

FINANCING BUSINESS INNOVATION

A Review of External Sources of Funding for Innovative Businesses and Public Policies to Support Them



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EXECUTIVE SUMMARY

Financing innovation activities is an important challenge for many firms. Because financial constraints that reduce investment in innovation hamper long-term economic growth, policymakers need to understand the different sources of funding businesses may use to fund their innovation activities, as well as the interventions they can develop to provide finance for innovative businesses.

This paper describes the actors involved and the types of funding available at different stages of the innovation process, the rationales for public intervention, and the advantages and disadvantages of some of the most commonly used policy instruments.

Innovation activities are more difficult to finance than other types of investment for several reasons. Innovation produces an intangible asset that does not typically constitute accepted collateral to obtain external funding. Also, the technological and market uncertainty of innovation activities makes the returns to investment highly uncertain, creating significant problems for the standard risk adjustment methods used by providers of funds.

The importance of each of these conditions in preventing access to finance for innovative projects depends on a variety of factors, such as the nature of the innovation activity and its industry, the size and age of the firm, and the stage of the innovation process.

This paper uses a streamlined version of an innovation process with three stages to categorize the different sources of finance available; in reality, considerable crossover takes place among instruments because innovation processes are not discrete.

KNOWLEDGE CREATION AND IDEA GENERATION

Innovation begins with an idea, sometimes in response to a particular challenge or to take advantage of a new opportunity. The amount of resources required for this first stage of the innovation process varies widely, depending on the type of innovation being created.

Raising external finance specifically for the first stage of the innovation process can be very difficult, since there is a high level of asymmetric information and no easy ways to align incentives. Knowledge and ideas are intangible, uncertainty is typically very high, and spillovers are thought to be stronger. This is especially the case for small, young companies with few assets and revenues.

As a result, governments are often among the few sources of external funding potentially available for particularly high-risk projects in this stage of the innovation process. While several forms of public funding exist, the most common are R&D grants and R&D tax incentives.

The choice between using grants or tax incentives to support private investment in innovation involves several tradeoffs, which explains why the approaches used by different governments can vary greatly.

Businesses have much to gain by adopting innovations not developed in house. They can face several barriers that hamper technology diffusion, however, such as information asymmetries between producers and users, high costs of switching to new technologies, high entry costs (especially in areas with important network effects), and technological path dependencies. Some of

these can lead to market failures, which governments may be able to help address.

Most instruments used for financing technology diffusion are grants, but they can vary from small payments—such as vouchers for connecting knowledge providers to small and medium-sized enterprises (SMEs)—to large programs to support industry-wide technology upgrading.

PROTOTYPE DEVELOPMENT AND MARKET DEMONSTRATION

The second stage of the innovation process involves getting from an idea to a new product, service, or process by developing prototypes and testing their potential for adoption in a real environment, be it with real customers or real employees.

Several forms of finance provision are available at this stage. Business angels are one of the main source of finance, typically in the form of equity or convertible loans. Early-stage venture capital funds, crowdfunding platforms, accelerators, and big corporates also play a role. Specialized knowledge and significant due diligence activity are required.

The public sector can support the development of private sources of finance serving this stage, but it also provides funding directly to companies, giving grants and loans as well as using pre-commercial procurement schemes.

COMMERCIALIZATION AND SCALING UP

Once an innovation has been developed and successfully user tested, the next challenge is to take it to market, start generating revenue, and scale it up. Two factors affect the ability to obtain finance for this particular stage as well as its source: the nature of the investments to be undertaken and the degree of uncertainty that prevails.

If risks and rewards are very high, venture capital is typically the only source available. If risk is low and the

investment required involves mainly the acquisition of easily redeployable tangible assets, then bank debt is more appropriate. In addition, firms that are scaling up their innovations may use several other sources of finance, such as business angels (if the investments required are relatively small), factoring and invoice discounting, new emerging forms of intellectual property (IP)-based asset finance, project finance (for large-scale investments with relatively low risk), private equity funds, public markets (initial public offerings—IPOs—and bonds), and corporates.

Governments also play a role, not only with several forms of intervention to support private providers of finance, but often also by directly awarding commercialization grants or loans to innovative businesses.

WHEN SHOULD GOVERNMENT INTERVENE?

Markets generally provide less finance for innovation than is socially desirable, due to the existence of asymmetric information, externalities, coordination failures, and institutional failures. These can provide a rationale for government intervention.

Finance interventions are sometimes also justified as part of a mission-driven policy. Rather than “fixing” a market or system failure, a government identifies a goal considered socially desirable (for example, addressing a social challenge) and designs a set of instruments to increase access to finance for innovations aimed at tackling it.

Some of these sources of failure vary in severity along the stages of the innovation process. For instance, externalities are typically presumed to be higher earlier in the process than in later stages, when firms are, in principle, better able to capture the benefits from their innovations. Similarly, asymmetric information may be highest in the earliest stages, when very few concrete outputs exist to show to the financiers, than later on, when the specifications of an innovative product and its potential market are more visible.

The size and age of the firm are also important to consider, since a large, established firm can use internal

resources and its better access to different sources of external finance to raise funding, which can then be used to fund its innovation projects. In contrast, market failures are more severe for young, small firms.

The existence of a market failure is not a sufficient condition for government intervention. The decision to intervene needs to weigh both benefits and risks, since several government failures can make public intervention impractical or even counterproductive. In other words, not all market failures are fixable, at least not at a reasonable cost for society (relative to the benefits of fixing them).

HOW CAN GOVERNMENTS INTERVENE?

Governments can use a variety of approaches to increase the availability of finance for innovative projects:

- Improving framework conditions and financial regulation, since maintaining well-functioning institutions that guarantee property rights, enforcing contracts, and providing efficient bankruptcy processes are the most important functions governments can perform.
- Providing funding to innovative firms, either directly via grants or government venture capital (VC) funds or indirectly through financial intermediaries, using, for instance, a fund-of-funds model, loan guarantee schemes, or provision of tax credits to early-stage investors.
- Providing an array of services, such as setting up networks of business angels, running investment readiness programs for entrepreneurs and investors, setting up or providing support for accelerators and incubators, or establishing credit mediation services

Several considerations are important when designing such interventions.

First, a very good understanding of the incentives of bureaucrats, politicians, financial intermediaries, and innovative firms is crucial when designing new schemes. For instance, credit guarantees can give

banks incentive to be less careful when selecting and monitoring companies. Similarly, while grants and government loans allow better targeting than credit guarantee schemes, short-term political objectives and lobbying by special interest groups may lead to the funds being misallocated. Therefore, it is necessary to develop mechanisms that prevent misalignment of incentives and target funding toward the appropriate recipients without being overly complex.

Second, both design and implementation failures are common. Therefore, it is important to put in place a monitoring system and a rigorous evaluation strategy to measure the success or failure of public interventions and change or discontinue them if necessary.

Third, looking at each type of funding and the policies to support it in isolation is not sufficient. Governments need to make sure finance is available for all the stages of the innovation process, since providing large amounts to support the initial phase may not translate into faster economic growth if young innovative firms cannot gain access to follow-on funding to commercialize their innovations. (The same principle applies to other stages.)

Fourth, access to finance is only one ingredient required to develop an innovation ecosystem. It is therefore important to consider the wider policy mixture, which includes measures to support the different actors in the innovation system, as well as the networks that connect them. Access to finance schemes that are too large given the level of development of the ecosystem can be counterproductive, so the timing and magnitude of the interventions need to be adjusted accordingly. An integrated approach that considers how the different interventions are linked to each other and exploits its synergies is therefore preferable.

Fifth, the measures with the greatest impacts are not necessarily the most expensive ones, so it is important to consider a wider range of alternatives. Providing advice (for example, through investment readiness programs), increasing information available (for example, through an IP registry), supporting networks (for example, business angels networks), or

improving skills (for example, by providing training for entrepreneurs and managers) are low-cost interventions that in some cases may have a better rate of return than large tax incentive and guarantee programs.

Sixth, governments should design monitoring and evaluation frameworks to assess the extent to which the objectives of the interventions are achieved. Progress toward these measurable objectives can be monitored through intermediate outcomes and influenced by flexible interventions. The challenges of monitoring and evaluation involve (1) identifying the goals the intervention is designed to achieve, (2) identifying key indicators that can be used to monitor progress, (3) setting targets, which quantify the level of the indicators, and (4) tracking progress to inform policymakers (Khandker et al. 2009). Finally, the quality of institutions determines both what sources of finance are available and how much impact public interventions will have. For instance, countries with poor institutions are unlikely to be able to effectively deliver complex access to finance support schemes, due to the risk of rent seeking and capture, as well as the lack of experienced civil servants to administer the schemes.

More importantly, the most effective interventions governments can undertake to increase innovation financing are not about creating new support schemes, but rather improving the overall regulatory and institutional framework within which innovative firms and finance providers operate. This includes issues related to contract enforcement, investor protection, and bankruptcy regulation. Legal protection of outside investors is an important determinant of the development of financial markets. If laws protect investors and are well enforced, shareholders and creditors will be willing to finance firms, and financial markets will be more developed. Protective laws will encourage investors to pay more for securities because entrepreneurs will return higher interest rates and distribute more dividends when the risk expropriation is reduced. Thus, protection of investors can increase financial development in terms of both depth and diversification of financial instruments, thus allowing more entrepreneurs to finance innovation with external funds. Finally, IP rights protection stimulates the creation of innovative financial instruments that facilitate access to external funding.

INTRODUCTION: THE POLICY ENVIRONMENT FOR FINANCING INNOVATION

Innovation is the main driver of long-term economic growth. The accumulation of capital, whether in the form of physical assets such as plants and equipment or through better human capital, cannot indefinitely sustain growth unless new products, services, processes, and/or business models are developed and implemented (Solow 1957).

While increasing innovation is a priority for advanced countries, it also has an important role to play in developing countries and emerging economies. Catching up with the countries at the technology frontier requires not only imitating what they have done, but adapting it to the particular country circumstances. Innovation is also required to address some of the specific, yet very important, challenges developing countries face. And very often developing countries, free from the constraints of existing systems and infrastructure, can skip existing technologies and develop new, radical innovations (as demonstrated by leapfrogging examples, from Kenya's M-Pesa mobile banking to India's frugal innovation methods).

Several factors contribute to creating an environment that enables innovation activity, such as an educated population and sound institutions. One factor is also consistently ranked among the top barriers firms face when they want to innovate: unavailability of finance.

Numerous studies have demonstrated innovation activities are more difficult to finance than other types of investment.¹ While some firms can use internal sources to fund their innovation activities, both entrepreneurs' savings and firms' retained earnings are limited, so many have no option but to raise funding from external sources.

The aim of this paper is to summarize the different external sources of funding businesses can use to fund their innovation activities and some of the interventions policymakers have developed to enable greater access to finance for innovative businesses.²

A STREAMLINED VERSION OF AN INNOVATION PROCESS

The different sources of finance available can be categorized in several ways, according to the nature of the actors that provide it, the characteristics of the instrument, or the stage of the business that is receiving the funding. This paper uses a streamlined version of an innovation process with three stages to frame the discussion. While innovation processes are not this discrete, but rather very much continuous and intricate, considering these stages is useful:

1. Knowledge creation and idea generation
2. Prototype development and market demonstration
3. Commercialization and scaling up/replication

The process does not need to be seen as a linear one that begins with basic research at an R&D lab and concludes with the commercialization of a new product. Ideas for new products may arise not only from new scientific advances, but from customers as well. Failed prototypes can lead to new ideas, while many innovations involve reengineering existing

¹ See Hall and Lerner (2009) for a review.

² While innovation happens throughout an economy—in businesses, governments, and nonprofit organizations (and often emerging at the intersection of these different actors)—the focus of this paper is on finance for innovative businesses.

processes and business models within organizations, applying lessons learned in the scaling-up phase. Therefore, while this basic framework can apply to different types of innovation, from the development of new products to the redesign of organizational structures, the importance of each stage and the resources required to complete it successfully will vary, depending on the nature of the innovation activity.

The innovation process used here is viewed from the perspective of the firm that is developing and producing an innovation. Another angle also important to consider is the adoption of innovations not developed in house. Thus, the paper closes with a brief discussion on technology and knowledge adoption, focusing on the different sources of finance that can fund investment by firms interested in adopting technologies and innovations developed elsewhere.

THE RATIONALES FOR PUBLIC SECTOR INTERVENTION TO SUPPORT FINANCE FOR INNOVATION

Markets generally provide less finance for innovation than is socially desirable, which provides a justification for government intervention.³ Specifically, markets underinvest in innovation for several reasons (even if, as discussed below, the severity of market failures can vary, depending on the stage of the innovation process):

1. **Asymmetric information:** Information about the likelihood of success of a particular innovation project is not only limited, but asymmetric. The entrepreneur (or firm) looking for finance has more accurate information than potential investors about how promising an innovation project is, as well as about the entrepreneur's effort and choices when developing it. This leads to two classical sources of market failure:

a. **Adverse selection:** If banks don't know the default risk of a particular borrower, they can only price a loan based on the average default risk. As a result, low-risk borrowers face higher interest rates than they would if there were perfect information, and they may choose not to seek

loans. This increases the risk of the remaining pool of borrowers, since those who are willing to pay high interest rates are usually also high-risk. Therefore, this pushes up the interest rate the bank needs to charge to break even, which in turn may discourage lower-risk borrowers from applying for funding, increasing again the default risk in the remaining pool. Adverse selection affects equity finance, too. The firm issuing equity has better information on its value than potential investors, so it will seek to raise finance when stock markets overvalue the company and try to avoid it when the stock is undervalued.

b. **Moral hazard:** Banks cannot perfectly monitor the activities of the inventor after the loan has been approved. As a result, an inventor may be tempted to take on a more risky project than what had been originally agreed upon, since in case of success he or she gets of all the upside, while in case of failure the loss is capped. Moreover, if the firm is close to being in financial distress, the cost for the inventor of taking on additional risk becomes negligible, which can lead to the inventor's choosing recklessly risky projects. In other words, debt may induce firms to take on more risk than optimal, although it may also have the opposite effect. Specifically, debt can have a disciplining effect in comparison to equity, since monthly payments and the possibility of losing control in case of bankruptcy can help focus an inventor's mind. Equity fundraising is subject to moral hazard due to the corporate governance issues created by the separation of ownership and control. In short, inventors have the incentive to undertake projects that benefit them even if they don't maximize profits, and external shareholders may not be able to observe easily whether inventor behavior is deviating from that which maximizes shareholder value.

³ For a full discussion of the market and government failures associated with access to finance for innovation, see Bravo-Biosca (2014).

The outcome of adverse selection and moral hazard is that projects with positive net present value (NPV), which inventors would choose to undertake if they had enough money, may fail to attract sufficient external capital and thus not be developed.

2. **Externalities:** Innovation activities generate spillovers, since inventors rarely can fully appropriate the returns their innovation activities generate. Inventors can use intellectual property, secrecy, or first-mover advantage, among other strategies, to capture the returns from their innovation activities. They cannot, however, prevent other firms' learning from both their successes and failures (which can also provide valuable lessons) and replicating, fully or partially, some of their successes, whether by launching similar products or services or adopting similar processes or business models. As a result of these spillovers, the social return to innovation investment is higher than the private return, and markets invest less in innovation than is socially optimal. This market failure is a common rationale for several innovation policy interventions, such as R&D tax credits, which aim to close the gap between social and private returns to R&D by increasing the latter.
3. **Coordination failures:** Innovation activity happens within a "system," with different actors and networks as well as underlying infrastructure and institutions. Entrepreneurs come up with ideas, investors back them with their funding, and the new firms try to attract talent, suppliers, partners, and customers. If successful, they expand, go through an IPO, or are acquired in a profitable trade sale. Most (if not all) parts of the system need to be in place for it to function well, and missing parts may not emerge if some others are missing. This creates the typical chicken-and-egg problem and is one reason clusters are so difficult to replicate.
4. **Institutional failures:** To work, markets require a set of well-functioning institutions. While not a market failure in a strict sense, an institutional failure can severely damage access to finance for innovative firms. Individuals will not invest in building innovative businesses if property rights are not guaranteed and their firms can be confiscated. Inefficient

contract enforcement leads to relationships between different parties being governed by trust rather than contracts, making it more difficult to raise funding beyond family and friends. Inefficient bankruptcy regulation reduces the recovery value in case of financial distress, discouraging the provision of credit in the first place. IP markets and IP-based lending cannot really develop without an efficient intellectual property rights (IPR) system, while banking regulation and accounting standards can also have an important impact.

The market failure rationale is not the only possible justification for government intervention in access to finance. Another approach commonly used by policymakers considers instead the innovation system and its failures. The innovation system consists of the set of actors, rules, and relationships that interact in the innovation process. System failures refer to the components that are not working appropriately and therefore should be fixed, and they include, for instance, the institutional failures discussed above.

Access-to-finance interventions are sometimes justified as part of a mission-driven policy. Rather than "fixing" a market or system failure, the motivation in this case is to address a social challenge or develop a new industry. In other words, a government identifies a goal that is considered socially desirable (for example, reducing climate change) and designs a set of instruments to increase access to finance for innovations aimed at tackling it (for example, clean tech). In this case, finance is typically only one of multiple policy levers used to coordinate action toward addressing that particular challenge or goal.

The severity of some of these sources of failure varies along the stages of the innovation process. For instance, it is typically presumed (but not universally accepted) that externalities are higher in earlier than in later stages of the innovation process, when, in principle, firms are better able to capture the benefits from their innovations. Similarly, asymmetric information may be highest in the earliest stages, when concrete outputs are very few, than later on, when the

specifications of an innovative product and its potential market are more visible to the financiers. Consequently, the importance of the different market failures in every stage of the innovation cycle is discussed in their respective sections.

MAIN CATEGORIES OF EXTERNAL FUNDING

The discussion in this paper covers the actors and forms of finance that are available within each stage of the innovation process. They fall within three broad categories of external funding:

1. **Debt:** Debt finance consists mostly of loans and bonds. The financier provides funding for a determined period of time and requires the firm to pay back the lent amount and interest on that amount on an agreed-upon schedule. With debt finance, an entrepreneur maintains full control of the firm, something most SME owners strongly prefer. But debt finance also implies more volatile returns on equity as well as higher risk of bankruptcy, which can result in total loss of control, a wipeout of all shareholders' equity, and the liquidation of the firm. (Moreover, bankruptcy is typically an inefficient and value-destroying process.)
2. **Equity:** Equity finance entitles the provider of capital to an ownership stake and a share of the revenue of the venture. Issuing new equity dilutes an entrepreneur's control of the firm and can become a source of conflict if disagreements among shareholders emerge, even if it also increases risk sharing and gives the entrepreneur access to the investor's networks and expertise.
3. **Dedicated innovation funding:** Firms may also be able to obtain funding with no payback requirements, no cost of capital, and no dilution of ownership. Direct government funding in the form of grants is the clearest example, but some private sources may also offer funding with few strings attached, such as gift-based crowdfunding platforms. Many forms of government funding, such

as public loans and public venture capital schemes, do, however, entail some payback to governments for their contributions.

Each of these forms of funding has different costs for the firm, with gifts and subsidies being, by definition, the cheapest source. Beyond these, pecking-order models suggest firms prefer to fund their investments with internal funds and then with debt, and only then issue new equity, since the cost of funds increases with the severity of asymmetric information problems (which are discussed in more detail below). Taxation also influences the relative cost of each source, since in many tax systems around the world interest payments are tax deductible, distorting the choice between equity and debt in favor of the latter.

There is also a variety of hybrid forms that combine features from equity and debt, such as venture debt and asset-backed instruments. In particular, new forms of asset-backed finance for IP and intangible assets are emerging. Public sector interventions can also combine equity and debt features with a giveaway component (for example, subsidized interest rates).

