Innovation for Transformation

Fostering innovation to address societal challenges

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Fostering innovative startups in the pre-seed phase

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Innovation for Transformation –
Fostering innovation to address societal challenges

Results Paper 4

Fostering innovative startups in the pre-seed phase

Results Paper 1: Good practices in mission-oriented innovation strategies and their implementation
Results Paper 2: Networking and exchange in mission-oriented innovation processes
Results Paper 3: Addressing societal challenges through disruptive technologies
Results Paper 5: An agenda for the future: Innovation for transformation

Author
Marianne Kulicke

Scientific analysis
Fraunhofer ISI

REINHARD MOHN PRIZE 2020

Fostering Innovation. Unlocking Potential.

As part of the "Fostering Innovation. Unlocking Potential." project, which was launched within the framework of the Reinhard Mohn Prize 2020, we have conducted a global search to identify noteworthy examples of innovation-promoting initiatives, mechanisms and strategies that could be applied to promoting innovative capacity in Germany and Europe. One objective of our efforts has been to ensure that Germany remains technologically – and thus economically – competitive. But another key objective here is to address societal challenges while ensuring humane, democratic and inclusive economic development. We start from the premise that two paradigms – "strengthening innovation and technological competitiveness" and "solving societal problems through innovation" – can be combined to mutually reinforce each other.

Innovation for Transformation

Although Germany regularly performs well in international rankings of competitiveness and innovative capability, a closer look at things shows that despite all its strengths and the confidence key economic indicators suggest, the intensity of innovation – particularly in key digital technologies – in Germany as well as Europe has been on the decline in recent years. Moreover, Germany has delivered hardly any disruptive innovations, that is, those innovations that fundamentally change the rules of a market or consumers' usage behavior. This is problematic both in terms of economic as well as societal considerations – particularly since the answer to many of the societal challenges we currently face might very well be found in the innovations of leapfrogging technologies. Our project aims to help unlock this potential and make the solutions it delivers a reality.

With this vision in mind and in line with Reinhard Mohn's vision of "Learning from the World," the Bertelsmann Stiftung conducted extensive global research on good practices that are applied in various international contexts. In cooperation with the Fraunhofer Institute for Systems and Innovation Research ISI, the findings have been summarized in four results papers. Each paper has a different focus but explores the extent to which competitiveness can be linked with mission-driven approaches to societal issues.

- The **first paper** outlines the theoretical framework used for the global study and draws on selected international case studies to show how a broader umbrella strategy for innovation can effectively combine technological and economic competitiveness with efforts to solve societal issues. The paper explores in particular the aspects of governance involved with innovation policy and shows what Germany has to learn from examples in other countries.

- The **second paper** examines how the development and diffusion of new and societally relevant technologies can be promoted through appropriate networking mechanisms that engage actors in business, research, politics and civil society in open innovation processes. The paper thus features several examples of good practices found in other international contexts that both Germany and Europe can learn from.

- The **third paper** takes a close look at how the framework conditions for disruptive innovations in particular can be strengthened. It also describes the lessons learned in countries such as Israel, Japan and the United States that are relevant for Germany in its efforts to become a top location for innovation.

- The **fourth paper** (present study) is devoted to the question of how to improve the conditions for establishing and growing societally relevant (high-tech) startups in their initial phase of being founded. The paper thus presents a variety of good practices from examples around the world and discusses their key takeaways.

- **Conclusions** derived from all four papers are integrated into the **"An agenda for the future: Innovation for transformation"** publication.

Each paper is available at www.bertelsmann-stiftung.de/innovation-for-transformation-en.

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In the future, only communities that face up to global competition and repeatedly demonstrate their ability to innovate and perform can succeed and endure.

Reinhard Mohn

CONTENT

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Key findings

- This study asserts that the relative quantitative and qualitative gap in innovative companies founded in Germany can be traced back to weaknesses in the initial phase of company creation – that is, at the very beginning of the creation process, when potential founders are deciding whether to engage in entrepreneurial activities. By presenting exemplary good practices and solutions from other developed countries, this study aims to provide inspiration through the lessons learned and foster the transfer of useful knowledge. It emphasizes the need to strengthen support for the culture of commercialization in the research sector and measures targeting the pre-seed or preparatory phase of company creation. In addition, it underscores the need for policies ensuring the complementarity of public funding programs and private risk capital.

Current situation

- A highly innovative economy like Germany's must leverage its full potential to achieve the UN Sustainable Development Goals but remain competitive along the way. Startups in particular can take advantage of the opportunities presented by disruptive, radical technologies while helping drive the diffusion of innovative applications. New impact-oriented firms, which seek to bring about positive economic, environmental or societal change, are particularly important in this regard, as their innovations and agility provide inspiration to companies in the midst of the transformation process.

- In international comparison, Germany lags behind with regard to the number of startups in the country demonstrating great potential for growth and innovation. This is particularly so in terms of the number of spinoffs able to transfer the latest knowledge and research findings from the country's research community into innovative products and services.

- For more than 10 years, Germany has seen the volume of its university and non-university research expand significantly. This should be expected to lead to more leverageable research findings and a significant increase in research-based spinoffs. This latter outcome has failed to materialize, however.

- Some progress has been evident: In some urban regions of Germany, vibrant startup ecosystems featuring a diverse range of support options have emerged. Investments in startups by private equity investors are now reaching levels that were unthinkable only a few years ago.

- Federal and state-level government funding programs have sought to bolster the entrepreneurial culture at universities and give well-targeted support to founders in the pre-seed phase of company creation. This specific focus is rare in international comparison. Significant progress has been evident with regard to the entrepreneurial culture, but not yet with regard to the number of new companies founded.

Startup-founding potential and commercialization culture in the research community

- Within the German policy environment, collaborative projects between research and business entities are the primary means of translating research results into commercial products or services. The current support mechanisms and structures within research institutions offer little room for the pursuit of alternative approaches. A crucial condition for founding a new company with manageable levels of risk is having research results that are ready to be commercially leveraged.

- The examples of good practices from abroad show that in these locations, great importance is attached to the application of research findings in bringing about positive societal and economic impact. Indeed, such activities constitute a key aspect of many researchers' self-conception. Special support programs facilitate commercialization (e. g., KAMIN in Israel, the Commercialization Fund in Ireland, or the Idea to Innovation Grants in Canada), and funding programs fulfilling small-scale financing needs are available on a rapid-approval basis (e. g., Boston University's Ignition Award Program).

- These measures are supported by comprehensive infrastructures that support efforts to commercially leverage research, including spinoffs (e. g., KTH Innovation at the KTH Royal Institute of Technology in Stockholm, ETH Transfer at the Eidgenössische Technische Hochschule Zürich (ETH Zurich), Yissum at the Hebrew University Jerusalem and T^3 at Technion University in Haifa). In some cases, institutions maintain their own validation funds, creating greater flexibility for steps to be taken toward market-readiness (e. g., universities in the United States, United Kingdom and the Netherlands).

Current funding policies for pre-seed support and the culture of entrepreneurship

- Support programs in Germany for would-be founders in the initial stage of company creation are primarily aimed at students, recent graduates and researchers. The focus is on universities as incubators of innovative new firms. Aspiring founders who already work in the private sector are generally not eligible to apply.

- The examples of good practices reveal considerable scope for universities to provide both financial support (e. g., the University of Zurich's UZH Life Sciences Fund for Spin-Offs) and advice (e. g., Imperial College London's Founders Choice Program). It is also clear that these universities treat spinoffs as an important aspect of their strategy. In some cases, universities also rely on models of company formation that are not present in Germany (e. g., the T^3 Technion Entrepreneur in Residence (EIR) program at Technion University in Haifa).

Complementarity of state funding and private risk capital for startup financing

- Government funding programs often serve as an initial building block in startup financing. Publicly financed equity capital still serves as an important means of attracting private capital.

- The current dynamic with regard to private early-stage financing has produced large-sum equity investments; indeed, very large funding rounds for startups have become increasingly common. There is considerable diversity with regard to investors (business angels, early-stage investors, venture capitalists, corporate venture-capital firms, etc.).

- For startups with clear growth potential, there is currently no shortage of offers.

- The emerging German startup scene is very attractive for foreign investors, in part due to the lack of competition from large German funds, which is in turn attributable to the limited investment opportunities afforded to institutional investors.

- Most innovative startups do not have major growth potential. They are primarily financed through their own profits or government grant programs.

- Within Germany itself, there is little equity capital or "patient" capital focused explicitly on impact-oriented startups. Yet startups whose business models are not geared toward rapid growth need such patient capital. Foreign examples (such as the university venture funds managed by large British universities) provide funding for years of development at research-based startups, right up to the point of market breakthrough.

The study sees a need for action in the following areas:

- Researchers' financial flexibility needs to be expanded so that they can generate more solutions with positive societal or economic impact. Options in this regard include expanding the focus of research-funding programs (e. g., to include post-R&D leveraging), creating specialized funding programs to review commercialization potential and technical feasibility, and creating (pilot-style) validation funds at research-focused universities that offer flexible financing for steps toward commercialization.

- Expanding pre-seed startup funding programs. This should focus on technology-specific support (e. g., expansion to the entire IT sector, climate-change solutions), and support for aspiring founders who are already working in the private sector.

- Creating continuously accessible funding offers by eliminating fixed application deadlines.

- Expanding funding options for impact-oriented startups. This could take the form of a free-standing program or a line of funding within an existing program; either way, the program should consider the impact-oriented specifics within its eligibility criteria.

- Expanding support for new companies to include new business-creation forms, such as "founding without a founder," or firms that involve collaboration between universities and private-sector companies.

- Expanding eligibility for publicly financed equity capital to include startups with moderate growth potential, and those that may need considerable time before achieving a market breakthrough.

1. INTRODUCTION

1

1.1

Innovation performance and the startup gap

Germany has for many years placed among the top ranks in assessments of the world's most innovative economies.[1] The same is true with regard to the volume of research and development (R&D) work conducted both in the private sector and by publicly financed research institutions. Preliminary calculations show that the German government, universities and private-sector businesses collectively invested around €105 billion for this purpose in 2018 (a gain of more than 50 % relative to 2010). In the same year, the number of people employed in R&D activities increased to nearly 708,000 full-time equivalents (+29 % since 2010; BMBF 2020).

BACKGROUNDER

Startups are new companies with innovative business ideas and significant potential for growth (a "scalable business model"). This phase in a company's lifecycle comes once the **seed phase** (that is, the phase in which all the preparatory work, including the development of a business model and business plan) is complete. The duration of the **startup phase** varies significantly across different areas of technology and sectors (for example, typically lasting two to three years for internet firms, but eight to 10 years in the life sciences). The same is true of capital requirements and the time required to make a market breakthrough. Typical sources of financing include various **forms of equity capital** (business angels, startup investment firms, venture-capital firms, corporate venture-capital firms, institutional investors), as well government grant programs. Due to the high level of default risk, bank credit does not play a significant role at this stage. Some innovative new companies can finance growth relatively quickly through income from business activities. Growth-oriented startups aim to rapidly expand, swiftly penetrate markets and establish an international presence. This often means expanding their product or service offerings fairly quickly, with corresponding growth in their organizational structures. **Growth financing** is the business traditionally pursued by venture-capital investors.

Some very positive trends are also evident with regard to the formation of new businesses. Hotspots such as Berlin, Munich, Hamburg, Cologne and Leipzig have shown strong growth in the creation of new enterprises with digital business models that are embedded in and accelerated by vibrant startup ecosystems featuring a wide range of support options. While the conditions provided by these metropolitan areas are conducive in particular to the late phases of founding a company (e. g., firm formation and growth), they also help cultivate role models and foster an entrepreneuerial spirit.

However, this kind of dynamic is not evident across Germany as a whole. Our attention here should focus on more than the absolute number of new businesses created. Indeed, special attention should be paid to companies with high growth and innovation potential. Thus, when we refer to "startups" in the following text, we will be referring specifically to this category of a new company. Within Germany, the quantity of this specific kind of new enterprise in particular is regarded as worryingly low in international comparison (Cornell University, INSEAD, WIPO 2015; Sternberg et al. 2020; OECD 2015a).[2] This includes research-based spinoffs from academic research institutions that presumably translate the latest knowledge and research results swiftly into innovative products, services and business models.

A comparative shortfall or gap with regard to startups is a problem, because disruptive and radical innovations (also referred to in Germany as *Sprunginnovationen*; for more on this, see Results Paper 3 in this series) open up a wide range of business

1 See, for example, BDI Innovation Indicators 2020 (Frietsch et al. 2020), Bloomberg Innovation Index (see www.visualcapitalist.com/the-10-most-innovative-economies-in-2019/, accessed on December 15, 2020). 2 In the Global Entrepreneurship Index 2018, the German startup ecosystem was ranked at only 15th place, trailing behind 10 other European countries; see https://thegedi.org/global-entrepreneurship-and-development-index/ (accessed on December 15, 2020).

opportunities and unlock economic potential. Innovations trigger the creation of wholly novel application fields and markets, while innovators direct productive scrutiny toward established companies' business models. This can be seen, for example, in firms active in the fintech and insurtech fields – that is, innovative companies in the finance and insurance sectors that employ modern technologies and thereby restructure existing markets.

Startups themselves often act as innovative pioneers in the development of such disruptive and radical innovations, or – as is the case for the vast majority – contribute to the broad diffusion of innovations that serve as the foundation of their business activities. In doing so, these companies make important contributions to the necessary transformation of the innovation system, while additionally enhancing economic and technological competitiveness and potentially supporting efforts to address societal challenges. Problems such as climate change in particular are difficult to solve through conventional methods, and thus demand wholly new instruments and technologies – reason enough to support young, innovative companies and help them reach their potential.

This potential is particularly evident in startups with exceptional rates of growth, as these have reacted with particular agility and focus to new market opportunities. These startups, with a market value of at least €1 billion, are referred to by the financial world as unicorns or unicorn startups.[3] In October 2020, the global unicorn club included a total of 490 unicorn startups.[4] Nearly half were based in the United States, and another one-quarter in China. The United Kingdom and India followed at a considerable distance, with 23 apiece. Germany performs comparatively poorly in this regard, with only 12 unicorn startups on this list.[5]

Germany's weakness: A shortage of startups

Despite the progress cited above, the annual number of new companies founded in Germany remains too low. Above all, there are too few exponential-growth startups that are implementing highly innovative business ideas with exceptional potential for societal impact. As a result, Germany's innovation landscape is lacking in potentially groundbreaking sources of inspiration, and existing ideas are undoubtedly being lost. In the interest of enabling the transfer of knowledge, the present paper draws on research on international examples of good practices to present approaches that could be used to remedy this state of affairs.

The causes

One reason for the comparative paucity of research- and knowledge-based companies that originated in the context of universities, technical schools and non-university research institutions may be related to their research environments, which offer too little impetus for considering the potential for commercialization in general, and the development of spinoffs in particular. It can be presumed that the fear of failure has a negative impact on the willingness to engage in entrepreneurial activity among those who, in fact, have the requisite (technological) know-how. Measures seeking to stimulate interest in founding companies cannot compensate for the lack of an entrepreneurial mindset – which is often assumed of researchers and many university graduates – if these target groups are limited in their willingness

3 A valuation of this kind is produced at the time of an IPO, or in the context of a new financing round. The value is calculated based on the market price of a single share multiplied by the total number of shares issued, or by the price paid by investors for a stake in the company along with the percentage of the firm received in return; see www.cbinsights.com/research-unicorn-companies (accessed on November 16, 2020). 4 See www.cbinsights.com/research-unicorn-companies (accessed on November 16, 2020). In 2016, Fortune magazine listed just 174 unicorn startups. The increase can be attributed to several causes, with the venture-capital boom certainly playing a role. That is, an increasing quantity of investment-ready capital is competing for high-growth startups, a fact that drives valuations and thus share-purchase prices upward. 5 This includes Auto1 Group, Otto Bock HealthCare, N26 and Celonis, among others. However, with regard to valuation, the German companies lag well behind the top group, which includes the Chinese firms Bytedance and Didi Chuxing, as well as SpaceX, Airbnb, Epic Games, Wish and Klarna.

take risks and engage in entrepreneurial activity. For those with a desire to found new companies, especially research-based or innovative, knowledge-intensive firms emerging from the research community, Germany has long offered a range of funding and support programs. Indeed, this spectrum of support has recently been significantly expanded. By contrast, there are few measures that seek to stimulate the new-business potential specifically within the community of existing companies. On the other hand, the long-heard argument that there is too little risk capital available to finance ambitious early-stage projects with large sums has been refuted by numerous recent examples of high-volume financing rounds.

One additional reason for the low propensity to engage in entrepreneurial activity is the fact that highly skilled workers have had very good conventional employment opportunities for many years. However, this has also been true in other developed countries such as Israel and the United States, which produce numerous internationally successful startups.

Support policies and startup financing

For many years, the difficulty of accessing risk capital, in large part due to unfavorable legal and tax conditions, has been seen as a serious barrier to the creation of more startups. However, the years preceding the coronavirus pandemic saw an enormous expansion in the number of early-stage investments, despite the lack of any notable changes in these conditions. Domestic and especially foreign investors were attracted by swiftly growing companies that have taken advantage of the opportunities offered by digital transformation. Thus, there is no longer a general lack of risk capital for the seed or startup phases of new growth-oriented companies. By contrast, the supply of capital for the growth phase of ambitious companies is often seen as insufficient, with improvements needed in the legal and tax frameworks, for example. Such changes could broaden the allowed-for scope of activity and, as a consequence, the level of interest shown by institutional investors (see, for example, Kelley et al. 2015; OECD 2015b; Achleitner et al. 2019).

