Fostering Entrepreneurship In Higher Education: Complete Report

A Comparative Study of Silicon Valley and Germany

Insights and Recommendations for Enhancing Stand-up and Spin-off Ventures in German Universities.

Study by Cambrian Futures
Commissioned by DWIH San Francisco

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Land of Ideas

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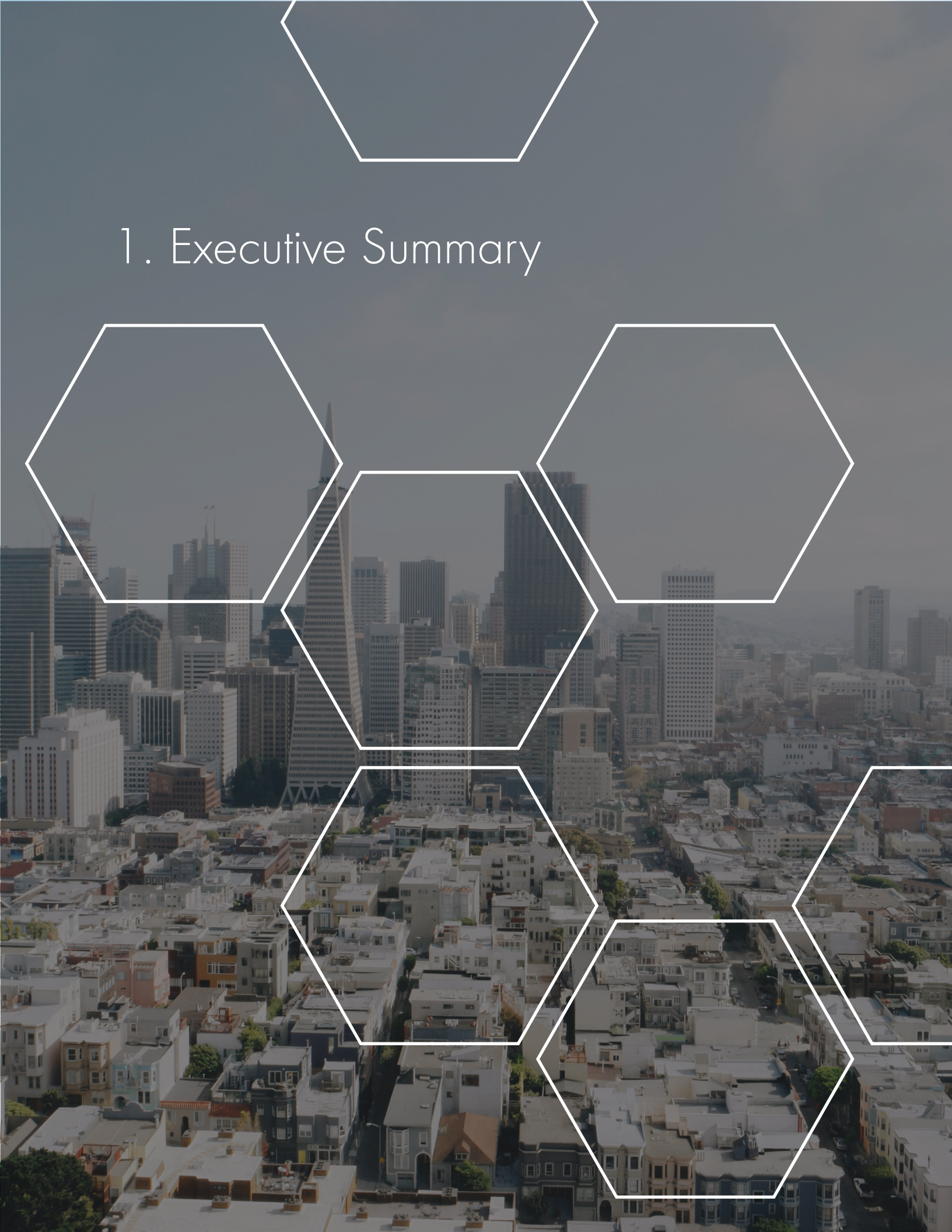

1. Executive Summary

Higher education institutions serve as one of the world's largest drivers of economic and societal well-being, going beyond education and research to take an active role in entrepreneurial, innovative, and technological growth. The United States, and California in particular, have become exemplars of how technology transfer and university-born entrepreneurialism can transform business, government, and cultural life. Countries, states, cities, and universities worldwide have sought to replicate Silicon Valley's model with varying degrees of success. While technology transfer and entrepreneurial success are never a "one size fits all" story, California and its university-to-business pipeline provide a useful guide for higher education institutions worldwide.

This report provides a comparative view of the technology transfer and entrepreneurship ecosystem between Germany's and California's institutes of higher education. It seeks to provide recommendations, selected and/or tailored for Germany's unique realities, that could expand the capacity of its universities to better capitalize on university-generated intellectual property (IP) and the entrepreneurial energy of their faculty, researchers, and students. Such cross-border and cross-cultural comparisons come with inherent limits, some overt and some more subtle. The countries' different legal and institutional frameworks pose an obvious challenge to this type of analysis. Limited data on different types of university-originated ventures complicate efforts to make direct quantitative appraisals. Even the degree to which broader cultural and societal factors differ, such as attitudes toward risk tolerance, affect entrepreneurial activity and mindsets around university ecosystems.