THE CHALLENGES TO FINANCE INNOVATION

Raising funding from external sources involves a series of challenges. Some are common for any type of investment, while others are specific, or more severe, due to the nature of innovation activities. In particular, two characteristics of innovation make financing more difficult:

1. *Innovation produces an intangible asset:*

Intangible assets do not typically constitute accepted collateral to obtain external funding. Much of the knowledge created in innovation processes is tacit rather than codified and embedded in the human capital of a firm's employees (who can leave) and its organizational capital. Even when this knowledge is codified and registered—for instance, in the form of a patent—its value is hard to measure. In addition,

in contrast to tangible assets, such as machines that can easily be redeployed into other uses, the value of intangible assets can be difficult to separate from that of the other assets in the firm. Therefore, they typically have limited salvage value in case of business liquidation—consider, for example, how much a brand or a patent is worth on its own if the firm goes bankrupt. Ongoing attempts to create more liquid IP markets may help temper some of these concerns, but only for a subset of intangible assets.

2. *The returns to innovation investment are highly uncertain:* The distribution of returns for an innovative project is unknown. Therefore, not only is innovation a risky activity, with failure a common outcome; it is also uncertain. In other words, since quantifying the probability of success and failure is typically impossible, the expected return to that investment cannot be estimated. This uncertainty creates significant problems for standard risk adjustment methods used by funding providers. Two types of uncertainty are typically present—technological and market uncertainty—and the mixture of them can vary. For instance, while developing a new pharmaceutical often carries considerable technology risk, the market is usually easy to define because the number of people with a particular medical condition and the system for purchasing drugs in each country can both be easily identified. Clean technologies vary in the degree of technology risk but often have considerable market risk, as their potential markets can be heavily affected by government policies (for example, subsidies for solar panels) that frequently change. And although the technology risk of new online businesses is often quite low, market risk can be very high—indeed, often no market is easily identifiable (for example, Twitter), and traditional revenue models don't apply.

How important each of these characteristics is in preventing access to finance for innovative projects depends on a variety of factors:

1. *The nature of the innovation activity and its industry:* Some types of innovation activity have

very uncertain chances of success and/or require large financial resources, while others involve little risk and few resources. For instance, developing new drugs or clean energy technologies requires large investments and involves significant uncertainty. In contrast, creating a new mobile application involves low investment and has limited downside risk and potentially very large returns. Similarly, within every industry, firms can undertake very different types of innovation. Creating new products, improving processes, and developing new business models involve different levels and types of resources (not always or uniquely financial) and create different types of intangible assets. Some of these assets are easier to finance than others, since it may be possible to use some as collateral or even finance them as standalone projects independent of the firm behind them.

2. *The stage of the innovation process:* Early stages of the innovation process are typically more difficult to finance, since both uncertainty and intangibility are high, while at the later stages much of the uncertainty may have been resolved, and investments are focused on tangible assets. This is not always true, however. Knowledge creation and idea generation can be costly and uncertain if they involve massive investments in R&D to create (for example) a new drug, but also cheap and low-risk, if only a few brainstorming sessions and some desk research are required to improve a service offering. Differences also occur at the other end of the process. Commercialization and scaling-up innovation can be subject to much uncertainty if they involve, for instance, rolling out capital-intensive clean energy plants in a market with low technology maturity, a lack of regulatory certainty, and high risk of obsolescence or financing large marketing campaigns in winner-takes-all digital markets. But uncertainty can be relatively low if commercializing a patent-protected drug shown to be effective for a previously incurable disease or adopting a new process throughout an organization.

3. *The size and age of the firm:* While some sources of funding (for example, project-based finance) are

linked to specific projects, most are provided to the firm and/or guaranteed by its assets. Therefore, the characteristics of firms affect their ability to fund their innovation projects:

- Young firms are generally small and have very limited assets, so their success is intimately linked to the success of their innovation projects. If an innovation project is very uncertain, so will be the chances of success for the firm, since the risk is very concentrated.
- Older, small firms with existing portfolios of products and some assets face lower overall uncertainty (since their success is not necessarily linked to a single product launch); in addition, they typically have some assets that can be pledged as collateral.
- Large, established firms have not only large asset bases that can be used as collateral/ guarantees, but also broad portfolios of products and diversified pipelines of innovation projects, as well as access to a wider range of sources of capital (with a lower cost of capital). Therefore, even if the outcome of their innovation projects is both uncertain and intangible, they have much less difficulty getting access to finance than young firms.

When considering which types of external finance are available for each stage of the innovation process, the discussion in this paper will focus particularly on those firms that are least able to fund their own innovation activities. These tend to be young and small businesses, rather than larger firms that can get access to sufficient resources internally and externally.

TYPES OF PUBLIC INTERVENTION

Governments can use a variety of approaches to address the failures that limit the availability of finance for innovative projects. The most common are the following:

1. **Framework conditions:** Maintaining well-functioning institutions that guarantee property

rights, contract enforcement, and efficient bankruptcy processes, among others, is the most important role governments can play. Tax laws and intellectual property regimes can also facilitate (or hinder) access to finance for innovative firms.

2. **Financial regulation:** Most types of financial intermediation activities are regulated, so the design of rules such as Basel III has an impact on credit provision. For instance, the availability of credit for IP-rich firms will be affected by the ways in which different types of intangible assets are treated when determining required capital ratios. Similarly, the growing regulation of crowdfunding can help consolidate it or, alternatively, hamper its development. An example from several decades ago is the change in the regulation of U.S. pension funds allowing them to invest into VC funds, which significantly contributed to the development of the VC industry.

3. **Providing funding:** Governments can also give money to innovative firms, either directly to them or indirectly through financial intermediaries. Examples of the former include grants, R&D tax credits, and government VC funds, while examples of the latter include using a co-investment or fund-of-funds model or giving tax credits to early-stage investors.

4. **Providing services:** This may involve setting up networks of business angels, running investment readiness programs for entrepreneurs and investors, setting up or providing support for accelerators and incubators, or establishing credit mediation services.

GOVERNMENT FAILURES: THE RISKS OF GOVERNMENT ACTION

The existence of a market failure is not a sufficient condition for government intervention. The decision to intervene needs to weigh both benefits and risks, since government failures can make public intervention impractical or even counterproductive. In other words, not all market failures are fixable, at least not at a reasonable cost to society relative to the benefits.

Bravo-Biosca (2014) discussed several reasons government attempts to fix market failures (as well as

system failures) in the access-to-finance space might fail to work as desired, some of which are briefly summarized here:

- No advantage and possible disadvantage for governments in fixing failure relative to the operations of the market (for example, for grant initiatives, governments will probably need to undertake costly due diligence, as would the private sector; but they may be worse than the private sector at selecting prospective projects and investees)
- Asymmetric information and misalignment of incentives (for example, public loan guarantee schemes may give banks incentive to be less careful when selecting companies to fund)
- Limited additionality and crowding out (for example, aggregate investment may increase by less than the amount of public funding provided)
- Rent seeking and capture (for example, government action may be captured by special interest groups or established incumbents, leading to inefficient interventions)

- Political factors (for example, election cycles may encourage politicians to choose short-term policies)
- Bad policy design (for example, governments may copy policies from other countries that aren't suitable or fail to provide holistic policies that consider the full innovation cycle and ecosystem)
- Implementation failures (for example, good policies may fail as a result of inefficient bureaucracies and inexperienced staff)

Therefore, rather than assuming all market failures can or should be fixed, the focus should be on tackling those that are socially desirable to address, given the limitations of government action.

Policymakers should note that there can also be additional positive policy impacts above and beyond the impact of the financing, particularly on the recipient businesses. Some of these impacts can be observed through a process called behavioral additionality (see Box 1).

BOX 1. BEHAVIORAL ADDITIONALITY—DOES INNOVATION FUNDING HAVE OTHER EFFECTS?

Policy instruments like grants and R&D tax concessions are designed to deliver financial support to businesses. They can, however, also have a broader impact on recipients and even on unsuccessful applicants. This is called behavioral additionality, and a variety of behavioral additionality effects can be induced by government funding:

- If robust, a grant application and assessment process forces the business to articulate and justify its business plan and commercialization strategy, and the reporting process helps build its administrative and financial management capabilities.
- Studies of several countries (for example, Finland and Japan) have shown that government funding not only allowed firms to accelerate the completion of R&D projects (enabling them to introduce new products or services into the market sooner), but also encouraged them to launch projects that entailed greater technological challenges than they might otherwise have pursued.
- Government funding can encourage firms to engage in more collaboration in R&D projects. A German study indicated that existing partnerships were intensified and new ones initiated as a result of government funding. A study of the U.S. Advanced Technology Program showed that many consortia and joint projects were formed directly as a result of government funding, and that collaboration continued beyond the participation in the government-funded project—often on different projects.
- A range of different methodologies can be used for measuring behavioral additionality, each with its own strengths and weaknesses. Surveys allow for the collection of information from a large set of firms, but they must often be based on the results of more in-depth interviews that identify the range of behavioral changes that can be induced by a particular government program and the point in business innovation processes at which government assistance is sought. Econometric techniques can further highlight relationships between participation in a government R&D program and changes in firm behavior. A robust approach would combine methodologies.

Source: OECD (2006).

STAGE I: KNOWLEDGE CREATION AND IDEA GENERATION

Innovation begins with an idea, sometimes in response to a particular challenge, other times to take advantage of new opportunities. Ideas may be the result of new advances in scientific research, but they may also emerge from many other sources, such as directly from customers or suppliers or from observing their behavior.

The amount of resources required for the first stage of the innovation process varies widely, depending on the type of innovation being created. It may require substantial investment in knowledge creation or involve only a negligible cost that even cash-constrained startups can afford.

When substantial investment is required, financing can be particularly challenging. Large, established firms typically have access to internal funds and the ability to raise external funding, whether in the stock market or by using some of their other assets as collateral for debt finance. On the contrary, young, small firms typically have neither of these (and funding from family and friends is limited).

Raising external finance specifically for the first stage of the innovation process can be very difficult, since the level of asymmetric information is high, and there are no easy ways to reduce agency problems by aligning incentives. Knowledge and ideas are intangible, so they are not generally good collateral. In addition, uncertainty is typically very high, since it is impossible to predict what the returns of these investments in knowledge creation will be. This is also the stage where spillovers are thought to be stronger, which is an important justification for public intervention.⁴

As a result, governments are often the only source of external funding specifically suited for particularly high-

risk projects in this stage of the innovation process. While there are several forms of public funding, the most common are R&D grants and R&D tax incentives. Obviously, governments also fund universities and public research centers, where many knowledge creation activities happen (on which private sector firms build later).

R&D GRANTS

This section discusses the importance of R&D grants as a source of funding. It describes their main characteristics (size, duration, complexity, targeting, allocation mechanisms, match-funding requirements, repayment conditions, and restrictions) and the types of grants that exist. The section explores the advantages and disadvantages of using grants to finance innovation and presents some empirical evidence about their impact.

What it is. A grant is simply a mechanism for dispensing funding. It is a widely used tool that comes in many different shapes and sizes and is used for many different purposes. This extremely flexible instrument can be used to fund R&D and innovation as well as several other types of activities.

Some basic features that usually distinguish a grant are the following:

⁴ Asymmetric information on its own is not a sufficient rationale for public intervention, since governments face the same (or higher) due diligence costs and therefore don't have an advantage over the private sector and cannot improve on its allocation of resources. See Bravo-Biosca (2014) for additional discussion.

- It involves a particular level of government providing public money to a recipient who is not another part of the same government.
- It is made from within a particular program or initiative that has been established with a particular policy aim.
- It is intended to help the recipient achieve a particular purpose that aligns with the particular policy aim of the dispensing program.
- The recipient will be required to act in accordance with particular terms or conditions regarding how the grant moneys are used.

Characteristics. Within innovation policy, grants are used across a wide range of areas, and they can provide funding for the following:

- Individual projects within a company (for example, R&D or technology commercialization grants)
- Knowledge diffusion and external advice from consultants (for example, vouchers for innovation consultants, grants for seminars/training on new technology)
- Multistage collaborative R&D involving several research organizations and/or businesses
- Equipment purchases (for example, scientific instrumentation)
- Soft infrastructure and their services (for example, clusters, accelerators, innovation intermediaries)

Given this diversity, innovation support grants range widely in size, scope, duration, complexity, and allocation mechanisms. This means there are several design choices to consider:

1. **Size:** They can be small (under \$50,000—for instance, \$5,000 vouchers); medium; or large (\$10 million–\$20 million for large-scale R&D collaborative projects).
2. **Duration:** Undertakings funded by grants can range from short one-off projects to endeavors lasting several years.
3. **Complexity:** Grant funding can vary from a simple process, in which a short form is submitted and

the grant is awarded, to complex multistage, multi-payment, multi-partner processes. Multistage collaborative R&D grants are usually more complex than individual project funding because research and industry parties can have quite different cultures, timelines, and preferences in terms of project design. (They may also require IP ownership to be sorted out up front.)

4. **Targeting:** Grants may target particular groups of recipients, such as SMEs, or be open to all types of recipients, regardless of size, objectives, legal form, or nationality. Large companies can be eligible for grants, but their contractual obligations are usually more restrictive than those of SMEs. Grants can also be targeted toward particular sectors, technologies, or challenges. For instance, governments may establish selection mechanisms to help them balance the grant budget across thematic areas; alternatively, they may assign a large proportion of the funds to a particular sector or science field.
5. **Allocation mechanism:** Grants can be allocated on a competitive basis or an entitlement basis. In a competitive selection process—the most common allocation mechanism—applicants submit proposals in response to periodic calls with specific deadlines. These proposals are judged against set criteria and ranked by a review panel that usually includes experts who can provide independent, transparent, fair, and merit-based assessments. Based on criteria such as excellence, relevance, experience, collaboration, and economic impact, the best proposals are selected and grants awarded accordingly. Alternatively, especially for small ones, grants are dispensed on an entitlement basis, whereby an applicant that meets a particular set of criteria receives the grant automatically without a competitive process. In that case, the grants can be allocated on a first-come, first-serve basis until the budget is exhausted within a specific time frame.
6. **Match-funding requirements:** Grants may require a contribution from the recipient to increase accountability and leverage additional resources. This funding contribution may vary, depending on the characteristics of the project and the recipient.

Typically, the larger the firm, the larger the required co-financing amount. Small and medium-sized firms often are required to match less than 50 percent, while matching grants may finance almost 100 percent of the innovation projects conducted by research institutions and universities. Acceptable co-financing usually includes the beneficiary's own internal resources but may also involve raising external funds from the private sector in the form of equity or debt.

7. Repayment conditions: Grants usually do not require repayment (unless the recipient does not spend the funds), and thus they avoid financially constraining new firms. There are examples of grants, however, that the recipient is required to repay if certain milestones are met. These are usually related to commercialization activity—for instance, some grants are repayable when commercialization becomes sufficiently profitable. In that case, the grants are repaid at a specified rate of annual revenue derived from sales of a product or service (or subsequent products or services based on the technology developed with public funding). If the company is sold, then lump-sum payments are often required.

8. Restrictions: The list of costs eligible to be financed by a grant can vary, but recipients typically are free to allocate the resources across the different approved categories provided by governments. These may include remuneration, intermediate inputs, purchases of machinery, and renting of infrastructure, among others.

R&D grants are only one of the many types of grants that exist. Grants' flexibility in being able to be applied to different stages of the innovation process (from the very early stage to the scaling-up phase) makes them one of the most commonly used instruments.

Grants are often used for technology and knowledge diffusion, for instance. Small grants are used to encourage SMEs to obtain external advice from consultants or are provided in the form of vouchers to enable them to work with research organizations. This is discussed in greater detail under technology diffusion.

Some schemes provide an integrated series of grants to support innovative growth businesses. Aimed at building businesses that undertake innovative activity as much as they are aimed at funding innovation directly, they are designed flexibly to meet the different needs of businesses at different stages (often accompanied by an advisory service). For instance, the Commercialisation Australia initiative offers a package of grants that allow a client SME potentially to obtain funding for up to four different purposes: (1) to get access to the expert external advice and services required to commercialize intellectual property; (2) to assist with recruiting a chief executive officer or other executive; (3) to fund proof of concept activity; and (4) to bring a new product, process, or service to market.

Advantages and disadvantages. Grants can be a very effective instrument to increase investment in innovation by firms. Several evaluation studies have shown they can create additionality effects. For instance, an impact evaluation study of a matching grant scheme in Flanders, where firms can apply for subsidies to basic research (50 percent), prototype research (25 percent), and mixed research (38 percent), found that an additional €1 of support will result in €1.34 of private R&D, rejecting full crowding-out effects (Aerts and Czarnitzki 2006). East German firms receiving public R&D support achieve, on average, four percentage points higher R&D intensities than unsupported firms (Almus and Czarnitzki 2003), while full or partial crowding out are also rejected for German R&D performing firms receiving grants (Czarnitzki and Hussinger 2004). Crowding out may happen in some circumstances, however—in particular, when governmental support emerges as a perfect substitute for private investment. This occurs when public funding is assigned to innovative activities that would have been financed in the absence of public assistance, not leading to a net gain in innovation investment.

Grants allow the innovator to share the risks embedded in an innovation project. In case of failure, innovators only lose their own matching contributions (if any) or do not repay the grant (in case that was a requirement). They can also help firms speed up the

commercialization process, making the business more likely to beat competitors to market.

Grants can also stimulate collaboration between research institutions and the private sector. Collaboration among firms and between firms and universities is crucial to foster innovation, avoid duplication of innovation efforts, and stimulate knowledge spillovers, and grants can help overcome barriers that hamper it. For example, companies may have insufficient information about the capabilities of research institutions or universities. They often assume academic organizations do not understand their needs, and that their services are expensive, of low quality, and not always delivered on time. To address these barriers, grants may be awarded only to scientific consortia that include participation of research institutions or universities and the private sector, or be contingent on businesses' employing and embedding graduates or researchers within them. Collaborative grants can also focus on collaboration between large companies and SMEs, or between local and multinational companies.

The choice between using grants or tax incentives as the main instrument to support private investment in innovation involves several tradeoffs, which explains why the approaches used by different governments can vary greatly (OECD 2011). Grants give governments the ability to target innovation projects that are better aligned with their policy goals, while tax incentives are much more difficult to target. In other words, grants allow governments to target those projects that have the highest rate of social return, while tax incentives may, in contrast, be supporting innovation projects with very low (or even negative) rates of social return.

The benefits of targeting by selecting the most promising projects go hand in hand with the challenges associated with "picking winners." This is relevant because innovators are usually more informed than governments about the potential of different innovation projects, even if it is also true that innovators' focus is typically on the private return of a particular project. Governments' focus should be the

social return of the project (even if operationalizing this is not easy to do in practice).

The targeting associated with grants programs can also incentivize rent-seeking behavior, with potential beneficiaries within a potential target market lobbying in favor of it. Government action can therefore be captured by special interest groups, leading to suboptimal interventions. Political factors can interfere with the timing and the scope of interventions—for instance, if politicians coordinate them with the political cycle, even when delinking the two would produce better results.

One advantage of grant programs is that they can create incentives for recipients to be accountable. For example, grants can be given in tranches conditional on the accomplishment of specific goals. This is important because, as mentioned, informational asymmetries are particularly present in the first stages of the innovation process, creating agency problems such as moral hazard. Conditioning the disbursement of funds on the achievement of particular objectives is a good way of aligning the incentives between the government and innovators.

The need for accountability also means that grants are usually associated with high bureaucratic and administrative costs, imposing heavy information obligations and procedures on potential beneficiaries. Given that grants tend to be allocated using several eligibility criteria and complex selection mechanisms, managers of small projects may not have the resources to prepare long and cumbersome applications. High compliance costs can also reduce the pool of applicants, even if the target group is very large. In addition, lack of public resources to expedite the application process can negatively affect the scope, timing, and outcome of the grant program. Since the cost for good grant administration is usually fixed, providing and overseeing small grants is not much less expensive than for very large grants.