Germany's strengths: Support in the pre-seed stage

The present study looks at the issue of startup financing from a broader perspective. A focus on the equity-capital form of financing alone would not sufficiently address either the pre-seed phase or startups with low capital requirements, the latter of which have little appeal for private equity-capital investors. In the pre-seed – or preparatory – phase, especially for research-based projects, significant financing is needed in order to test the feasibility and market appeal of technical solutions, conduct R&D work for the desired range of products or services, and take the steps necessary to secure needed resources (capital, staff, business contacts). At this point, public-sector funding programs often constitute the initial building block of the entire startup financing structure. Germany has an extensive range of funding programs that has in fact expanded steadily in recent years. For this reason, public-sector funding programs and private startup financing must be considered together.

1.2

Our thesis: Startup gap is partially rooted in early-stage weaknesses

This study is based on the thesis that the causes of the quantitative and above all qualitative gap in the formation of new companies can be traced to weaknesses in the initial phase of new-business creation – that is, before companies are actually started, at the point when potential founders are fundamentally deciding whether to engage in entrepreneurial activities. In this phase, potential founders are primarily influenced by their professional and personal environments:

1. Universities, technical colleges/universities of applied sciences, and non-university research institutions are home to fully comprehensive and thematically broad research activities. However, they provide researchers – especially young researchers – with very little encouragement or even the flexibility to systematically explore the potential for a commercial leveraging of their research results, or the feasibility of their technological solutions. In general, there are too few incentives and support structures to push knowledge and research results forward to the point of economic value creation – either in general or more specifically by leveraging intellectual property through spinoffs.

► **Chapter 4.3: Good practices in improving research commercialization**

2. The current support paradigm is too narrow in scope. It requires researchers to exit the environment in which they have thus far worked and swiftly adopt the role of entrepreneur during the challenging pre-seed and business-building phases. This is the "traditional" path to starting a company and involves those with the relevant knowledge becoming entrepreneurs. It further assumes that even in the absence of professional experience, graduates with promising entrepreneurial ideas can acquire the needed capacities to build a high-growth startup and convince capital investors and business partners to participate, largely through skills-development programs, advice, coaching, mentoring, networking with investors and so on. The assumption is also that such support services are best offered by an entrepreneur-services office that is embedded within the university structure or otherwise associated with the university. The logic of this approach assumes that the proximity of such an office to its target groups is more important than comprehensive experience in building a business. The latter of which is rarely found in such university institutions, as opposed to within private sector accelerators, for example.

► **Chapter 5.2: Weaknesses regarding new firms originating in research institutions, and possible solutions**

3. The potential for increasing startup activity in Germany is far from being exhausted. The diverse range of funding available for startups in the country has been expanded in recent years. Yet this funding focuses almost exclusively on research institutions and rarely targets spinoffs from companies. Studies on startups show, however, that their initiators generally did not launch their companies directly after leaving university.

► **Chapter 5.3: Increase pre-seed phase support to aspiring founders in the private sector**

4. The range of forms available to new companies is far from being exhausted. Similarly, opportunities to increase the rate at which new companies are created have not been sufficiently exploited. For example, there is little public-sector funding available for new companies using models such as "founding without a founder" (in which the researcher continues to pursue their research, and a management team implements the business idea jointly with them), "launch with a strong partner" (in which an established company works closely with a team of founders) or the launch of particularly ambitious projects in cooperation with entities from the research and private sectors.

► **Chapter 5.4: Creating additional funding options for alternative forms of company formation**

5. Many startups' financing needs cannot be covered by private equity capital alone, because only a small percentage of such firms meet the high return requirements associated with this form of financing. Government financing offers are to some extent appropriate for the remaining startups, but there are still gaps in certain categories, including new companies with societal or environmental relevance (new impact-oriented firms).

► **Chapter 6.2: Possible financing gaps for new firms lacking major growth potential**

6. New companies likely to require considerable operating time before a possible market breakthrough require "patient" capital that does not expect returns on its investment after just a few years.

► **Chapter 6.4: More patient capital is needed for low-growth firms**

Improving support for founders in the initial phase

In seeking to identify solutions for the problem areas identified, this study examines the initial phase of new-business creation, along with the variables influencing this embryo stage that is vital to the process of establishing ambitious new firms (Figure 1). The following are the key factors in the initial phase:

- Eliminating barriers to company creation: What hurdles hinder individuals willing to create a new company in the practical implementation of their entrepreneurial plans?

- Filling the new-company pipeline: How can the number and structural quality of initiated new-business projects be increased?

- Maximizing potential economic relevance: How can the transition from innovative business models to growing companies be stimulated?

- Taking inspiration from the environment: If a region has a critical mass of projects and people interested in founding new companies, a founder ecosystem develops, which in turn produces synergistic and amplifying effects with respect to potential co-founders, investors, social reinforcement and media attention. Moreover, such a region may also develop an international reputation, attracting people and resources from other areas (Wallisch 2017).

FIGURE 1

STAGES OF DEVELOPMENT FOR AMBITIOUS NEW COMPANIES

Initial phase	Potential founders decide for or against entrepreneurial activity, based on influences from their professional and personal environments • Acquisition of knowledge and development of research results • Inspiration provided by role models and commercialization-promoting structures in the work environment • Review of innovative solutions' commercialization potential and technical feasibility • Identification of business opportunities and ways of implementing them • Assessment of one's own capacity to think and act entrepreneurially
Seed phase	Preparatory work • Development of business model and business plan • Assessment of the business idea's commercial viability and market appeal • Development and implementation of business idea into commercially leverageable results or prototype • Search for grants, investors, business partners, co-founders etc.
Startup phase	Business building and early growth, including formal company establishment • Development of product or service completed • Expansion of staff, organization, production and distribution • Public funding acquired and first investment rounds raised • Successful market entry and early sales • Customers acquired, and contracts with business partners signed • New company becomes increasingly well-known
Expansive growth and internationalization	• Expansion of business activities and rapid growth • Rapid market penetration, sharp revenue increases, profits are realized • Further extensive rounds of investment • New target markets, expansion of distribution structures to international markets • Expansion of company offerings to include new applications and customer groups • Significant expansion of employee base and management capacities • Strategic partnerships established, competitive position secured and expanded

Source: Author

1.3

Methodological approach

The study is based on findings from the long-standing research project accompanying the "EXIST – Existenzgründungen aus der Wissenschaft" funding program;[6] from evaluations of additional support mechanisms intended to spur the creation of more innovative, knowledge-based and research-based startups; and from studies of Germany's equity-capital market conducted by Fraunhofer ISI. Building upon this foundation, the authors carried out a comprehensive evaluation of relevant publications. Research and on-site interviews both in Germany and abroad, carried out by Bertelsmann Stiftung staffers, served as an additional source of information, especially with regard to the examples of good practices (see 8.1). With the dual aim of providing inspiration and engaging in the transfer of knowledge, the present paper presents a variety of exemplary approaches and instruments that could serve as examples for German innovation policy.

Examples of good practices in other developed countries

Especially with regard to factors influencing the initial company-creation phase, Germany displays both clear strengths and weaknesses. This study identifies points at which improvements could be made both generally and in the existing domestic support system for innovations and new businesses. Such improvements could be realized through the adoption or adaptation of good practices from other developed countries (e. g., the United Kingdom, Israel, Canada, Sweden, Switzerland). In some cases, these approaches could be used to build further upon existing strengths.

Although the developed countries cited vary substantially with regard to their range of business structures and research activities, they presently exhibit considerable similarities with regard to the approaches and instruments used to stimulate and support startups. This relates to the measures and offers pursued by public (funding) institutions, private companies, investors, consulting companies, and so on. The progressive convergence is the result of a lively cross-border dialogue regarding good practices, the spread of successful international approaches, the adaptation of such approaches to local circumstances, and a general alignment between regional startup ecosystems due to the work of internationally active partners (e. g., venture-capital firms, business builders, consulting companies) and diverse forms of transnational cooperation (in some cases including EU support).

Structure of the study

This study initially takes a deeper look at the process of founding innovative new companies (Chapter 2), as well as at the current environment and startup ecosystem in Germany (Chapter 3). It then addresses the study's underlying thesis, that Germany's quantitative and above all qualitative startup gap is caused by problems in the initial phase of new-business creation. We discuss Germany's strengths and analyze its weaknesses in the areas of commercialization (Chapter 4), funding policy (Chapter 5) and startup financing (Chapter 6). The study draws connections between the identified weaknesses and the examples of good practices cited from abroad. This is intended to provide guidance as to how the identified weaknesses might be remedied.

6 See www.exist.de/EN/Home/home_node.html (accessed on October 22, 2020).

2.

Innovative business activity in Germany

It is not possible to specify precisely how many startups are created every year, as there is a lack of reliable statistics on this specific topic. Moreover, the findings of studies both internationally and within Germany differ substantially depending on how they define this term.[7] The KfW Startup Report 2019 (Metzger 2020a) reports that about 9,000 new companies qualifying both as innovative and growth-oriented were founded in 2016. This figure increased substantially to 12,500 in 2017, but then subsequently fell slightly to 11,600 in 2018.[8]

The Leibniz Centre for European Economic Research (ZEW) has long provided data on new-company activity in the knowledge economy (R&D-intensive industries and knowledge-intensive services).[9] For 2018, it reported the creation of around 21,300 new companies, with a strong declining trend evident nationwide since 2006/2007 (BMBF 2020). However, this decline was weaker in Berlin, Bavaria, Hamburg and Baden-Württemberg. The comparison between German federal states for 2017 shows regional structural differences with regard to the founding of new companies. Startups, according to the definition given above, presumably constitute a small group within this overall total. In the European context (EFI – Commission of Experts for Research and Innovation 2020), Germany's rates of new-company creation in R&D-intensive industries and for knowledge-intensive services were low in 2017, well behind the corresponding rates for the United Kingdom and France (Figure 2). However, these rates reflect only the number of new companies in relation to the existing stock of companies – the latter of which has already been very high in Germany for many years.

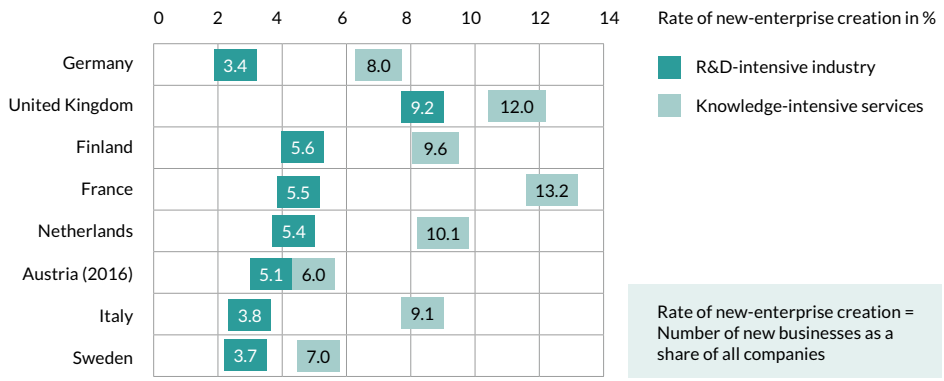
Germany's rate of new-enterprise creation in R&D- and knowledge-intensive sectors is rather low.

7 A compilation of data on individual countries can be found at www.gtai.de/gtai-de/trade/specials/update-startups/special/status-quo-75482 (accessed on November 17, 2020). However, this does not include the leading developed countries. 8 For comparison: According to KfW, the number of startups regarded either as innovative or growth-oriented is of a completely different order of magnitude. Using a broad definition, these figures are respectively 54,000 for 2016, 60,000 for 2017 and 70,000 for 2018. 9 The first group, with high levels of expenditure on research and development (R&D), includes companies in the aerospace, pharmaceutical, electronics and computer-manufacturing sectors, for example. Knowledge-intensive services include software development, IT consulting and technical laboratories, for example.

FIGURE 2

RATE OF NEW-ENTERPRISE CREATION IN R&D-INTENSIVE INDUSTRIES AND KNOWLEDGE-INTENSIVE SERVICES (2017)

International comparison



Sources: Business Demography Statistics (Eurostat) and Mannheimer Unternehmenspanel. ZEW calculations in Bersch and Gottschalk 2019 and EFI 2020.

Germany's weaknesses: Low growth in knowledge-economy companies

Startupdetector also provides data on the establishment of new companies that have innovative business ideas and significant growth potential (Petzolt et al. 2020). In 2019, out of around 106,000 new companies recorded in the commercial registry, a total of 2,280 were classified as startups (2.2 %). One-quarter of Germany's startups were created in Berlin. Bavaria, North Rhine-Westphalia and Baden-Württemberg together accounted for another 45.1 percent. The remaining federal states each contributed considerably lower shares.

New business formations in Germany additionally show the following characteristics, in some cases representing positive developments, while in others serving as evidence of weaknesses:

- The share of new-enterprise creations with societal relevance (new impact-oriented companies) cannot be precisely quantified; however, data from funding programs and studies such as the German Startup Monitor (Kollmann et al. 2019) indicate that new companies emerging from the research sector often seek to contribute to the solution of societal problems.[10]

- The combination of digital business models with innovative approaches in the areas of new mobility, sustainability, the energy transition, climate change, resource efficiency, the aging society, health, prevention and other such topics is reflected in the increasing number of new businesses that take advantage of support programs, take part in idea or business-plan competitions, or seek to raise private capital.[11]

10 The Green Startup Monitor for 2018 and 2020 (Fichter und Olteanu 2019, Olteanu und Fichter 2020) classifies around 21 percent of newly formed innovative companies as green startups, estimating the total number of such enterprises (younger than 10 years) at around 6,000. These firms' products, technologies and services help protect the environment, the climate and natural resources. Growth plans followed by green startups are similar to those of other startups, at least with regard to revenue and employment. Some strive for very rapid growth, but a considerably larger share aims for more limited growth. 11 Including social entrepreneurship, in which a company's business focus is associated with a social mission, and profit serves as only a means to an end. See the definition in the German Social Entrepreneurship Monitor (Scharpe and Wunsch 2019).

- The number of new companies emerging from the four large non-university research organizations (the Fraunhofer and Max Planck societies, and the Helmholtz and Leibniz associations) that seek to leverage intellectual property or know-how, and for which a formal commercialization agreement has been signed, is overall quite low. Moreover, this figure has shown only low growth rates in recent years. A total of 55 such new companies were created in 2016, followed by 51 in 2017 and 64 in 2018, with most emerging from the Fraunhofer Society or the Helmholtz Centers (GWK 2019).
- Women are strongly underrepresented among founders of innovative companies, as well as on teams of founders. Depending on the study, their share ranges from 13 percent to 19 percent.[12] This is primarily attributed to the low share of women in science, technology, engineering and mathematics (STEM) courses, and to a limited appetite for risk.

THE ISSUES IN BRIEF

- In all developed countries, there is a lack of reliable data on startups; this makes it more difficult to make statements regarding successful strategies for stimulating the creation of new companies outside the well-known hotspots.[13]
- The rates of new-company creation in R&D-intensive industries and knowledge-intensive services are lower in Germany than in other European countries. Moreover, they have been declining for many years.
- Outside of specific hotspots, there is little evidence of dynamic business-creation activity in Germany.
- Studies on startups indicate that a significant proportion of new enterprises have sociopolitical relevance.

12 According to the KfW Startup Report 2019 (Metzger 2020a), women constituted 19 percent of startup founders in the 2016 – 2018 period. In the Bitkom Startup Report 2019 (Bitkom 2019), only 25 percent of 308 IT and internet startups had women on their founding teams. The German Startup Monitor (Kollmann et al. 2019) reported a female-founder share of 15.7 percent in 2019; this share had shown steady increase since 2015. **13** Numerous studies on successful startup ecosystems in Germany and abroad have described the local effects associated with stimulating new-enterprise creation and the growth of innovative new firms. However, they define the idea of "startup" differently, and the data-collection processes are not directly comparable. The 2020 Global Startup Ecosystem Report (GSER), produced by Startup Genome and the Global Entrepreneurship Network (2020), offers a comprehensive overview of startup ecosystems, evaluating the 140 leading ecosystems.

3. GERMANY'S CURRENT ENVIRONMENT AND STARTUP ECOSYSTEM

3.1 STARTUPS PROVIDE MORE OPPORTUNITIES AND INSPIRATION TO FOUND NEW COMPANIES

3.2 VITAL STARTUP ECOSYSTEMS: ENVIRONMENTS THAT STIMULATE NEW BUSINESSES

3

3.1

Startups provide more opportunities and inspiration to found new companies

The push for technology through digital transformation is stimulating new businesses

In recent decades, technological breakthroughs (e. g., the invention of microchips, discoveries in the life sciences, the creation of the internet) have always been the primary driving force behind the formation of innovative new companies. Such breakthroughs have triggered disruptive and radical innovations, gained strength through numerous adaptive and incremental innovations, enabled novel business models, and attracted venture-capital investors (Bygrave und Timmons 1992; see also Results Paper 3 in this series). Institutional and private investors have made substantial contributions to funds focused on these areas, and investment particularly in new companies has risen sharply. Successful investment examples have mobilized other people interested in founding new companies, as well as other equity-capital investors.

We see this effect with digital transformation, particularly in the area of artificial intelligence. The technological upheaval is intensifying the need for new solutions able to address the major societal challenges that are inducing changes in all areas of our life and work (acatech 2016; DLR and VDI TZ 2020).

