CHAPTER 1

Why innovation matters—and what the government should do about it

- **R&D spending in ECA countries remains low, standing at an average R&D-to-GDP ratio of 0.9 percent, about half of the EU27 average of 2 percent. The Czech Republic and Slovenia, the ECA economies with by far the highest R&D intensity, spend just about 1.5 percent of GDP.**
- **Innovation outputs are comparatively low in ECA, even when considering the level of R&D inputs, which reflect institutional and capacity weaknesses and the low share of private R&D. Even the leading ECA country in terms of granted patents in USPTO, the Russian Federation, lags behind OECD and other large middle-income countries in R&D output, including a much lower number of patents and scientific publications per capita.**

- **Does government intervention have a role in raising public R&D and stimulating private R&D, as well as commercializing new ideas and absorbing technologies from around the world? The answer is yes, but a qualified yes: well-targeted government interventions can moderate several market failures affecting investment in innovation but can also aggravate them if badly planned and executed.**
- **Should support instruments be neutral about sectors? Although some OECD countries apply a mix of technology-neutral and technology-specific approaches, weaknesses in the governance and institutional framework in ECA countries often distort the allocation process, rendering them subject to enormous pressures from vested interests.**

As policymakers in Europe and Central Asia (ECA) debate ways to increase and maintain productivity and economic growth—and speed up convergence with Europe—they need to find ways to create an environment that is conducive to the application of knowledge in the economy through innovation and learning. The history of excellence in learning and basic research in several ECA countries provides some basis for hope that commercial innovation could be adopted and built "on the shoulders" of the past. Translating this research foundation into economically productive commercial applications, however, remains a critical missing link in ECA countries. Against that background, this book focuses on public policies for building supportive knowledge institutions and creating an incentives framework for the support of commercial innovation.

We distinguish between innovation and technology absorption as follows. The Organisation for Economic Co-operation and Development (OECD) Oslo Manual identifies four types of innovation: *product innovation, process innovation, marketing innovation,* and *organizational innovation*. These innovations can be new to the firm, new to the market, or new to the world. The advantage of using such a broad concept of innovation is that it includes all activities involved in the process of technological change. These range from identifying problems and generating new ideas and solutions, to implementing new solutions and diffusing new technologies. *Absorption*, a subset of innovation, is the application of existing technologies, processes, and products proved and tested in a new environment in which the processes have not yet been tested and the markets and commercial applications are not fully known (box 1.1). This distinction does not preclude important complementarities between innovation as a whole and absorptive capacity. Innovation promotes absorptive capacity because human capital generation and knowledge spillover effects associated with the innovative process build absorptive capacity. The ability of an economy to research and develop new technologies increases its ability to understand and apply existing technologies. Vice versa, the absorption of cutting-edge technology inspires new ideas and innovations.

BOX 1.1
Defining innovation and absorption

- *Innovation:* the development and commercialization of products and processes that are new to the firm, new to the market, or new to the world. The activities involved range from identifying problems and generating new ideas and solutions, to implementing new solutions and diffusing new technologies
- *Product innovation:* development of new products representing discrete improvements over existing ones.
- *Process innovation:* implementation of a new or significantly improved production or delivery method and implementation of a new organizational method in the firm's business practices, workplace organization, or external relations. This includes "soft innovation," such as reorganization of layouts, transport modes, management, and human resources.
- *Incremental innovation:* innovation that builds closely on technological antecedents and does not involve much technological improvement upon them.
- *Absorption:* the application of existing technologies, processes, and products proved and tested in a new environment in which the processes have not yet been tested and the markets and commercial applications are not fully known—that is, they are new to the firm. It is a subset of innovation.
- *Absorptive capacity:* a firm's capacity to assess the value of external knowledge and technology, and make necessary investments and organizational changes to absorb and apply this in its productive activities.

Source: Authors.

Yet, the adoption of existing technology through trade, foreign direct investment (FDI), or licensing is not guaranteed or cost free.[1] Firms and countries need to invest in developing "absorptive" or "national learning" capacity, which in turn is a function of spending on research and development (R&D). Thus, domestic R&D has a role in developing a firm's

1. Cohen and Levinthal 1989; Kinoshita 2000.

ability to identify, assimilate, and exploit knowledge from the environment—that is, enhancing the *absorptive capacity* of the economy.

Innovations may be undertaken by individual entrepreneurs or startup firms—with no existing market power—or by incumbent firms with market power. It is the new entrants or the firms with no existing market power that are popularly claimed to be more likely to undertake the most dramatic and revolutionary innovations. However, worldwide, most successful innovations are born, bred, and brought to market in larger incumbent firms with market power; often these innovations are incremental but nonetheless critical for sustained growth and job creation.

As for R&D, we use the widest definition to cover outcomes related to improvements in existing processes or products as well as the imitation and adoption of knowledge—it is not restricted to original innovation. The OECD defines R&D to "comprise creative work undertaken on a systemic basis in order to increase the stock of knowledge and the use of this stock of knowledge to devise new applications." Following the literature, R&D should be understood as "the process by which firms master and implement the design and production of goods and services that are new to them, irrespective of whether they are new to their competitors—domestic or foreign."