Grant funding can have additional impacts beyond the funding it provides. Being awarded a grant sends

positive signals about the quality of the projects produced, which can facilitate firms' later access to external sources of finance.

Many firms backed with public support at an early stage will look for venture capital financing when entering more mature stages, so successfully navigating a competitive grant process can provide a certification of quality and give credibility to the innovator, as it is seen as a form of due diligence.

Table 1 provides a summary of observations regarding R&D grants.

R&D TAX INCENTIVES

This section discusses the use of R&D tax incentives to foster innovation. It starts with a description of the different types of R&D tax incentives governments can use to finance innovation (tax credits, enhanced deductions, and depreciation allowances). It follows with a discussion of their characteristics (target group, eligible costs, base amount, and carry-forward and refund options) and finishes with the advantages and disadvantages of using them compared with other forms of government support. Finally, the section presents the main findings regarding their impact.

What it is. An R&D tax incentive reduces the tax liability of firms undertaking R&D and innovation activities, thereby lowering the private cost of R&D and stimulating additional investment in innovation activities. There are several types of tax incentives, described in more detail by Correa and Guceri (2013) and Van Pottelsberghe et al. (2003):

1. **Tax credits:** They allow firms to reduce their tax obligations by deducting a share of their R&D expenditures. Thus, a tax credit affects corporate taxes directly instead of taxable income. The firm's cost reduction depends on R&D expenditures and the applicable tax credit rate.
2. **Enhanced deductions:** They allow firms to deduct 100 percent of eligible R&D expenditures, plus the

deduction rate, from their taxable income. Thus, firms can deduct a larger amount than their actual R&D expenditures. The firm's cost reduction is the product of R&D expenditures, the applicable tax allowance, and the applicable corporate income tax rate.

3. **Depreciation allowances:** These are tax deductions that recognize the loss in value of a fixed asset. R&D depreciation allowances treat R&D expenditures as capital goods that depreciate over several years because they are supposed to have a positive impact on firms' future revenues and are less related to variable operational costs. In some cases, the depreciation allowance permits a deduction from taxable income of the capital expenditure used to conduct innovation activities.

Characteristics. The design of a tax incentive requires governments to define the target group, the list of eligible costs, the base amount, and the treatment of firms without profits (Correa and Guceri 2013; OECD 2010; Van Pottelsberghe et al. 2003):

1. **Target group:** Tax incentives are generally neutral. That is, they are applied to all the innovators without distinguishing by region, size of the company, sector, or type of innovative activity. There are circumstances, however, under which incentives are designed to benefit a particular group, such as small and medium-sized enterprises (SMEs). SMEs can be targeted by different mechanisms. For example, governments can explicitly limit access to the tax incentive to these companies. Or they can grant higher tax exemption rates to them or impose upper limits on the tax credit that are easily exceeded by large firms. Finally, governments can offer other instruments, such as cash refunds for loss-making companies.
2. **Eligible costs:** Most countries use the Frascati Manual (OECD 2002) as the basis for their definition of R&D to classify eligible and ineligible expenditures. They take three different approaches, however, to defining eligible R&D, which focus in turn on wages, current R&D, and current and capital R&D (Van Pottelsberghe et al. 2003). The first approach promotes investment in human capital. This is important, as nearly all R&D activities revolve around skilled staff from a variety of

TABLE 1 Design and Implementation Observations—grants

INSTRUMENT	OBSERVATIONS
<p>R&D grants (individual projects)</p>	<ul style="list-style-type: none"> • They are relatively straightforward to administer; however, small grants are generally as costly to administer per unit as large ones, so small grant programs can be quite burdensome. • They allow government support to be directed at quite specific innovation activities that policymakers want to target (for example, particular types of technology). • Effective programs also assess whether the applicant is a sound business with the necessary skills and business model to take the innovation to market; this assessment process can help the business. • These assessment and decision-making processes are resource intensive and need to be merit based and free of political and bureaucratic interference if schemes are to be effective. • Grants can “convert” from non-repayable (for example, via a loan) if the project/recipient is successful. Although administratively more complex, this provides an opportunity for government to “share in the upside.” • Selection processes are subjective, so expertise is needed to assess relative technological and market merit. Experience has shown that if the decision makers are unskilled or the selection process politicized, suboptimal projects will be chosen, and meritorious applicants may stop bothering to apply. • Matching grants (requiring co-contributions from recipients) are an optimal model, as they ensure commitment from the clients. Experience has shown that without a significant matching component, companies can waste taxpayers’ money without making any real commitment to success. • Effective programs assess the technical merit and the market merit and whether the applicant is a sound business, with the skills and business model to take the innovation to market. Experience has shown that if all three are not assessed well, the likelihood of real commercial success is greatly diminished. • The assessment and grant management processes need to allow authorities to collect the right information and manage their risks. Experience has shown that poorly managed programs collect too much irrelevant information from clients and have pointlessly burdensome reporting regimes and slow decision-making and disbursement processes, all of which • are particularly damaging in technology commercialization, where speed to market is vital. KPIs need to be focused on outcomes and to reflect the reality that innovation is not always a linear process, so projects may vary (from the initial proposal) in the ways in which they develop.
<p>R&D grants (collaborative projects between public and private sector)</p>	<ul style="list-style-type: none"> • See above. Many points about grants for individual projects also apply to collaborative grants. • Given the differences in incentives and culture between the public and private sectors, policymakers should not assume a collaborative grant program will automatically induce effective collaboration between the two. • These programs can be dominated by the public research sector, which is generally more motivated to seek funding and has greater experience in applying for grants. Business is less likely to set aside time for complex application processes. This can lead to projects that advance the research agenda of the research applicant but are not necessarily outcome focused. • To ensure genuine collaboration and assist nascent sectors, some initiatives provide support for intermediaries to undertake independent “brokering” of projects to ensure the interests of both industry and research are represented. This is particularly important for large collaborative projects, which may involve considerable funding support and be of strategic importance to the country, as the cost of poor projects can be great. • For large strategic programs, a multistage application process to allow feedback and the optimization of bids may also be sensible. • Nonsectoral programs may not be truly “neutral.” Existing sectors with the resources for and experience in grant seeking can end up dominating selection processes. • Experience has shown that if the decision makers are unskilled or the selection process politicized, then suboptimal projects will be chosen, and meritorious applicants may stop bothering to apply. If this approach is new to policymakers, involvement of overseas experts on selection panels should be considered. • Effective programs assess the technical merit, the market merit, whether the applicant consortia are genuine, and whether the resources being promised (especially in-kind resources) are genuine. • The assessment and grant management processes need to allow authorities to collect the right information and manage their risks. Experience has shown that poorly managed programs collect too much irrelevant information from clients and have burdensome reporting regimes and slow decision-making and disbursement processes.

disciplines. But the other two options better reflect total R&D costs (Van Pottelsberghe et al. 2003). Governments sometimes extend eligible expenditures to include the costs of acquisition of intangibles, such as patents, licenses, know-how, and design (OECD 2010). Obviously, the more activities that are deemed eligible, the greater the potential incentive to promote innovation activities. A larger list, however, may impose significant costs on the government. No matter the definition of expenditure chosen, this is a very complex area, as many firms are tempted to maximize their potential exemptions by manipulating and relabeling activities.

3. Base amount: The value of a firm's tax credit can be calculated by either volume-based or incremental assessment (Correa and Guceri 2013). A volume-based scheme corresponds to the total eligible R&D expenditures of the last fiscal year. An incremental approach calculates the tax credit from the increase in R&D, above a particular base amount established by the fiscal authority. A first-best policy would use the incremental approach to subsidize only the R&D activity that would have not been conducted in the absence of the fiscal stimulus. This information is not available to the government, however. In fact, the traditional assumption is that firms' R&D would have been stable in the absence of the tax credit, which supports a volume-based scheme (Lentile and Mairesse 2009). Most countries use volume-based tax incentives. A few use an incremental base (including the United States and Ireland) or a hybrid scheme that combines volume and incremental R&D as eligible expenditures (for example, Portugal, Japan, and Spain) (OECD 2010). Sometimes both are used within the same instrument but with R&D that occurs above a baseline (which is often the previous year's R&D) attracting a higher level of subsidy. The volume-based approach imposes more revenue forgone for the government, but it minimizes the likelihood of firms engaging in opportunistic behavior by changing their R&D strategies to maximize tax gains (Correa and Guceri 2013). It is also relatively easy to implement, although it has its own administrative challenges.

4. Carry-forward and refund option: If firms have no profits, they do not have any company tax obligation, and so cannot benefit from these schemes. This entails that tax credit is an instrument aimed at established companies and will have little impact on the innovation activities of startups. Some countries allow firms to request a tax refund be paid in cash, while others allow it to be used in the future when the financial situation of the firm improves (Correa and Guceri 2013). Thus, firms may carry forward unused R&D credits.

Table 2, based on Correa and Guceri (2013), provides some examples of the design choices made by different countries when designing their R&D tax incentive schemes.

Advantages and disadvantages. R&D tax incentives effectively reduce the marginal cost of investing in R&D, and, by reducing the cost, they encourage businesses to undertake more R&D. Specifically, they equal the marginal cost and the marginal revenue of a profit-maximizing firm at a higher level of investment in R&D. Bringing the private return closer to the social return helps rectify the suboptimal level of investment caused by the externalities in innovation activity, which results in innovators not fully appropriating the benefits of their inventions.

Empirical studies show these incentives are effective in fostering private R&D, even if they also inevitably subsidize R&D activities that would have occurred anyway. In the United States, according to Hall and Van Reenen (2000), "The R&D tax credit produces roughly a dollar-for-dollar increase in reported R&D spending on the margin. However, it took some time in the early years of the credit for firms to adjust to its presence, so the elasticity was somewhat lower during that period." Similar results have been found for other countries, with similar conclusions arising from an analysis of the incremental R&D tax credit in France from 1993 to 2003, for which "one Euro of tax credit would give slightly more than one Euro of total R&D . . . and increases the growth of the number of researchers" (Duguet 2012).

TABLE 2 Examples of R&D Incentives

	MAIN CORPORATION TAX RATE ¹	ELIGIBLE EXPENDITURES	ENHANCED DEDUCTIONS	TAX CREDIT	ALLOWANCES FOR CAPITAL GOODS	CARRY-FORWARD OR PAID OUT AS NEGATIVE TAX	OTHER RELEVANT INFORMATION
Canada (federal) ²	General: 15% Small business: 11%	Salaries, materials, overheads, lease, subcontracting expenses used in experimental development to achieve technological advancement to create new materials, devices, products, or processes, or improve existing ones; applied research with a specific practical application in view; basic research to advance scientific knowledge; support work, only if the work directly supports, the eligible experimental development, or applied basic research.		20% federal tax credit, 35% for small firms (on first \$3 million) +Provincial credits	100% immediate expensing for machinery and equipment (not buildings)	100% refundable for expenses and 40% refundable for capital expenditures	
France ³	General: 34% Small business: 15%	Staff costs for researchers and technicians, operating expenses, spending on R&D performed by government agencies, universities, NGOs and other organizations approved by the Ministry of Research, depreciation and amortization of property and buildings used directly in R&D; R&D includes activity that aims at significant technological advancement, requires scientific methods and specialized personnel.		30% up to €100 million, above that 5%.	100% immediate expensing of R&D equipment.	Unused tax credits can be carried forward or refunded after three years	Some new applicants may receive tax credit at rates of 40% in the first year, 35% in the second year, then the standard rate. Different caps apply to in-house and outsourced R&D. Income from intellectual property is subject to lower tax rate.
Spain ⁴	General: 30% Small business: 25% (or 20%)	Salaries of R&D&I personnel, cost of capital goods that are dedicated to R&D; R&D includes investigation with the purpose of acquiring new knowledge and its application. Technological improvement of materials, products, processes.		25% volume, 42% incremental, with base as the mean of the two prior years. 12% for technological innovation. 17% on cost of qualified personnel assigned exclusively for R&D. +Regional incentives	Additional 8% credit for amounts invested in fixed capital, except real estate.	Carry-forward for 15 years	40% discount in Social Security contributions for staff employed to perform R&D&I activities.. Different caps apply to different tax credits. Income from intellectual property is subject to lower tax rate.
United Kingdom ⁵	General: 24% Small business: 20%	Employee costs for staff who are actively engaged in carrying out R&D itself, staff providers, materials, payments to clinical trials volunteers, utilities, software used directly in the R&D.	130 % for large firms 225 % for SMEs		100% immediate expensing for capital used in R&D	Carry-forward and cash credit for SMEs up to 12.5% of surrenderable losses.	Minimum R&D spend of £10K required. Subcontracted work is subject to special provisions. A cap applies to cash credits. Income from intellectual property is subject to lower tax rate.

Source: Relevant government institutions; see footnotes. Some summary information obtained from ERAWATCH and Deloitte 2012 Global Survey of R&D Tax Incentives, February 2012

¹ OECD Tax Database, corporate income tax tables. For a more detailed presentation of exceptions, refer to the source.

² Canada Revenue Agency, <http://www.cra-arc.gc.ca/txcrdt/sred-rsde/bts-eng.html>

³ France Ministry of Research and Higher Education, <http://www.industrie.gouv.fr/enjeux/innovation/credit-impot-recherche.php>

⁴ Spain Ministry of Economy and Competitiveness; <http://www.idi.mineco.gob.es/portal/site/MICINN>; Spain Ministry of Science and Innovation Análisis comparativo sobre el diseño, configuración y aplicabilidad de Incentivos Fiscales a la Innovación empresarial, 2011.

⁵ HM Revenue and Customs; <http://www.hmrc.gov.uk/ct/forms-rates/claims/randd.htm>

Cross-country studies have also supported the positive effect of R&D tax incentives. Using data on tax changes and R&D spending in nine OECD countries over a nineteen-year period (1979–97), Bloom et al. (2002) found that “a 10 percent fall in the cost of R&D stimulates just over a 1 percent rise in the level of R&D in the short-run, and just under a 10 percent rise in R&D in the long-run.”

A result of this evidence has been an increase in the use and generosity of R&D tax incentives in recent years, with the number of OECD countries using them rising from eighteen in 2004 to twenty-six in 2011 (Correa and Guceri 2013), while their design has been simplified. Several economies have also increased their R&D tax incentives to ameliorate the negative consequences of the economic crisis of 2008–9,⁵ when many businesses significantly cut their research activity.

Another motivation for their growing use is tax competition. R&D tax incentives can help attract international R&D to locate in particular jurisdictions. This is particularly the case within multinationals, where some R&D can be footloose and different business units are competing for it. On the other hand, large multinationals can engage in sophisticated tax planning, reducing the effectiveness of R&D tax incentives.

As discussed in the previous section, the choice between direct and indirect mechanisms to support innovation activity in the private sector involves several tradeoffs. An ongoing debate questions whether it would be convenient to partially rebalance government support toward direct mechanisms, particularly in those countries where the quality of institutions is high, which enables them to allocate funding efficiently as well as resist rent-seeking attempts.

At the core of this debate is whether neutrality or targeting is more desirable. Tax incentives are typically neutral with regard to field of research and type of firm and designed to target all R&D performers, so they have a wider reach and are more accessible than R&D grants (OECD 2010).

Tax incentives therefore provide discretion to innovators to decide where to spend resources. Given that firms have more information than governments about the costs, benefits, and risks of different innovation projects, they may be expected to be better at selecting projects. But firms will select profit-maximizing projects that align with their corporate strategies and may not choose innovation projects with high social returns. In fact, by definition, the marginal project undertaken as a result of the availability of R&D tax incentives is not the project with the highest private return, either (since those are already profitable), but the one that is only potentially profitable if a tax credit subsidizes it. Therefore, these may be relatively poorer R&D projects that may have failed to get through a competitive grant process. The targeting inherent in grants and loans programs may make them better tools to foster long-run R&D initiatives, while tax incentives risk ending up promoting short-run R&D activities.

Also, tax incentives are not totally neutral. A few large R&D performing firms typically capture a large proportion of the tax incentives provided, while small and young firms, as well as firms in non-R&D-intensive sectors (such as service sectors), benefit much less. Attempts have been made to extend tax incentives to cover non-R&D-based innovation investments, but the evidence on the externalities emerging from these investments is much less developed.

Governments have also targeted particular groups of interest, such as SMEs, offering them more generous schemes. This can be justified as well by the evidence showing higher additionality of R&D tax incentives in small firms than in larger firms.⁶ Some tax schemes provide credits to small companies on their R&D expenditure (rather than on taxable revenue), which provides an

⁵ Increased indirect support has included enhanced deduction rates, a broadening of the definition of eligible R&D expenditures, and relaxed carry-forward provisions.

⁶ Lokshin and Mohnen (2012) studied the R&D fiscal incentives program in the Netherlands, and, while they found the program fostered R&D investment, they could only reject the hypothesis of crowding-out effects for small firms.

additional source of working capital for young, pre-revenue firms starting to commercialize technology.

Tax incentives usually involve fewer bureaucratic procedures than R&D grants, as governments do not have to evaluate, select, and monitor projects. They also have lower administrative costs, as governments do not need to administer financial resources or manage contracts. They are, however, complex to design, and they require specialized administrative skills and a robust and skilled audit capability within government to ensure they are not abused. If this capability is not in place, it should be developed before a concession is introduced.

Tax incentives also create administrative burdens for firms, especially SMEs, as tax officials typically demand considerable paperwork (Correa and Guceti 2013). Filling out application forms and complying with regulations cost firms' time and money, and in many countries a lucrative consultancy market has grown around such incentives. To remediate this problem, some countries have established specialized R&D units, which help firms prepare documentation and alleviate problems that arise when application procedures are not well documented in program regulations.

Tax incentives are, in principle, less exposed to rent-seeking behavior than grants because they are entitlement schemes rather than competitive programs (that is, if applicants are eligible they automatically receive the entitlement), but they are not immune to rent-seeking activities.⁷ If they are narrowly based or have differentiated levels of support, they can lead to distortionary behavior as business seeks to continue to maximize their benefits. So, if a higher rate is provided to SMEs, they may seek to restrict their growth artificially or change their corporate structures to keep receiving the concession.

Finally, most tax incentives programs are large initiatives, often making up one of the largest components of innovation support, so introducing a tax incentive is usually a significant policy and budgetary commitment. Furthermore, from a government budget management perspective, tax incentives are less

attractive than grants because governments can only guess what the revenue forgone will be, whereas with grants the expenditure parameters are neatly defined.

Table 3 provides a summary of observations regarding tax incentives

INSTRUMENTS TO FINANCE TECHNOLOGY ADOPTION AND RESEARCH-INDUSTRY COLLABORATION

This section discusses features of the technology adoption process and the instruments that can be used to finance it and explores the dynamics of research-industry collaboration. It emphasizes the role of grants and vouchers in fostering technology adoption and presents information about programs that have been employed in several countries to address this issue.

Importance of technology adoption. Businesses have much to gain by adopting innovations not developed in house. Technology adoption and knowledge absorption are particularly important priorities for developing countries, given that acquiring and using knowledge that already exists is less costly and less risky than creating new knowledge, while the rewards can be huge. Therefore, policies that facilitate access to global knowledge are critical.

In some cases, this knowledge resides within the research sector. There is also much knowledge in the public domain to which businesses can get access at little or no cost if they have sufficient absorptive capacity.

Some features of the technology adoption and industry-research collaboration process. Firms can adopt technologies developed elsewhere by several channels. One of the most common is by acquiring machinery and equipment and integrating it into existing businesses. The know-how embodied

⁷ See the example of the Patent Box in the UK, the benefits of which will be concentrated among a small number of large R&D-intensive businesses.