Window of opportunity: Currently a wide range of entrepreneurial options for startups

Two groups of companies in particular benefit from leaps in technology and low market-access thresholds: Innovators, which themselves develop novel products and services and introduce them to the market; and – to a large extent – adaptors, whose offerings build and expand on these innovations, often developing them further. Opportunities arise for bootstrapping (i. e., founding a company without capital) and lean entrepreneurship (i. e., founding a company with minimal capital), both of which entail low levels of personal founding risk, a rapid proof of viability for the underlying business idea, and rapid revenues from the first products or services.

While the media eye has often focused on the young overseas companies that have risen quickly to become world leaders (e. g., Facebook, WhatsApp, Spotify, Netflix), the number of young companies with ambitious growth plans is gradually increasing in Germany too. These primarily belong to the adaptor group, and have only rarely themselves contributed to technological breakthroughs. Considerable quantities of risk capital are flowing into these firms (e. g., Blinkist, Auto1, Flixbus, Check24, Zalando, N26), and expansionary growth is leading to a rising societal appreciation for innovative companies.[14]

Impact of startups on employment

A current study conducted by dealroom.co (2020a) describes the employment effects of startups in Berlin. As of 2019, a total of just under 2,000 companies founded since 2006 employed around 78,000 people (+32 % since 2017). Within that total, 29 percent was attributable to companies founded since 2016. About 20 percent of the jobs were in the area of product development or software engineering. But the employment impact of startups in Berlin cannot be accounted for by a few high-growth companies alone. Only about 17 percent of these 78,000 employees worked in one of the top 10 startups in terms of growth, while about 25 percent worked in the top 50. The remaining startups, a large majority of the whole, had an average of 32 employees. Berlin performs significantly better in this regard than does Amsterdam (1,519 startups with around 38,000 employees), for which the study provides comparative data.

14 This is shown by a representative survey conducted on behalf of the Bitkom digital association, for example; see www.bitkom.org/Presse/Presseinformation/Startup-Gruender-haben-einen-guten-Ruf (accessed on October 22, 2020).

Startups as accelerators of technological advances

New innovative companies, and particularly startups with their strong growth potential, are becoming an important factor for sustainable economic growth and in securing long-term economic competitiveness (Rammer et al. 2016; Röhl 2016). For example, new companies create additional jobs and, in some cases, entirely new markets. In addition, new firms inject new life into traditional corporate organization models.

Recently, the focus has primarily been on startups' potential for innovation. Startups are, for example, expected to make especially significant contributions as accelerators of technological progress; as the source of disruptive, radical and many incremental innovations; and as modernizers of corporate and regional structures. As digital transformation proceeds and we face major societal challenges, these expectations are growing significantly. Issues such as climate change, demographic change in the developed countries and global pandemics have created a need for exceptional solutions and groundbreaking technologies that can be brought into widespread application by agile new companies. Today, for example, BioNTech SE and CureVac N.V. (respectively founded in 2008 and 2000) have found themselves in the political and public spotlight. Their development exemplifies the long time periods that may be required for a market breakthrough in highly innovative areas.

The German small-and-medium-size enterprise (SME) or *Mittelstand* sector is lagging behind considerably with regard to the use of digital technologies. As a result, we see a growing number of funding approaches in Germany that seek to enhance cooperation and establish new forms of collaboration (e.g., digital hubs) between research institutions, startups and Mittelstand companies. Established companies want to benefit from startups' innovative capacity, for example by gaining access to new business and operating models, or by introducing modern technologies and new process ideas.

Coronavirus pandemic 2020/2021: Driving or arresting momentum?

The crisis of 2020/2021 is expected to provide an additional boost to digitalization and innovation, affecting all areas of society and the economy as it expedites the pace of digital transformation. However, the crisis is initially increasing the challenges faced by startups. A number of issues come into play here, including the need to secure and develop core business operations; the continuing need to access risk capital, skilled staffers and other funding sources; the desire to develop new business relationships with companies that are themselves suffering from the effects of the pandemic; the overall decline in societal purchasing power; and the possibility that consumers may prove resistant to market innovations.

Understandably, this has had a negative impact on potential founders' interest in using their research results, knowledge and business skills to engage in entrepreneurial self-employment, assuming the risks associated with founding a new company. The KfW development bank has also forecast a sizable decline in the establishment of new businesses (Metzger 2020b).

3.2

Vital startup ecosystems: Environments that stimulate new businesses

Before the outbreak of the coronavirus pandemic, Germany had made significant progress toward generating a startup environment that encouraged the creation of new companies. Over the course of the last decade, vibrant startup ecosystems have emerged with amplifying effects for potential founders both domestically and abroad, as well as for consultants, investors and potential business partners. Universities and non-university research institutions serve as important players in these support networks. Potential founders have access to a well-developed physical and support infrastructure that enables them to concretize and realize their business ideas.

Startup ecosystems are characterized by a broad spectrum of measures and services offered both by private and public entities. From the point of view of the target groups, these offerings may be complementary, may represent alternatives to each other or may compete with one another.

It is precisely the visible and invisible links between participants that justify the utility of such systems as part of a broader architecture for innovation. The high level of internal interaction and cooperation for the benefit of startups is evident in numerous event formats (e.g., pitch, idea and business-plan competitions; hackathons; startup nights) and public-private approaches. The startup spirit is self-reinforcing, stimulating other potential founders and collaborators to provide further support for new companies.

However, it is also clear that regions with strong and weak rates of new-company creation are drifting apart, with the former drawing people and resources away from the latter.[15] Moreover, traditional company-location characteristics are losing importance in favor of determinants of digital competitiveness (Deloitte 2018: 8) such as fast data-transmission speeds through broadband networks and a diversity of options for digital cooperation. Only after the end of the coronavirus crisis will it become clear how fragile or resilient such ecosystems are. Heavily influenced by global economic and technological developments, they are based on the expectation that young companies will generate far-reaching innovations and high growth rates. Such companies are generally still in a critical phase of development. Nonetheless, reports on financing rounds for startups in 2020 as yet show no significant decline in equity investors' interest in early-stage financing.

15 The study by Kulicke (2017: 23), for example, indicated that a significant share of EXIST-backed new-company projects emerging from universities in the state of Brandenburg led later to new companies in Berlin. Although there is also a reverse effect, the balance in terms of new business creation clearly skews in Berlin's favor.

THE ISSUES IN BRIEF

- Digital transformation offers a window of opportunity, and is producing a wide range of entrepreneurial options for startups. The number of startups that contribute to technological breakthroughs is very low, while the share of those adapting others' innovations is high. At the same time, startups are gaining increasing significance as accelerators of technological progress within the Mittelstand.
- The 2020 coronavirus pandemic is pushing digital transformation forward and, as a result, is generating more business opportunities in digital technology – though it is initially likely to slow the creation of new companies.
- In recent years, Germany's urban regions have fostered an environment encouraging the creation of new enterprises. This has been furthered by the establishment of a large number of ambitious new firms with digital business models, an increasing societal appreciation for innovative companies and substantial media attention.

4. FOUNDING POTENTIAL AND THE CULTURE OF COMMERCIALIZATION IN THE RESEARCH SECTOR

4.1

Origin of startups in Germany's research and private sectors

In Germany, a startup's origins – that is, a founder's previous activities and the source of their underlying business idea – can lie in very different institutions and areas (Figure 3).

A startup's origins may ultimately affect the business model's degree of innovation and growth potential, as well as the founders' entrepreneurial expertise and the technological implementation of the underlying idea. Its origins may also influence the founders' market knowledge and network of contacts with possible business partners, the degree to which the new company is growth-oriented, the scope of the founders' own financial resources, the enterprise forms considered during the company-creation process, and additional points relevant to the emergence of successful young companies.

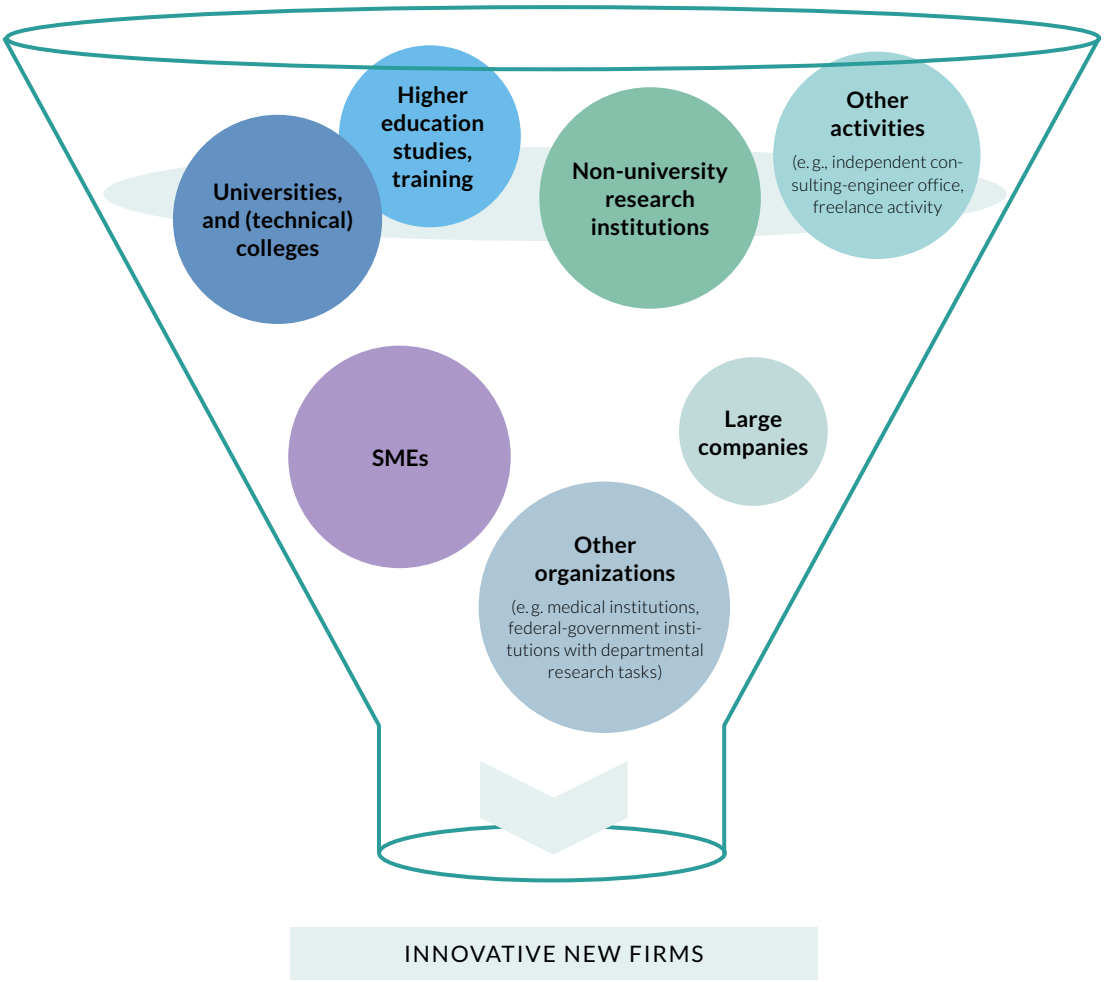
For the last 20 years, both public attention and official funding policy in Germany have clearly focused on spinoffs from universities, technical colleges and non-university research institutions.[16] However, the data on activities surrounding the creation of new firms from within such research-focused institutions is unsatisfactory.

Large research organizations in Germany such as the Fraunhofer and Max Planck societies and the Helmholtz and Leibniz associations also play an active role with regard to spinoffs. They focus on creating new enterprises that are allowed to leverage the organization's intellectual property rights in return for an equity stake in a company or licensing rights. The research organizations thus benefit from the transfer and subsequent commercialization of research results. In return, the startups receive intensive support during the company-creation process. Given the rather large scope of researchers and budgets at the disposal of these institutions, politicians have been critical of the rather low annual output of such spinoffs.[17]

The number of new enterprises originating from existing companies is largely unknown. Their initiators are likely to combine industry experience, knowledge about market opportunities, technological expertise and possibly a network of potential business partners. This much has been shown by recent studies.[18] Thus, many people starting new companies do so only after a number of years of professional activity, and not directly following university studies or the acquisition of a doctorate. However, founders have very often attended university in some capacity, with a total of 81.7 percent having a university degree (43.1 % in STEM subjects, 38.6 % in economics or business-related subjects).

16 For example in the BMWi's EXIST Transfer of Research programs and Business Start-up Grants; the GO-Bio: Founding Initiative Biotechnology competition; the Gründungen: Innovative Start-ups für Mensch-Technik-Interaktion program, see funding database at www.foerderdatenbank.de. 17 See, for example, the parliamentary question on the issue of "Spin-offs from Universities and Non-University Research Institutions," Bundestag documents 19/3057 (http://dipbt.bundestag.de/dip21/btd/19/030/1903057.pdf) and 19/3653 (http://dip21.bundestag.de/dip21/btd/19/036/1903653.pdf) (both accessed on November 17, 2020). 18 In 2019, Startupdetector (Petzolt et al. 2020) identified the creation of 2,280 new enterprises nationwide whose CEO-level executives had an average age of 35. One-fourth of founders had attained executive-level experience at another company within the last 10 years. In the German Startup Monitor (Kollmann et al. 2019), nearly half of the 1,926 founders surveyed (average company age: 2.4 years) were between 25 and 34, about one-fourth were between 35 and 44, 16 percent were 45 or older, and only 8.4 percent were 24 or younger.

FIGURE 3
INSTITUTIONAL ORIGINS OF INNOVATIVE NEW FIRMS



Source: Author

4.2

Increasing research results – more opportunities for commercialization and new firms

Strong increase in publicly financed research in research institutions

Germany's great and growing potential for spinoffs from within the research community is driven by the strong expansion in research over the last 15 years in universities, non-university research institutions and technical colleges, as well as by the increasing importance attributed to universities' "third mission."[19] These factors have had both a beneficial and an inhibitory effect on the creation of new firms from within the research community (Figure 4).

The enhancement of research at German universities can be traced back to the federal and state governments' 2005/2006 Excellence Initiative (now the Excellence Strategy) promoting science and research in German universities, as well the significant expansion in both field-specific and non-technology-specific research funding (BMBF 2020). Much the same is true of non-university research organizations (e.g., through the Pact for Research and Innovation) and – to a much lesser extent – for the technical universities.

Challenge: Utilizing opportunities to found more research-based firms

This expansion of research funding generated an increase in the volume of commercializable knowledge and research results, as well as a significant increase in the number of people working in the research sector. The Excellence Initiative funding and the basic-research support provided by the German Research Foundation (DFG) do not involve collaboration with companies. The output associated with these programs is typically not directly commercializable, instead forming the basis for further research. To ensure that these programs make a contribution to solving societal challenges, as well as to growth and employment, the key would be to enhance interest in commercialization within research circles, while also expanding access to financing for validation activities and pre-commercialization R&D work.

By contrast, the R&D funding currently provided by the federal and state governments and the EU focuses primarily on projects that involve collaboration between the research community and the private sector, with the participating industry partner typically pursuing the commercialization of findings. But even here, as experience with the EXIST program has shown, there remains room for other forms of commercialization such as spinoffs.

The developments outlined here have improved teaching and research career opportunities for some researchers on temporary contracts, as many of them are offered appealing jobs in the private sector. This competes with the prospect of engaging in entrepreneurial activity which, as a rule, carries significant personal risks and challenges, primarily through the necessary shift in roles from researcher to entrepreneur.

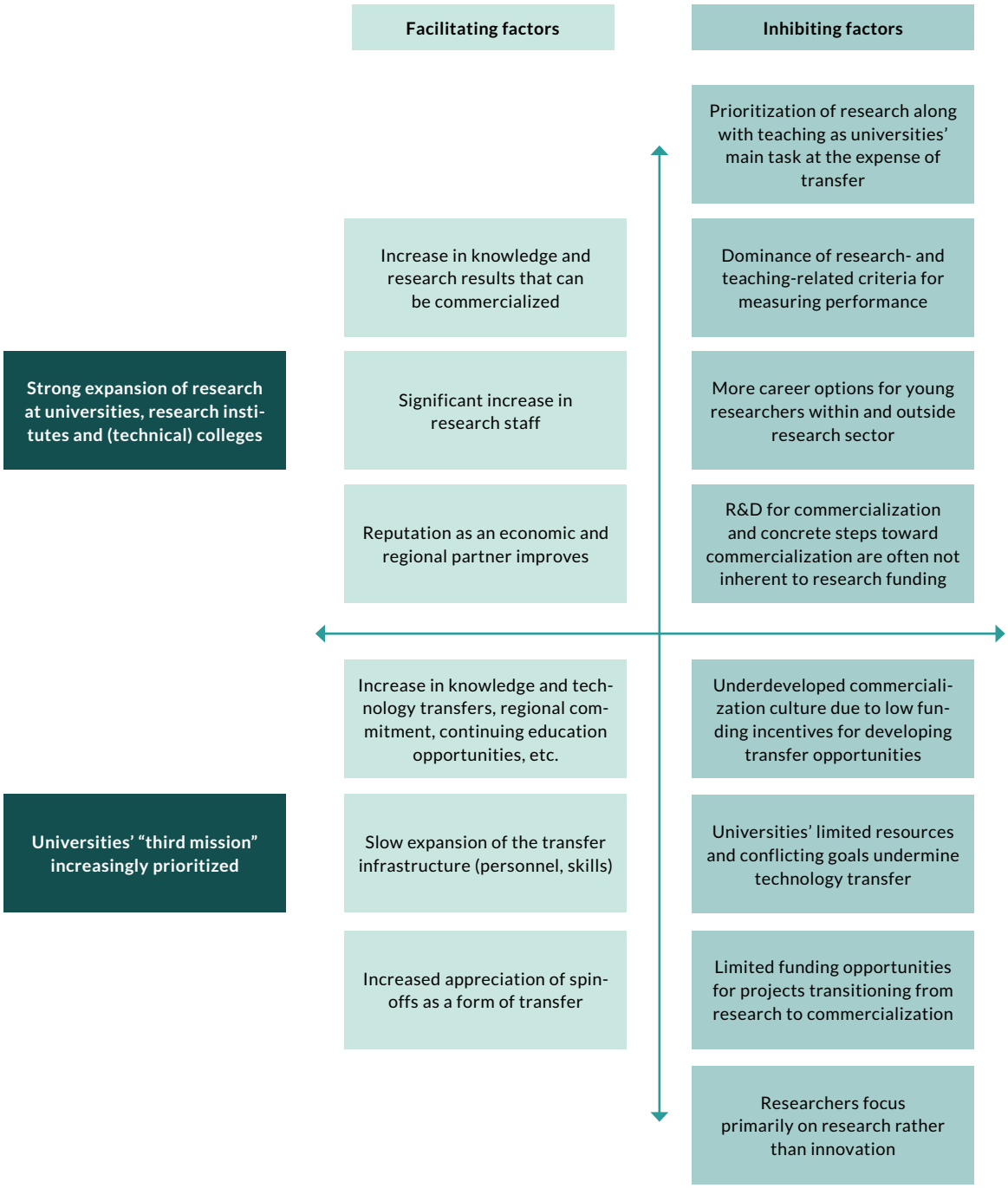
Funding figures from federal programs promoting the creation of research-based firms offer no indication that the strong expansion in research funding has provided any measurable impetus for more research-based startups.