Our choice to focus on public support of commercial innovation is driven primarily by the increasing attention policymakers in the ECA region are directing toward enhancing investments in R&D in their respective countries—in other words, "client demand" for an analysis of the R&D commercialization support systems. The European Union's (EU) EU2020 (formerly Lisbon) Strategy prompted the EU accession countries and other ECA countries to consider implementing financial instruments to promote innovation, including venture capital schemes (in many cases, there was little consideration for the necessary institutional requisites or appropriateness of the instrument). In a number of countries in the former Soviet Union (for example, Russia, Ukraine, and Kazakhstan) and in other post-transition countries, the legacy of research and human capital also provides an incentive to revive their research capacity. However, absorptive capacity remains an issue in all ECA countries. Some of them are likely to have higher productivity returns from investments in building absorptive capacity than in commercial innovation.

The current allocation of research funding contributes to the apparent lack of collaboration between the science and business sectors. The aim of the financial instruments we recommend is to address those problems through the encouragement of private R&D in companies by providing incentives for collaboration through the cofunding of "consortia" of firms and universities or research institutes to implement innovative projects.

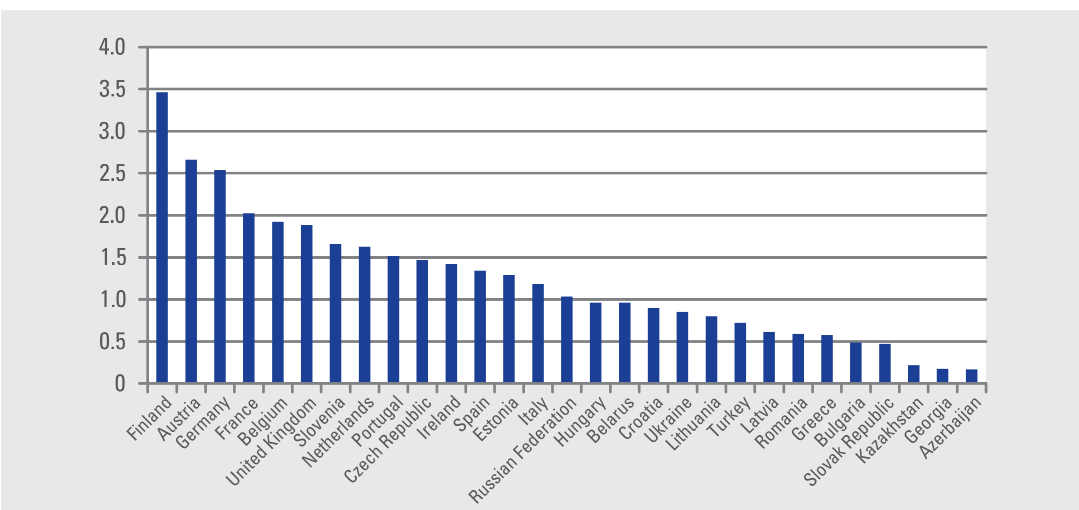
Nonfinancial instruments, such as business support services, incubators, and economic support zones, are suggested as complementary components of the financial instruments. A sound investment climate is considered an essential prerequisite for innovation and absorption.

The focus of this study on R&D and on commercialization is consistent with the view (elaborated in chapter 3) that commercial innovation and R&D are key factors driving *self-sustained*, long-term economic growth and, moreover, that these factors are generated from within the economic system, responding to economic incentives.

Although there is a wide variation in the intensity of R&D spending across countries, it tends to be lower in ECA countries—where the average R&D-to-GDP ratio is 0.9 percent (figure 1.1) and the world average is 2.4 percent. Some Nordic countries like Finland and Sweden spend about 4 percent of GDP on R&D, which is around double the OECD and EU27 averages. The large OECD countries including the France, Germany, the United Kingdom, and the United States have an R&D intensity of between 2 percent and 3 percent. The Czech Republic and Slovenia, the ECA economies with by far the highest R&D intensity, spend just about 1.5 percent of GDP. And human resources for R&D are unevenly distributed in ECA, though most ECA countries have a higher stock of researchers than other middle-income countries such as Brazil and Malaysia (figure 1.2).

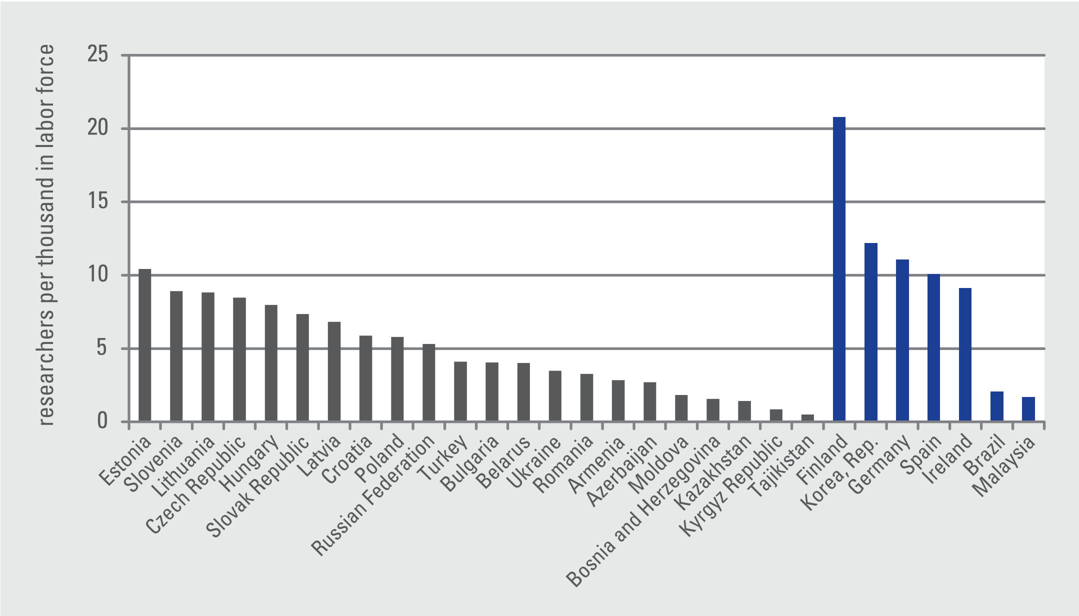
Moreover, innovation outputs are comparatively low in ECA, even when considering the level of R&D inputs. Russia lags behind OECD and other large middle-income countries in R&D outputs—including a rela-