TABLE 3 Design and Implementation Observations—tax Incentives

INSTRUMENT	OBSERVATIONS
Tax incentives for R&D	<ul style="list-style-type: none"> • Tax incentives can be quite a flexible instrument; they can have a standardized, broad-based approach or contain different levels of incentives for different types of activities. For example, some provide higher subsidy levels for particular types of companies (such as SMEs) or for “additional” R&D expenditure that is significantly higher than the businesses’ previous average of R&D expenditure. • There are variations in how to apply the incentives—credit/concession/depreciation—all of which have slightly different accounting impacts on the claimant businesses. • Decision making on what innovations to support is entirely in the hands of businesses, so government has no involvement in choosing which innovation activities to support. As long as activities are eligible, they will be supported by the measure. • Tax incentives can be used as a strategic instrument by governments to attract overseas R&D via foreign direct investment, often as part of place-based schemes like science parks. • Most schemes work by reducing the corporate tax owed by the claimant business, which is paid on profits. If the business is not profitable, it generally cannot claim any benefit (although it may be able to make a claim in the future, when it is profitable); this may reduce the impact of the incentive. • Like all tax instruments, simple and broad-based schemes are the easiest to design and administer. The more complex and multifaceted schemes are not only harder to administer; they can lead to distortionary behavior (for example, SMEs trying to stay a certain size to remain eligible). • Because there are various approaches to defining, measuring, and applying tax incentives, they are complex to design. As they are generally legislatively based, they are also complex to change. Care should be taken to ensure they support the right types of innovation activity, are well integrated into the existing tax system, and have robust audit and compliance functions. • They work best in environments where the tax system is relatively robust, as they will be subject to extensive tax minimization efforts by users, particularly large companies with the resources to make such efforts. • These are generally large schemes with significant budgetary implications. Large schemes can make government budget management difficult, as predicting their usage accurately can be difficult. Since they operate on the revenue (forgone) rather than the expenditure side of the budget, however, only their administration requires a budget allocation.

in new machinery, in business processes (like Six Sigma), or in the combination of both (such as the introduction of information technology and related business practices) that is developed externally and disseminated into existing firms is a significant element of business innovation around the world (Hall and Khan 2002).

The adoption of new technologies can be expensive, particularly when new production equipment must be purchased and experts hired to provide training. As a result, firms may not be willing to adopt them (if they don’t recognize their value) or may be unable to do so (if they cannot get access to sufficient finance to cover the cost of adopting them).

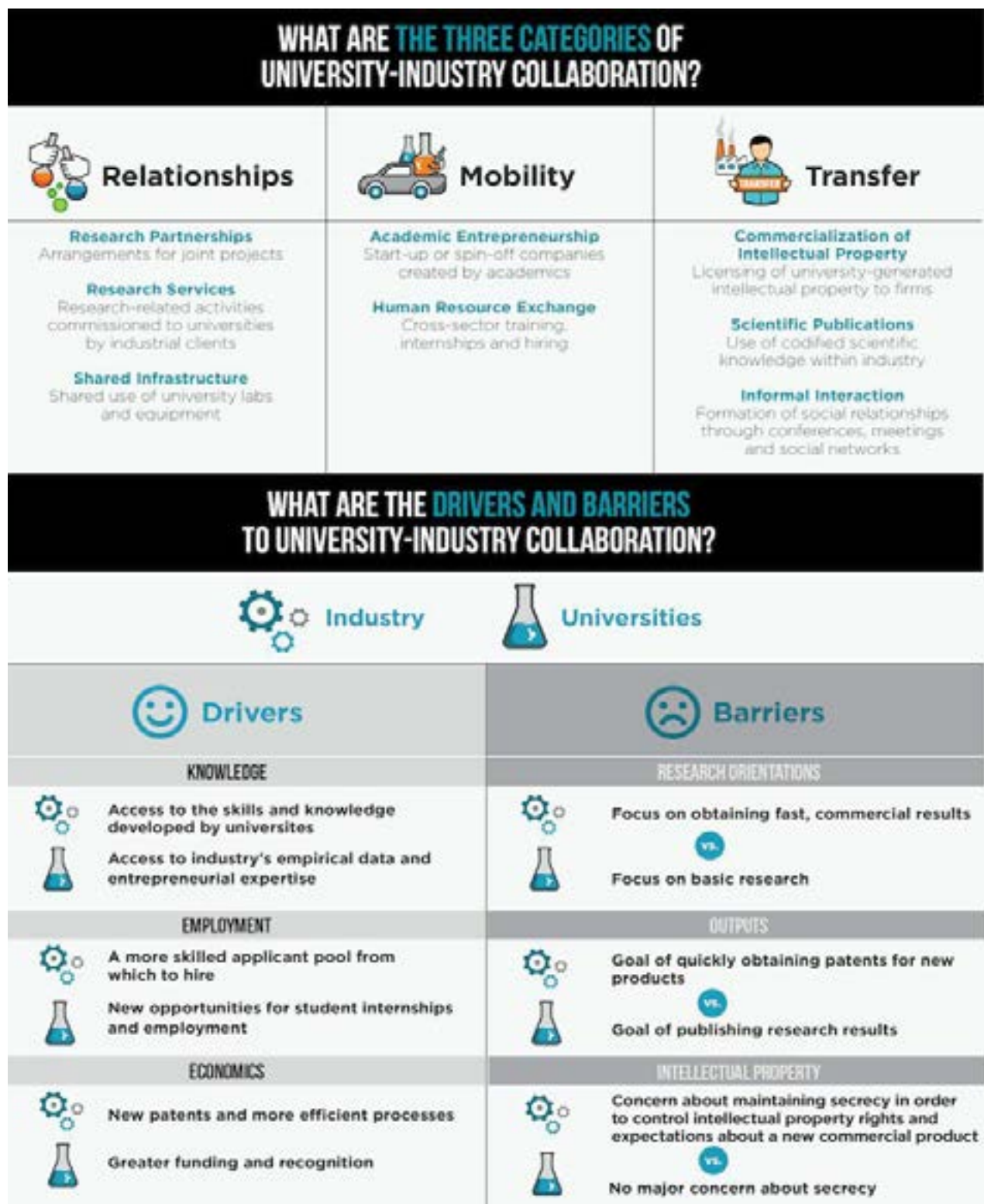
Several other barriers also hamper technology diffusion and collaboration, such as information asymmetries between producers and users, high costs of switching to new technologies, high entry costs (especially in areas with important network effects), and technological path dependencies. Some of these can lead to market failures, which governments may be able to help address.

Another potential source of new knowledge resides in the research sector, generally R&D. The types of collaboration and the challenges associated with them are in figure 1.

Policy interventions. Policy instruments to aid new technology adoption generally target SMEs, which are typically less informed about new technologies and may also be quite reluctant to risk introducing potentially disruptive technologies. Similarly, SMEs may not understand how to work with research providers or business consultants who can help reduce the risks and costs of the adoption process. Finally, SMEs may not only be unable to see the rewards of adopting new technologies; they may also lack the resources to afford them.

In addition to advisory services, several types of subsidies can be provided to SMEs to reduce the upfront costs of technology and make its adoption more attractive. In some cases, advisory services are linked to funding to help implement change, but standalone funding initiatives also exist. Sometimes funding is directly provided to SMEs, while in other

FIGURE 1 University–Industry Collaboration



Source: IPP.

instances it supports the soft infrastructure and related services that help enable knowledge diffusion (for example, clusters, accelerators, innovation intermediaries, trade/industry associations that run technology dissemination events, and so forth).

Small grants to obtain expert advice on organizational or process innovation or to support the accreditation of International Organization for Standardization (ISO) certifications can be effective mechanisms to promote knowledge absorption and technology adoption. For instance, to drive energy-efficient practices, the Canadian government has a facility that provides up to C\$40,000 to companies that decide to implement the ISO 50001 standard certification (Energy Management Systems Standard). In addition, the program provides industry networking opportunities, customized energy management workshops and toolkits, and technical information.

The UK Manufacturing Advisory Service provides advice to manufacturing SMEs to improve their business and production processes, as well as small grants for clients to bring in external experts to help implement this advice. This type of advisory service–grant package not only supports the direct infusion of new knowledge into the business, but, ideally, it can also help improve SMEs' future capacity to find and implement external knowledge themselves by showing them how to go through the process. Singapore also provides support through a simple grant for capability development via external knowledge providers (see Box 2).

“Innovation vouchers” are another instrument used to encourage SMEs to seek access to new knowledge sources. Specifically, the government gives vouchers to SMEs to purchase services from knowledge providers, such as universities or research organizations (IPP 2014). The vouchers are intended to promote collaboration between the scientific community and the private sector, which is difficult for several reasons. Universities and research organizations usually have insufficient information about private sector needs, while company management might believe universities and research organizations do not understand company needs, or that knowledge services are overpriced. Small vouchers, usually granted for consulting services, are a simple instrument that can help support knowledge diffusion.

One disadvantage of vouchers is that while they create short-term alliances, they may be less effective for fostering cooperation in the long run. A variation on this approach is to encourage the placement of researchers or technical people within SMEs as another way to support knowledge absorption. For instance, the Australian government runs its Researchers in Business initiative, which supports the physical placement of researchers from universities or public research agencies into SMEs to work on improvement projects for them. Brokering support is also provided to address the complexities of contracts and IP and to ensure the right cultural fit between the researchers and the SMEs.

BOX 2. SINGAPORE INNOVATION AND CAPABILITY VOUCHER

The Innovation & Capability Voucher (ICV) is a simple voucher valued at S\$5,000 to encourage Singaporean SMEs to take their first step toward capability development. SMEs can use the voucher to upgrade and strengthen their core business operations by acquiring external consultancy services in the areas of innovation, productivity, human resources and financial management.

Apart from consultancy, ICV also supports SMEs in the adoption and implementation of simple solutions to improve business efficiency and productivity. SMEs can use the ICV to implement productivity solutions under the supportable cost categories of (i) equipment & hardware, (ii) technical solutions, (iii) professional services, and (iv) design & renovation

Each SME is entitled to a maximum of eight vouchers. Each ICV project must be completed before the submission of a new application. The duration for each project should not exceed six months.

Source: <http://www.spring.gov.sg/Enterprise/ICV/Pages/innovation-capability-voucher.aspx>.

Given the cultural differences between the research sector and SMEs, vouchers work best when accompanied by some type of brokering, since a pure financial incentive does not address the information asymmetries. Both this type of initiative and vouchers could be categorized as variations on the R&D grant

scheme model, but with an explicit added goal of inserting external capability into a business.

Table 4 provides a summary of observations regarding technology adoption and industry–research collaboration.

TABLE 4 Design and Implementation Observations—technology Adoption and Industry–research Collaboration

INSTRUMENT	OBSERVATIONS
Technology adoption and industry–research collaboration	<ul style="list-style-type: none"> • A key market failure is often insufficient information (SMEs lack awareness and/or mistrust external consultants), so to be effective, instruments need to address this problem in addition to providing funding. • Vouchers are much more effective when brokering between the SME and a potential research provider is offered (in addition to funding) to reduce the substantial transaction costs faced by both parties. • This brokering usually involves skilled people who understand business and research, so they can communicate with both sides and work through potential contractual and IP issues. • Vouchers generally involve small amounts of funding to introduce new knowledge by subsidizing external advice. They are most effective when delivered as part of a structured improvement plan that has identified the core needs of the business to which the intervention is targeted. • Subsidizing the purchase of capital equipment can be expensive, so policymakers need to be careful to assess whether there are additionality and any spillovers beyond the recipient for such an approach.

STAGE II: PROTOTYPE DEVELOPMENT AND MARKET DEMONSTRATION

Getting from an idea to a new product, service, or process involves several challenges. Even if technological uncertainty has already been resolved (and this is not always the case), significant market uncertainty still exists. Will it be possible to create a product someone will want to buy? Will the new production process work as planned? Can a different business model be profitable in practice?

The second stage of the innovation process provides some answers to these questions by developing prototypes and testing their potential for adoption in a real environment, be it with real customers or real employees.

The financial resources required for this stage depend on the type of innovation being developed, as well as the industry. Developing a new drug to the point where it can be commercialized can easily cost hundreds of millions, while the cost of piloting a new internal communications system may just be some employees' time.

Similarly, the availability of finance also depends on some of these factors, given that different types of innovation involve not only different amounts of investment, but also different degrees of uncertainty and intangibility. The market test can be quite stringent, as evidenced by the many new product launches that fail, but failure rates are not uniform.

Furthermore, most of the investment in this stage is in the form of intangible assets, but as these become more defined, some can already be protected by intellectual property. IP opens up access to other sources of finance, since, for instance, some forms of IP

can already be used as a guarantee to raise asset-based finance.

As in earlier stages, large, established firms can use internal resources and their better access to different sources of external finance to raise funding, which can then be used in different parts of their businesses, including their innovation projects. In contrast, young, small firms face a more difficult challenge, particularly after they've already tapped into their families and friends for funding (as well as sometimes into their credit cards).

Several forms of finance provision have emerged that can provide funding specifically for this stage, typically in the form of equity or convertible loans (since standard debt is typically not well suited, given the potentially high failure rate in this stage). Good judgment is important to discriminate between good and bad innovation projects, which typically requires very specialized knowledge and significant due diligence activity.

Business angels, with their expertise and deep pockets, are therefore a main source of finance at this second stage. Early-stage venture capital funds also play a role, particularly when the investment required is too large for business angels (such as in biotech), although venture capital activity has progressively shifted toward larger and later-stage investments. (Therefore, VC is discussed in the following section, which looks at the third stage of the innovation process: commercialization and scaling up.)

Taking advantage of the wisdom of the crowds can also be a useful mechanism to reduce the cost of due diligence, particularly for consumer-facing innovations

with limited technological uncertainty, which explains the emergence and growing role of crowdfunding platforms.

Several other sources of finance, not discussed specifically here, can fund prototype development and market demonstration, from accelerators (which sometimes also provide some seed equity finance) to big corporates (which, for instance, run corporate VC and acceleration programs to back innovative ventures aligned with their corporate strategies). Challenge prizes, while not a funding mechanism per se, can also help mobilize resources to develop and market test new prototypes.

The public sector plays a dual role in this stage, supporting the development of private sources of finance but also directly providing finance to business, whether using R&D tax incentives (discussed in the earlier section), direct loans to companies, or several types of grants. One mechanism becoming more popular is pre-commercial procurement, so it is discussed in this section in detail.

All these interventions ultimately have a common rationale, addressing the suboptimal level of innovation investment due to the existence of externalities in innovation activity. Many also aim to address specific market failures, however, such as coordination failures, if governments can have an advantage over the private sector in solving them.

BUSINESS ANGELS

This section explores the role of business angels in financing prototype development and market demonstrations. It provides a full characterization of business angels (types, motivations, activities they support) and explores the advantages and disadvantages of using them to finance the second stage of the innovation process. The section finishes with a discussion of the policy interventions that can encourage and support business angel activity.

What it is. The informal venture capital market is composed of wealthy individuals, called business angels, who invest their own capital in young, unquoted firms.

Business angels do not have familial or institutional connections with the firms they finance. Rather, they are generally successful business people and entrepreneurs who look for attractive investment opportunities in a segment of the market that is not covered by institutional investors. Thus, business angels fill an “equity gap” between the money entrepreneurs can raise from family members or other internal sources, such as their own savings or personal borrowings, and the investment venture capitalists may provide.

Characteristics. There are different types of business angels (see Van Osnabrugge and Robinson 2000 for a compendium of classifications). Some are former senior management people who are looking for new jobs. Others are experienced entrepreneurs who want to enlarge their investment portfolios. Still others make a hobby of investing, typically in small amounts, in several firms at the same time. Finally, some business angels are altruistically drawn to projects with a social development aspect.

Business angels have basically three motivations (Van Osnabrugge and Robinson 2000): (1) obtaining financial returns, (2) participating in the development process of the ventures they finance, and (3) satisfying altruistic feelings by, for example, transferring experience and knowledge to amateur entrepreneurs. Financial considerations are not always the top priority, since business angels often enjoy hands-on participation in the projects they finance and helping their local economies to grow. In addition, they can provide mentoring and advisory services, as they often have deep knowledge of the markets in which they invest.

Business angels need to be relatively patient (Freear, Sohl, and Wetzel 1995) and willing to take on risk and accept the possibility of illiquidity over a long investment period. They are accountable only to themselves because they invest their own money and therefore have strong incentives to undertake thorough due diligence prior to investment. The most active angels, the so-called “deal makers,” rely more on private than public sources of information about the quality of investment opportunities. They also use

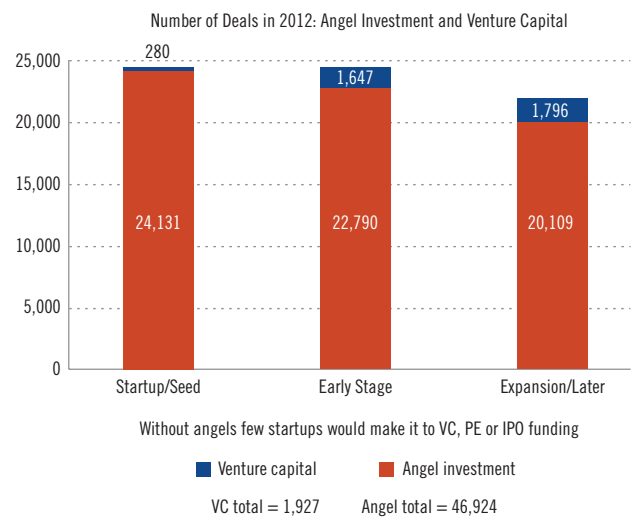
networks of contacts they have developed to learn about potential deals (Kelly and Hay 2000).

Business angels invest in startup firms and early-stage ventures (Van Osnabrugge and Robinson 2000; Sohl 2006). According to Van Osnabrugge and Robinson (2000), “They are the largest sources of risk financing for entrepreneurial firms, vastly exceeding the institutional venture capital industry.” For example, they provide approximately 80 percent of the seed and startup capital for high-tech firms (Sohl, Van Osnabrugge, and Robinson 2000). Recent evidence shows that business angels’ activity increased during the financial crisis of 2008–9, while venture capital and lending activities decreased (Mason and Harrison 2013).

Business angels are often involved in smaller investments than venture capitalists (Robinson and Van Osnabrugge 2000). Mason (2006) writes that “business angels, investing on their own or in small ad hoc groups, will typically invest up to £100,000, or even £250,000, while the larger angel syndicates will make investments of £500,000 and above.” Their investment activity typically focuses mainly on the second stage of the innovation process, although they also invest in commercialization and scaling up (the third stage) in sectors with relatively limited funding requirements. Compared to venture capital, they invest small amounts but in a much wider range of businesses (see figure 2)

More recently, angels have shown an increasing preference for investing in groups, which allows them to make bigger deals, share risks, reduce informational asymmetries, and speed up the matching process through the use of websites (Sohl, Van Osnabrugge, and Robinson 2000). The trend has been fueled by the widening of the equity gap, as venture capitalists finance larger ventures. A characterization of angel groups in the United States by the Kauffman Foundation shows they include no more than eighty people, and their members invest between US\$25,000 and US\$100,000 in each deal. There are at least two models for running angel groups; the member-led model, which is run by a member or a committee, and the manager model, run by a professional manager.

FIGURE 2 Angels Fund Nearly All Seed/Early-Stage Deals



Source: Jeffrey E. Sohl, Center for Venture Research and 2013 NVCA Yearbook.

Networks play a matchmaking function between angel investors and entrepreneurs, although they do not invest directly themselves. They help make the investment process more efficient by connecting angels wanting to invest with other players in the local ecosystem (incubators, VCs, development agencies, banks, stock exchanges, and so forth) and, most importantly, with entrepreneurs looking for capital.