While additional funding programs focused on the creation of this kind of firm have been launched in recent years,[20] none have been directed explicitly toward fostering an innovation mindset among recipients. Furthermore, none of these programs have sought specifically to support pre-commercialization work – as the precursor to actual commercial leveraging – in the form of funding that enables recipients to review a technical solution's commercialization potential or feasibility without engaging in a cost- or labor-intensive application procedure.

19 The "third mission" refers to universities' task – in addition to the core tasks of teaching and research – that includes activities such as knowledge and technology transfers, regional engagement, continuing education and social innovation. (Henke et al. 2017; Frank et al. 2019; Frank and Lehmann-Brauns 2020). 20 For example, the "Excellence Startup Center.NRW," which seeks to improve the transfer of research results; the BMBF Enabling Startups program that encourages the creation of more companies in the quantum technology and photonics fields; or the "Innovative Start-ups für Mensch-Technik-Interaktion" program.

FIGURE 4

RESEARCH-INSTITUTION TRENDS RELEVANT TO ENTREPRENEURSHIP IN GERMANY



Source: Author

4.3

Good practices in improving research commercialization

The extensive scope of funding currently provided by Germany's federal and state governments to promote the creation of new firms aims explicitly at improving the entrepreneurial culture within universities (and non-university research institutions). For example, students, graduates and research personnel are encouraged to pursue the option of founding a company as a means of translating knowledge and research results into economic or societal benefits. As a result, the entrepreneurial culture at universities has improved significantly over the last decade.

On the other hand, due to a lack of comparable funding, progress has been limited with respect to creating a culture of commercialization open to economic value creation. Knowledge and technology transfer has long been emphasized as an aspect of the third mission of universities, and takes place primarily on a person-to-person basis (through teaching or doctorates) and in research collaborations with companies or research institutions.

Thus, efforts to reach out to the target group of researchers to encourage them to engage in entrepreneurial activities face unfavorable conditions precisely in those areas where people may be thinking about or preparing to start a new firm (Figure 5).

FIGURE 5

RELEVANT AREAS PRECEDING THE FORMATION OF RESEARCH-BASED COMPANIES

Source: Author

1. Germany's current culture of commercialization

- Limited emphasis on innovation: Although this varies across specific research fields, researchers' intrinsic levels of interest and opportunities beyond academia do not provide sufficient impetus to encourage them to participate in transferring research results to the market and into products. However, this varies from field to field, as technical fields are geared more strongly toward innovation than are the natural sciences.

- Technology transfer given no notable weight in research indicators: Ratings assessing the performance of research institutions and researchers (Frank et al. 2019) have few indicators that measure technology-transfer performance. The same is true of the award criteria used by providers of public-sector research funding. Rather, there is a clear dominance of criteria associated with research and teaching activities. In terms of knowledge and technology transfers, these criteria constitute misaligned structural incentives. Contributions to addressing societal and environmental challenges are not rewarded. There are therefore few incentives for department chairs to give proactive, ongoing support to spinoffs.

- Perceived contradiction between research and the culture of commercialization: Activities aimed at the commercialization of research results have a poor reputation within the scientific community as compared to publication activities (although there are differences between disciplines in this regard).

2. Funding for reviewing commercialization options and verifying the practicability of new results

- In many areas of "traditional" research funding, there is little scope to cover further pre-commercialization work associated with an R&D project's research results (e. g., by constructing prototypes, engaging in further testing, or developing business models), at least without making a separate funding application to a different program. EU-wide aid rules define the research content and work activities that are eligible for funding, and generally exclude work aimed at readying products or services for market.

- There are currently few funding options at the interface between research and commercialization that would allow excellent but not yet market-ready research findings to be used to launch a new firm, or generally be better capitalized upon with the help of business partners. This is a clear weak point in international comparison, as some countries have long offered well-funded programs to review the commercialization potential and feasibility of technological solutions, as shown by examples from Israel, Ireland and Canada.
► **Example box 1**

- Research institutes within (research-intensive) universities have limited financial flexibility to engage in commercialization efforts on their own initiative. Here too, Germany is significantly worse off internationally than research universities in the United Kingdom or the Netherlands, for example. These latter entities have access to their own funds that enable them to take swift pre-commercialization steps, without the need to engage in a long application process with uncertain prospects of success.[21] ► **Example box 2**

- Programs supporting the development of business models are available in only a few areas (e. g., the BMBF's New Products for the Bioeconomy idea competition). However, these areas have recently undergone expansion.

21 Private foreign universities can usually draw on a significant quantity of endowment funds contributed by private donors. The four leading American universities (Yale, Harvard, Stanford and Princeton) alone have endowments collectively worth around $129 billion. There have been proposals to involve private wealth-holders more deeply in the financing of research work with societal impact here in Germany as well (www.handelsblatt.com/meinung/gastbeitraege/analyse-serie-global-challenges-achleitner-und-rocholl-wie-privates-kapital-staatliche-macht-staerkt/26632298.html?ticket=ST-1490285-YWKSFbBdjIduyUKnuurI-ap5, accessed on November 20, 2020). However, this approach cannot be easily integrated into Germany's largely state-funded university system.

EXAMPLE BOX 1

Funding programs for improving the commercialization of publicly funded research results

A number of developed countries offer special funding programs for individual researchers or research groups that create incentives and the flexibility to direct their R&D activities toward commercialization. These programs support work conducted directly after the formal conclusion of the original research projects (serving a bridging function between research and application). For example, this can allow a review of technical feasibility, an assessment of potential applications or a survey of expected market responses. Such independent programs signal the importance of commercializing publicly financed research, while additionally producing examples of success and good practices and opening up opportunities for future market partnerships.

Good examples of this type of model can be found in Israel (KAMIN incentive program), Ireland (Commercialisation Fund Programme), Denmark (proof-of-concept (POC) grants), Canada (Idea to Innovation grants), as well as the EU-level European Research Council Proof of Concept grants (which have low annual funding amounts, however). The funding sums granted are usually less than €100,000, or in the range of a few hundred thousand euros for a funding period of one to two years. The research projects do not have to be carried out in cooperation with companies. The subsequent commercialization process can take place in conjunction with an existing company or a newly formed firm. KAMIN, as one example, requires that the research supported be innovative and original with regard to its industrial application. The projects thus have a clear orientation toward further commercialization within the Israeli economy, with the aim of achieving a high level of added value there. The funding, which covers 85 percent to 90 percent of the project budget (according to the current exchange rate, about €110,000 per year, with higher values for collaborative projects), is supplemented by professional support for the research projects with the goal of increasing the chances of success. Another integral element is cooperation between the research institute and an industrial company that is governed by a marketing agreement. The institute retains the rights to the intellectual property acquired under such an arrangement.

Additional information:

KAMIN:
https://www.innovationisrael.org.il/en/reportchapter/innovation-authority

Commercialisation Fund:
www.enterprise-ireland.com/en/researchers/research-commercialisation-supports/commercialisation-fund.shortcut.html

Proof of Concept:
https://tt.dtu.dk/For-DTU-Start-Ups/Start-Up-Funding

ERC Proof of Concept:
https://erc.europa.eu/funding/proof-concept

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EXAMPLE BOX 2

University validation funds for pre-commercialization work

Especially in the Anglo-Saxon countries, research universities and institutions tend to have their own well-endowed funds and programs for the purposes of supporting pre-commercialization work involving research results, and for subsequently bringing them to the point of commercial application. Spinoffs also play a (major) role here as one avenue of commercialization. Financing is provided for the pre-seed and seed phases of the new firm, and to some extent also the early-stage phase.

Examples include the funding provided in the context of the University Challenge Seed Fund (UCSF) by universities in the United Kingdom, the Twente Technology Transfer Fund (TTF) in the Netherlands, and the Deshpande Center at the Massachusetts Institute of Technology (MIT) in the United States. The UK and U.S. funds cited here are largely based on significant initial contributions by private donors, on the scale of many millions of euros.

Additional information:

UCSF: https://innovation.ox.ac.uk/award-details/university-challenge-seed-fund-ucsf/

TTF: www.twentefund.nl/about/

Deshpande Center: http://deshpande.mit.edu/

Boston University's Ignition Award Program provides researchers who have ideas with clear commercial potential with the resources to take a critical step toward market-readiness (e. g., through proof-of-concept funding or prototype development). The program is open to all university departments, and also accepts proposals that are still in the conceptual stage. The Ignition Awards are also intended to produce learning effects with regard to the commercialization of research results, the potential market value of ideas, and collaboration with private-sector companies. The awards are endowed with prizes of $25,000 and $75,000. Investors and industry representatives are involved in the selection process.

Additional information:
www.bu.edu/researchsupport/project-lifecycle/finding-funding/ignition/

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3. Flexibility to hire staff for pre-commercialization development work

- Limited ability to retain temporary employees: If pre-commercialization work cannot be conducted immediately after the conclusion of a research project, universities have little flexibility to bridge employment gaps. As a result, know-how critical for these subsequent steps is lost.

- Little scope for rapid, non-bureaucratic financing for market-oriented post-docs who want to assess the potential of their research: Such individuals tend to leave their institutions or shift to new research projects, even if they might otherwise have an interest in exploring whether their results have application potential or can contribute to innovative solutions. The examples from Switzerland show how young researchers can be directly addressed and provided with incentives to identify the potential held by their own research, especially with regard to possible positive societal impact. ► **Example boxes 3 and 4**

EXAMPLE BOX 3

Exploring the potential impact of research results: ETH Lausanne's Pitch Your Impact competition

The ETH in Lausanne has held this competition on an annual basis since 2017. It is open to doctoral students, post-docs and research assistants at the School of Architecture, Civil and Environmental Engineering (ENAC). It is meant to inspire these individuals to identify the potential societal impact of their research projects and/or inventions, requiring them to communicate this in a pitch and thus convince the public that the project will benefit society and is worthy of investment. The competition participants receive training supervised by Idea On Stage, and present their ideas in a public competition in front of the ENAC community and a jury. With regard to the realization of societal benefits, there are no requirements as to the specific form of activity or goals; that is, there is no direct reference to the establishment of a new company.

Additional information:
www.epfl.ch/schools/enac/innovation/innoseed/events/pitch-your-impact-2019

EXAMPLE BOX 4

Leveraging the commercialization potential of research results: The Pioneer Fellowships program at ETH Zurich

This fellowship program, which is supported by private donations, enables ETH Zurich to make annual grants to young researchers (individuals or teams of two) in order to promote the further development of research results. The goal here can be to develop and commercially leverage a highly innovative product or service concept through, for example, the establishment of a new company. Projects may alternately seek results with societal relevance but without commercial application (although the guidelines for the selection of the grant recipients emphasize economic and technological criteria). The potential for creating solutions to societal challenges does not play a role. However, a 2018 study on ETH spinoffs emphasized that an increasing number of new firms are in fact focused on sustainability and issues having to do with climate change.

Additional information:
https://ethz.ch/de/wirtschaft/entrepreneurs/entrepreneurship/pioneer-fellowships.html

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4. Support infrastructure for commercialization efforts and new research-based firms

- German universities lack a full-fledged commercialization-support infrastructure for researchers: Infrastructure of this kind is weak in Germany in international comparison (Roessler 2020; Kulicke et al. 2019). In this regard, there are major differences as compared to the United States, the United Kingdom, Israel, Canada and other important developed countries. ► **Example box 5**
- Generally no implemented processes for creating new firms based on the institution's intellectual property (IP): Research universities in other countries have long had guidelines for the use of their IP. In the case of ETH Zurich, such guidelines are meant to balance the interests of the patent holder and the spinoff. ► **Example box 6**

EXAMPLE BOX 5

Professional technology-transfer and business-building support within the university: Oxford University Innovation

Focused on teaching and research, German universities are only slowly and gradually expanding their capacity to engage in technology transfers as part of the third mission. Leading UK universities, by contrast, have for decades maintained extensive staffs and developed considerable expertise in the areas of IP management and spinoffs. This is done through specially created subsidiaries that actively guide those taking the steps to commercialize their research results, and take equity shares in the spinoffs. They see themselves as enablers and co-creators of research-based spinoffs, and work systematically with research groups to evaluate their efforts to realize a project's economic potential. They contribute intellectual property (primarily patents), and can use university funds to participate in the seed and startup financing rounds. Over the years, a dense collaboration network has grown up that includes, for example, private investors, technology companies and specialized consulting firms.

For example, Oxford University Innovation, a wholly owned subsidiary of the University of Oxford, offers support for university researchers who want to commercialize their IP (e. g., through licensing; creation of a spinout; or by making contacts with companies in need of technology, investors and other potential partners). In addition, this group administers the university's patent portfolio and equity stakes in previous spinoffs, organizes the Angels Network (through which investors and sponsors are contacted for early-phase projects), and manages the university's own startup incubator.

Since 1997, Oxford University Innovation has overseen the creation of more than 100 new technology companies based on the results of research conducted at the university. These results remain the university's property. According to the organization, a new company is spun off every two months, on average. In October 2020, nearly 40 people were employed within the investment and new ventures, licensing and new ventures, and startup incubator divisions.

Additional information:
https://innovation.ox.ac.uk/

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EXAMPLE BOX 6

Guidelines for university spinoffs: ETH Zurich spinoff guidelines

ETH Zurich's guidelines regulating the commercialization of university research results that result in a spinoff apply to all employees and graduates. They are intended to clarify the form and content of support services that may be provided by the ETH Zurich technology-transfer office (ETH Transfer), while at the same time safeguarding the research freedoms and scientific independence of university members, and disclosing or avoiding potential conflicts of interest.

ETH's two roles are distinguished from one another:
1) Providing support in the process of creating new firms, and
2) Ensuring economic compensation for the use of ETH intellectual property. The guidelines contain detailed information on the support services that may be provided to a new spinoff, as well as the limitations to such support. They also specify the conditions for the use of ETH patents and other IP, along with the possibility of taking equity stakes in the spinoffs

Additional information:
https://ethz.ch/de/wirtschaft/entrepreneurs/spinoff.html

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THE ISSUES IN BRIEF

- In Germany, funding policies for the initial phase in establishing a startup are largely focused on the research sector. Efforts to create new companies originating from within existing enterprises are rarely addressed.
- Germany has a strong research base within universities and non-university research institutions, which has indeed grown significantly in recent years. It can be assumed that this has also produced a greater volume of research findings that could be commercialized. However, there has not as yet been a significant increase in the creation of research-based spinoffs.
- German funding policy is focused primarily on collaborative projects between research entities and private-sector companies, involving the transfer of knowledge and research results into commercial application The funding approaches and structures commonly used within research institutions offer little scope for other avenues of commercialization.
- The examples of good practices from other nations show that significantly higher importance is attributed to activities aimed at increasing the societal and economic impact of research findings. This gives researchers substantially greater flexibility with regard to modes of commercialization. At the same time, they have access to networks and teams of professionals that assist in the commercialization process.

5. FUNDING POLICIES FOR PRE-SEED SUPPORT AND THE CULTURE OF ENTREPRENEURSHIP

5.1

Strengths: Joint focus on pre-seed support and the culture of entrepreneurship

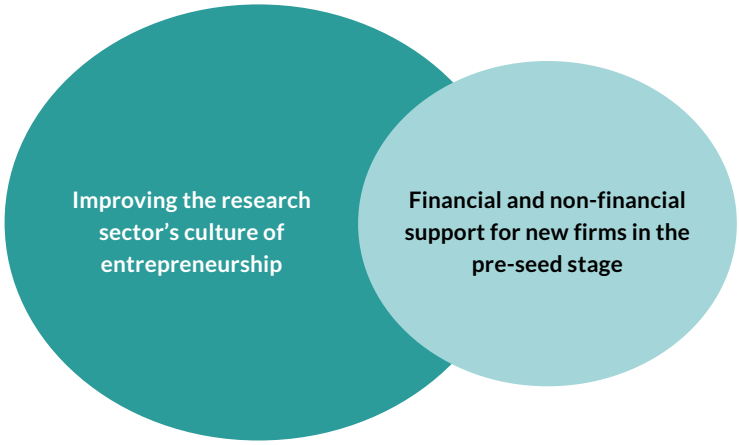
While the German research sector's culture of commercialization continues to feature several weak points and develop only gradually, German funding policies aimed at fostering a culture of entrepreneurship within universities have made significant gains in recent years (Kulicke and Seuss 2016; Kulicke 2018). However, these policies have yet to deliver the aimed-for strong increase in the number of innovative new knowledge- or research-based companies. Nonetheless, funding programs have produced several unicorn startups, as well as other young companies that have significant potential to make a positive societal impact, and which have attracted high levels of initial investment (e.g., Celonis SE and Prime Vector Technologies (PVT)[22]).