To account for these limitations, this analysis employs an "innovation ecosystem" lens, which extends beyond legal and institutional frameworks to examine a wider array of factors that enable or hinder entrepreneurship in higher education. Innovation ecosystems involve the interplay of the academic, private, and public sectors and their collective focus on developing inventions and scaling them into innovations that potentially shape how economies and societies evolve. Working from that innovation ecosystem perspective, the study compares Germany and California across five key dimensions: 1) intellectual property and personnel law; 2) organizational capacities and networks; 3) talent pools and practices; 4) mindset, culture, and education; and 5) funding landscape for university ventures. The chapters that follow provide a breakdown of each of these dimensions, as well as recommendations based on that analysis.

Intellectual Property And Personnel Law

Following the introduction in Chapter 2, Chapter 3 delves into the historical development and contemporary state of legal and programmatic frameworks in the U.S./California and Germany, with a particular emphasis on intellectual property (IP) law, personnel, and employment law. While both countries recognize the crucial role of universities in technology transfer, Germany has realized less success in patenting and patent commercialization activities, despite modeling its IP laws after the U.S. This is partly due to the lack of emphasis on patent commercialization and the neglect of auxiliary laws, such as budgetary regulations or state aid law, which persistently hinder universities today. While German institutions have begun incentivizing more startup endeavors among researchers, the prevalent risk-averse culture still curtails entrepreneurial initiatives.

Recommendations:
For IP Law[1]

- Establish a national priority list of innovation spaces and incentives for Länder and their universities to generate IP
- Establish fast track and additional funding for promising patents
- Establish a central advisory unit for IP commercialization

For Personnel And Employment Law

- Establish federal professional development and similar career path opportunities
- Make entrepreneurial activities a component of academic careers
- Promote entrepreneurial skills and exchange with the private sector

Organizational Capacities And Networks

Chapter 4 delves into the differing organizational capacities and networks in the two countries. Technology transfer offices (TTOs) play an indispensable role in efforts to promote IP commercialization and entrepreneurial activity. A narrower focus and sparser resources for German TTOs have hindered their effectiveness. While Germany has produced a strong model of regional clusters and hubs of industrial activity that bridge the higher-ed and business communities, adopting the more multi-sectoral types of collaboration seen in California could further enhance these relationships.

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[1] Additional details of these recommendations follow the analysis in the subsections of each chapter.

Recommendations:
For Technology Transfer Offices

- Strengthen the TTO network in Germany and establish exchange platforms with TTO networks in the U.S.
- Develop and promote specialized programs for technology managers
- Create programs between TTOs and business, science, and engineering schools
- Create a global partnering and bridging network with industry incubators and accelerators instead of building isolated university programs

For Mechanisms To Promote University-Industry Collaboration

- Experiment with government funding of multi-university and interdisciplinary collaborations
- Set up DATI as a TTO-like national service platform
- Connect venture capital and corporate venturing groups to DATI

Talent Pools And Practices

Chapter 5 shifts focus slightly from structural and institutional frameworks to the core roles that human talent pools and practices play in the acceleration of tech transfer and entrepreneurship. In both California and Germany, migrants fuel significant shares of entrepreneurial activity, underscoring the importance of factors such as language and mentorship. These elements can help retain talent, but additional legal and financial incentives could help Germany become a more enticing home for the world's top students, researchers, professors, and startup founders.

Recommendations:
For The Role Of Migrants In Entrepreneurship

- Introduce English as a second official language in Germany
- Induce founders in the U.S. to open a second headquarters for Europe in Germany
- Design a program for scientists of German origin in the U.S. and elsewhere to become mentors for the next generation of German entrepreneurs

For Talent Attraction And Retention At Universities

- Increase the share of English-language programs at German (excellence) universities
- Foster student exchange between U.S. and German universities
- Offer free certificates in entrepreneurship, venture finance, and IP regulations and processes to foreign students

Mindset, Culture, And Education

Chapter 6 widens the innovation ecosystem lens even further to consider the sometimes hard-to-define but critical role that mindset, culture, and education play in universities' entrepreneurial ecosystems. This perhaps shows the starkest contrasts between California and Germany, where a shift toward a more entrepreneurial and risk-tolerant mindset would likely enhance tech transfer and startup formation. An expanded emphasis on interdisciplinary and entrepreneurial education with more experiential and problem-based programs would help instill the social-emotional skills that drive entrepreneurship (e.g. grit, resilience, and networking).