Groups tend to be more overtly focused on investment opportunities. Some take the form of clubs to whom potential investors pitch, after which the participant investors decide on an individual basis whether they wish to invest. Some groups also undertake due diligence on behalf of their members. And some groups operate pooled investment vehicles (sidecar funds), using funds raised from members. These funds then invest alongside individual investors and allow angels to spread their portfolio risk.

Advantages and disadvantages. Projects that have been backed by business angels are more attractive to formal sources of funding than non-backed projects, as angels reduce informational asymmetries and thus play an accreditation role. According to Madill et al. (2005), technology firms in Ottawa backed by informal private investors were better able to raise capital from venture

capitalists. The authors found that 57 percent of angel-backed firms were able to get funds from venture capitalists, compared to only 10 percent of non-backed firms. The evidence supports the view that business angels reduce informational asymmetries and make entrepreneurs more likely to succeed.

Using business angels to finance a company can have disadvantages, however. Angels tend not to have the volume of funds to continue reinvesting in later stages of capital-intensive businesses, so entrepreneurs have to seek other funding that potentially dilutes the angels' holdings. For entrepreneurs, significant transaction costs can be associated with managing a range of small angel investors. Angels are also not always informed investors (even if they believe they are), nor do they necessarily bring relevant business knowledge to the table.

Policy interventions. Governments have put into place several types of interventions to encourage and support business angel activity, such as tax incentives, co-investment funds, and network support (one example is Malaysia, discussed in Box 3). Some of these interventions are of a permanent nature (to address the externalities market failure), while others are only temporary (to address coordination failures until a vibrant business angel community becomes self-sustaining).

1. **Tax incentives:** They aim to increase the supply of investment into innovative businesses by providing different forms of tax relief to investors. They apply to angel investors but sometimes also to larger corporate investors, and they may have unforeseen beneficiaries as well, such as supporting crowdfunding activity (as for instance happened with one of the UK schemes). Tax incentives take a number of forms:

- “Front end”: When an investment is made in an “eligible” business, a concessional rate or credit can be claimed.
- “Back-end”: When a holding equity in an “eligible” business is sold, any profits are either tax-free or have a reduced rate of capital gains tax applied to them.
- Roll-over or carry-forward relief on capital gains: These enable investors who sell holdings in “eligible” businesses to reinvest in different “eligible” businesses without paying capital gains tax on those profits.
- Young, innovative company schemes: These typically provide tax relief and a reduction in social charges for young firms that have a demonstrated innovation focus (for example, the French *Jeune Entreprise Innovante* scheme).

2. **Capacity building and networks support:**

Interventions may focus on improving investment skills or on supporting the infrastructure of both business angel networks and business angel groups. Sometimes governments have helped establish networks and supported them until they became self-sustaining.

3. **Co-investment schemes:** Governments can also co-invest with angels in innovative businesses, either via pooled angel investment vehicles or with individual angel investors. These schemes differ from venture capital schemes in that they are “deal by deal.” The mechanism is generally for government to “accredit” particular angel groups that can prove they have robust due diligence processes and good financial backing. The government then co-invests when these groups decide to invest in particular deals. Compared to a traditional venture capital fund, this

BOX 3. MALAYSIAN BUSINESS ANGEL POLICY

The Malaysian government has established the Cradle Fund, a unit of the Ministry of Finance that seeks to create an ecosystem to support a strong and innovative business building environment for technology entrepreneurs in Malaysia. Cradle provides funding and advisory support to entrepreneurs but also provides support to the Malaysian Business Angel Network, which is responsible for the accreditation of individual angel investors and angel investor clubs, for creating awareness and training for angel investors, and for monitoring angel investment statistics in Malaysia.

Cradle also administers the Angel Tax Incentive, which is designed to help technology-based startups in Malaysia raise funding by offering tax incentives to accredited angel investors who wish to invest in young high-growth or high-technology companies.

Source: <http://www.cradle.com.my/faq/>.

BOX 4. THE SCOTTISH CO-INVESTMENT FUND

In 2003, the Scottish government developed a co-investment fund that partners with existing private funding entities, such as angel investors, venture capital firms, and syndicates, to inject additional capital into targeted underfunded markets. The SCF follows the lead of its private sector partners by allowing them to make all of the investment decisions and provides matched funding on the same terms, up to a limit. The fund was designed as a way to address the equity gap while keeping the public sector intervention minimal.

By relying on their partners to make the investment decisions, the SCF does not have to devote as many resources to conducting due diligence. It addresses the needs of early-stage businesses, providing matched investments between £100,000 and £1,000,000. Investment deals using SCF funding are limited to SMEs based principally in Scotland. Each must be from an approved business sector, have fewer than 250 employees, and have less than £16 million in net assets. The fund has a target rate of return of 20 percent.

The SCF seems to have increased the capacity of the equity capital risk market, both by enabling partners to increase the size of their deals and by attracting new investors into this space (more so with the angel community than the VC market).

Source: Beattie and De Vroey (2014).

model offers some advantages for policymakers, as it encourages a range of different entities to assess and invest in companies. This gives greater choice to entrepreneurs seeking funding and, potentially, a wider geographical spread of sources of investment

capital. One of the best-known and most copied examples is from Scotland (see Box 4).

Table 5 provides a summary of observations regarding equity investment instruments.

TABLE 5 Design and Implementation Observations—equity Investment Instruments

INSTRUMENT	OBSERVATIONS
Business angel co-investment schemes	<ul style="list-style-type: none"> • Business angel co-investment schemes encourage the development of a wider investment base, which gives greater choice to entrepreneurs seeking funding. This base is more likely to have a wider geographical spread than formal venture capital, as angel groups are invariably regional in focus. • These schemes generally operate at the seed stage, which has few other private sector sources of innovation capital. The downside is that successful investments can need later-stage capital, so policymakers must ensure the availability of later-stage growth capital that can make follow-on investments. • The model “outsources” the due diligence on deals to the business angel groups, so policymakers need a robust mechanism to assess and accredit this investment capability and be certain this standard is maintained. • These schemes have relatively low management costs compared to formal funds, while still benefiting from the investment judgment and know-how of private investors who put their own money into deals. • This assessment capability is highly specialized, so governments need to develop or buy specialized capability to make the assessments and manage these types of schemes rather than relying on career bureaucrats. • These schemes can be criticized for co-funding deals that angel investors would have funded anyway, and for the reported tendency of some angels to “keep” the best investments for themselves while referring the “lower-quality” investments to the co-investment schemes.
Tax incentives for investors in innovative businesses	<ul style="list-style-type: none"> • Front-end tax concessions (where investors get a benefit the year they invest) are preferred by investors, as they provide an immediate tax benefit based on how much is invested, regardless of returns. • Setting the concessional rate is a key issue, as too low a rate will simply not induce additional investment, while too generous a rate will drive tax minimization behavior and result in poor-quality investing. • Back-end tax concessions (where investors receive their benefit when an investment is sold) have less impact in inducing additional investment, first, because investors have to wait (often several years) to see any returns, and, second, because they may not see returns if the investment does not grow. • These incentives are often combined with angel investment initiatives to provide incentive for early-stage investment activity. They can help encourage successful entrepreneurs to reinvest in innovation rather than in other, less risky markets (such as property). Given the rise of self-funded and self-managed investment/retirement around the world, tax incentives can be an avenue for innovative young companies to tap this market. • These incentives leave the investment decisions in the hands of the investors, so they can indirectly encourage the upskilling of investors. • Investors are usually well educated and wealthy and thus more likely to engage in tax minimization. So, as with any tax concession, care needs to be taken in design and implementation of these incentives, bearing in mind that they will only be effective in environments where tax is being collected from this target market in the first place.

CROWDFUNDING

This section discusses the relatively new area of crowdfunding as a source of innovation financing. It explores the different types of crowdfunding, some of its advantages and disadvantages as a source of innovation funding, and the potential role of policymakers in influencing its development.

What it is. Crowdfunding is defined as “the practice of funding a project or venture by raising many small amounts from a large number of people, typically via the Internet.”⁸ Although some types of crowdfunding have existed for a long time, the Internet has enabled its fast development during the last four years, since it makes connecting people online much cheaper and thereby enables SMEs and entrepreneurs to tap directly into individuals’ capital to fund their projects.

Although there are several variants, crowdfunding often follows this process: first the entrepreneur pitches his or her idea to the operators of the platform. They will, in turn, screen the proposal and, if they approve it, launch the pitch. Each pitch has its own microsite, containing a description of the project, its needs (funding target), the timeline, and the reward model. A crowdfunding round ends with one of two scenarios. In the all-or-nothing model (AoN), the money that has been pledged is transferred only if the target is reached by the end of the period. In the keep-it-all (KiA) model, the money is transferred even if the target is not reached. Implementation of the project then follows.

Characteristics. Four main financing models fall under the umbrella of “crowdfunding”: the donation-, reward-, lending-, and equity-based models (Giudici et al. 2012):

1. **Donation-based model:** The typical aim is to raise funds for a cause with a social purpose. They are often in the form of direct donations toward specific projects rather than for an organization.
2. **Reward-based model:** This is similar to a pre-purchase agreement for a product or service. The size and type of reward typically increases with the amount an individual investor pledges, following

a tiered system. The cost to the entrepreneur of providing the reward should be lower than the donation required for attaining it.

3. **Lending-based model:** This model involves peer-to-peer lending on commercial or noncommercial terms. Lenders usually see this as a purely financial proposition and are motivated by the return they can get, which is determined by the borrower’s credit rating (the platforms, such as UK-based Funding Circle or U.S.-based Lending Club, use data on borrowers to assess how risky they are). Peer-to-peer lending can also be done on noncommercial terms with a low interest rate or no interest rate, typically to support entrepreneurs with more social missions.
4. **Equity-based model:** Investors receive an equity share in the business in return for their investments. This is the least-used type of crowdfunding since there are many regulatory barriers to its adoption, but it can provide long-term capital to develop new innovative projects and businesses.

Advantages and disadvantages. Several advantages explain the fast growth of crowdfunding platforms in recent years. Crowdfunding can be more flexible in scope and scale than traditional sources. In particular, it is less subject to threshold effects (that is, funding volume has no natural lower or upper bound). In other words, it makes it possible to raise funding for relatively small projects that would not be attractive propositions for other types of investors relying on more expensive due diligence processes. Therefore, crowdfunding can be an excellent source to fund the development of prototypes that do not require large amounts of finance.

Three factors contribute to making crowdfunding a cheaper source of funding than traditional sources: crowd-based due diligence, (partial) disintermediation, and mixed motivations for investors.

1. **Crowd-based due diligence:** Taking advantage of the wisdom of the crowds can reduce the costs

⁸ Oxford Dictionary Online.

of due diligence, since the financing round doubles as free market research (to determine whether a market exists or not), thanks to the all-or-nothing feature. In other words, the due diligence that is built into crowdfunding is virtually free. It may not be necessarily objective and of good quality, however. The “wisdom of the crowds” leads to better decisions when the crowds are relatively well informed (for example, in the case of consumer-facing products) and technological uncertainty is low. But it can also lead to worse investment decisions, since the aggregation of information from uninformed individuals may simply be herd behavior and not informative at all.

2. **(Partial) disintermediation:** Most of the activity takes place on “standardized” crowdfunding websites or “platforms,” which reduces intermediation costs. Even if crowdfunding platforms take a share of the amount raised (usually around 5 percent) as a fee for the service, this is a generally lower transaction cost than for other sources for projects of this magnitude.

3. **Mixed motivations:** Many crowdfunders have other reasons to invest beyond maximizing commercial returns. They often have ethical concerns, see a social utility to the project, have a personal interest in having the solution rolled out, or are simply passionate about the venture. The fact that crowdfunding appeals to both financial and nonfinancial motives means the investees get the access to finance on better terms.

Crowdfunding has several other advantages beyond decreasing the cost of access to finance. For instance, allowing investors to invest small amounts makes it easier for them to build more diversified portfolios, thus reducing the overall risk they face (even if amateur investors cannot assess the risk of the investment as well as professionals would).

Crowdfunding can also remove geographical boundaries on raising finance. While most forms of investment have a home bias, crowdfunding platforms facilitate the matching of projects and investors from different countries, even if they are thousands of miles

apart. This makes it easier to find investors interested in an innovator’s project, although to date regulation has hampered some forms of cross-border crowdfunding.

While some types of crowdfunding are promising sources of finance, a series of issues can limit its development. To begin with, crowdfunding is not suitable for just any type of product. For instance, the biotech sector would have a hard time leveraging the potential of crowdfunding, since the required investments might be too big, and amateur investors are unlikely to have much understanding of the potential of the product. In other words, the concept of the “wisdom of the crowds” may not always apply in early-stage financing.

In addition, there is potential for fraud and hacking. While this risk may diminish as the market establishes itself and the reputation of platforms becomes an important competitive factor, the collective action problems that hamper monitoring will not disappear. In other words, no one (except maybe the crowdfunding platforms themselves) has the incentive to invest significant time in examining whether a proposed venture is real or fraudulent.

Crowdfunding investors provide finance, which is helpful but may not be sufficient, at least in comparison to other types of funders. After all, investments in ventures and innovation typically entail much more than just money. The investor–investee relationship is more complex and enriching, with investors sharing their expertise and providing mentoring—something crowdfunding cannot typically provide.

Another potential issue is the risk that crowdfunding leads to too many first-stage investments without the capacity to ensure later-round funding. This can create a bottleneck and eventually fail to lead to the creation of sustainable businesses or the roll out of new innovations. If the businesses are good, however, funding for later stages should eventually become available from crowdfunders or other sources.

Ultimately, crowdfunding can be a substitute for and/or a complement to traditional finance markets. It

can replace the way businesses are financed or just impose itself as the missing link in the chain, filling the equity gap and funneling tested ventures to later-stage investors for further rounds of funding. Crowdfunding may also serve to finance ventures that fail to secure loans (or, at least, this is what some empirical evidence suggests).⁹ This may help explain why the growth of crowdfunding coincided with protracted institutional funding in the wake of the financial crisis.

Policy interventions. Crowdfunding is a very recent phenomenon, and not many government initiatives have focused on promoting its activity. Some existing programs, however—such as the UK tax incentives for business angels—have unintentionally benefited investors in crowdfunding platforms, and they are being expanded to encourage these activities. The UK government has also co-invested alongside “the crowd” in peer-to-peer lending.

The main concern of policy intervention on crowdfunding is how to regulate it. Platforms using equity-based models face the greatest impediments, since regulation in some countries (such as the United States) bans general solicitations of retail investors investing in unlisted companies.

Many countries are currently revising their regulatory frameworks, trying to balance the risks of fraud with the advantages of having vibrant crowdfunding platforms. Some examples of new regulation include ensuring that the executives of the platforms are suitably qualified; requiring that professional investors account for at least 5 percent of any investment round; vetting would-be users/investors to ensure they understand the risks of investing; and putting restrictions on the maximum amounts unaccredited investors can commit for a particular project or in a platform overall.¹⁰

For developing countries, platforms can offer innovative entrepreneurs access both to capital and expert advice that is simply not available locally. This is particularly the case if the diaspora is connected to local businesses; these platforms potentially reduce search costs for both investors and investees significantly.

TABLE 6 Design and Implementation Observations—Crowdsourced Funding

INSTRUMENT	OBSERVATIONS
Crowd-sourced funding	<ul style="list-style-type: none"> • Policymakers need to distinguish among the different types of funding that fall under this category. • This is an evolving space, but most issues concerning its further development relate to financial and investment market regulation rather than innovation policy. • Although crowd-sourced equity funding receives considerable attention, peer-to-peer lending is currently far more significant, and this may continue to be the case.

Table 6 provides a summary of observations regarding crowdsourced funding.

PRE-COMMERCIAL PROCUREMENT

This section discusses the area of pre-commercial government procurement as a policy tool for funding innovation. It explores the different types, its advantages and disadvantages, and the significant impact of a well-known example: the U.S. Small Business Innovation Program.

What it is. Pre-commercial procurement (PCP) is a way of procuring R&D services aimed at developing innovative solutions in areas where no commercial solutions yet exist. PCP is undertaken with the intention of potentially purchasing the outcome of the R&D once it is commercialized in the form of an innovative and tailored solution (a product or a service) to an issue of public interest.

For example, a contracting authority dissatisfied with existing commercialized/off-the-shelf solutions would solicit and select several suppliers to compete in developing alternative solutions to the problem it faced. After an initial exploration on behalf of the potential suppliers, the procurer would evaluate the pros and cons of each solution and progressively eliminate competitors along the different development stages (solution design, prototype, test series), even if typically

⁹ See Collins and Pierrakis (2013).

¹⁰ See Collins (2014) for additional discussion.

retaining at least two alternatives until the final stage to avoid monopoly power.

Note that pre-commercial procurement and public procurement of innovation (PPI—that is, the purchase of commercialized innovative solutions) are distinct. PCP precedes PPI and does not itself necessarily entail the purchase of the outcomes of the R&D. PPI is another way to leverage the purchasing power of the state to finance innovation, and, given the magnitude of public procurement in many economies (several times larger than governments' innovation budgets), it is one that should be considered carefully as well.

Characteristics. Pre-commercial procurement is a family of approaches with many possible schemes that can differ significantly in terms of design, management, and operation (Rigby 2013):

- 1. Design and allocation mechanism:** PCP can be conceived of as a single procurement contract managed in various contractual phases or different public procurement contracts. One or more competitions can be organized along the different stages of the PCP. The number of competitors involved and retained can also vary. Finally, it may or may not require private co-investment.
- 2. Intellectual property rights:** An important feature to consider is whether the intellectual property rights (IPRs) of the R&D and the solution are transferred to the contracting authority or remain with the developer. In the latter case, the terms of the licensing rights for the use of the developed solution can already be agreed upon at the PCP stage. In some cases, the developed solution can become open sourced.
- 3. Within-government organization and mandates:** PCP can be the preserve of each department or public body (autonomous or bottom-up approach) or of a central agency in charge of coordination, execution, and control (top-down approach), or a mixture of both (Rigby 2013). Some methods allow for easier pooling of the demand across public bodies or countries. Participation by different departments can be optional or mandatory.

For instance, the Small Business Innovation Research (SBIR) program in the United States (described in greater detail in Box 5) imposes a mandatory spending level on the different agencies engaging in R&D procurement, while the UK's Small Business Research Initiative (SBRI) only has recommended and, thus, optional provisions.

4. Eligibility: The firms that are eligible for PCP support can vary both in the ownership structure (partially locally owned or not) and the size of the businesses.

Advantages and disadvantages. Pre-commercial procurement can be an effective instrument to support the early stages of the innovation cycle, particularly the second phase (prototyping). Despite being a procurement contract, it shares some of the features and benefits of a grant. PCP can serve to correct the market failures that lead to suboptimal investment in innovation (such as externalities), while at the same time fulfilling a strategic purpose.

Specifically, PCP is targeted by design, and therefore allows funding to be directed where it is most needed. In addition, it can act as a signaling device, not only about the quality of a firm's innovation project, but also about future markets from which governments are interested in buying (sometimes also acting as first buyer and playing a catalyst role). Thus, it can help mitigate information issues and attract investment from VCs and other private investors into the companies supported. Synergies between the PCP scheme and other public sector support can also be created to ease access to finance in follow-on stages.