A number of other factors may be diminishing the general interest in starting new companies. Perhaps most prominently, potential founders often have excellent job prospects within the conventional employment market. Moreover, it is becoming increasingly difficult to find co-founders and qualified employees.

Over the last two decades or so, funding policies seeking to stimulate the creation of innovative firms have had two primary areas of focus, seeking both to improve the culture of entrepreneurship and to provide support for new-company projects in the pre-seed or preparatory phase. In recent years, the range of funding instruments used for these purposes has been significantly expanded (Figure 6).

In both areas, federal-level programs in particular have been (and continue to be) premised upon integration into a regional network of research- and private-sector partners. This has provided vital impetus for the emergence of regional startup ecosystems, for instance in Berlin and Hamburg.

FIGURE 6
FUNDING-POLICY PRIORITIES FOR FOSTERING INNOVATIVE NEW COMPANIES



Source: Author

22 Celonis, funded through the EXIST Business Startup Grant program, was spun off from within the Technical University of Munich in 2011. It was valued at more than €1 billion in a 2018 round of financing. PVT is developing a second-generation COVID-19 vaccine, which is expected to enter the approval process by the end of 2021. In October 2020, it received an increase of €18 million on top of its original funding through the EXIST Transfer of Research program.

Improving the research sector's culture of entrepreneurship

Germany in particular has taken the approach of promoting a culture of entrepreneurship within universities, focusing on these institutions as the point of origin for startups. The intention is thus to encourage universities to provide more support to new-company projects, and to view this as one of their core tasks.

Such approaches are rare in comparable countries (one exception being the AplusB Scale-up program in Austria). Here in Germany, with the EXIST Culture of Entrepreneurship program, the federal government has since 1998 repeatedly renewed funding programs intended to inspire students and researchers to create new companies. This support encompasses all phases in the emergence of new founders and new companies – that is, not simply for firms launched directly after studies or work as a researcher, but also for those created later in the founder's professional life. Most of the individual federal states in Germany have tailored their own programs to match the EXIST funding approach.

Mid-2020 marked the beginning of the four-year EXIST Potentials funding cycle (a part of the broader EXIST Culture of Entrepreneurship initiative) for 142 universities of different sizes and types. The Federal Ministry for Economic Affairs and Energy (BMWi) is budgeting around €150 million for this purpose. This program is intended to stimulate the creation of new companies – either in the short term, through spin-offs by researchers and graduates, or in the medium to long term, insofar as future founders are exposed to the topic of entrepreneurship during their studies, thus inspiring an interest in entrepreneurial activity.

Significant momentum with new state-level funding approaches

With the goal of furthering the digital transformation and intensifying the commercialization of research results, Germany's larger federal states have recently implemented initiatives that bundle measures together rather than treating them as separate programs (e.g., the Startup BW campaign in Baden-Württemberg). Moreover, the states' funding volumes are comparable with those of federal-level programs (e.g., €150 million for the Excellence Startup Center in North Rhine-Westphalia). Another new trend has also emerged in recent years, in which state-level programs are providing support to new-company projects no matter what their institutional origin (e.g., technology-specific startup accelerators in Baden-Württemberg, various measures associated with the Gründerland Bayern initiative). Thus, these programs are also able to address new firms emerging from within existing companies or other organizations.

Support for new firms in the pre-seed stage

Current German funding policies intended to support the creation of new firms have the following strengths:

- A clear focus on the research sector, with programs designed to meet its specific needs;
- Extensive grants provided for firms even in the pre-seed or preparatory stage – a comparatively rare feature internationally;
- This type of support implies a relatively early intervention in the firm-founding process, when few funding sources other than the founders' own resources are available. This approach is also rare in international comparison;[23]
- There are thus low market-entry barriers with regard to starting a new company, in that personal hurdles are reduced; university graduates and research staffers are encouraged to apply their skills entrepreneurially soon after leaving university or their research institution as they enter self-employment;
- The support for firm-creation projects is provided through an entrepreneur-services office within the university structure, in order to facilitate access to the target group;
- Incubator and accelerator support is provided without taking equity shares in the new company, the practice generally pursued by private investors (in which case this is typically paired with intensive coaching by industry experts);
- There are funding programs with a broad, non-technology-specific approach (that is, the projects do not need to be research-based), and with an excellence approach (that is, mostly technology-specialized, with high requirements for innovative content and growth potential). The aim here is to address different groups of innovators, and fully exploit the diverse potential for new firms;
- Support is provided to projects both with and without significant growth potential, including those seeking to help address societal or environmental challenges (new impact-oriented firms).

Currently, federal programs annually provide funding to about 250 to 300 projects that have yet to reach the stage of formal company establishment (BMBF 2020). In addition, numerous projects receive support from the large research institutions or through

23 A cross-national comparison of startup ecosystems and funding approaches can be found at www.gtai.de/gtai-de/trade/specials/update-startups/oekosystem-75468#58508 (accessed on October 22, 2020).

state-level programs. These also generally lead to the formal establishment of a company. Only a portion of such ventures aim explicitly at commercializing research results, and are based on use of the origin organization's intellectual property. However, these new firms' business models are expected to have clearly innovative content.

The following figures demonstrate the extent of the funding provided:

- EXIST Transfer of Research: Support provided to 176 projects between 2015 and 2019, with the goal of spurring the creation of ambitious and highly innovative new companies (total funding of €153.3 million, funding ratio up to 100 %, average amount of around €871,000, + €180,000 in follow-on financing at time of formal company establishment).

- EXIST Business Startup Grant: between 180 and 220 projects supported annually, with the goal of fostering the creation of new innovation-oriented, knowledge-based firms (2019: total of €29.5 million disbursed). Requirements regarding growth potential and the innovative content of the underlying business idea are not as high as for the EXIST Transfer of Research program.

- GO-Bio (Founding Initiative Biotechnology) competition: Focus on large, especially technologically ambitious projects, with consequently significantly fewer recipients receiving funding (a total of 12 projects in 2014 and 2016, total of €43.2 million disbursed, average of €3.6 million per project).

5.2

Weaknesses regarding to new firms originating in research institutions, and possible solution

The extensive funding activity focusing on research institutions also displays some weaknesses. These are examined in the following section. The international examples of good practices presented in this paper offer promising solutions in this regard.

1. Funding paradigm: Turning researchers into entrepreneurs

Firm-creation funding in Germany is based on the idea that researchers, as bearers of the relevant know-how, will leave their prior work in order to create a new company either alone or as part of a team, subsequently building the business and growing gradually into the role of entrepreneur. German universities offer only limited structured support programs for research staff members seeking to found firms using university-owned intellectual property. Imperial College London's Founders Choice™ program for researchers is an example of good practice in this area, with two distinct support models for founders with different backgrounds and levels of experience.

▶ **Example box 7**

Research funding in Germany also assumes that members of the target group of recent graduates and students have a substantial learning-curve capacity. That is, the programs are premised on the idea that the knowledge these individuals acquire in their technical studies, paired with an innovative business idea, is sufficient to start a company. Thus, according to this theory, they can assume the entrepreneur's role as long as they gain the right qualifications, take advantage of pre-seed support services offered by a university network, and engage in a certain amount of on-the-job learning.

FIGURE 7

FUNDING WEAK POINTS FOR NEW FIRMS WITH RESEARCH INSTITUTION ORIGINS

Source: Author

EXAMPLE BOX 7

Spinoff program tailored to researchers' experience levels: Founders Choice, Imperial College London

As a relatively new instrument launched in 2017, the Founders Choice funding program has expanded the range of support offered by Imperial College London. The university's entrepreneurial ecosystem has grown steadily over the last two decades, and is constantly evolving. Today, the institution is home to many academic researchers who have gained experience in founding and growing companies. Others have a personal network that includes people with the relevant know-how. Since 2017, Imperial Innovations and Imperial College London have offered the Founders Choice™ program, which contains two funding tracks, the Founder Driven Route and the Jointly Driven Route. Their respective designs and requirements are geared to the participating researchers' experience levels. The scope of support provided by the Imperial Innovations venture support unit and the resulting percentage of company equity that must be provided in return are each based on the degree of assistance needed by the founders.

The first option includes the basic support package (up to 12 months). Under this model, founders take a comparatively greater share of responsibility for implementation, which requires correspondingly greater efforts on their part; for this reason, the equity share taken by the university – 5 percent to 10 percent – is lower than that specified in the standard "College Rewards to Inventors" guidelines. The second option offers an expanded support package for researchers who have less experience with starting a new company. In this case, the new-firm creation process takes place with more extensive support, with the support team helping to find resources, capital and employees with the right skills. In return, Imperial College receives a significant equity share in the new enterprise. In both cases, the spinoff's use of the underlying intellectual property takes the form of an exclusive license.

Additional information:
www.imperial.ac.uk/enterprise/staff/industry-partnerships-and-commercialisation/commercialisation/forming-a-startup/founders-choice/

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However, such individuals typically lack networks that include potential business partners and people experienced in building or creating companies. Similarly, they tend to lack knowledge about the application side, about customer needs or about competitive behavior. This forces the newly minted entrepreneurs into a steep learning curve as they try to build out the skills and networks they lack, and find appropriate partners and investors. Most funding programs in Germany are not open to other target groups, such as people who have already worked in a company for a number of years, and who thus already have considerable sectoral experience and market knowledge (unless such individuals are part of a founding team that otherwise consists of students, recent graduates or researchers). Some state-level programs are open to such individuals, but the sums provided are not particularly appealing.

This person-focused approach is meant to enhance the transfer of knowledge from the publicly funded research sector into the private sector, and generally tap the potential of the university community's creative minds. Funding for new-firm creation in Germany is thus not only focused on the early stages of the company-founding process, and on the research sector as the origin of new firms' business ideas; it is also focused on the identity of the founder. This largely means that alternative firm-creation models such as "founding without a founder," addressed in section 5.4, are excluded.

2. Universities foster entrepreneurial skills

In the last 20 years, the development and expansion of entrepreneurship education in Germany's universities (Kulicke 2018) has largely come within economics or business departments and is paired with elective courses in other disciplines, particularly within the STEM subjects.

This early focus on entrepreneurship as a topic of study has the following strengths:

- Course content is largely focused on "entrepreneurial thinking and acting" (entrepreneurship and intrepreneurship). Students thus gain in-depth insights into the topic during the course of their studies.

- The teaching and learning formats employed help spark interest within the target group (e. g., summer-school courses, engagement with real-life topics such as the development of innovative projects, planning games, webinars, e-learning mechanisms, etc.).

However, there are also limitations to the way in which universities teach entrepreneurial skills:

- For example, the lecturers are typically professors of entrepreneurship, with only a minority possessing appreciable experience working at a company or starting a business.

- The growing range of courses reaches only a small share of students (who are typically already interested in starting their own companies).

Universities that receive multi-year funding through EXIST or state-level programs also offer a range of skills-development programs for people in the pre-seed or preparatory stage of starting a new firm.

This generally involves lecturers from outside the university, who bring a deeper knowledge of the subject. Structured skills-development and consulting programs specific to new firms with high growth potential, or tailored to certain technology fields or sectors, are rare due to the lack of a critical mass of participants. Such programs are also dependent on third-party financing, as German universities lack the financial resources to offer services of this nature.

Private accelerators and incubators can offer significantly deeper and more focused support, including mentors with experience in the sector or in founding a company, coaching services, access to networks, and even jobs and resources. Because they typically provide such support in return for an equity share in the newly created firm, they have a great interest in the success and growth of a new-company project. In recent years, a large number of such accelerators have arisen in Germany (Zinke et al. 2018), such as Telekom's hub:raum accelerator, the Microsoft Ventures Accelerator Berlin and the Merck Accelerator.[24] Given its economic weight, however, Germany's performance with regard to the number of such accelerators and incubators is somewhat below the average in comparison to France, the United Kingdom, Spain and Italy.[25]

3. Universities' proactive role in research-based spinoffs

Federal and state funding for research-based spinoffs in Germany typically flows to universities, with the aim of helping these institutions build expertise and generate interest in founding new companies, advise researchers interested in becoming founders, and provide the infrastructure – such as laboratories, equipment and workplaces – needed for pre-commercialization R&D work and the development of business models. If potential founders are to be inspired to enter the initial phase of new-company planning, their research institutions must have vibrant cultures of entrepreneurship and commercialization, with promotors who proactively scrutinize research results for commercialization potential and consciously seek to motivate teams of founders. However, universities in Germany rarely assume this active role, which can stretch from the initiation of startups to the search for external management to take over the business-building tasks necessary to commercialize the university's research results and intellectual property. This task does not align with German universities' own conception of their responsibilities, and they do not have the resources needed to carry it out. Many research universities abroad operate in a very different way, playing an active role in the creation of new firms and providing founders with a comprehensive set of resources, as the example of Israeli universities shows. ► **Example box 8**

24 In its country study on Germany, the Social Innovation Monitor (SIM 2019) found 247 incubators/accelerators. More than half of these had been created in the last five years, with one-fourth located in Berlin. Just under two-thirds were purely private, while an additional 15.4 percent were public-private institutions (as of 2018). Fifty-one were examined more closely. Within this group, only three were classified as social incubators, meaning than more than half of the startups supported aimed at positive social impact; these came mainly from the environmental and agricultural sectors. While 46 percent of the 51 incubators also supported social startups, these were nearly all profit-oriented. 25 For the Social Innovation Monitor's additional country studies and comparisons, see www.efanews.eu/item/14072-first-report-on-the-impact-of-european-incubators-and-accelerators.html (accessed on October 29, 2020).

EXAMPLE BOX 8

Technology transfer and spinoff funding at universities: Yissum Technology Transfer Office, Hebrew University Jerusalem

Israel's top and most internationally reknown universities have technology-transfer units whose resources and accomplishments are comparable with those of their counterparts in the United Kingdom or the United States. They play an active role in bridging the research and private sectors.

At the beginning of 2020, the **Yissum** technology-transfer office at **Hebrew University** in Jerusalem employed about 25 people, who served as enablers of startups among their other roles. Since its inception in 1964, this office has supported more than 170 spinoffs, including numerous high-growth companies. In addition, it offers a broad set of support mechanisms covering the various phases of new-company creation, beginning with the idea-development and subsequent early phases. These services include incubators and technology-specific accelerator and mentoring programs. The office is additionally embedded in a dense support network of established companies and investors.

Additional information:
www.yissum.co.il/

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4. Benefits for universities from research-based spinoffs

Globally, universities that provide financing for company-founding projects or which allow the use of intellectual property rights often receive equity shares in the new companies in return. This enables them to reap significantly greater benefits in the future, following the success of the new company, than are immediately evident in the present. However, German universities have little financial leeway to pursue such a path.

In principle, universities in this country have a dual and potentially contradictory role with regard to spinoffs using their research results. On the one hand, to the extent they offer support for the firm-creation process using their own funds, they are supposed to support such projects free of charge during the preparatory or pre-seed phase (with advice, incubation and networking services, workspace, laboratory equipment, etc.). On the other hand, they are required to commercialize publicly financed research results at market prices (e. g., by awarding a license). However, licensing fees that are set too high can be a burden on the liquidity of newly formed firms. Therefore, licensing agreements often reflect only the costs of registration and the maintenance of intellectual property rights. The universities generate significant revenue in this way only in isolated cases. The option of transferring intellectual property rights in return for an equity share in the new enterprise is only rarely attractive for German universities, as they cannot raise their own capital.

This represents a clear difference as compared to many foreign universities, which can also provide new firms utilizing their intellectual property rights with extensive early-stage financing. For example, no university in Germany has the degree of financial flexibility enjoyed by the Imperial College London's Innovation Fund. ► **Example box 9**

The University of Zurich's UZH Life Sciences Fund is a prime example of a partnership with large regional companies that can be tapped to provide financing for newly created firms. This network also helps firms find new business partners in the future. ► **Example box 10**

EXAMPLE BOX 9

Early-stage investment in new firms created by recent graduates or research staff: Imperial College London's Innovation Fund

Established in 2020, the Innovation Fund has taken over a similar predecessor fund's equity-investment activities. It invests in the early stages of high-growth, knowledge-intensive companies founded by recent graduates or research staffers in areas such as medicine, engineering, biochemistry, genetics, materials science, quantum computing and data science. Contributors to the fund include alumni and other investors who want to support the commercialization of inventions developed at Imperial College. The fund is managed by one of the leading fund-management companies in the United Kingdom. In addition to its initial investments, it can make follow-on investments alongside other investors.

The fund is associated with a diverse set of support programs, as well as a network designed to support new firms and promote research-derived ideas that can lead to the creation of new companies.