FIGURE 1.1
ECA needs to boost its R&D spending



Source: Authors' calculations based on UNESCO and USPTO data for 2007.

FIGURE 1.2
ECA's researcher population is unevenly distributed



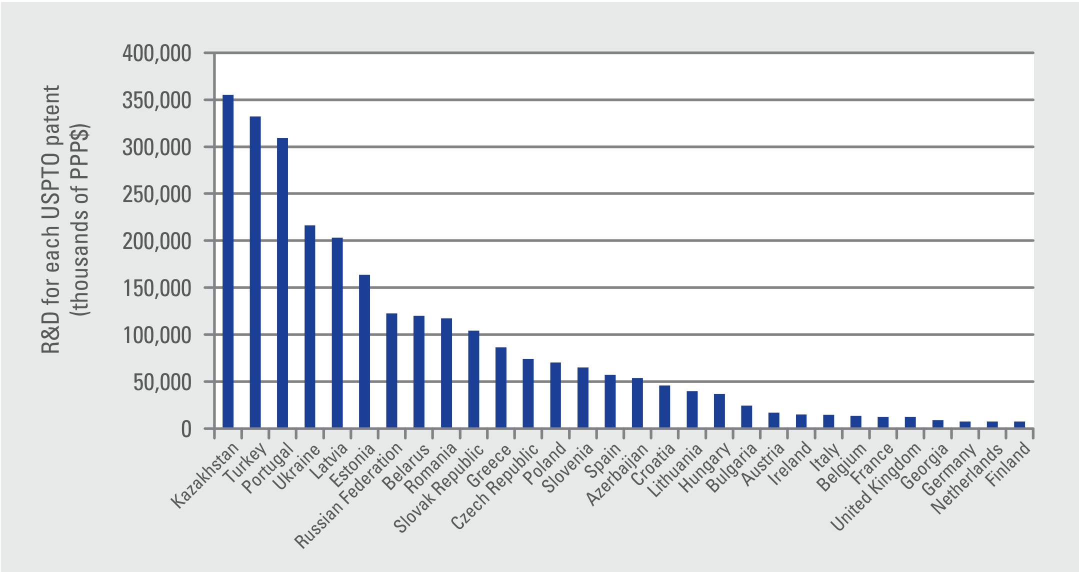
Note: All headcount data are for 2007, except for Malaysia, 2006.
Source: UNESCO statistics.

tively low number of patents and scientific publications per capita.[2] In fact, they spend more on R&D than most EU15 countries for each U.S. Patent and Trademark Office (USPTO) patent they generate (figure 1.3). Hence, ECA's low patenting performance can be attributed to both its low level of investments in R&D and inefficiencies within its innovation system. It must be emphasized that USPTO patents measure only innovation at the global technological frontier, while much of the R&D in ECA countries is used for catching up purposes. Radosevic (2005) does not find inefficiencies in R&D in ECA countries when considering national patents, but comparing national patents has its shortcomings since patents may be easier to obtain in one country than in another. However, in his empirical work, Radosevic does find inefficiencies in converting measures of innovation outputs, such as patents, into productivity in ECA countries. As a result, ECA countries are quickly being surpassed by China and India in terms of patenting (see figure 2.5, chapter 2).

Financial support to stimulate commercial investment in R&D by firms is important in ECA because the average R&D-to-GDP ratio does

2. Schaefer and Kuznetsov (2008) show that despite Russia devoting significant resources at the aggregate level to R&D, it is not translated into higher levels of total factor productivity. The authors suggest that the coexistence of a large R&D sphere and low productivity in manufacturing indicates low productivity in R&D institutions and weak links between R&D and the economy.

FIGURE 1.3
ECA's R&D efficiency is still low



Source: Authors' calculations based on UNESCO and USPTO data for 2007.

not reveal the whole picture of the structural misallocation of resources between private and public sectors and between basic and commercial R&D in the transition economies. Typically, the bulk of R&D spending in ECA, as much as two-thirds of the 0.9 percent of GDP, is financed by governments, whereas only about one-third is financed by the private sector. By contrast, in countries with high rates of R&D expenditure, such as Finland, Germany, Japan, Ireland, Sweden, and the United States, the share of industry-related R&D spending ranges from 65 percent to 70 percent, whereas government spending amounts to only 20–30 percent (OECD 2002).