For instance, Lerner (1999) analyzed the impact of the SBIR program. The PCP scheme provided awards capped at US\$100,000 to finance feasibility studies and an award capped at US\$750,000 to finance development work. One decade after their involvement in the program, the SBIR awardees showed better performance (in terms of employment and sales growth) than unsupported firms. Crucially, awardee status appeared more important than the amount of funding received, and the evidence showed the

BOX 5. THE SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

The SBIR program is a pre-commercial procurement scheme introduced in the United States in 1982 that mandates the use of 2.5 percent of the federal R&D budgets from all government departments and agencies with large R&D budgets to contract R&D services from SMEs. The program is highly competitive and awards 4,000 contracts a year on average, worth US\$2 billion. It is structured in three phases:

- Phase I: To establish the technical merit, feasibility, and commercial potential of the proposed R&D efforts, with awards that normally do not exceed US\$150,000 in total costs for six months.
- Phase II: To continue the R&D efforts initiated in phase I (if successful), based on their scientific and technical merit and commercial potential, with awards normally not exceeding US\$1 million in total costs for two years.
- Phase III: To pursue commercialization opportunities resulting from the phase I and II R&D activities. While this third phase is not funded by the SBIR program, some federal agencies may provide follow-on funding for additional R&D or production contracts for products, processes, or services intended for use by the U.S. government.

Source: sbir.gov.

strongest positive impact for firms in areas with venture capital activity, thereby suggesting that SBIR backing functioned as quality certification.

From a policymaker perspective, PCP may always have significant advantages beyond being a funding tool for innovation. PCP provides a mechanism to support the development of innovations in response to the challenges policymakers face, potentially enabling the delivery of better solutions at lower cost and with reduced risk:

1. **Delivery of a better solution:** PCP typically involves considerable interaction between the procurer and the provider, which helps clarify needs and specifications and enables better-tailored solutions than if independently developed, as well as off-the-shelf solutions. Increased interaction also entails a better understanding of the capabilities and limitations of the solution on behalf of its future end users.
2. **Potential lower cost:** Tailor-made solutions typically have most critical capabilities, but they may not contain unnecessary costly features which off-the-shelf solutions might include (although developing a totally new solution can be more expensive than tweaking existing commercialized solutions). PCP can also ensure lower market prices by having suppliers compete at a pre-commercial stage and requiring lower license fees as a counterpart for the development cost and risk being shared with the procurer.

3. **Reduced risk:** PCP allows buyers and suppliers to share the risks and benefits of developing new solutions. It can also reduce overall risk of failed development, since the solutions developed better meet expectations, and prototypes can be tested in a real operational customer environment. PCP may also accelerate the development of new solutions, reducing time to market.

In some cases results will be less optimal, and pre-commercial procurement may end up not delivering on its promise, leading to more expensive and time-consuming processes. Even on these occasions, this policy tool can help create markets and encourage private sector players to enter them, the case of the AaKash Tablet computer being one example (see Box 6).

Convertible grants. One form of grant that is most applicable at this stage of the innovation process is the repayable grant, or innovation credit. The key feature of these grants is that their repayment is conditional on the success—either technical or commercial—of the project.

This type of conditional credit can be inappropriate for early-stage innovation, where uncertainty is high, but it is more suitable when financing innovation activities that are closer to the market, particularly when information asymmetries have been reduced and risks attenuated.

In some schemes, though, an early-stage grant can be repaid if the project is successful—an example is given

BOX 6. AAKASH TABLET: BRINGING LOW-COST COMPUTERS TO STUDENTS IN INDIA

In 2010, the Indian government announced the development of the Aakash tablet to provide low-cost computers to the nation's growing population of college students. At a cost of US\$35, the tablet would be the world's cheapest computer, helping India improve Internet connectivity at its thousands of colleges.

While the government eventually did deliver the low-cost, subsidized tablets to students starting in November 2012, they came one year late, following several iterations of the product. A number of lessons were to be drawn from the project, regarding the importance of the following:

- *Clear procurement evaluation criteria.* Because of the unclear criteria in the initial public procurement, delivery expectations were not met. Furthermore, the government chose a company that had never produced a tablet before, making timely and cost-efficient production difficult.
- *Market creation.* The project succeeded in creating a market. Because DataWind proved it could make a tablet for under US\$60, more tablet makers entered the market. Now, more tablet makers are operating at this price point, building a market among students and other Indian citizens for low-cost tablets.
- *Incorporating customer feedback.* The government listened carefully to the feedback from citizens and endeavored to improve the design based on it. Such public procurement of a consumer product, while delayed by several disputes, represented a first in India.

Source: IPP 2014.

in Box 7. An alternative approach can see the grant converted into a loan if the project is successful. For instance, under the Malaysian Cradle Fund, a grant can be converted into a loan if the recipient receives other forms of funding, financing, or a sales contract.

These types of schemes offer some advantages over equity funding and “straight” grants. Businesses prefer government loans to equity financing because they do not dilute their ownership. The reimbursable nature of loans encourages discipline in the recipient. Loans also allow the government to recover part of the money it lends, which can be recycled to support some type of funding facility. This offers social returns as well, providing the broader community with the chance to share the benefits of successful commercialization to which they have contributed through their taxes,

without unduly impeding the commercialization process.

As an alternative to grants, these loans are typically provided by innovation agencies, unlike the debt products provided by financial institutions discussed later in the paper. They are, however, more administratively complex and expensive to administer than non-repayable grants, usually requiring a much longer period of management and interaction with the client (although this can have benefits for impact assessment). In some cases, they can lead to perverse behavior as recipients seek to structure their arrangements to avoid repaying the credit.

Table 7 provides a summary of observations regarding other instruments.

BOX 7. SERBIA'S MATCHING GRANT SCHEME WITH ROYALTIES

A good example of a matching grant program with royalties is the one sponsored by the Serbian government. It aims to expand collaboration opportunities for innovative micro and small companies with strategic partners (such as private sector industry, R&D organizations, and venture capital/private equity funds). The objective is to promote private sector R&D and commercialization of innovative products or processes. The financing awarded under the program covers a maximum of 70 percent and up to €100,000 of the budget for a two-year project. The minimum of 30 percent of the total budget is provided by the grant recipient.

Upon successful commercialization, royalty payments are made, based on the revenue from product/service sales or subsequent products/services emerging from the funded technology. Any such royalty payments are made at a rate of 5 percent of annual revenue derived from sales of product or service or 15 percent of licensing revenue derived from such product/service up to 120 percent of financing received from the program or for up to five years, whichever is earlier. If the company or the technology developed using the grant funds is sold, a payment of 120 percent of the financing is required.

Source: <http://www.innovationfund.rs/matching-grants-about-the-program>.

TABLE 7 Design and Implementation Observations—other Instruments

INSTRUMENT	OBSERVATIONS
Pre-commercial procurement	<ul style="list-style-type: none">• This policy instrument provides innovative businesses with both funding and a potential market for their innovations, which doubles its value. Plus, it can provide solutions government would not otherwise have obtained.• It is more complex than a standard grant, as it involves a two-stage process: the first stage is to ascertain internal government needs and the second is to seek market solutions.• The instrument can be challenging for government entities and officials not used to seeking outside knowledge and policy and technology solutions. They may also resist being required to “set aside” budget to do so.• It can also be challenging for standard government procurement approaches, which are usually based on price/value for money for predefined goods and services, not outcome-based solutions.• The scope of these instruments is somewhat limited to supporting innovation relevant to government needs. The field can be quite broad, however—especially in the context of inclusive innovation, where the focus is on finding innovative models for delivering mainstream services like health, education, energy, and finance services to lower socioeconomic groups.• It needs to be transparently managed, otherwise it runs the risk of being used to favor otherwise uncompetitive providers.

STAGE III: COMMERCIALIZATION AND SCALING UP

Once an innovation has been developed and successfully user tested, the next challenge is to take it to market, start generating revenue, and scale it up. Two factors affect the ability to obtain finance for this particular stage, as well as what its source will be: the nature of the investments to be undertaken and the degree of uncertainty that prevails.

At this stage, technological uncertainty has generally been resolved, but some market uncertainty remains. While a “product” and some satisfied early adopters already exist, it is still unclear whether the right market to commercialize that innovation has been identified, how large the potential customer base actually is, and how many competitors the firm will face. In addition, significant delivery risks are involved when running a much larger operation. For instance, it is often difficult to replicate a particular business model that works in small scale but may require significant changes to work as desired on a much larger scale. How important uncertainty is in this stage depends on the characteristics of the actual innovation. In some cases, technological uncertainty in earlier stages may have been very high but resulted in an unbeatable innovation with relatively low commercialization risk (for example, an AIDS vaccine with 100 percent demonstrated effectiveness). In others, technological uncertainty may have been low, and the innovation faces instead significant market uncertainty (for example, a new taxi app). Similarly, uncertainty may have been high both in earlier and later stages (a new cancer drug that competes with existing ones) or low in both stages (the introduction of a new process to learn from customers’ complaints).

Very different types of investment can also be required, depending on the type of innovation being scaled up.

In some cases, the investment required may be better measured in terms of time and managerial attention rather than actual cash (for example, when scaling up new organizational practices across plants); in others, this stage may require large but tangible investments (for example, building new energy plants), while in still others the investment may create instead an intangible asset (a large marketing campaign to increase brand recognition).

Both the level of uncertainty and the type of assets being financed ultimately determine the difficulty of obtaining funding and who provides it. If risks and rewards are very high, venture capital is typically the only source, even if not necessarily easy to obtain. If risk is low and the investment required involves mainly the acquisition of easily redeployable, tangible assets, then bank debt can be an easy-to-get and relatively cheap source of finance. Also, some firms may be at the stage where they can already undertake initial public offerings (IPOs) and list their companies in the stock market, while in other cases business angels may be able to provide sufficient funding if the investments required are relatively small.

As in prior stages, large companies have a wider range of options to raise external finance when their internal sources of finance are insufficient (or if they prefer to hold onto their cash as insurance in case bad times are ahead). They can tap equity markets with secondary stock offerings (or an IPO, if still a private company) or raise debt finance, either from banks or by issuing bonds.

In addition, firms scaling up their innovations may use several other sources of finance, such as factoring and invoice discounting, new emerging forms of IP-

based asset finance, or project finance for large-scale investments with relatively low risk.

While this section discusses these different sources of funding, it is useful to mention that other players can have an important role as well. Large corporations are the clearest example. Some have their own in-house corporate VC funds. Others may provide funding to support the growth of an innovative company by acquiring a minority shareholding or the full company, while if the company is part of their supply chain, corporates may also facilitate finance to them or act as lead customers. Private equity funds are another potential source, particularly if the business has solid revenues and an easily understood business model. Governments also play a role, not only with several interventions to support private providers of finance, but often also by directly awarding commercialization grants or loans to innovative business.

Several market failures diminish firms' access to finance in this stage of the innovation process, even if it is often argued (though not universally agreed) that the severity of market failures is lower than in earlier stages. Also, the market failures that affect each of the different sources of finance vary widely, as does the desirability of government intervention to try to fix them. The most innovative and, hence, risky ventures tend also to be those that produce the highest externalities, which can justify public intervention to support venture capital. Venture capital also provides a typical example of coordination failure, but this rationale can be used as well to support the development of new models of financial intermediation until they become self-sustaining. Asymmetric information is also a commonly cited rationale for public intervention in this stage (even if the asymmetry is lower and easier to address than in earlier stages). The due diligence cost that makes the provision of finance unprofitable for private investors, however, needs to be paid regardless (even if funded by government), and the risk–reward ratio is the same; so it is unclear that asymmetric information is a sufficient rationale on its own to justify government intervention.

VENTURE CAPITAL

This section explores the role of venture capital in financing innovation and helping build innovative businesses. It provides a description of what venture capital is and how it works and its advantages and disadvantages. It then outlines the different types of policy instruments used (government funds, co-investment funds, fund-of-funds models) and provides examples of successful, and relatively less successful, interventions.

What it is. Venture capital firms are fund managers that invest in companies with high growth potential. These tend to be newer firms that need capital to grow but do not have a significant asset base, strong cash flows, or a long credit history that would allow them to raise debt finance. The distinguishing feature of investee businesses is their potential to grow exponentially in size and value if successful (Barry et al. 1990).

Venture capital funds are raised from institutional investors (for example, pension funds and insurance companies) and wealthy individual investors and are usually managed via partnerships. The VC managers of the fund are described as general partners (GPs) because they manage the fund and are liable for its legal debts and obligations. The investors are described as limited partners (LPs) because their liability for debts and obligations is limited to the amount of their investment in the fund. LPs are passive investors because they are precluded from getting actively involved in the management of portfolio companies.

Characteristics. Several factors set venture capitalists apart from other types of funds and financial intermediaries and make them particularly suitable to invest in young innovative firms with high risk but also high potential.

Before investing in a business, a VC firm conducts a thorough analysis to gain a detailed insight into the business's strengths and weaknesses, its growth potential, and the prerequisites for achieving this growth. This includes assessing the originality of the potential intellectual property, evaluating the risks of

imitation, and examining the market conditions (Florida and Kenney 1988). Because of this strict filtering process, even if venture capitalists usually receive a large number of proposals, they only invest in a small minority.

If its assessment is positive and the VC fund decides to invest in the firm, its shareholdings are typically in the form of preferred stock or convertible notes, giving additional control rights. The VC fund will generally join the investee board and participate in the decision-making process of the company, and, under certain circumstances, they may also be able to impose the replacement of the management of the firm (Kaplan and Stromberg 2003). Investment is usually provided in tranches and only when particular milestones have been met.

To have diversified portfolios and ameliorate the high-risk nature of their investments, VC funds make a number of investments. Most expect a few very successful investments to balance out the negative returns from the rest of the portfolio. They can invest in firms at several stages of the innovation cycle, although most of their recent activity has focused on later-stage investments. VC funds often co-invest with other VC funds, and, unlike in private equity investment, they usually have minority shareholdings in their investees, with founders, management, business angels, and other VC funds as the other co-investors.

VC funds have a relatively long-term focus, since they are based on a model of ten-plus-two years, which means they run for at least ten years with the possibility of extending for another two if they have not divested all their investments. The closed-end nature of most VC funds, whereby investors must commit their investments for the length of the fund and cannot redeem them early, makes this a long-term bet for investors, but it also allows investee businesses the time to develop without the threat of key investors withdrawing their liquidity at any point.

The usual investment cycle is for funds to invest over the first five to six years of the fund. New investments are not made as the focus moves to growth and exit,

although follow-on investments will occur in some investees in the later years. Many viable investments require more than one round of capital raising, so funds need to divide their resources to cover both initial and follow-on investments.

Most investments are held on average between five and seven years and, given their nature, are quite illiquid (another reason the sector is riskier than others). Some are held for much shorter periods, either because it quickly becomes apparent that growth prospects are low or because an exit becomes available. Others are held for longer, either because some technology areas take a considerable time to reach the market (for example, pharmaceuticals) or because economic conditions make it difficult to realize value. The recent financial crisis lengthened the holding time of many investments because capital became very scarce, general economic conditions made it hard for new businesses to grow quickly, and the market conditions for exits were poor.

In popular culture, venture capital investees are matured to the point where they are launched via an IPO or stock market launch. In reality, IPOs are extremely rare. Many investments do not succeed and are closed down (albeit quietly and in an orderly fashion). For the minority that continue to grow, the exit strategy can be via an acquisition by a larger firm, a merger with a competitor, or a buyout by managers in the business.

Advantages and disadvantages. Venture capital funds can play a crucial role in helping firms innovate (Florida and Kenney 1988). Kortum and Lerner (2000) examined the effect of venture capital on patented inventions in the United States across twenty industries from 1965 to 1992. Controlling for R&D spending, they found venture capital funding increases patenting rates: “A dollar of VC is three times more effective in stimulating patenting than a dollar of corporate R&D.” Venture capital represented only 3 percent of corporate R&D from the late 1970s to the mid-1990s, but the funds accounted for 10–12 percent of privately funded innovation in the United States.

In addition, VC-backed firms' patents more often lead to breakthrough innovations, as they are more frequently cited by other patents, and venture capitalists, at least in Silicon Valley, are more likely to fund innovators rather than imitators (Hellman and Puri 2000). The location of VC activity also matters when considering its benefits, however. For instance, the evidence shows the European VC industry was not as important as the U.S. industry in fostering innovation (Popov and Roosenboom 2012).

Venture capital is often described as "smart capital," as venture capitalists can benefit their investee companies in several ways beyond the provision of capital. These benefits include assisting with business planning and strategy, mentoring the managers, providing strategic, technical, commercial, and legal advice, improving corporate governance, helping to recruit key staff, and making connections (Gans et al. 2002; Gorman and Sahlman 1989). In some cases, they will step into their investees and work for periods of time, and they usually sit on the board. They also create networks of collaboration among investors, universities, R&D centers, large and technologically oriented firms, small entrepreneurs, and skilled workers (Florida and Kenney 1988). This provides venture-backed companies an advantage over other firms, increasing their chances of success.

It is less clear that venture capital is always perfectly aligned with related policy goals of governments. Even though they are long-term investors, venture capitalists ultimately want to exit their investments on financial terms that are most advantageous to themselves and their investors. In some cases this will involve a sale and/or move of the business overseas, which may not be the option preferred by governments. Policymakers usually want to see businesses, particularly if they have received taxpayer support, growing domestically or, at least, retaining a significant amount of value-adding activity locally. Also, some argue that venture capital receives too much policy attention, given the small number of firms it funds, and that some (though not all) of this attention should be redirected toward other sources of funding, as well as toward improving the wider innovation ecosystem.

Finally, VC returns have been very low since the dotcom bubble burst (Lerner et al. 2011). Aside from some star funds, most VC funds struggle to make positive returns and, thus, raise additional funding from private investors. Consequently, the proportion of government capital as a proportion of all capital raised by VC funds is rising in most countries around the world. As an example, in 2007 government agencies accounted for less than 10 percent of investment in European venture capital, while by the first half of 2011, this had grown to over 55 percent. There is a debate on whether this underperformance relative to other asset classes is a structural issue that calls for revising the whole model or is the result of cyclical factors and thus will improve over the next couple of years as exits are made.

Policy interventions. Venture capital plays an important role in supporting risky ventures that provide a path to market for nascent technologies, until the point where they have been effectively "de-risked" and become suitable for mainstream actors. Therefore, they contribute to reaping the benefits of R&D investments that might have been supported by the state, with the potential growth benefits this entails for an economy.

Two market failures can serve as justification for government intervention to increase VC activity in an economy. The first is coordination failure. A VC industry will fail to develop in a region unless it has a good pipeline of promising startups, business angels to back them in their earlier stages, and lawyers able to negotiate VC deals and IP agreements, as well as sufficient experienced investment professionals, developed exit markets, and a supportive regulatory and fiscal environment (among other conditions). Yet many of these will not emerge without a developed venture capital industry in the first place. Given that place and history matter, building a functional market may require temporary support from government, until the "system" is fully developed and hence self-sustaining. This highlights another lesson: trying to promote a VC capital industry by providing financial support to VC funds is unlikely to be successful if measures are not also put into place to develop the whole ecosystem.

BOX 8. UK REGIONAL VENTURE CAPITAL FUNDS—THE MIXED RECORD OF POLICY INTERVENTION

The Regional Venture Capital Fund (RVCF) program was launched in 2002. It established regionally based venture capital funds for which most investment was provided by the private sector. It was meant to demonstrate to potential investors that commercial returns could be made by funds investing in the equity gap, so that future funds could have less government subordination, and risk capital to growing small businesses could increase without displacing other activity in this part of the market. Nine funds were established, with the British government supplying approximately £75 million of the total £226 million of capital. Each fund was subject to strict investment limitations, which affected the spatial diversification and capital provision of the portfolios.

The investment returns of the Regional Venture Capital Funds have been poor, with much of the blame being placed on their design. Furthermore, 36 per cent of the amount invested went to management fees. The design affected the funds' ability to get access to good-quality deals; the timing of investments; their geographical coverage; their sizes; and their ability to make follow-on investments and to exit individual investments on a timely basis.

The pool of viable business propositions targeted by the funds was restricted in some cases by investment criteria—for example, by their regional focus and the total allowable investment limit for a business of £500,000, which restricted the size of initial and follow-on investments.