Additional information:
www.imperial.ac.uk/news/195957/innovation-fund-imperial-staff-student-startups/

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EXAMPLE BOX 10

Transfer of research results into commercial use: The University of Zurich's UZH Life Sciences Fund for spinoffs

The University of Zurich is a research-focused university with long experience in supporting spinoffs (including more than 100 since 1999 alone). This fund, created in 2017, is focused on spinoffs from the life sciences and the field of biology, and is meant to accelerate the transfer of UZH research results into commercial application. The business ideas supported must be grounded in basic research conducted at the university. Rather than being provided by the university, the financial resources employed come in equal measure from the UZH Foundation and the Novartis Venture Fund. The target sum is CHF 20 million, which is to be invested over the course of six years. The UZH Foundation is focused on research funding, and seeks donations from private individuals, other foundations and businesses with the aim of furthering the strategic priorities of the University of Zurich.

Additional information:
www.media.uzh.ch/de/medienmitteilungen/2017/UZH-Life-Sciences-Fund-investiert-in-erstes-Spin-off.html

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5.3

Increase pre-seed phase support to aspiring founders in the private sector

Germany offers no specific pre-seed funding program for founders who have already worked in a company for a number of years. Nor are such entrepreneurs generally eligible to apply for university-focused programs. If such individuals need a long period of preparation to develop a business model for an innovative idea, conduct extensive pre-commercialization development work or make customer contacts, they have only a few funding options available to them, largely in the few federal states offering programs open to would-be founders regardless of their institutional origin.

Better support is needed for startups with roots in other companies.

Founders coming from within companies can receive funding from federal-level programs (e.g., EXIST's Transfer of Research or Business Startup Grant programs) only as part of a team of founders from research institutions. They otherwise have access only to the general range of funding for new companies (mostly loans or investments in return for equity). However, these options typically require the enterprise to have been formally established. Thus, before this point, they must either use their own resources or convince private investors to participate. That said, a close contact network of possible business partners and investors associated with the founder's previous professional activity can significantly ease the transition into entrepreneurial self-employment. The Austrian AplusB Scale-up Program shows how pre-seed funding, despite being focused on research institutions, can still include new companies created from within private-sector companies. This enables both groups to benefit; companies gain access to research findings, while the research institutions and their members gain access to their corporate partners' networks of private-sector contacts. ► **Example box 11**

EXAMPLE BOX 11

Support by university-associated incubators: AplusB Scale-up in Austria

Since 2017, the Austrian Federal Ministry for Climate Action, Environment, Energy, Mobility, Innovation and Technology, working with local federal states and additional (regional) donors, has funded six university-associated incubators that work to support new-company projects from within the academic environment in the pre-seed and early-stage phases. The initiative has an annual budget of €16 million. The focus is on providing direct support to the new enterprise's founding or management team, and specifically on helping them to network with other regional companies and institutions. In addition, financial support is provided during the period of preparation for entrepreneurship (in the form of an interest-free loan of up to €50,000 per team). In this regard, the connection to the regional university is not as close as in the case of Germany's EXIST initiatives. The focus is on new research-, technology- and innovation-based (RTI) enterprises with significant potential and/or propensity for growth. These can come directly from university or non-university research institutions, or simply involve close cooperation with the academic sphere (e. g., spinoffs from within companies that are mentored by a university professor). The goal is to give the teams of founders early access to networks of established companies and financiers, so as to prepare for market entry.

Even under the predecessor program (the AplusB centers, launched in 2002), most of these incubators had developed into central points of contact for all new RTI firms in their regions, regardless of these enterprises' institutional origin. Founders coming from within companies thus had access at least to non-financial support services. The Tech2B incubator in Linz in particular has been able to provide additional services beyond the funded aspects of its activity, collaborating closely with companies for spinoff projects.

Additional information:
www.aws.at/aws-aplusb-scale-up/

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5.4

Creating additional funding options for alternative forms of company formation

Funding for the creation of new research-based firms in Germany typically requires that the founders (or those possessing the key know-how) give up their previous activity and work primarily for the new enterprise – if necessary, after a transitional period. This means that the goal is an independent, autonomous company.

Alternative forms of company formation such as "founding without a founder" are not supported under these programs. Under this alternative model, researchers provide the technological basis for a new company, but do not themselves shift to full employment by the new firm. The development of the business model and the subsequent business-building activities are carried out by a suitable management team with industry experience. Many spinoffs from universities in the United States, Israel and the United Kingdom take this form, which brings together the latest technological research results with business and industry experience. ► **Example boxes 12 and 13**

As the majority of pre-seed support programs in Germany require applicants to be a research institution or an individual within such an entity, they are not open to models such as a "launch with a strong partner" or a "sponsored spinoff" from within an existing company that involves collaboration with the employer.

Particularly ambitious firm-founding projects involving partners from both the research and private sectors currently have access only to very limited funding options earmarked for big-ticket projects (e.g., Life Science Incubator, Photonics Incubator). Such projects require a long period of preparation, entail extensive and high-risk R&D, and have major capital requirements once entering the business-building phase. One option for such nascent firms is the European Innovation Council's EIC Accelerator, which selects only a few projects per year, but which – once a project is approved – results in the mobilization of large amounts of funding. ► **Example box 14**

THE ISSUES IN BRIEF

- Germany's efforts to expand the number of spinoffs coming from the research sector have focused in part on stimulating the development of a culture of entrepreneurship within universities, and raising awareness of entrepreneurial activities among potential founders at an early stage.
- Progress toward a vibrant culture of entrepreneurship can be seen in an increasing number of German universities. However, the number of new firms being created is not yet showing significant rates of increase.
- Germany currently has a growing range of grant programs that offer pre-seed support. This enables aspiring founders to enter into entrepreneurial self-employment without taking on major financial or personal risks. However, these funding opportunities are rarely tailored to new firms that have a sustainable or social orientation.
- The target groups are mostly students, recent graduates, researchers and alumni. Universities are seen as the primary birthplaces of innovative new firms. This excludes aspiring founders coming from within existing companies.
- The support paradigm under which founders are required to give up their previous activity and grow into the entrepreneurial role excludes other, alternative models of company formation.

There are few opportunities in Germany for solutions with large numbers of participants involving the interplay between startups, research and large technology companies, and which require significant amounts of funding. For instance, there is no program here like the MaRS Discovery District in Toronto, which brings together actors from a number of areas within the context of an accelerator. ► **Example box 15**

Another alternative model of company formation is one in which founders can make a smooth transition to entrepreneurial self-employment, but also have the possibility of returning to their previous employer. Some research institutions in Germany allow their employees to take a leave of absence to prepare the groundwork for a new company. However, there is no comprehensive national-level right – as exists in Sweden – that enables employees to take a leave of absence to start a company and also guarantees their ability to return. A provision of this kind could provide an incentive to create more new companies.
► **Example box 16**

EXAMPLE BOX 12

Support for new high-tech firms in the university environment: The T³ Technion Entrepreneur in Residence program at Technion University in Haifa

The Entrepreneur in Residence (EIR) program introduces businesspeople into the Technion research environment. Together with the T³ technology-transfer office, these individuals work to identify promising technologies that can be used to start a startup. By drawing in this way on experienced businesspeople who can bring the technologies to global markets, the Technion University researchers can continue to focus on their academic research while at the same time ensuring the commercialization of new technologies.

The businesspeople participating in the EIR program have up to six months to discover a business idea and initiate a startup. During this time, they are active in a variety of departments. They do not pay to participate in the program, and they receive shares in the newly formed company. Preference is given to individuals who want to establish a company headquarters close to Technion, so as to ensure close dialogue with faculty members, Technion laboratories and the technology-transfer office.

The EIR program provides the businesspeople with support both as they explore potential opportunities and in the commercialization process. After a possible business idea has been identified, the entrepreneur works with the Technion Entrepreneurship and Innovation Center over the next three months to develop a detailed business strategy. The EIR board of directors makes the final decision regarding the ultimate acceptance or rejection of the business concept. The company is then established, and the entrepreneur is responsible for implementing the business plan, raising capital, achieving milestones, and so on. However, the startup can draw on a broad range of continued support from Technion, including access to institutes for further R&D, administrative and legal services in the company-founding process, and more.

Additional information:
https://ver2015.presidentsreport.technion.ac.il/technion-entrepreneur-in-residence-program-eir/

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EXAMPLE BOX 13

Commercialization of new technologies in the university environment: KTH Innovation Stockholm

KTH Innovation, the technology-transfer office of Stockholm's KTH Royal Institute of Technology, Sweden's largest technical university, helps KTH researchers, students and employees develop business ideas and commercialize research results. The range of assistance provided includes business-development coaching, help with patents, assistance in drafting contracts and agreements, assistance in securing financing, team-building, and more. This support is designed to allow researchers to continue pursuing their research careers, while also gaining commercialization experience – up to the point of forming a new company, if this is desired. If a new company is the goal, but the founder wishes to keep his or her research role, KTH Innovation supports the researcher in hiring a suitable business-development expert who will take over the task of building the new firm.

Additional information:
www.kth.se/en/forskning/forska/kth-innovation-kommersialisering-av-ny-teknik-1.4573

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EXAMPLE BOX 14

New firms with significant funding needs, with early involvement of private capital: EIC Accelerator

One approach targeting companies with very significant R&D expenditures is the European Innovation Council's EIC Accelerator. The project's pilot phase, beginning in late 2019, was launched with a budget of €275 million. It is based on a blended-finance model. Through a combination of grants and equity investment, significantly higher funding levels (up to €17.5 million per company) are possible. The goal is to accelerate the growth of innovative European companies. A total of 75 startups and SMEs can be supported. In the current phase, seven of 142 applications submitted from Germany were successful.

Additional information:
https://ec.europa.eu/easme/en/section/sme-instrument/eic-accelerator-funding-opportunities

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EXAMPLE BOX 15

Support for new firms through accelerators: MaRS Discovery District, Toronto

The MaRS Discovery District offers a broad range of infrastructure and service programs tailored to startups' needs, including networking events, consulting services offered by experts and scale up or recruiting services. One key aspect of the support is access to the MaRS ecosystem, a specially selected group of businesspeople, companies, investors, researchers and government representatives. The MaRS facility offers space to more than 120 tenants, including research institutes and global technology companies. The combination of these three areas (infrastructure, service programs, access to the MaRS ecosystem) is intended to create a highly innovative environment and space for creativity. To date, the facility has supported more than 1,200 high-growth Canadian knowledge- and research-based companies in areas such as clean tech, health, fintech and software. The companies supported since 2008 have raised a total of CAD 6.3 billion, and collectively had a total of 17,200 employees in 2018.

Additional information:
www.marsdd.com/startup-services/

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EXAMPLE BOX 16

Legally regulated leave-of-absence options for employees seeking to found companies (Sweden)

Since 1997, Sweden's Right to Leave to Conduct a Business Operation Act has granted full-time permanent employees the one-time ability to take up to six months of unpaid vacation in order to start a business. The incentive effect lies in the option of returning to the previous activity. The intended new firm may not compete with or lead to any material adverse effect for the founder's previous employer.

Additional information:
http://elibrary.lt/resursai/Uzsienio%20leidiniai/Countries/Sweden/Employment/em2001_02.pdf

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6.

Startup Financing

Examinations of the topic of startup financing tend to narrow quickly to the issue of venture capital (VC) and its availability. However, only a small proportion of innovative new firms are suitable for VC funding (e.g., those with very strong growth prospects, an experienced management team, assessable implementation risks or a clear exit path) or even have a need for significant levels of financing. Moreover, the spectrum of suitable financing forms is considerably broader. In Germany, state funding programs dominate in the initial phase, with public equity capital and business angels often playing an important role immediately after the firm's official establishment. Private venture-capital providers then enter as co-investors, and are dominant in the startup phase – provided that the new firm can meet this kind of investor's high growth requirements.

Often, internet-based and digital business models do not have extensive early financing needs, with greater amounts of funding required only once the companies have demonstrated their feasibility and sustainability. Bootstrapping (forming a company without capital) and lean entrepreneurship (forming a company with little capital) are also possible; indeed, in locations characterized by strong entrepreneurial activity, a large number of projects and new firms using these models have emerged in recent years. In these instances, funding for the company comes from early profits, a model that persists until investors can be convinced to participate or the company can be financed entirely through its own cash flows. Therefore, the topic of external financing is not of great importance for new firms of this kind, at least in the initial phase – although this does not rule out a need for more extensive resources to finance growth at a later phase.

6.1

Government funding programs as a building block of startup financing

As outlined in section 5.1, grants are used in Germany to fund the early stages of startup creation. This means that a well-funded preparatory phase is possible even before a firm has been formally established. The grants represent an important initial building block in startup financing overall, although the primary focus on universities and the research sector, along with limited budgets, means that only a portion of the new firms created every year can be addressed. The programs supporting research-based projects provide considerable amounts of resources for pre-seed activities, for which private investment is rarely available.

Some federal states also offer grant programs for the business-building phase following a firm's formal establishment. However, for the startup phase in a company's development, there is a much broader supply of funding available in the form of equity capital provided by public funding institutions, which often invest alongside business angels or private early-stage funds. In addition, young, innovative companies can take out promotional loans.

The supply of equity capital has grown in recent years.

Public equity capital as a means of supporting the market and leveraging private capital

For many years, Germany was characterized by a pronounced lack of private-sector equity capital in the seed and startup phases. This was in large part due to an unfavorable legal and tax environment (which to some extent is still the case), as well as the significant risk associated with this early developmental stage, and a general sense that the expected returns were too low to justify such risk (Kulicke 2012). With the aim of closing these gaps, particularly following the collapse of the internet bubble and the subsequent slump in the market for private investment in new firms, the High-Tech Gründerfonds (HTGF) was created in 2005, initiated with a significant contribution from today's Federal Ministry for Economic Affairs and Energy (BMWi) and supplemented by partners from the private sector.

In its requirements for young firms seeking capital (growth potential, experienced management team, clear exit path), the HTGF does not differ significantly from private investors, as it would otherwise be impossible to engage in joint financing rounds with such partners, and it would be difficult to complete the crucial follow-on financing rounds so critical for fast-growing businesses. This means that in essence, the HTGF is not a typical provider of public funding, but instead an investor that places high demands on the businesses in which it takes equity. For this reason, it can provide financing for new impact-oriented firms only if these meet the return-on-investment (ROI) requirements it applies to all other new companies.

Following its launch, the HTGF became the most important early-stage investor for tech startups with significant growth potential. It also had considerable influence on the emergence and equity-investment policies of other publicly supported new-firm and technology funds at the state level. Its presence helped to increase engagement by private investors and business angels, and enhanced banks' willingness to provide loans. Even today, it retains a vital function in this segment,[26] although its importance has declined significantly thanks to the surge in availability of private risk capital.

Stabilizing the supply of financing during the coronavirus pandemic

Not long after the beginning of the coronavirus pandemic, the German federal government and a number of federal states began implementing measures seeking to stabilize the supply of financing for new and young innovative companies, with the aim of preserving the successes achieved in recent years. Particularly worthy of note is the coronavirus-related package of measures focused on startups, young technology companies and small Mittelstand firms, with a price tag of €2 billion.[27] The program's first pillar provides public funds that are used to match venture-capital firms' investments in new enterprises. The goal is to enable such funds to continue to be able to make equity investments in innovative and growth-oriented startups, thus shoring up the supply side of the private-sector capital market.. The second pillar is intended to provide access to financing for startups and small enterprises that are not or not yet financed by private investors. To this end, instruments are being created in conjunction with the federal states and regional-level institutions (*Landesgesellschaften*), with the aim of building on existing support structures.

Even before the coronavirus crisis, lawmakers and funding agencies were making concrete efforts to improve the environment for equity investment in Germany. For example, there is a move to reduce hurdles for institutional investors such as insurance companies, pension funds and banks with regard to placing capital in equity-investment funds. The degree to which these and many additional long-requested regulatory changes will be affected by current economic developments is as yet impossible to assess.

New sources of capital aim to offset the negative impact of the coronavirus crisis.

26 To date, the HTGF's nearly 600 portfolio companies have collectively raised more than €2.4 billion from private investors in the form of co-investments and follow-on financing coming after their initial seed investments. The three funds created to date collectively have around €900 million in assets under management. Only about 30 percent of the assets in the third fund (operating since September 2017) have been invested (as of mid-2020). See www.htgf.de/de/ueberuns (accessed on September 1, 2020). 27 See www.bmwi.de/Redaktion/DE/Pressemitteilungen/2020/20200430-2-mrd-euro-massnahmenpaket-fuer-start-ups-steht.html (accessed on September 1, 2020).

6.2

Possible financing gaps for new firms lacking major growth potential

Federal and state funding for innovative new companies following their formal establishment comes primarily in the form of equity investment, with requirements similar to those associated with private-sector venture capital. Indeed, it is rare for public financing to be limited only to grants in the initial stages of development. Moreover, startups also have access to the broad range of promotional loans that are available to all kinds of new firms (primarily through the Kreditanstalt für Wiederaufbau (KfW) and the individual federal states' business-development banks).

However, there is a gap in such offerings for new firms that have significant capital needs, but which lack appeal for equity-capital investors from either the public or private sector. For these entities, promotional credit is not an adequate option, as this can be a burden on companies' liquidity over the long term in cases of slow growth rates. There is currently a lack of empirical evidence regarding the scale of such needs (the number of such firms and the financing volumes required) and the question of how often new firms with economic or non-economic relevance are consequently constrained in their development.