This chapter's goal is to provide countries with a general guide for evaluating the instruments to support innovation and the necessary institutional requisites for its effective application. Another key message is that ECA countries need to analyze the state of their national innovation systems before embarking in the adoption of many of the financial instruments pursued by EU countries to support innovation. Some countries may not meet the basic institutional requisites, such as economic incentives, education, and information infrastructure, to absorb innovation instruments effectively. Other countries may have institutional bottlenecks that need to be addressed before or concurrently with embarking on an innovation program.

The rationale for innovation

Ever since the path-breaking research of Robert Solow in 1956, economists have known that a country's long-term economic growth stems mostly from technological change, rather than traditional inputs such as capital and labor. Indeed, a vast array of subsequent empirical research over a half century has shown conclusively that at least half the growth in per capita income, in virtually every country studied, is associated with the growth of what is called total factor productivity (TFP)—that is, the famous "residual" to which we attach the label of technological change. But what exactly does this residual contain, how does it evolve over time, and what is the nature of the economic forces that determine its course and pace?

Indeed, one of the frustrating aspects of the early phase of economic thinking about these matters was that the growth of TFP—arguably the single most important economic phenomenon—appeared to economists as an impenetrable "black box" and seemed to occur outside the realm of economic forces. A long and fruitful research agenda pioneered by Griliches, Jorgenson, Denison, Rosenberg, and their associates sought to open this "black box" to understand its contents. However, it was only with the extensive development of endogenous growth theory in the late 1980s (Romer 1986, 1990; Lucas 1988; Grossman and Helpman 1991) that the economic profession came to accept the view that innovation, spillovers, and R&D were indeed the key factors driving self-sustained, long-term economic growth and, moreover, that these factors were generated from *within* the economic system, responding to economic incentives.[3]

In recent years, many studies have explored the interplay between competition and innovation, along with their impact of growth (Aghion and others 2005). Although Schumpeterian growth models predict that only firms with market power would have the resources and incentives to innovate, these studies find that in the more developed economies, among the incumbent firms closer to the "technology frontier," competition does encourage innovation. As for transition economies, a further study (Aghion, Carlin, and Schaffer 2002) shows that competitive pressures raise innovation in both new and incumbent firms, subject to hard-budget constraints for incumbent firms and the availability of financing for new firms. How about Europe as it edges closer to the world technology frontier? A recent study (Aghion and Howitt 2005) argues that Europe would benefit from a competition and labor market policy that

3. Work on education and technological change by Nelson and Phelps (1966) mentioned that technological progress was key to growth and highlighted the difference (for growth) between human capital stock and accumulation. However, it was only in the late 1980s that those views were widely shared.

not only emphasizes competition among incumbent firms but also stresses the importance of entry, exit, and mobility. The bottom line is that the closer firms in ECA countries move to the technology frontier, the more competitive pressures and market structures will play a role in the innovation capability of a country.

This conceptual framework molds our analysis: on the one hand, the view of the centrality of innovation and knowledge creation in the growth process, and on the other hand, the understanding that these are economic factors that may be shaped and influenced by properly designed economic policies. Building on that view, a recent study by the World Bank (Chen and Dahlman 2004) seeks to decompose "knowledge" into a wide array of indicators—each of which represents an aspect of knowledge—and assess their contribution to growth. The study, which covers 92 countries from 1960 to 2000, confirms that knowledge is a significant determinant of long-term economic growth. It finds that an increase of 20 percent in the average years of a population's schooling tends to increase the average annual economic growth by 0.15 percentage points. As for innovation, a 1 percent increase in the annual number of USPTO patents granted is associated with an increase of 0.9 percentage points in annual economic growth. And when the information and communication technology (ICT) infrastructure, as measured by the number of phones per 1,000 persons, is increased by 20 percent, annual economic growth tends to rise by 0.11 percentage points.

One corollary of the developments just sketched was the emergence of a soundly based and carefully articulated economic rationale for public support of R&D and innovation, which is by now widely accepted among academic economists and practitioners. The basic argument for public support of R&D is that innovation is a critical factor for growth (and hence, among others, for poverty alleviation), but a well-functioning market economy cannot generate by itself the optimal levels of R&D. There are two main sources of market failure with respect to R&D:[4] partial appropriability (owing to spillovers), which does not allow inventors to capture all the benefits of their invention, and information asymmetries—for example, the difference between the information that an

4. For a full list of rationales for state interventions in fostering knowledge creation, see the flagship study of the World Bank's Latin American and Caribbean Studies, de Ferranti and others 2003. It lists other important aspects of knowledge creation that prevent markets from generating the optimal level of knowledge: the long-term and risky nature of R&D investments, lumpiness of innovation, and coordination failures. See Baumol (2002) for a description of the features of the free market economy (market structure, productive entrepreneurship and rule of law, markets for technology trading, and reasons why R&D expenditure might be efficient despite substantial externalities on innovation) that explain its effectiveness in promoting innovation and growth.

inventor looking for financing has about an invention and the information that the potential financier has. These failures inhibit private firms from investing enough in innovation and R&D, thus depriving the economy of one of the key levers for sustained growth.[5]

Coping with spillovers

A basic feature of knowledge creation is that the returns from investments in it are not fully *appropriable* by the original investor. Knowledge has significant public good attributes—that is, once created it can be used repeatedly by multiple actors at no or very low extra costs. Firms making investments in knowledge creation capture only a portion of the benefits created. They do not receive compensation for the "spillovers" that their innovative efforts generate—that is, for the positive externalities of their actions on other firms and agents. Further, new technologies confer benefits to the purchasers of new products (consumers and producers alike) that often exceed any increase in the selling price that can be sustained. These nonappropriable benefits are also referred to as *spillovers* to consumers and are of particular importance in the context of "general purpose technologies." Both types of spillovers, namely, the purely technological externalities and the excess benefits to buyers, imply that the social returns from innovations may be far larger than the private returns (Jaffe 1998).