Source: 2009 National Audit Office, *Venture Capital Support to Small Business*.

A second potential rationale for public intervention in VC is the positive externalities from the innovation activities generated by the investee companies. While this could be a justification for a permanent intervention to support VC activity, some argue the benefits from doing so may not outweigh the costs, given the existence of government failures. Another rationale often used to justify public intervention is the so-called “equity gap.” For small VC deals, the cost of the due diligence required to select which companies to invest in may be too high relative to the potential reward, so VC funds have progressively refocused toward larger and later-stage deals, creating an “equity gap” that leads to suboptimal investment in early-stage companies (see Box 8). As discussed earlier, however, this market failure arising from asymmetric information is not a sufficient rationale on its own for public intervention.¹¹

Governments can use a range of different mechanisms to support the provision of venture capital and build local capability within the sector:

1. **Capacity building:** Governments can try to build the capacity of the VC market with several types of measures, such as by attracting foreign experienced funds to operate in the region, building more connected networks, or supporting entrepreneurs to become investment ready.
2. **Tax incentives:** As with business angels, many governments have created specific tax incentives

to reward individuals (or corporates) that invest in VC funds to increase the supply of investment into innovative businesses. The incentives can take a number of forms, which have been discussed in more detail in an earlier section.¹²

3. **Government-run VC funds:** Governments have directly established, financed, and managed VC funds, which in theory operate in similar fashion to private VC funds. In Europe these have often been underpinned by structural adjustment funds, and they often have a regional focus. They were often the first attempt to create a venture capital industry in many countries, but the regional focus has limited the scope and quality of deal flow, and the personnel may not have been first class. Consequently, their performance has often been poor.
4. **Fund of funds:** A model used in various areas of the finance industry, fund of funds involves a government establishing an overarching investment instrument with a significant allocation of capital, which then co-invests in existing or new private sector VC funds. This allows government to spread investment activity among several different funds that potentially have different business models and different investment/sectoral/geographical focus.

¹¹ See Bravo-Biosca (2014) for further discussion.

¹² See the discussion on policy interventions in the business angels section.

This promotes diversity in the market and should enlarge the pool of experienced fund managers.

5. *Co-investment funds*: Similar to those used to encourage business angel activity, co-investment funds typically work by matching public funds with those of private VCs, investing alongside them.

This approach leverages private money with public funding while keeping investments commercially focused by following the lead of private investors.

The OECD recently surveyed its members about their use of these types of equity investment measures and found the following (Wilson and Silva 2013):

- These programs have been increasing in the past five years, especially funds of funds and co-investment funds. Thirteen out of thirty-two OECD countries indicated they have direct public equity funds, twenty-one out of thirty-two have fund-of-funds programs, and twenty-one out of thirty-two also have co-investment funds in place.
- Around 45 percent of the programs have sector requirements (some targeting specific sectors—usually information and communications technology, biotech, and clean tech), while most have geographical restrictions, requiring the investee firm to be headquartered in the home country (58 percent) or, often, in a particular region within the country (37 percent).
- Half of the instruments focus on a specific stage, which is often seed (83 percent) and/or early stage (79 percent), even if they allow follow-on funding rounds (93 percent). Only a few have investee age requirements (27 percent), but investee size requirements are common (66 percent).

Several precautions should be taken when intervening in the venture capital market. First, interventions should neither be too small, since their impact is minimal, nor too large, since they may have counterproductive effects, not only crowding out current investment but also damaging the future development of the VC industry. Without additional investable propositions, more public money may only reduce the opportunities available for private venture capitalists (assuming any exist), reducing their returns and thus forcing them out

of the market or making it more difficult for them to raise follow-on funds in the future.

Second, delegating to professional investors the decisions on what companies to invest in and leveraging private funding is considered a more effective approach. In other words, rather than setting up publicly owned venture capital funds, using a fund of funds (assuming the market is large enough to justify one) or a co-investment model is considered preferable, even if the design, management, and incentive structures of these instruments also play a determining role.

Governments generally need to build capability to manage any equity investment activity, and most establish specialized financial institutions to do so. The performance of any equity investment vehicle is almost completely dependent on the effectiveness of the fund managers, so the process of selecting the fund manager is the key stage of the process. But making this selection is extremely hard—early-stage equity investing is new, and most potential managers will either have poor records or no records at all. The instinct is often to fund financiers/bankers as fund managers; experience indicates, however, they can struggle to adjust to early-stage investing and often try to take their funds “back” into later-stage funding, where they are more comfortable.

The design of equity instruments is subject to policy tensions. The desire to see commercial returns (or at least some returns) from taxpayers’ investments and to build a local equity finance sector does not always align with the desire to see innovation commercialized and innovative local SMEs grow. Venture capitalists are looking for exits, and if this means selling a promising SME that is commercializing public sector research to an overseas company and seeing it move offshore, they will do so.

The ability to attract private co-investors is also highly sensitive to the incentive structure offered by fund managers in relationship to both capital returns and profit (particularly whether capital protection or preferred treatment on capital returns is offered). So policymakers are frequently called upon to allow co-investment funds to

BOX 9. THE YOZMA FUND—THE MIXED RECORD ON POLICY INTERVENTION

The Yozma story relates one of the most successful interventions ever to foster the venture capital industry and promote innovation by high-tech firms. Various factors contributed to its being the right scheme at the right time, however. First, Israel had started to provide significant support to business sector R&D in the late 1960s, which started to build the potential investment pipeline. The massive immigration of professionals from the Soviet Union in the early 1990s and the laying off by the Israeli military industry of hundreds of aerospace engineers provided a large pool of technology workers and potential entrepreneurs. Interested in promoting the expansion of high-tech industry and taking advantage of this human capital, the government was convinced that the development of a competitive VC industry was an essential precondition to increasing innovation and growth. Domestic private capital did not give enough support to innovation, and foreign investors were not willing to allocate funds without guarantees of returns. This created a challenge for the expansion of Israel's high-tech industry, which the government was keen to address.

In 1993, the Yozma program was launched, with the goal of creating a critical mass of venture capital investment, attracting foreign financial investors and promoting knowledge creation to perpetuate the industry without government support. The program was based on a US\$100 million government-owned VC fund with two objectives: to invest in private VC funds and to invest in high-tech Israeli companies. The government decided to direct US\$80 million to the first objective and the remaining US\$20 million to the second. The target level for private capital was US\$200 million to US\$250 million.

To apply for public capital, a VC fund would have to engage a foreign investor, as well as a reputable domestic financial institution. Gaining access to foreign investors was much easier than in the past, as government participation signaled to them that the high-tech industry had both intrinsic potential and state backing. A total of ten private Yozma funds were created under the program, each of which received up to US\$8 million (40 percent of the US\$20 million public funding), with a five-year option to buy the government's shares at a predefined cost (which most funds took advantage of). The success of the program was measured by the creation of private unsupported capital funds. The total amount of money under management in early 2001 was US\$6 billion, and between 1993 and early 2014, it was US\$15 billion.

Source: Avnimelech and Teubal (2002a, 2002b, 2004).

offer highly preferential treatment to private investors. This presents a policy challenge, however: how much should governments underwrite private investors' risk? The Yozma fund (discussed in Box 9) delivered excellent returns to its investors in the 1990s, and its general model has been widely copied. As is explained in the box, though, Yozma occurred at a specific time in a specific ecosystem. Very few other co-investment schemes in the world have ever delivered the level of returns Yozma achieved.

Regardless of which particular design is chosen, policymakers must to try to ensure their domestic equity investment industry has well-developed international

links, is benchmarked against international norms, and attracts international investors. This is important not only because the path to market for many innovative investees will be international, but also to ensure the local managers are operating at global standards of practice. Governments can also use multiple approaches within the same instrument to assist different elements of the ecosystem and diffuse risk. The description in Box 10 of the Tech-based SMEs Venture Capital Introductory Fund from China provides one example.

As with other forms of financial intermediation, public funding is only one contribution governments can

BOX 10. CHINA—TECH-BASED SMES VENTURE CAPITAL INTRODUCTORY FUND

China started the Tech-based SMEs Venture Capital Introductory Fund in 2007. By making equity investments and providing investment subsidies, this government VC fund is aimed at encouraging commercial VC firms to make investments in technology-based SMEs. Four instruments have been designed under it:

1. Parallel investment, where the fund co-invests with other VC firms, with 50 percent of other VC firms' equity investment
2. Risk subsidies for VC firms, where the fund is compensated for the cost and loss of VC firms that have made investments in technology-based SMEs
3. Grants for portfolio reserves, where the fund provides grants for technology-based SMEs that are being incubated and coached by VC firms
4. Grants for portfolio reserves, where the fund provides grants for technology-based SMEs that are being incubated and coached by VC firms

Source: <http://168.160.159.71/english/mission.htm>.

TABLE 8 Design and Implementation Observations—equity Investment Instruments

INSTRUMENT	OBSERVATIONS
Government-run VC funds	<ul style="list-style-type: none"> • Introducing this instrument may be necessary if there is no history of or infrastructure for early-stage equity funding and private sector investment is unlikely. • Policymakers need to be realistic about expected returns, given that early-stage equity investing is a learned skill and the record of investment returns of these types of funds has been poor. • The record of regionally focused funds in particular has been bad, and new schemes should learn from these lessons. If a fund is to be regionally focused, they need to be realistic about whether deal flow is sufficient. • It is important to establish funds on commercial lines, with commercial incentives and commercial independent management. • Governments need to develop or buy specialized capability to manage these types of schemes rather than rely on career bureaucrats.
Co-investment fund	<ul style="list-style-type: none"> • A co-investment fund enables fund managers to leverage government funds to raise private capital, with fund managers making all the investment decisions on commercial terms. • Robust mechanisms are needed to select potential funds. Selecting fund managers is extremely hard—early-stage equity investing is new, and potential managers will either have poor records or no records. The selection process should, then, involve extensive due diligence and expertise. • This assessment capability is highly specialized, so governments need to develop or buy specialized capability to manage these types of schemes rather than rely on career bureaucrats. • The instinct is often to fund financiers/bankers as fund managers; however, experience indicates they struggle to adjust to early-stage investing, as it involves a different skill set than is usual for them. • It is important to try to ensure funds have international links and are benchmarked against global performance standards. • The ability to attract private co-investors is highly sensitive to the incentive structure offered to them around both capital returns and profit (particularly whether capital protection or preferred treatment on capital returns is offered). This presents a policy challenge: how much are governments prepared to underwrite private investors' risk? • A healthy funding ecosystem has a mixture of funds with different business models. Funding is also needed at the different stages (seed/startup/growth) so innovative businesses can continue to grow. • The traditional model of the ten-plus-two-year, closed-end fund making equity investments, with fund managers taking a 2 percent annual management fee, is being challenged by other, more flexible models. If they have some experience, policymakers should not be overly prescriptive regarding what model funds should use but should focus instead on the investment outcomes. • Policymakers and government stakeholders need to accept that many investments will not be successful, and most will take many years to exit.
VC fund of funds	<ul style="list-style-type: none"> • See above • A fund of funds can be a mechanism to spread the investment activity among several different groups who can have different business models and investment/sectoral/geographical focuses. • This promotes diversity in the market and builds a larger pool of experienced fund managers. • The goals of generating commercial returns, building a venture capital industry, building the local ecosystem, and building innovative local SMEs do not always align, which can generate policy tension. Objectives and expectations need to be clear. • The performance of any equity investment fund is almost completely reliant on the effectiveness of the fund manager, so the process of selecting the fund manager is the key role of a fund of funds. • A government needs to build or buy specialized capability to manage a fund of funds rather than rely on career bureaucrats. • Countries need to have sufficient deal flow to justify multiple funds. • Design features can include recycling returns to the government into new funds, enabling a degree of self-sustainability. • The fund of funds is sometimes integrated into a broader finance organization (for example, a business development bank), which offers a range of financial support through a variety of instruments.

make to the success of the industry. Venture capital is a global industry with global norms, and investors are far more comfortable operating in countries whose laws reflect these norms and whose institutions can effectively enforce them in an efficient but not burdensome manner.

Table 8 provides a summary of observations regarding equity investment instruments.

STOCK MARKET

This section explores the role stock markets play in financing later-stage innovations and what innovation-related policy interventions are relevant to the use of stock markets by innovative businesses.

What it is. Stock markets—or equity markets—are the marketplaces in which shares of companies are issued and traded at agreed-upon prices. Such transactions

take place either through stock exchanges, where stocks are listed and traded, or in over-the-counter negotiations, when trading is done directly between the parties outside of the stock exchange. Market participants range from small, individual retail investors to large organizations, such as mutual funds, banks, hedge funds, and insurance companies, as well as corporations trading their own shares.

Characteristics. Stock markets facilitate raising equity finance from investors not related to the firm and give investors the ability to buy and sell their ownership stakes in an open market. Firms enter the stock markets with an initial public offering (IPO), which allows the public to acquire stocks of the company first. Firms may issue additional equity at later stages via secondary offerings, and they often trade with their own stock—for instance, purchasing some back. Firms may exit the stock market for a variety of reasons, such as being acquired or going bankrupt or not being able to satisfy the minimum listing requirements if circumstances have changed since the IPO.

The open and public nature of stock markets is associated with two of the characteristics that set them apart from other types of financial intermediation: price discovery and liquidity. Stock prices aggregate the information from all participants in the market, providing an estimate of the present value of future cash flows. Even if financial markets are not always efficient (as demonstrated by the global financial crisis), investors can know at any time how much their equity shares are worth (or have an estimate), and react accordingly. The liquidity that exists in well-functioning markets allows investors to sell or buy stock easily at the market price when they desire it. In contrast, an equity investor investing in an unlisted firm needs to undertake much more due diligence to estimate its value and can face significant difficulties finding a buyer (being forced to sell at a discount).

Well-functioning markets require all investors to have access to the same information provided by the firm, so several regulations need to be in place to avoid insider

trading and protect minority shareholders. Similarly, given that listed firms have dispersed shareholders with limited incentives to monitor them, stock market regulation also aims to improve corporate governance in the firms, so that managers' decisions seek to maximize shareholders' returns rather than their own private benefits.

Advantages and disadvantages. Stock markets play both direct and indirect roles in enabling innovation activity. Directly, they provide a channel to allow firms to raise external equity rather than rely only on debt finance, a less appropriate instrument to finance innovation activities given the inherent risks innovation involves. Indirectly, they offer an important opportunity for earlier-stage investors, such as venture capital funds, to sell off their equity and exit their investments profitably. While IPOs are not the most common strategy to exit VC investments (trade sales are), they tend to be the most profitable one, so a healthy stock market can provide incentive for investment in much earlier stages of the innovation process.

Firms that use more equity finance and less debt (for example, less leveraged) are more innovative on average, having higher patenting rates (Rossi 2005). Similarly, countries with higher financial development, both in terms of debt and equity markets, have higher levels of patenting. But stock markets are associated with more radical innovation, while debt finance is associated instead with incremental innovation (Bravo-Biosca 2010).

Whether stock markets are as supportive of innovation as they could be is, however, a matter of debate. While in principle they give managers incentive to maximize long-term shareholder value, in practice they may encourage short-term behaviors. After all, markets are often more prone to react positively to immediate earnings rather than to uncertain and long-term payoffs. Investments in innovation are difficult to monitor; in addition, firms may be reluctant to share openly all the information about their innovation pipelines for fear competitors will copy them. The result is that managers may focus too much on achieving quarterly earnings targets rather than on increasing long-term value.

BOX 11. GERMANY'S NEUER MARKT

Many countries have sought to create second-tier markets focused on high-tech companies, with less stringent listing requirements to make it easier for them to raise external equity finance. In particular, they set weaker requirements regarding capitalization, profitability, pre-IPO shareholder equity, IPO value, free float, and track record. The Neuer Markt in Germany was one of several European attempts (such as Italy's Nuovo Mercato, France's Nouveau Marché, Spain's Nuevo Mercado, and UK's AIM) to replicate the success of NASDAQ. But, as with most other attempts, its success was short lived.

Launched in the midst of the dotcom bubble in 1997, the Neuer Markt became the largest high-tech exchange in Europe, with a peak capitalization in 2000 of more than US\$113 billion; but by 2002, it had fallen by over 90 percent, and by 2003, it had ceased operations. Insufficient liquidity, bankruptcies, and fraud all contributed to its demise.

Reaching the right balance between investor protection and listing costs, as well as between accessibility for small firms and a sufficient scale to generate enough liquidity, has been a difficult challenge that only a few, such as UK-based AIM, appear to have overcome.

Source: Revest and Sapio (2011).

Policy interventions. Well-functioning stock markets are an important condition to facilitate access to finance for innovative firms, both for fast-growing companies that are trying to scale up their innovations by raising equity with IPOs and for business angels and venture capitalists who invest in earlier stages of the innovation process and need a route to exit.

The main role for policymakers is to set up an effective regulatory framework that protects minority shareholders without being too burdensome on firms—a difficult balance to achieve. Beyond this, governments can try to make it easier for smaller and younger firms to list in the stock market by creating new marketplaces specially focused on them (see Box 11 for an example), with less strict filing requirements. The success of these initiatives has been mixed at best, however, since attracting sufficient investors to create a market with an acceptable level of liquidity has proved difficult.

BANK DEBT

This section explores the role of bank debt in financing innovation. It will outline the various types of debt (how it is secured, typical terms) and its advantages and disadvantages, and will discuss the various types of credit-related policy interventions available to policymakers.

What it is. Bank debt is the most common source of external finance for firms. Banks typically provide at least two forms of debt financing: bank loans and

credit lines. A loan is a type of debt provided with the expectation of repayment of the principal with interest according to a determined payment schedule. A credit line, such as an overdraft, gives bank clients access to additional funding at any time, as long as it does not exceed the maximum amount agreed on with the bank, and usually with no interest payment required on the unused portion of the credit line (even if at a fee). Many other types of debt finance also exist, some of which may be provided by specialist finance providers (as discussed later in this section).

Characteristics. The conditions attached to a bank loan depend on a variety of factors, such as the profile of the borrower and the activities it wishes to finance. Several considerations are important when structuring a loan:

1. **Secured versus unsecured:** A secure loan is guaranteed by specific collateral that can be seized in case of default. In an unsecured loan, the lender instead has a general claim on the assets of the borrower in the event of a failure, which can be executed as part of the bankruptcy process. Secured loans are more common and provide more protection to lenders, since they can recoup their funds ahead of unsecured creditors. Given the higher risk, unsecured loans are given to firms, such as large, established companies, with long borrowing histories and good prospects for the future (often this is done with syndicated loans involving several banks).

2. Type of collateral: Any of the borrower's assets can, in principle, act as collateral in a secured loan. Examples include machinery, equipment, real estate, merchandise, savings accounts, and accounts receivable. Banks prefer "redeployable" assets (such as physical assets) as collateral, since their "value in an alternative use is almost as high as in their current use" (Hall 2005). Even if the collateral has relatively low value outside the firm, however, it can still provide a strong incentive for repayment if it represents a key asset for the firm, to the point that the firm cannot function without it. Some forms of intangible assets can also be used as collateral, but despite the growing importance of investment in intangibles across many economies, these are still rarely used (even if there have been some interesting recent developments).¹³

3. Debt term and schedule: Short-term loans are used to finance operations and working capital requirements, while long-term loans are more commonly used to fund investments such as premises, equipment, and machinery (and sometimes also for R&D or the purchase of intangible assets, such as patents and trademarks). Repayment of bank loans is generally done in installments following a determined timeline (that is, the debt schedule). Unlike with typical bonds, the payments cover both the interest rates and a share of the principal, even if the latter can sometimes be delayed for a set period of time from the date the loan was awarded.

4. Interest rate: Interest rates can be fixed or they can be variable, in which case they are tied to some reference rate (for example, LIBOR) or a central bank rate. The higher the risk of default, the higher the interest rate for that loan.