No significant German equity-investment offerings explicitly target new impact-oriented firms

Neither the public equity funds, nor the vast majority of private investment funds in Germany have an explicit focus on new impact-oriented firms. According to the Green Startup Monitor 2018 (Fichter and Olteanu 2019), green startups face considerably greater implementation hurdles than do other startups, for example in raising capital and accessing state funding programs. Among a small group of such companies, equity capital is an important source of financing, with these firms thus appealing to return-oriented investors. For example, the 10 green companies attracting the highest sums of equity investment in 2017 and 2018 collectively raised €319 million, with half going to startup financing, and half going to growth financing. On the other hand, there is a gradually growing number of initiatives, smaller funds, and crowdfunding or crowd investing platforms that can be used to finance social entrepreneurship projects with low capital requirements.[28]

Published information on completed financing rounds show that substantial equity investment sums are today flowing into new impact-oriented firms seeking to help achieve the UN Sustainable Development Goals (SDGs) – as long as the returns typically expected by venture-capital investors are met. According to dealroom.co (2020b), a total of around €6 billion was invested in impact-oriented startups across Europe in 2019. A few mega-deals account for a significant share of this sum, and later-stage financing rounds (capital for late growth phases) are also included. The deals already concluded in 2020 indicate that further growth can be expected. Impact-focused investments represented more than 15 percent of all venture-capital investments in Europe in 2019. This figure has tripled in the last decade. In the United States (just under 10 %) and Asia (about 7.5 %), the importance of such investments remains lower, but is also increasing rapidly.

28 See, for example, the list at www.social-startups.de/finanzierung-fuer-social-startups (accessed on November 18,2020).

6.3

Dynamic equity-capital activity in the private sector

Steep rise in startup investments by private investors

Within just a few years, the equity-capital situation within the German startup segment has fundamentally improved without any significant changes in legal or tax regulations. One indicator in this regard is the steep rise in investments in startups by private investors. The spectrum ranges from business angels, who generally focus on very early stages of a firm's development, to early-stage and venture-capital firms, including funds managed by companies (corporate venture-capital firms) that typically focus on the startup and expansion phases. The boundaries delineating the traditional distinctions between these stages of growth have all but disappeared; at the very least, they have little to do today with a company's age.

At present, the prevailing view is that there is no shortage of risk capital in Germany for companies in the startup phase, but there remains a shortfall for those in the growth phase. Supporting this assessment is the fact that both overall investment volumes and average deal sizes are larger today than in 2012,[29] for example; in addition, the rate of growth shown by investment amounts has exceeded that shown by the number of deals. However, market developments in Germany continue to trail significantly behind those in Southeast Asia or the United States (see, for example, Stresing et al. 2018; Achleitner et al. 2019).

Increasing deal sizes are an indicator that the supply of investment-seeking capital exceeds the demand produced by venture-capital-ready companies. It also signals high return expectations on the part of investors, as well as a need to finance rapid company growth on the part of startups. This means that companies in Germany can now attract very large funding volumes in a single financing round, with such deals no longer representing exceptional cases.[30]

Annual market development data provided by different institutions differ for a number of reasons: their information sources are not identical; the extent to which informal equity-capital investments (usually by business angels) are included varies; and the age ranges of the investment recipients considered differ, with the studies defining "startup" differently. Here, for example, we consider Ernst & Young's (2020) Startup Barometer 2019. This is based, among other sources, on press releases from startups and investors, and includes startups that had been formally established within the previous 10 years. For 2019,[31] it shows the following:

- A total of €6.23 billion in risk capital was invested in 704 startups in Germany, with the second half of 2019 seeing record-breaking national figures (+13 % in the number of deals, +36 % in terms of investment volumes as compared to 2018).
- The bulk of this investment was located in Berlin (proportion of total deals and volumes: 34.7 % and 59 %) and Bavaria (17.5 % and 24.9 %), with North Rhine-Westphalia (11.9 % and 4.3 %) and Hamburg (7.2 % and 4.1 %) trailing well behind.
- Berlin and Bavaria each show above-average deal sizes, generated by a number of major deals with very large financing rounds.

29 Amount of funds pledged to a company by all participating investors in the course of a financing round. In cases of rapid growth, there is typically a series of financing rounds in rapid succession, mostly with different groups of investors, with each round reflecting the company's ongoing development. 30 For example, T-knife GmbH announced in August 2020 that it had raised €66 million in a financing round that included four venture-capital providers. T-knife is a 2018 spinoff from the Max Delbrück Center for Molecular Medicine, with backing from the Charité – Universitätsmedizin Berlin. The firm is developing new cancer therapies using modified immune-system T-cells. See www.mdc-berlin.de/de/news/press/66-millionen-euro-fuer-das-berliner-spin-t-knife (accessed on August 17, 2020). 31 The information provided by the German Private Equity and Venture Capital Association (BVK) reports lower figures, as it does not include investments by business angels, for example. BVK statistics can be found at www.bvkap.de/statistiken/bvk-statistiken-deutschland (accessed on September 7, 2020).

- The major deals affect the sector shares as well; the mobility sector accounted for one-fourth of these investment flows, with fintech/insurtech accounting for just over one-fifth, and software and analytics just under one-fifth.

- The sectoral distribution does not allow conclusions to be drawn as to the share of companies with business models making a contribution to addressing societal challenges.

- Around three-quarters of the investments made in 2019 involved sums lower than €5 million, while about 10 percent were between €5.1 million and €10 million, and another 10 percent between €10.1 million and €50 million. The top 20 were all over €50 million, with 13 – all coming within a single financing round – exceeding €100 million.

Figure 8 highlights the dynamism of startup financing both Germany-wide and in the federal states receiving the most investment. Berlin's dominance in 2015 had weakened by 2019, with its share in investment volumes declining from 79.0 percent to 59.3 percent, and the share of deals falling from 58.5 percent to 37.2 percent. Other locations are thus catching up. Despite being ranked at third place, the large state of North Rhine-Westphalia accounts for comparatively few deals. Baden-Württemberg is not in the top group.

The dealroom (2020a) study on venture-capital investment in Berlin shows that even in Germany's hotspot, this source of funding does not play a role for the majority of companies founded over the course of a given year. The study notes that 78.2 percent of the 1,940 startups launched in Berlin since 2006 had been built without venture capital. Among the remaining 423 startups, there had been nine megadeals (totaling €250 million or more), while others had benefited from extensive financing rounds. According to this study, a record-breaking sum of €11.4 billion was invested in Berlin startups between 2015 and 2019, although some of these had been founded more than 10 years previously. Venture-capital investment flows were particularly high in 2019, reaching a total of €4.1 billion.

Business angels are an important group of investors for early-stage companies; however, the number of such figures in Germany can only be estimated. Berger et al. (2020), examining data for 2015 and 2018 from the IAB/ZEW Startup Panel, show that between 6,400 and 12,900 professional business angels had engaged with these new-firm cohorts. Moreover, these funders had invested in an average of three to six companies within these cohorts.

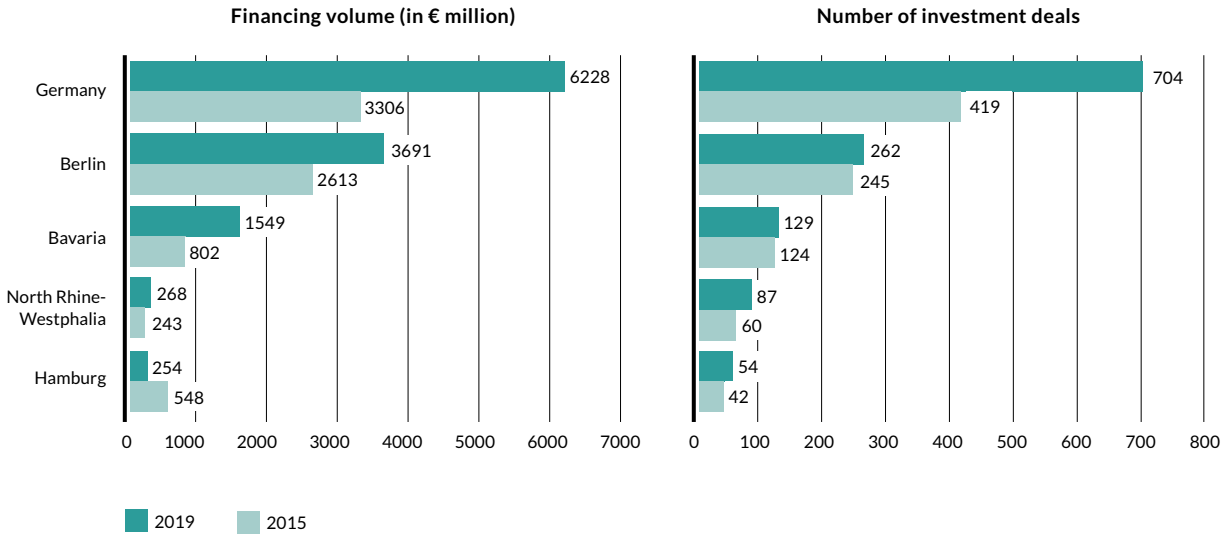
Increasingly, following the sale of their company shares, successful founders are taking on the role of business angels, investing in the coming generation of founders. However, the exit option of an initial public offering is rarely available in Germany. In such cases, exits by equity investors or the original founders most often take place through the sale of shares to other companies.

Appeal of the emerging German startup scene for foreign investors

Metropolitan areas in Germany with many capital-seeking, potentially high-growth startups have seen a strong inflow of foreign capital. As a consequence, large investors, accelerators and other entities have set up local branch offices. The German hotspots identified above, especially Berlin, have been experiencing such effects for a number of years. This development has also been viewed critically by some (e.g., Achleitner et al. 2019), who attribute it to the lack of large domestic funds, as well as the lack of opportunities afforded to German institutional investors to invest domestically. This trend could lead to a displacement of domestic capital by foreign investors, which carries the risk of an outflow of technology if the shares are sold to other foreign companies upon the investors' exit.

FIGURE 8

TRENDS IN FINANCING VOLUMES AND INVESTMENT DEALS



Source: Ernst & Young 2020

6.4

More patient capital is needed for low-growth firms

Equity capital can, of course, be held only temporarily, that is, until the company that has taken the investment reaches an enterprise value allowing for substantial capital gains. Time horizons in the early-stage segment are in this regard shorter than in later stages. Early investors expect an increase in value in just a few years, so that they can sell their stakes and generate substantial returns on their investment. However, some innovative new companies require more time before they are able to generate growth, and thus also need "patient capital" that remains in the company for longer periods, with lower ROI expectations (Achleitner et al. 2019). Such firms' ability to attract investment is reduced if these funders have alternatives, as is currently the case; among the new firms seeking risk capital today, many have digital business models that show the potential for rapid growth.

New enterprises needing patient capital also tend to entail significant implementation risk and uncertainty before their sustainability can be accurately assessed, and before market revenues can be expected (particularly in the life sciences, but also in "traditional" industries). A certain share of new sustainable or socially oriented enterprises also have needs of this nature, as they cannot match the growth expectations of profit-oriented companies. There is currently only a limited amount of patient capital available in Germany (Achleitner et al. 2019).

A portion of the spinoffs from universities also have a need for patient capital; for this reason, universities in the United States and United Kingdom, or partners working closely with them, have for years operated so-called university venture funds (UVFs). Efforts by German universities to create their own similar funds have not been successful.

The German federal government's funding programs for the creation of new research-based companies (e.g., the GO-Bio competition, EXIST Transfer of Research program) can also be seen as an alternative to patient capital. That is, they provide financing through a protracted preparatory phase, during which extensive R&D work is still being carried out in the origin organization, the business model is being developed, resources for the creation of the company are being secured, and so on. The formal establishment of the company takes place only once a relatively advanced state of implementation has been reached. Moreover, grants are also available for the first steps taken toward implementation.

In the United States, this form of UVF did not take hold until recently. A first fund was created in the 1980s at the University of Chicago's technology transfer office (these ties were cut in 1992, after which it continued as one of the largest research-focused funds in the United States). However, only a few American universities ultimately created their own funds, with the majority instead working closely with traditional risk-capital investors. The situation is somewhat different in the United Kingdom. ► **Example box 17.** UVFs finance spinoffs based on technologies whose development require more time and resources than is the case for startups emerging from companies. Conventional equity investors in the United States and the United Kingdom aim at financial returns after three to five years; thus, startups with longer developmental phases are less attractive to them if a market breakthrough can be expected only after eight to 10 years.

University-aligned risk-capital funds focus their investments on opportunities that emerge from the universities, and typically draw on capital provided by the universities themselves as well as resources from private, "patient" investors. The investor circle also includes highly successful previous spinoffs that were created with support from the university.

EXAMPLE BOX 17

Financing startups through university-supported funds: University venture funds with patient capital, United Kingdom

In the United Kingdom, university risk-capital funds were created beginning in 2000, initially at the University of Oxford. Most university funds were created in their current form a few years later, including Imperial Innovations at Imperial College London in 2006, the University of Manchester's UMIP Premier Fund in 2008 (with GBP 32 million in assets under management), and Cambridge Innovation Capital in 2013 (currently totaling GPB 125 million, contributed jointly by the University of Cambridge and its most successful spinoffs).

After Imperial College's technology transfer office was floated on the London Stock Exchange, significant sums were contributed to the fund, enabling it to raise more than GBP 300 million for equity investments in spinoffs from the university. In 2020, Imperial Innovations and the university parted ways (Touchstone). The latter risk-capital fund now invests in spinoffs from universities in the greater London area and the southeast of England.

Additional information:
https://innovation.ox.ac.uk/award-details/university-oxford-isis-fund-uoif/

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6.5

Lack of financing options for new sustainability or impact-oriented firms

For many years, Germany lacked any funding programs tailored to the needs of new sustainability or impact-oriented startups. Nor were these firms' specific requirements reflected in the funding conditions or evaluation criteria of federal or state-level programs for new innovative knowledge- or research-based enterprises.[32] Among the private investors in the German Private Equity and Venture Capital Association's (BVK) membership, not a single one has a focus on impact-oriented startups that explicitly want to contribute to solving societal or environmental problems. However, since 2019, the German Federal Environmental Foundation's (DBU) Green Startup program has offered an option for new firms and startups that innovatively combine solutions for the environment, ecology and sustainability with a focus on digitalization.[33]

Internationally, there are a wide range of programs involving grants, equity investment and other support mechanisms focused on the creation of new sustainable or socially oriented firms, generally offered by foundations, sponsors, non-government organizations, accelerators and other similar entities.[34] Most focus on "social projects" rather than new social enterprises, which also have the goal of realizing financial returns. The EU additionally offers options for social entrepreneurship that are available to existing and newly founded companies.[35]

In Germany too, the topic of social entrepreneurship has attracted significant attention over the past decade, and private financing offers have emerged particularly for projects with low capital requirements.[36] However, this has not yet been reflected in public funding programs tailored specifically to this form of entrepreneurial activity, and which would offer funding sums exceeding just a few tens of thousands of euros. In this regard, two forms of new firms must be distinguished. With regard to the extent of societal impact, the absolute number of startups is not the most critical measure – particularly if their business activities are primarily small-sale, they have only a few employees over the long term and their programs do not have far-reaching consequences for existing companies. Appreciable societal impact is produced primarily by new firms that combine a social or environmental business model with significant potential for growth or impact (new impact-oriented firms). This need not be a contradiction, for example in the case of products for efficient energy use that meet with widespread adoption, or solutions that facilitate better healthcare in rural areas.

If Germany's government in fact increases its focus on sustainability requirements for new firms and funding programs, as promised in its High-Tech Strategy 2025 (BMBF 2018), a significant and societally desirable revaluation of social and environmental business models with broad impact is likely to take place.

32 For Germany's social entrepreneurship performance in international comparison, see ICF Consulting Services 2014; Göler von Ravensburg et al. 2018; Oestreich und Fuchs 2019; Thomson Reuters Foundation 2019. 33 See www.dbu.de/startup (accessed on October 23, 2020). 34 See https://globalpeacecareers.com/magazine/40-social-enterprise-grants-for-your-consideration/ (accessed on October 23, 2020). 35 See https://ec.europa.eu/social/main.jsp?catId=952&intPageId=2914&langId=en (accessed on October 23, 2020). 36 See, for example, the overview at www.social-startups.de/finanzierung-fuer-social-startups/ (accessed on October 30, 2020).

THE ISSUES IN BRIEF

- Grants often constitute the initial building block for startup financing overall.
- For many years, equity capital provided by publicly funded business-development banks served to stabilize the market while private capital showed low levels of investment. It still helps to leverage private capital investments today.
- The market for early-stage financing has been quite dynamic for a number of years, with the amount of capital invested increasing significantly. Equity capital is invested by a variety of different providers with different strategic interests (business angels, early-stage firms, venture-capital firms, corporate venture-capital firms). For startups with significant growth potential, there is currently no shortage of funding offers.
- The emerging German startup scene holds substantial appeal for foreign investors, who are often involved in large financing rounds. There is a broad lack of large German funds, and institutional investors in Germany have limited ability to invest in equity-based funds.
- The majority of newly created firms do not have major growth potential. There may be a funding gap within this segment. In addition, there are no equity-investment offerings explicitly tailored to new impact-oriented firms. There is also a lack of the patient capital needed by startups whose business models do not allow for rapid growth.
- Relatively swiftly following the outbreak of the coronavirus pandemic, public funding measures were implemented that sought to secure the successes achieved by startups and send encouraging signals to aspiring founders. These may have contributed to the fact that there has not been a slump in early-stage financing, as was feared at the beginning of the pandemic.

7.