As a result of this gap, innovators operating in a market economy will invest in R&D less than the socially optimal amount; the extent of underinvestment depends on the extent to which social returns exceed private returns, and that may vary widely across fields, technologies, stages along the innovation cycle, and so on. Empirical studies have shown that typically the social rates of return of R&D expenditures are very large, often several times larger than private ones (Klette, Møen, and Griliches 2000). Moreover, these studies show that the returns from R&D exceed by a wide margin the returns from other types of investments, particularly from investment in physical capital. This implies that a government role in increasing the amount of resources devoted to R&D at the economy-wide level can have significant social benefits.

Spillovers may occur in many different ways, one being the mobility of R&D personnel and entrepreneurs. The process of innovation and its commercialization in an enterprise builds the human capital of its employees. Employees acquire R&D skills and an understanding of tech-

5. Clearly though, it is not enough to spell out such an economic rationale: for it to lead to policy, it must be weighed against the *costs* of government intervention, namely, the well-known problems of "industrial policy," capture, and corruption, which constitute the so-called government failures.

nologies and markets that are partly general—that is, they go beyond the specific knowledge embodied in the innovation and protected by intellectual property rights. Employees that move from one firm to another carry with them this human (or innovation) capital, which may benefit their new employers beyond the increment in wages that the mobile employees may receive. If mobility takes the form of migration, then the origin countries may be unwittingly "subsidizing" the destination countries through these spillovers. Thus the mobility of R&D personnel and entrepreneurs is an important transmission mechanism for spillovers, and hence a channel that should be closely monitored because it may have both positive and negative effects on any given country.[6]

Openness to trade and FDI increases the probability of receiving spillovers that originate elsewhere. As Coe and Helpman (1995) have shown, large economies tend to benefit the most from international spillover flows mediated by trade. Countries can increase their productivity by importing goods (especially capital equipment) from foreign, more advanced technologies (Coe, Helpman, and Hoffmaister 1997). Another potential source of technology spillover is FDI, though investors frequently "keep their knowledge at home" (Blomstrom and Kokko 1999). That is beginning to change (for example, R&D is moving to India), though the international principles still maintain control of the innovations through patents registered abroad.

The impact of FDI is indirect, through "spillover effects,"[7] owing to the presence of multinationals—first, because they create links with domestic firms and, second, because their presence spurs domestic producers to invest in new technology to compete with the foreign-owned firms. For example, in the Czech manufacturing sector during 1995–98, the indirect effect of R&D through the development of the absorptive capacity was found to be far more important than the direct effect of innovative R&D in increasing productivity growth of the firm; it was also found that R&D and intra-industry spillovers from FDI go hand-in-hand (Kinoshita 2000).

6. The spillovers-based argument clearly holds for large, mostly closed economies: being closed there is no risk of spillovers slipping out, and being large there is a high probability that at least some other local economic agents will benefit. In small open economies, spillovers may spill *out* of the country and benefit external firms and consumers rather than the local economy. Any policy designed to promote R&D should aim not only at increasing total R&D but also at increasing total R&D in a way that incentivizes *local* spillovers rather than external leakages, develops absorptive capacity, and ultimately affects the productivity of a wide range of sectors in the local economy.

7. Spillover effects (from neighboring countries or industries) arise when production affects the economic activity of other local firms or their employees. Positive spillover effects occur through the supply of new information, new technologies, managerial practices, and so on. Thus the "social" gain is larger than the profit or productivity gain made by the "source" company.

In Poland, so far, spillover effects leading to technology improvements in firms are observed only in a few industries, such as the auto industry, in which foreign R&D is high.[8] To be able to capture these international spillovers, the country needs to develop "absorptive capacity" (Cohen and Levinthal 1989), which entails, among others, investing in local indigenous education and innovation.

Another result of partial appropriability is "coordination failure." Often, technical advances in a given field require complementary advances by numerous distinct parties. Any one party may find that it is not worthwhile to develop one component of the system unless it can be sure that others will develop complementary components. If these parties do not have a mechanism to coordinate their investments, it is possible that no investment will occur. Government support may tip the balance such that multiple actors will invest in R&D independently. Innovation instruments can also be designed specifically to remedy coordination failures in innovation by encouraging "consortia" of universities/research institutes and firms or by promoting technology "clusters."

Coping with unequal information and the "funding gap"

A second source of market failure related to knowledge creation has to do with asymmetric information between inventors and external agents (for example, investors such as banks). Innovative activities entail by necessity a fundamental information asymmetry, certainly ex ante, that is, at the stage at which the inventor formulates the idea and seeks funds to develop it. It can be assumed that inventors have sufficient knowledge of the technology and of the details of the planned innovation, of their true abilities to carry it out, and of the efforts they are willing to put into developing the innovation. However, there will always be a significant gap between what the inventor knows and what an external agent can gauge, even if the information on those crucial matters is well documented.

