the Program Level*

Project-level impact evaluation, however, will not address the overall goal of the program in regard to directly stimulating private investment in innovation. Many R&D grants programs, technical assistance programs, and VC programs

have suffered from poor utilization of funding because the program was too early in the life cycle of innovation, or because of poor program design in regard to the attractiveness of the financing package, or because of poor implementation in regard to the government delivery vehicle.

An M&E tool, therefore, should aim specifically to monitor the use of funding and the underlying factors driving use. In that regard, the program should take into account an expected time lag associated with changing incentive structures in the economy. Low uptake during the early years of the program should be expected and even encouraged. Above all, pressure to invest in lower-quality projects during this early phase should be avoided because early failures are much more likely to negatively affect market perception of investments in innovation than is slow ramp up.

At the same time, underuse of funding must at some point be evaluated to determine whether to release funding for other uses. In that regard, the program design in relation to the attractiveness of the financing package to the private sector, as well as the implementation vehicle, should be evaluated to determine whether they are creating bottlenecks in the program. Surveys of program firms/clients and nonclients can provide input on whether and how the program is fulfilling its objectives. For example, the selection and disbursement process should also be evaluated in regard to its efficiency, effectiveness, and burden on the applicant. Overutilization of funding can also be evaluated similarly as to whether the incentive structure is so attractive that it leads to crowding out of private investment and whether the selection process is consistent with the objectives.

#### *M&E at the Economy Level*

Although the project and program evaluations are important measures, they do not address the more difficult determination of whether the overall program was beneficial for the economy.

Fundamentally, the most important evaluation of the program's overall success is determining whether implementing the program itself is helping to generate greater returns in relation to increasing the productivity and growth prospects of the local economy. Clearly identifying the causal connection between the specific program and the changes in the economy requires a long time span: ex post evaluation will have to take place when a sufficient number of years have elapsed since the beginning of the program.

M&E at the economy level is complex because the evaluation must show not only whether productivity and growth have increased, but also whether the program had an impact on that increase. Because, as argued in chapter 2, publicly funded R&D should be targeted at the generation of spillovers, it is important to focus not only on the commercial or technological successes under the program, but also on whether the program helped to generate increased R&D beyond the sum of its projects and to contribute to innovation at the economy level. The knowledge economy index (KEI) (see description in chapter 4) is likely to provide some of the best indicators of changes in the knowledge economy. These indicators will need to be observed over a period of time to note significant changes. Obviously, it will be difficult to identify to what extent changes at the economy level are due to the program rather than to other variables.

### 3.6 Conclusions

This chapter has dissected the variety of instruments that have been used in OECD countries to understand the principles underlying effective design, the rationale for the basic types of instrument, and the applicability to ECA countries. On the basis of this analysis, we have recommended three specific instruments for interventions: minigrants, matching grants, and VC leverage. These three instruments potentially address key pressure points along the innovation and commercialization continuum—minigrants

for early-stage research, matching grants for pre-commercialization-stage development, and VC leverage for commercialization and scaling up.

The availability of government assistance along these pressure points may, in some circumstances, constitute such a lever and may feed back into the system by providing incentives to other projects in the pipeline. At other stages of development, or under other macroconditions, there may be different levers to act on. This may be disconcerting, but it is of the essence of the phenomenon that we are trying to influence: extremely dynamic and fluid.

However, setting up one or more programs may not be sufficient to trigger the entrepreneurial response. Consider for example the case of Finland, which has also implemented extensive R&D support programs for more than three decades and is widely regarded as a prominent success in developing a thriving high-tech sector. Yet, a recent report on the Finnish innovation systems complains that there is still a noticeable shortage of innovative entrepreneurship (see Georghiou et al. 2003). Even more striking is the case of Chile, in which a World Bank project focused the support of innovation on the promotion and funding of VC. However, the well-funded VC program did not have a sufficient pipeline to invest in, and the project was not successful in raising R&D and innovation levels in the Chilean economy.

The difference between necessary and sufficient conditions is of the utmost importance here: the establishment of a direct support program for R&D is in many cases a necessary condition for innovation, but it is by no means a sufficient one. It may (also) have significant signaling value, showing serious commitment on the part of the government to promote innovation and R&D over the long run and, hence, making it worthwhile for the entrepreneurs to engage in innovation activities. But it may also fail if the requisite institutional conditions are not in place. The next chapter turns to such a discussion.