Outlook and action areas

Germany and Europe face major economic and technological challenges in maintaining their competitiveness as well as profound societal challenges that involve addressing problems such as climate change, demographic change, and ensuring effective healthcare. Innovations are crucial to progress as they develop new technologies, strengthen economic power, help conserve natural resources and ensure advances are made in social progress. Particularly in this context, startups play an important role as those businesses that set the trends as the drive and develop groundbreaking solutions. This paper should therefore be seen as part of a larger effort to advocate for an ambitious innovation policy that bolsters startups' ability to act in this capacity and treats them as essential to a country's innovation landscape.

Despite the gains made, Germany's startup system lags behind in international comparison

In recent years, Germany has seen dynamic growth in efforts to found innovative firms. Vibrant startup ecosystems have emerged in several of the country's urban regions, and the volume of risk capital flowing into startups has reached unprecedented levels. Now celebrated by politicians, existing companies and, increasingly, by society, startups have begun attracting a great deal of media attention. Successful new companies have become role models for those interested in setting up their own business and inspire others to consider engaging in entrepreneurial activity.

Pointing the way forward, startups are key drivers of economic development.

This boom has been triggered by the process of digital transformation affecting much of our working and private lives and which has opened up many business opportunities with low hurdles to entry. Sustainable business models are also playing an increasingly important role in addressing the aforementioned societal challenges.

This favorable trend is likely to continue, and will probably intensify, after the coronavirus crisis: Ongoing changes in the world of work suggest we will see an intensified surge toward digital transformation. Furthermore, the crisis has underscored the vital role young companies can play in research on vaccines and active substances – a role that is also conceivable in other areas. An increase in growth opportunities for newly founded businesses seems likely which, in turn, would make them more attractive to investors.

However, this dynamic growth – seen primarily in Germany's metropolitan areas – should not obscure the fact that the country continues to lag behind, particularly with regard to innovative and rapidly growing startups. In international comparison, Germany has yet to catch up with other leading industrial nations such as Israel or the United States. A low level of new-business activity is also evident in the number of early-stage investments, which have not grown anywhere near the extent to which investment volumes and average deal sizes have. Only a small share of innovative new companies are attractive to private, return-oriented venture capital because of their growth potential. This is also true of the apparent increase in the number of new companies that aim to develop solutions to the many challenges facing society.

Continued gaps in the funding landscape

Germany has extensive measures in place that are designed to support startups. Over the last two decades, these measures have been focused on the university sector. To date, however, there have been no offerings that are specifically tailored to innovative projects based in existing companies. Similarly, there is a lack of funding explicitly targeting impact-oriented companies or those which may be slow to reach a market breakthrough.

Apart from the fact that potential founders can find attractive employment alternatives in existing companies, one of the main reasons accounting for Germany's "startup gap" is the low level of interest in entrepreneurial activity in the country. One means of addressing the issue is found in the professional training provided through measures aimed at creating an entrepreneurial and commercialization culture across universities and non-university research institutions. Researchers in the research sector face a number of structural obstacles to targeting commercialization. In addition, there are far too few opportunities to transform knowledge and research results into economic value creation.

For nearly every weak point, there's a tailor-made solution

Areas demanding action in the initial company-creation phase are rooted in Germany's startup gap and still-nascent culture of commercialization:

- One of the country's strengths is the support provided for startups that begins as early as the pre-seed stage. This support should be expanded and made accessible regardless of the institutional background of those interested in starting a business:
  - The few existing funding programs for specific fields of technology (e.g., life sciences or photonics) should be extended to include other tech sectors as well, such as the IT sector more broadly and those developing tech solutions to climate change.

  - Funding opportunities should also be opened up to aspiring founders from existing companies or other organizations and thereby make it possible for such individuals to properly prepare themselves for such a transition. This is particularly important for those ventures that must undergo a lengthy, multi-step process, such as research-based firms. Explicitly addressing this kind of potential can result in a larger number of promising new businesses among founders who bring with them their business experience, market knowledge, networks and business partners.

  - Funding opportunities should also move away from the strictures of fixed deadlines that allow for applications to be submitted only once a year or every six months. Replacing this with an ongoing, rolling application process in which decisions are made swiftly allows those interested in setting up a company to do so quickly.

- In order to tap the innovation potential of impact-oriented firms more effectively, the scope of funding options should be significantly expanded:
  - this can be done by incorporating suitable evaluation criteria into existing funding programs (i.e., creating a dedicated funding line for such startups);

  - or by creating a specific funding program that is tailored to their specific needs, which would increase visibility and send a strong signal to others potentially interested in starting a business.

- Researchers at universities and non-university research institutions should have greater flexibility to commercialize their research results and increase the impact of their work. The urgent nature of the societal and ecological challenges we face suggest that we should do more to tap the potential found in German research institutions and their extensive activity while unleashing the creativity for new approaches to promoting and leveraging new businesses. Examples from abroad show the extent to which other dimensions are possible in terms of funding commercialization. Universities in other countries attach greater importance to activities that aim to increase the societal and economic impact of research findings. Their aim is to break down the rigid barriers between scientific research on the one hand and economic value creation on the other. In addition,

funding programs and financing options at such institutions broaden researchers' ability to test the applicability and feasibility of new approaches. These researchers also have access to much broader networks and teams of professionals that provide assistance. Improving the situation in Germany involves taking a variety of actions:

- Treat and promote development and commercialization activities as an intrinsic part of research projects so that they can follow seamlessly on the heels of R&D. This means at first taking full advantage of current EU funding requirements and, where possible, work toward expanding the scope of these opportunities, even if this is in all likelihood a lengthy process.

- Expand funding opportunities that target those activities where research and commercialization meet to address Germany's persistent funding gap. Good examples to draw on here are Israel's KAMIN, Ireland's Commercialisation Fund Programme, Denmark's POC and Canada's Idea to Innovation Grants. Quickly accessed funding offers should be made available to those with low levels of short-duration need (e. g., as with the Ignition Award Program at Boston University). Strengthening the translation of ideas into marketable products, processes and transfers, as specified in the German government's High-Tech Strategy, can help the country achieve the goals stated in both the Ministry for Economic Affairs and Energy's and Ministry of Education and Research's transfer initiatives.

- Create stronger incentives for (young) researchers to pursue the potentially (societally relevant) effects of their research (e. g., along the lines of the ETH Lausanne's Pitch Your Impact competition or ETH Zurich's Pioneer Fellowships program). More should also be done to show them the different means of leveraging research results that are protected by intellectual property rights (e. g., as per ETH Zurich's guidelines for spinoffs).

- Establish pilot-style funds targeting developmental research and commercialization for research institutions and thereby allow them to respond flexibly to funding needs (e. g., university validation funds that help bring ideas to market in the United States, the United Kingdom and the Netherlands). This requires at the very least initial funding in the form of grants. In addition, longer-term refinancing should be sought through the potential returns on commercialization. However, in the past 15 years, several attempts by German research organizations to pursue such an idea have failed.

- Funds of this type or, more generally, efforts to strengthen technology transfers and enable spinoffs require the professionalization and expansion of staff at German universities in the context of their "third mission" in line with that found at research universities in other countries (e. g., KTH Innovation at the Stockholm University of Technology, ETH Transfer at the ETH Zurich, Yissum at the Hebrew University of Jerusalem, and T^3 at the Technion University in Haifa).

- Instead of focusing exclusively on the classic paradigm of "transforming researchers into entrepreneurs," support should address other, new routes to setting up a company:
  - Founding without a founder: In this model, universities provide the context in which the technological basis of a business model originates; re-

searchers, or those with the know-how, do not themselves leave this environment. Business-building activities are carried out by company or start-up experts. Germany currently lacks the requisite conditions needed for this approach, which is widespread at research universities in the United Kingdom, for example (e.g., the network of universities and suitable companies available to Imperial College in London, and a willingness among researchers to commercially leverage their research). Ensuring that structured, intensive support for researchers interested in founding a company is an established feature of a university – as is the case at Imperial College (Founders Choice Programme) – would be a promising place to start. This should not mean, however, that researchers themselves have to take on all the tasks involved with starting a company.

– Joint ventures by universities and companies that leverage the benefits of both worlds: This model would be particularly beneficial to high-risk impact startups, which is something companies tend to shy away from when acting on their own. This is the approach taken by the Technion EIR program at T^3 of the Technion University in Haifa. Through this program, entrepreneurs interested in starting a company work together with the technology-transfer office to explore and act on founding opportunities at the university.

– Make it easier for eligible new firms to access funding: This involves supporting in equal measure innovators and adaptors (the impact potential, not the technology content is the decisive funding factor) as well as projects with a differentiated business plan or those that take a more evolutionary approach (i.e., learning-by-doing, the so-called Facebook approach). It can also involve classifying innovations that address societal challenges as a distinct category among the selection criteria.

- Innovative new companies that are not attractive to conventional investors should have improved access to risk capital. The same applies to companies showing moderate growth and which require patient capital. Major universities in the United Kingdom have their own risk-capital funds, to which former spinoffs have become key contributors after having achieved rapid growth. This kind of system helps make patient capital available. The University of Zurich also has access to a similar fund slated for spinoffs. The growing number of successful companies emerging from research institutions should be leveraged to mobilize capital by targeting alumni specifically.

8. APPENDIX

8.1

Global research on good practices – our interview partners

INSTITUTION/ORGANIZATION	INTERVIEW PARTNER
1E9 (Munich)	Herbert Mangesius
acatech – National Academy of Science and Engineering (Munich)	Dr. Jan Henning Behrens
Bertelsmann Foundation (Washington)	Irene Braam
Briter Bridges (London)	Dario Giuliani
Bundesverband Deutsche Startups e. V. (Berlin)	Christoph J. Stresing
Business Finland (Helsinki)	Pekka Sivonen
Canadian Institute for Advances Research (CIFAR) (Toronto)	Rebecca Finlay
Center for Data Innovation (Brussels)	Eline Chivot
Centre for Social Innovation (Toronto)	Raissa Espiritu
Co-Lab Sweden / Förnyelselabbet (Stockholm)	Pia McAleenan
Digital Catapult (London)	Brian MacAulay Cordelia O'Connell Jessica Rushworth
Ecosia (Berlin)	Dr. Wolfgang Oels
European Commission – Directorate-General Research and Innovation (RTD) (Brussels)	Maximilian Steiert Renzo Tomellini Isabel Vogler
Federal Ministry for Economic Affairs and Energy (BMWi) (Berlin)	Thomas Jarzombek, MdB
Federal Ministry of Education and Research (BMBF) (Berlin)	Engelbert Beyer Dr. Gisela Philipsenburg

INSTITUTION/ORGANIZATION	INTERVIEW PARTNER
Fonds de Recherche du Québec (FGR) (Montreal)	Julie Dirwimmer Sophie Gauthier-Clerc Benoit Sévigny
Founders Foundation (Bielefeld)	Sebastian Borek
German Chamber of Commerce and Industry in Japan (AHK Japan) (Tokyo)	Dr. Lucas Witoslawski
German Consulate General Montreal	Dr. Markus Lang
German Institute for Japanese Studies (DIJ) (Tokyo)	Dr. Susanne Brucksch Prof. Dr. Franz Waldenberger
German Research Center for Artificial Intelligence (DFKI) (Berlin)	Julia Gundlach
Innosuisse (Bern)	Eliane Kersten Marc Pauchard
Innovate UK – UK Research and Innovation (UKRI) (London)	Dan Hodges
Innovation Policy Lab – Munk School of Global Affairs and Public Policy, University of Toronto	Travis Southin Prof. David Wolfe, PhD
Institute for Competitiveness (I-Com) (Brussels)	Mattia Ceracchi
Internet Economy Foundation (IE.F) (Berlin)	Amelie Drünkler Clark Parsons
Japan Science and Technology Agency (JST) (Kawaguchi)	Prof. Hiroshi Nagano Tomoko Sawada
Kienbaum Consultants International (Cologne)	Stephan Grabmeier
Laboratorio de Gobierno (Santiago de Chile)	Roman Yosif
LabX – Laboratório de Experimentação da Administração Pública (Lisbon)	Bruno Monteiro
Lindholmen Science Park (Göteborg)	Tord Hermansson

INSTITUTION/ORGANIZATION	INTERVIEW PARTNER
MaRS Discovery District (Toronto)	Matthias Oschinski, PhD Dwayne Simms
Max Planck Institute for Innovation and Competition (Munich)	Prof. Dietmar Harhoff, PhD
Ministère de l'Économie et de l'Innovation Québec (Montreal)	Inji Yaghmour
Ministry of Economic Affairs, Agriculture & Innovation (The Hague)	Luuk Klomp
Ministry of Economic Affairs and Climate Policy (The Hague)	Koen de Pater
Ministry of Economic Affairs and Employment of Finland (Helsinki)	Anita Silanterä Kirsti Vilén
Ministry of Economic Development, Job Creation and Trade Ontario (Toronto)	Vasu Daggupaty Alex Lee Ernst Lueger
Mitacs (Montreal)	Coryell Boffy
Montreal Institute for Learning Algorithms (Mila) (Montreal)	Stéphane Létourneau
Nesta (London)	Peter Baeck Albert Bravo-Biosca, PhD Marieke Goettsch Eva Grobbink
Ontario Digital Service (Toronto)	Waqas (Wes) Iqbal
Organisation for Economic Co-operation and Development (OECD) (Paris)	Caroline Paunov

INSTITUTION/ORGANIZATION	INTERVIEW PARTNER
PHINEO gAG (Berlin)	Dr. Andreas Rickert
Prototype Fund – Open Knowledge Foundation Deutschland e. V. (Berlin)	Adriana Groh
Reinhard Mohn Institute for Corporate Management, University Witten/Herdecke	Prof. Dr. Guido Möllering
Roland Berger GmbH (Berlin)	Dr. Julia Oppermann
RWTH Aachen, Center Smart Services (Aachen)	Benedikt Moser
SDGx (Berlin)	Christian Walter
Sitra (Helsinki)	Timo Hämäläinen, PhD Markus Kalliola Paula Laine
Staatslabor (Bern)	Alenka Bonnard
Startup Genome (Berlin)	Marc Penzel
Swedish Incubators & Science Parks (Stockholm)	Kajsa Hedberg
UnternehmerTUM (Munich)	Johannes von Borries
Vector Institute (Toronto)	Cameron Schuler
Vinnova (Stockholm)	Göran Marklund Judit Wefer, PhD
ZEW – Leibniz Centre for European Economic Research (Mannheim)	Dr. Georg Licht

8.2

List of good practices

	AREA	GOOD PRACTICE EXAMPLE
1	Funding programs for improving the commercialization of publicly funded research results	KAMIN – Incentive Program (Israel); Commercialisation Fund Programme Ireland); Proof of Concept (POC; Denmark); Idea to Innovation Grants (Canada); ERC Proof of Concept (EU)
2	University validation funds for pre-commercialization work	University Challenge Seed Fund (UCSF), United Kingdom; Twente Technology Transfer Fund (TTF), the Netherlands; Deshpande Center, Massachusetts Institute of Technology (USA); Ignition Award Program, Boston University (USA)
3	Exploring the potential impact of research results	ETH Lausanne's Pitch Your Impact competition
4	Leveraging the commercialization potential of research results	Pioneer Fellowships program at ETH Zurich
5	Professional technology-transfer and business-building support within the university	Oxford University Innovation (United Kingdom)
6	Guidelines for university spinoffs	ETH Zurich spinoff guidelines
7	Spinoff program tailored to researchers' experience levels	Founders Choice, Imperial College London (United Kingdom)
8	Technology transfer and spinoff funding at universities	Yissum Technology Transfer Office, Hebrew University Jerusalem (Israel)
9	Early-stage investment in new firms created by recent graduates or research staff	Imperial College London's Innovation Fund (United Kingdom)
10	Transfer of research results into commercial use	The University of Zurich's UZH Life Sciences Fund for spinoffs (Switzerland)
11	Support by university-associated incubators	AplusB Scale-up in Austria
12	Support for new high-tech firms in the university environment	T^3 Technion Entrepreneur in Residence (EIR) program at Technion University in Haifa (Israel)
13	Commercialization of new technologies in the university environment	KTH Innovation Stockholm (Sweden)
14	New firms with significant funding needs, with early involvement of private capital	EIC Accelerator (EU)
15	Support for new firms through accelerators	MaRS Discovery District, Toronto (Canada)
16	Legally regulated leave-of-absence options for employees seeking to found companies	Right to Leave to Conduct a Business Operation Act (Sweden)
17	Financing startups through university-supported funds	University venture funds with patient capital (United Kingdom)

8.3

List of figures

8.4

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CONTACT

Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Germany
Phone: +49 5241 81-0
www.bertelsmann-stiftung.de

Dr. Daniel Schraad-Tischler | Director
Program Shaping Sustainable Economies
Phone: +49 5241 81-81240
E-Mail: daniel.schraad-tischler@bertelsmann-stiftung.de

Dr. Jan C. Breitinger | Project Manager
Program Shaping Sustainable Economies
Phone: +49 5241 81-81328
E-Mail: jan.breitinger@bertelsmann-stiftung.de

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Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Germany
Phone: +49 5241 81-0
www.bertelsmann-stiftung.de

Responsible for content
Dr. Daniel Schraad-Tischler | Dr. Jan C. Breitinger

Author
Dr. Marianne Kulicke

Scientific analysis
Fraunhofer-Institut für System- und Innovationsforschung ISI,
www.isi.fraunhofer.de

Contribution
Gabriel Zech

German language editing
Heike Herrberg

Translation
Barbara Serfozo

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Address | Contact

Bertelsmann Stiftung
Carl-Bertelsmann-Straße 256
33311 Gütersloh
Germany
Phone: +49 5241 81-0

www.bertelsmann-stiftung.de/fosteringinnovation

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