In particular, there will be significant information asymmetries in that respect between the inventor and mainstream financial intermediaries, such as banks and institutional investors, who lack the capacity to verify the specific technical information and claims of the entrepreneur. Poten-

8. This is consistent with Kinoshita's (2000) finding concerning Czech enterprises' data—in oligopolistic sectors, such as electrical machinery and radio and television, there is a significant spillover rate as a result of having a large foreign presence. Also, R&D investment has a higher rate of return in these sectors. However, less oligopolistic sectors, such as food and nonmetallic minerals, show no evidence of spillovers despite the large presence of foreign investors in them.

tial investors will therefore be skeptical of the likely returns on investments in developing new technologies. Entrepreneurs who could offer attractive returns may have no credible way of conveying such potential to risk-averse investors.

The information asymmetry makes it hard for a creditor or equity investor to predict the returns from a potential investment in innovative ventures, which implies that such funding is not likely to be forthcoming. In the absence of demonstrated cash flows or other collateral, a typical startup company or individual innovative entrepreneur will not have access to traditional sources of finance—this is the so-called funding gap. At the most basic level, the funding gap implies that entrepreneurs face stiff constraints in the funding of innovations and thus will not invest (or will invest too little) in innovative projects that may have high social returns. This funding gap has been studied in most detail in the United States, but the findings have direct implications for the ECA region as well.

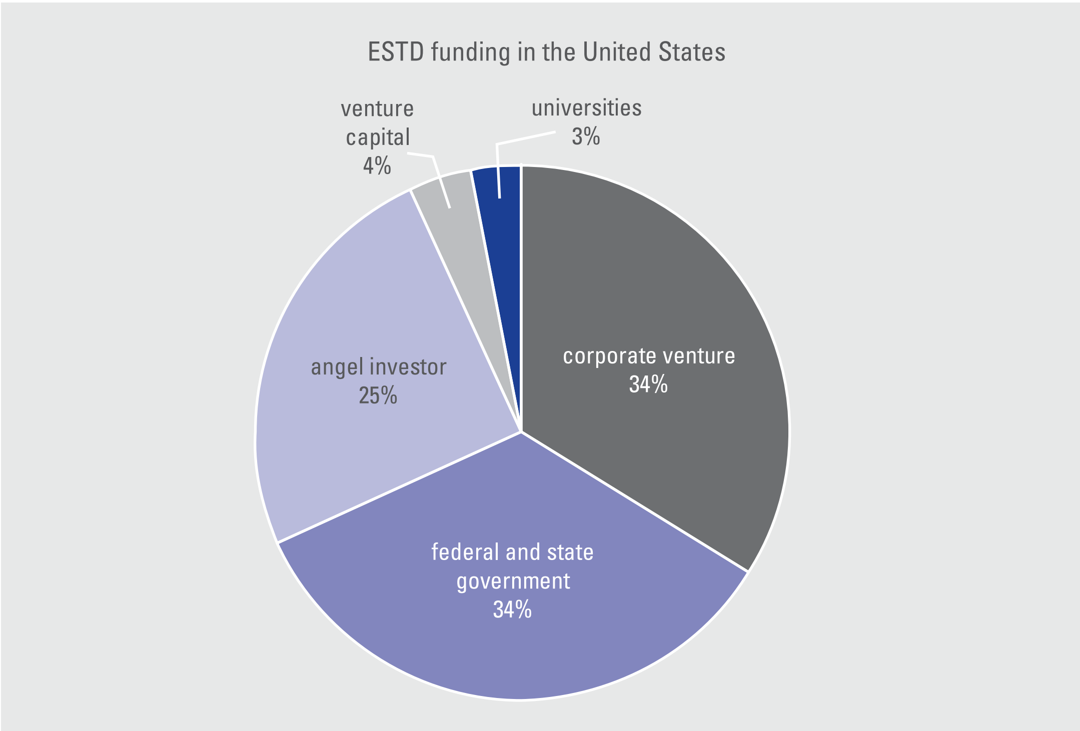
Early stage technological development (ESTD) is the most problematic phase in the innovation process and is defined as the link between invention and innovation, when a new product and market are identified. In this stage, product specifications appropriate to the identified market are demonstrated, and production processes begin to be developed, allowing estimates of production costs. At the end of this stage, the entrepreneurial venture has articulated a business case.

Figure 1.4 emphasizes the importance of internal financing by enterprises, government funding, and "angel investors" in the ESTD stage (Auerswald and Branscomb 2003). But most important, it emphasizes the virtual absence of more mainstream intermediaries such as banks, private equity, and other institutional investors. Although the percentages are for the United States only, figure 1.4 illustrates that, typically, even in one of the most advanced and innovative economies, early-stage finance of innovative projects is undertaken directly by firms, if they have the resources, or by very specialized institutions, with a significant role played by the government.

Not surprisingly, internal funds account for the biggest share of ESTD financing in the United States, because that is the most straightforward way of overcoming information asymmetries. Established enterprises know the track record of their own inventors/employees and, typically, have a better understanding of the market and the commercial potential of internally proposed innovations than do outside agents. Enterprises use the cash flows generated by established operations to finance innovation or source external funds on the basis of their balance sheet strength.