Advantages and disadvantages. A large evidence base shows how a well-developed banking sector contributes to innovation and economic growth (see, for example, Bravo-Biosca 2010; Levine 2005; Rajan and Zingales 1998). Bank debt is often the only source of external finance for many companies, and thus it helps fund their innovation activities.

Rather than engaging in intensive due diligence, bank debt reduces the asymmetric information problems in the lender–borrower relationship by transferring most of the risk to the borrower. In other words, the firm is required to repay the loan regardless of whether its innovation projects have succeeded or failed. While this makes bank lending cheaper than other sources, it also makes bank debt a very unappealing option for firms aiming to develop high-risk–high-reward radical innovations. In addition, banks will also typically stay away from high-risk ventures for which bankruptcy is a likely outcome for fear of not being able to recoup their money. Finally, repayment of bank loans typically requires a steady cash flow to service the debt, while innovation projects generally do not yield any return until their outputs are commercialized.

Even if banks may not be willing to finance investment in intangible assets such as innovation, having an intangible asset such as intellectual property (IP) may be an advantage for getting a bank loan, if it is considered a driver of cash flow that makes debt easier to service, signals the quality of a firm, or gives lenders some assurance that the entrepreneur is committed to the business (Brassell and King 2013; Mateos-Garcia 2014).¹⁴

Policy interventions. Given that bank debt is the main source of finance for SMEs, a well-functioning banking sector that allocates credit to those firms that require it (and deserve it) is an important driver of economic growth (Levine 2005). Because of this, many governments have designed special policies to increase bank lending to SMEs and mitigate the market failure caused by asymmetric information. Specifically, the due diligence that would be required to substantially reduce this information asymmetry (and the resulting moral hazard and adverse selection) would be too

¹³ See the discussion on specialist finance providers at the end of this section for some examples.

¹⁴ See the discussion on specialist finance providers below for additional information on IP-based finance instruments.

expensive to make the loan profitable, leading to suboptimal provision of credit to SMEs (unless sufficient collateral is available).

A clear market failure is not necessarily a sufficient rationale for government support, though, given that the cost of due diligence that makes lending unprofitable for banks needs to be paid regardless, even if it is funded by government, and the risk–reward ratio is the same. A case can therefore be made in favor of targeting SME lending schemes toward those groups of firms that create externalities. In practice, however, many of these schemes are often generic, supporting innovative firms but also non-innovative firms that don't create externalities.

There is one scenario when this may be justified, if the aim is to offset a credit crunch with a temporary intervention until financial markets go back to normal. Many unconventional interventions developed by central banks during the recent crisis to channel funding to banks as a way to increase credit provision to the economy provide clear examples, but they are not the only ones. Governments can use a range of tools to increase bank lending to SMEs, such as credit guarantees, subsidized public loans, credit mediation, and banking regulation:

1. **Credit guarantee schemes:** In one of the most common schemes, governments (partially) insure banks' losses on the loans covered by the guarantee in case the borrower fails to repay while leaving it to banks to decide which loans to give, taking advantage of their credit assessment expertise. An example from Korea is discussed in Box 12. These schemes can facilitate access to finance for firms with higher risk profiles, such as the young and innovative, by limiting the loss a bank faces if the firm defaults. The evidence on their effectiveness is scarce and mixed, however (Ramlogan and Rigby 2012). Two considerations are important to consider when designing a credit guarantee:

- **Misalignment of incentives and coverage ratios:** Credit guarantees can give banks incentive to be less careful when selecting

what companies to fund. While funding higher-risk loans may be the intended aim of the policy, governments sometimes have little control over whether the “wrong type” of risky company is being selected. As a result, credit loan guarantees may increase the number of borrowers who receive finance, but they may also raise the bankruptcy rate among those who did receive the guarantee.

- **Targeting:** Credit guarantees can be applied on a case-by-case basis (which is typically very expensive) or by securing whole portfolios of SME loans. They can be generic or targeted to SMEs with specific characteristics, such as age, size, sector, or (less easily) innovativeness (this would be the ideal target, since externalities are higher). Credit guarantees can be easily adapted to the characteristics of the firms (for example, made more generous for young firms) or to the economic cycle, so in downturns it is possible to increase the number of eligible companies (as well as the generosity of the scheme). Finally, the selection criteria should discourage reliable borrowers able to receive bank loans from opting into the scheme and provide for those that have been beneficiaries to be progressively phased out of it as their ability to get access to finance increases.

2. **Subsidized public loans:** Governments can provide loans directly to companies via state banks and other special-purpose public institutions. These loans generally benefit from subsidized interest rates and can be targeted toward specific objectives, such as export promotion. As with credit guarantees, the extension and size of government-subsidized loans can be adjusted to the economic cycle. Direct public loans allow for greater control than credit guarantee schemes. Insufficient expertise, soft budget constraints, political objectives, and lobbying can, however, lead to poor credit cultures with insufficient discipline, resulting in misallocation of credit and a poor use of taxpayers' money, in addition to the substantial administrative costs these schemes entail.

3. **SME loans securitization support:** Bank lending may increase if banks are able to offload some of

BOX 12. THE KOREA TECHNOLOGY CREDIT GUARANTEE FUND (KOTEC)

KOTEC was founded in 1989 to contribute to economic growth by providing credit guarantees to facilitate financing for new technology-based enterprises while promoting the growth of technologically advanced SMEs and venture businesses.

The usual process of a KOTEC technology guarantee is as follows. A potential borrower who cannot meet banks' lending criteria, typically as a result of being unable to provide satisfactory collateral, is referred by them to KOTEC. Staff in branches carry out an independent appraisal of the loan guarantee application to investigate the borrower's creditworthiness, the use to which the loan is to be put, the applicant's prospective ability to service the debt, and, above all, the superiority of the technology. In most cases, the banks rely on the investigation and approval by KOTEC for their decision on the loan extension. If successful, KOTEC issues a letter of guarantee to the borrower, which can be used to obtain a loan. Usually, the guarantee involves the payment of a fee, whose amount depends on the amount being guaranteed.

An evaluation has suggested this program has had a positive impact on firm performance in terms of employment and sales, but no significant effect on R&D investment.

Source: Oh et al. (2009) and the program website at eng.kibo.or.kr.

their portfolios of SME loans to other investors. SME loans securitization takes two main forms: (1) the creation of a security bundling a portfolio of loans, which can be sold to investors or used as collateral in repo markets; or, alternatively, (2) the issuance of a covered bond backed up by a portfolio of SME loans (Darvas 2013). SME loans securitization is common in some countries and almost nonexistent in others. It can involve several risks, as the experience of mortgages securitization has recently shown. But if the right regulatory framework is in place to limit misalignment of incentives (for instance, with banks having to hold the most junior, and thus risky, tranche), it can make a useful contribution. While this is a private market, policymakers can try to support its development in several ways, such as by purchasing the securities or offering guarantees until the market becomes consolidated.

4. **Credit mediation:** Governments can put into place a mediation service to which SMEs can refer in case of a loan rejection. Credit mediators aim to improve the communication and exchange of information between entrepreneurs and loan officers, as well as advising on how to improve business plans.

While all these interventions can help support access to finance for innovative firms, the most effective lever governments have at their disposal is banking regulation. Basel III rules determine the levels of capital banks need to hold for each type of lending they

undertake. Requiring lower capital ratios for SME lending is already an option. Allowing banks to count IP assets pledged as collateral toward their capital could help increase IP-based lending. More heavy-handed approaches include imposing net lending targets on banks as a condition of gaining access to central bank liquidity. Finally, governments can also support measures to increase the level of competition in the banking sector, leading to more and cheaper bank lending.

SPECIALIST FINANCE PROVIDERS AND OTHER SOURCES

What it is. Many specialist finance providers are active in the debt market alongside banks, offering a broad range of debt and hybrid services. Some offer services typically not offered by banks, such as mezzanine finance, a hybrid instrument combining characteristics of both debt and equity. Others offer traditional debt services, such as loans, with the specification that they will specialize in taking one sort of asset as collateral. Such assets can be intangible, such as intellectual property (for example, IP asset-based finance), but they can also be other types of assets, such as accounts receivable (for example, factoring or invoice financing). Lastly, a company's business partners can also be a source of finance, with the use of leasing and trade credits.

Characteristics. Specialist finance providers offer a range of instruments (some of which may also be offered by banks):

1. **Mezzanine finance:** These hybrid instruments combine characteristics of debt and equity. They are subordinated to secured debt but rank above equity if the firm defaults. Mezzanine finance can take many forms, such as unsecured debt, debt with detachable warrants, convertible debentures, or convertible preferred shares, among others. Convertible loans, for example, allow creditors to convert credit into an equity participation in the company if certain circumstances are satisfied. Mezzanine finance is typically used by middle-market companies to fill a shortfall in financing and fund their expansion, although it is more costly for the borrower than other sources, since it entails a higher risk for the lender.
2. **IP financing:** Estimating the value of IP is a difficult activity requiring specialized knowledge that banks often do not have. Specialist finance providers with expertise in IP have emerged to fill this gap. Their advantage is threefold: first, specialized experience allows them to value IP more accurately; second, they have the ability to use a portfolio of IP-based instruments; and third, they have skills and networks to maximize the salvage value of IP if the firm defaults, whether by reselling it, leasing it, or exploiting it for litigation purposes. The range of IP-based instruments is wide. IP-backed securities involve placing an IP asset (or claims over the income it generates) into a special purpose vehicle that issues securities backed by the asset's future income—for example, royalty-based financing (Mateos-Garcia 2014). In IP sale and leaseback agreements, an IP asset is acquired by the investor (or lessor) over a period of time and leased back in exchange for license fees. IP-backed loans are also possible (though not very common), with IP assets directly pledged as collateral for bank loans (Calderini and Odasso 2008).
3. **Factoring and invoice discounting:** Businesses can release the funds tied up in unpaid invoices with the help of specialist finance providers. They can sell their accounts receivable to a third party that will itself collect the outstanding credit (factoring) or advance the money until the business receivables are paid (invoice discounting). A great many third-party suppliers offer these services, so interest rates

and fees are crucial factors to discriminate among them. Accounts receivable can also be accepted as collateral for bank loans. Finally, new online invoice factoring markets are also emerging, following models similar to those used by crowdfunding platforms.

4. **Leasing:** An alternative to purchasing an asset with debt, a leasing agreement lets the firm pay a rental price for the use of equipment, machinery, or vehicles provided by a third party. While leasing does not count as a source of finance, strictly speaking, it is a mechanism that allows firms to reduce their external financing needs—something particularly useful for young, innovative firms with limited ability to raise external finance.
5. **Trade credit:** In addition to obtaining funding from financial intermediaries, businesses can shift part of their debt burdens to business partners up and down the supply chain to finance their day-to-day and short-term operations. For example, trade credit is granted by supplier companies to allow the buyer to postpone payment for the supplied good rather than paying on delivering. As a result, the buyer can first collect the proceeds of its production and then pay the supplier with the sale revenues, instead of having to pay up front. Trade credit is a very common source of finance for the retail sector, but probably less relevant for innovative small enterprises elsewhere.

Advantages and disadvantages. While generalizing is difficult, many among the wide range of specialist finance providers share two advantages. First, they provide firms needing external finance with an alternative source beyond the banking sector, making the economy less dependent on the health of banks' balance sheets. Second, they accumulate much more specialized expertise, with resulting efficiency gains. Specialist finance providers are also more flexible than banks, so they have more scope to experiment with different financing models.

On the other hand, as most specialist players are still very small, they do not provide a full substitute for bank finance. In addition, banks can take advantage of

their economies of scale and scope, even if they are less specialized on particular forms of asset-based lending. Finally, the cost associated with some specialist finance providers may not necessarily be low.

With regard to their suitability as a source of finance for innovative firms, most specialist finance providers are neither better nor worse than bank debt. Therefore, they are not a particularly appropriate source of finance for the earlier stages of the innovation cycle, but, like bank debt, they can be appropriate sources to fund some of the assets required in the commercialization and scaling-up phases. In addition, IP financing can help unlock the value embedded in a firm's IP, which, for many firms, can be substantial.

Policy interventions. A well-designed regulatory framework is the main ingredient in supporting specialist finance providers. This implies, for one thing, that regulation needs to be flexible enough to permit and encourage experimentation with financial innovation, including new securities, new business models, or new intermediation platforms. While the global financial crisis has demonstrated the risks financial innovation can engender, sensible innovation can have a positive effect. Specialist finance providers play a crucial role in testing these innovations in the market (if regulation allows them to, which is not always the case, even if the obstruction is unintentional).

Governments can also choose to support some emerging models of financial intermediation

actively—for instance, directly providing finance to them (see Box 13). The rationales for these policies may be multiple, from reducing the economy's dependence on the formal banking sector to addressing market failures. As with other types of innovation, financial innovation also generates externalities (even if not always positive). Similarly, coordination failures can slow down the development and adoption of new forms of financial intermediation in early stages. It is important, however, to design these policies (and how to phase them out) carefully to avoid unintended consequences.

Alternatively, in some cases the appropriate intervention is simply to avoid discrimination in comparison to other forms of finance, by making them eligible for tax incentives and public guarantees that already benefit more traditional finance providers.

Finally, governments may also have the key to developing some particular forms of specialist finance in unexpected (and also low-cost) ways. For instance, most countries do not have up-to-date IP ownership registries that specify the current owners of patents. To understand the impact this may have, it is useful to consider what would happen to the mortgage market if a bank were not able to check in a property registry whether the person to whom it is giving a mortgage actually owns the underlying property (as well as whether it has already been “remortgaged” several times). Because of this, one way governments can support the development of a liquid IP market to finance IP-rich companies is by creating a well-functioning IP registry.

BOX 13. UK BUSINESS FINANCE PARTNERSHIP

Several types of specialist finance providers can help reduce firms' reliance on bank lending and unlock additional funding. The British Business Bank has launched a new funding program to support different models of non-bank lending. Its aim is to diversify the available sources of finance for smaller businesses by encouraging new, smaller lenders into the market and hence help some of these alternative lenders reach sufficient scale. The ultimate goal is to expand the total amount and types of debt funding available to SMEs.

As part of this program, the British Business Bank has provided funding to asset finance lenders, debt and mezzanine funds, peer-to-peer lenders, and supply-chain finance lenders. The benefit for recipient financial institutions may be twofold: they not only obtain funding; they also, on some occasions, gain the credibility for their business models that is signaled by receiving government support, which can make it easier for them to obtain additional funding elsewhere.

Source: british-business-bank.co.uk.

TABLE 9 Design and Implementation Observations—debt Instruments

INSTRUMENT	OBSERVATIONS
Credit guarantee schemes	<ul style="list-style-type: none"> • Design is important to ensure the loan risk is shared among the lender, the borrower, and the guarantors. If incentives are misaligned, poor-quality lending can occur, or, if targeting is wrong, healthy SMEs will benefit despite being able to raise financing from existing sources. • If well designed, they can carefully target SMEs with particular characteristics sought by policymakers. They can also be quickly altered according to the economic cycle (and so rapidly scaled up if there is a steep downturn). • Successful schemes (for example, those with low default rates) insource the due diligence and have it undertaken by internal experts, although this is a higher-cost model. • Credit guarantee schemes will not generally reach early-stage startups whose revenues/collateral will be insufficient to satisfy the selection processes of lending institutions. • These schemes are appropriate for funding companies looking to grow incrementally but generally not suitable for funding significant growth.
Subsidized public loans	<ul style="list-style-type: none"> • Direct public loans allow for greater targeting than credit guarantee schemes, so they can be directed at innovative businesses. • Insufficient expertise, soft budget constraints, political objectives, and lobbying can lead to poor credit cultures with insufficient discipline, however. This can result in a misallocation of credit and a poor use of taxpayers' money, in addition to the substantial administrative costs these schemes entail.

Table 9 provides a summary of observations regarding debt instruments.

CONCLUDING REMARKS

This paper has reviewed the main sources of external finance available to fund innovation projects in their different stages of development, as well as what policies can be used to support them. Several considerations are important.

First, a significant gap can occur between the intentions of a policy intervention and the results it delivers. Whether this is the result of design or, alternatively, implementation failures, unintended consequences can happen. Because of this, it is important not only to put a lot of effort into the design of the interventions and their roll out, but also to put into place a monitoring system and a rigorous evaluation strategy to measure their success or failure, and to change or discontinue them if necessary.

As the World Bank has previously noted, 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 the quality of selection is driven by true innovative and commercial potential. The design of instruments is crucially dependent on the capacity of public servants to administer them and for the selection and decision-

making processes to be insulated from capture and rent seeking. Some of the most successful innovation support systems in the world rely heavily on the analytical and managerial skills of public servants to make informed and beneficial economic decisions. Weak public service institutions might result in a lack of capacity to do so.

Second, looking at each type of funding and the policies to support it in isolation is not sufficient. What is important is that firms have the necessary funding to develop their innovations from the concept stage to the scaling-up phase. Consequently, providing large amounts of finance to support the early stages of the innovation process may not translate into faster economic growth if young, innovative firms cannot get access to follow-on funding to commercialize their innovations. Similarly, creating very large venture capital support schemes will do little to create a sustainable VC industry if insufficient funding is available to develop a pipeline of promising startups in which venture capitalists can later invest. Therefore, governments need to look at the full “funding escalator” to make sure finance is available for all the stages of the innovation process. They also need to ensure market conditions and discipline are present at each step of the escalator. Overly generous escalators can simply provide easy money to uncompetitive projects, encouraging grant applicants to build apparently attractive innovations and businesses with little likelihood of commercial success.

Third, access to finance is only one ingredient required to develop an innovation ecosystem. It is therefore important to consider the wider policy mixture, which should include measures to support the different actors in the innovation system, as well as the networks that connect them. An integrated approach that considers how the different interventions are linked to each other and exploits their synergies is therefore preferable.

Fourth, the measures with the most impact are not necessarily the most expensive ones. Providing advice (for example, through investment readiness programs), increasing information available (for example, with an IP registry), supporting networks (for example, business angels networks), or improving skills (for example, training entrepreneurs and managers) are cheap interventions that may have better rates of return than large tax incentive and guarantee programs. Similarly, governments can help create and shape markets, as suggested by the IP registry example discussed in the previous section, without committing large amounts of public funds.

Finally, the quality of institutions determines both what sources of finance are available and how much impact public interventions will have. For instance, countries with poor institutions are unlikely to be able to effectively deliver complex access to finance support schemes.

More importantly, the most effective interventions governments can undertake to increase innovation financing are not about creating new support schemes but rather about improving the overall regulatory and institutional framework within which innovative firms and finance providers operate. These include the following:

- Insolvency and bankruptcy laws that provide appropriate balance to creditors and debtors, allow for the speedy resolution of cases, and do not place unreasonable obligations on entrepreneurs to reenter the market
- Contract laws that provide appropriate protection for all parties to contracts
- Employment laws that do not impede the ability of fast-growing companies to hire quickly and grow within a flexible employment framework (that is, protecting workers rather than jobs); this includes the ability to offer alternative remuneration incentives, like employee share options.
- Tax laws and administration that provide clarity and do not discriminate against the typical type of investment and investment structures used by different types of financial providers, and that allow for international staff and management to work in investee companies without punitive tax treatment, as well as using internationally recognized accounting standards
- Investment laws that do not restrict the ability of investors (particularly pension funds) to invest in different types of asset classes like VC, provide appropriate shareholder protection in case of disputes, and are not overly restrictive in relationship to the number of investors, the amount they can invest, the proportion of ownership, and the ease of entry and exit
- Intellectual property regimes that are internationally consistent, inexpensive, competent, and efficient
- Immigration systems that allow skilled professionals and management to be brought into a business from overseas when they are the best fit

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