### 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.