Angel investors are another important source of ESTD funding in the United States and to some extent in Europe. The term "angel investor" refers to successful entrepreneurs that look for new opportunities to

FIGURE 1.4
Corporate ventures and the government play a key role in the early stages



Source: Auerswald and Branscombe 2003.

invest private funds (earned from their own previous innovations) and are willing to invest in ESTD projects in technological fields that they understand well (having "been there and done that"). Studies of the behavior of angel investors frequently find that they are often heavily involved in the commercial decision-making and that this "business support" function can be as important as the financing. Managerial advice and commercial control over the ESTD entrepreneur are typical characteristics of the angel investor and venture capital funding models, as well as, of course, in internal funding models.

Given the short history of capitalist accumulation and profit-generating enterprises in ECA, internal financing by enterprises and angel investors is rare in the region and does not provide a viable basis for promoting innovation. The absence of angel investors is problematic not only from a funding perspective, but also given their role as sources of managerial expertise, as information brokers, and as access points to formal and informal networks of entrepreneurs and innovators. The role of government is therefore different in ECA countries than in OECD countries. The lack of "angels" and internal financing is acute, and the capacity of government agencies to fill their place is extremely limited. The Finnish case study in box 1.2 and the discussion in chapter 3 provide possible options for interventions that compensate for the absence of local angel investors by promoting international angel-investor networks and building public information marketplaces and networks.

ESTD requires patient and high-risk tolerant investment capital to fund early, prerevenue stages of research, development, and commercialization. Yet filling the "funding gap" requires specialized investors with the skills to evaluate and directly manage the risks of ESTD (angel investors or innovative managers in firms that are willing to invest retained earnings accumulated in other activities in the highly risky innovative projects) or governments with a broader public policy objective of capturing some of the spillovers associated with ESTD. In the absence of positive internal cash flows and angel investors, even if appropriability is adequate to yield a reasonable profit expectation, it may be impossible to secure the capital necessary to develop a new technology. Typically, in developing countries, the information asymmetry and "funding gap" problem is much more acute than in developed economies.

Why the government should play a role

In the presence of the markets failures discussed above, is there a case for government intervention in a market economy? The answer is yes, but a qualified yes: the necessary qualifications are about the *how* of government interventions.

The government plays a special role in promoting startups to generate new activities and support sustainable job creation because of the high risk that deters the entry of new ventures and the high failure rate once such ventures are established. This role derives from the asymmetry of risk between the government and the startup: for the private investor, the failure of a startup is a total loss, but from the society's point of view, that is not the case. In fact, the intellectual property assets that a failed startup created and the skills imparted to its former employees can be used to start a new enterprise utilizing those assets. Thus, for governments, the subsidization of failed startups contributes to innovation and the development of future startups. In particular, it is important that governments support new ventures that are based on intellectual property because those firms are, by definition, introducing new technologies and new products and developing new markets. Moreover, as Lerner (2009) points out, large firms often focus on existing clients, while new companies—faced with strong preexisting competition in established markets—often focus on developing and exploiting new market opportunities. Meanwhile, the dominance of these large firms in concentrated markets discourages the emergence of small innovative firms.

Thus, government interventions should promote the entry and growth of startups, particularly technology-based startups, through facilitating the commercialization of inventions and ensuring a level playing field between incumbent and small firms and the established large companies.

But while in a well-functioning market economy, there are institutions to facilitate effective government support and prevent abuses, in transition economies, government intervention might fail—or even cause harm—because of a weak institutional framework that is not conducive to intervention. As Josh Lerner of the Harvard Business School writes in a book[9] on entrepreneurship and venture capital: "When we look at the regions of the world that are, or are emerging as, the great hubs of entrepreneurial activity—places such as Silicon Valley, Singapore, Tel Aviv, Bangalore, and Guangdong and Zhejiang provinces—the stamp of the public sector is unmistakable. … While the public sector is important in stimulating these activities, I will note that far more often than not, public programs have been failures. Many of these failures could have been avoided, however, if leaders had taken some relatively simple steps in designing and implementing their efforts" (pp. 5,7).

The bottom line is that any public intervention must be weighed against the actual and potential costs of intervention. Market failures may justify government intervention to stimulate absorptive capacity in the private sector. However, policy design needs to account for potential risks of government failures, such as corruption, the capture of policymakers by large companies and other vested interests, and misaligned incentives of government officials who risk high penalties if their policies fail but expect little extra compensation if they succeed.

"Industrial policy"

How deeply should governments become involved in picking winners and supporting the country's industrial champions? It is a timely question as governments are stepping up their use of industrial policy—that is, an attempt by the government to actively promote the growth of particular industrial sectors and companies—despite the controversy surrounding the topic. Critics point out that "picking winners" strategies have often failed, leaving taxpayers to foot the bill, or have been turned into programs that in reality are "saving losers" that could only stay afloat with subsidies.

One of the concerns is that successful program design often requires "neutrality," which is aimed at minimizing distortions. Neutrality means that the government does not "pick winners" and does not decide which

9. Lerner 2009.

sectors or technologies to support. On one hand, historical evidence finds that countries that made a successful transition from agrarian to modern advanced economies had governments that helped individual firms overcome coordination and externality problems. This holds true for the long-established industrial powers of Western Europe and North America as well as for the newly industrialized economies of East Asia (Lin and Monga 2010).

But industrial policy has also led to major and extremely costly failures in developing countries, with the government's attempt to pick winners and losers often the culprit. In the 1970s, for example, industrial policy was often associated with failed import substitution policies. A review of several recent major industry successes in developing countries by Pack and Saggi (2006) provides little evidence in favor of activist government policy. Take the cases of India's software sector, Bangladesh's clothing industry, and China's special economic zones. In the first two, the government's main role was one of "benign neglect," while in the latter China imitated the earlier success of Singapore by enabling the location of foreign investment in enclaves that were well provided with infrastructure. Much of the earlier investment came from overseas Chinese. In other words, these success stories were driven primarily by private sector agents (often from abroad). A further limitation on the potential role of industrial policies as traditionally understood, Pack and Saggi argue, is that many industries that developing countries would like to support are now highly globalized—making it much more difficult to set up and nurture national champions in isolation from existing international industrial networks and supply chains.

So does industrial policy have any role to play in economic development? Rodrik (2004) contends that the traditional view of industrial policy (based on technological and pecuniary externalities) is outdated and does not capture the complexities that characterize the process of industrialization. He argues that the right way of thinking about industrial policy is as a discovery process—one where firms and the government learn about underlying costs and opportunities and engage in strategic coordination. His view is that industrial policy is more about eliciting information from the private sector than addressing distortions by first-best instruments. He envisions industrial policy as a strategic collaboration between the private and public sectors—the primary goal of which is to determine areas in which a country has a comparative advantage. The traditional arguments against industrial policy lose much of their force when one views industrial policy in these terms. For example, the typical riposte about governments' inability to pick winners becomes irrelevant. The fundamental departure of this viewpoint from classical trade theory is that entrepreneurs may lack information about a country's comparative advantage. Or more to the point, at the micro level, entrepreneurs may simply not know what is profitable and what is not.

The relevance of Rodrik's argument (2008) hinges on the institutional innovations that can be put in place to cope with information asymmetry and rent-seeking.[10] Among the valuable ideas and principles for institutional development he proposes, it is worth highlighting "embeddedness"—which refers to the institutions that help governments work more closely with the private sector to discover the nature of market failures, so that final targeting decisions are truly guided by "a process of discovery." This means the use not only of carrots but also of sticks to weed out policies or projects that fail, and broader accountability of industrial policy to the general public.

But is this argument sound? Brahmbhatt (2007) has argued that there is a circularity problem in Rodrik's hypothesis that second-best policies, such as industrial policy, are needed to address market failures affecting modern sector activities because first-best policies like strengthening governance and building institutions are too broad and unrealistic. If it is true that to make industrial policy work there is a need for quite sophisticated governance and institutional mechanisms, then might not the original first-best policies also make sense? Perhaps only a few developing countries can muster the institutional strengths needed to make industrial policy work. At any rate, practical implementation would require close attention to the necessary governance and institutional underpinnings of industrial policy.

Lin and Monga (2010) argue that the discrepancy between the positive outcomes of industrial policy in advanced economies and its negative outcomes in developing countries lies in the poor choice of industries supported in the developing countries. Too often, instead of "picking winners," governments end up "picking losers." They argue that developing countries have tended to support industries that are too advanced and hence too far from the economy's comparative advantage (which might lie in labor supported capital-intensive industries). In contrast, emerging countries—that is, the rapid technology followers—have tended to support industries that were consistent with the comparative advantages in their economies, and typically similar to mature industries in countries whose income level closely paralleled their own.

So should innovation support measures to target firms in particular sectors? The answer needs to be nuanced. Two of the world's most advanced economic areas, the EU and the United States, apply a mix of technology-neutral and technology-specific approaches—with EU and U.S. enterprise R&D programs extensively engaged in "picking" technol-

10. Cited from Brahmbhatt 2007.

ogy areas.[11] Are these policies "picking winners" or, in Rodrik's terminology, state support for self-discovery in novel technologies? Countries sometimes make exceptions on neutrality for technologies thought to exploit a comparative advantage, or general purpose technologies thought to have particularly strong spillovers on the rest of the economy, such as ICT, and for technologies associated with public goods, such as health, food security, and climate change. In countries willing to facilitate firm self-discovery to promote diversification, support for innovation would need to be directed away from mature industrial sectors. This, of course, implies that governments have the capacity to identify those sectors with the highest positive spillovers. Moreover, in all cases, governments can rely on the fact that the private sector is willing to back a particular project as a minimal market test.

In some ECA countries with a closed economy or where there is no level playing field in the market, technological neutrality could be a mixed blessing. On one hand, it would ensure that governments do not pick overly ambitious sectors, and on the other hand, there is a risk that the enterprises, which are doing well because of a monopolistic position or subsidies, could submit innovative projects that seem profitable on paper due to the benefits from the above subsidies or monopoly. To avoid this distortion, project selection must be done from a social point of view by eliminating monopoly gains and subsidies from the project's anticipated cash flows.

Now that we have established the key reasons why innovation matters for boosting growth and living standards, the big question is how policymakers in ECA can improve the ability of their countries to tap into the global technology pool and how to leverage this knowledge to generate more innovations. As the chapter 2 explains, the process of knowledge absorption is neither automatic nor costless.

11. See http://cordis.europa.eu/themes/home_en.html#cloud and http://www.atp.nist.gov/atp/category.htm.