Recommendations: For Culture And Mindset In Higher Education And Innovation Ecosystems

- Actively support bottom-up development of highly local startup communities
- Create strategies to facilitate and enhance trust as the most valuable currency for professional transitions and information exchange
- Create networking and collaboration platforms with trusted transaction mechanisms

For Interdisciplinary And Entrepreneurial Education

- For undergraduates, incentivize and enable more openness to interdisciplinary studies and IP collisions
- For graduates and researchers, incentivize and enable cross-functional and cross-border team formation
- Integrate experiential learning
- Encourage interdisciplinary collaboration and hubs
- Develop and/or expand digital entrepreneurship platforms

Funding Landscape

In Chapter 7, the report concludes with an analysis of venture funding around the higher-education institutions in California and Germany, looking at the status of both early- and late-stage funding. The longstanding and robust venture-funding environment in the U.S. and California has spawned a diverse set of capital sources, including everything from government grants, to crowdfunding and alumni investing. Germany relies far more heavily

on government grants and, despite recent capital-market reforms, it will need to incentivize domestic startup investment in ways that diversify the funding sources for universities' startups and entrepreneurs. Finally, while regulations governing foreign acquisition of both public and private companies in the United States are relatively streamlined and mature, Germany's regulatory environment is somewhat less efficient and sub-optimally arranged for venture exits through foreign acquisition.

Recommendations:
For Early-Stage Funding

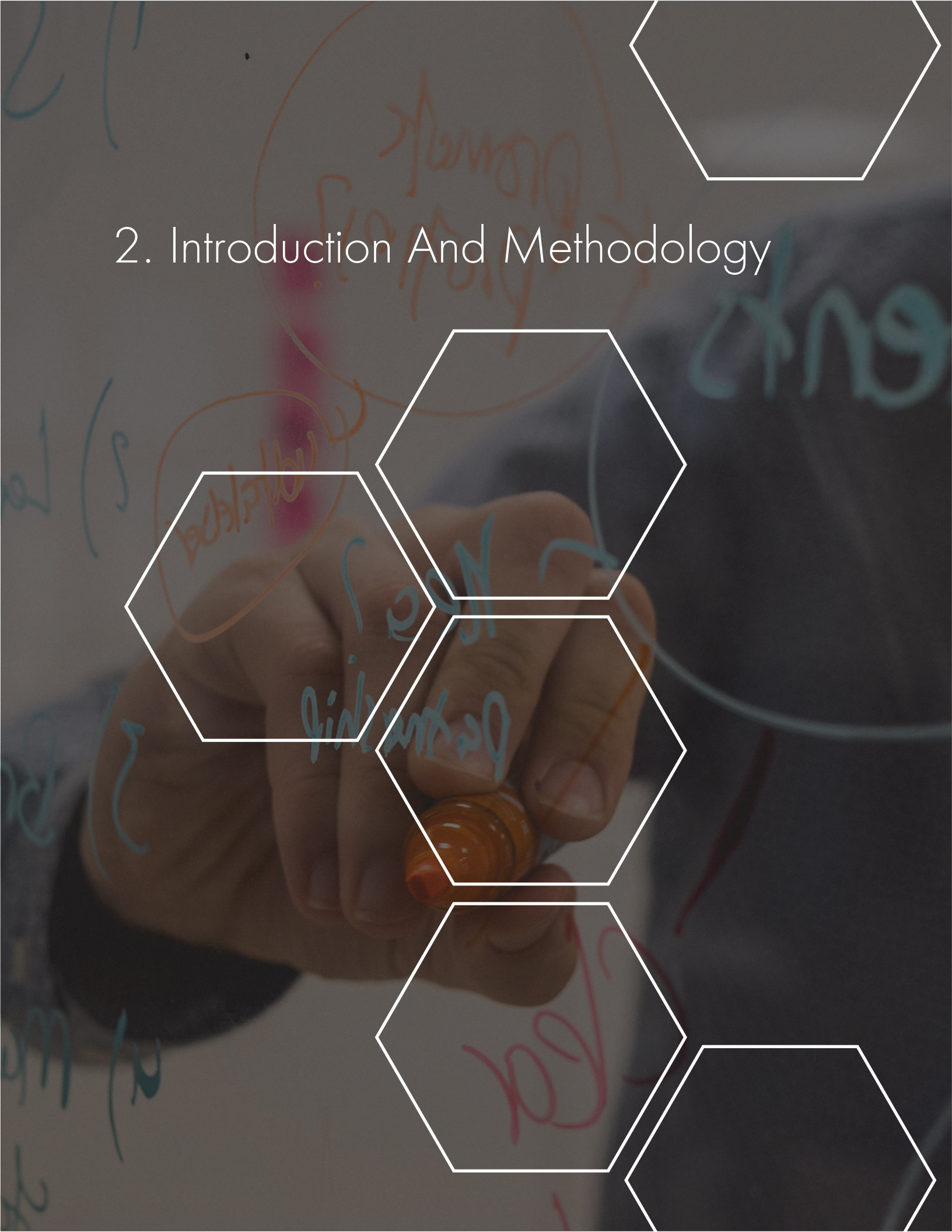
- Foster academic entrepreneurship through tailored university venture funds and regulatory adaptations
- Implement a standardized framework for financing IP transfers into spin-offs

For Late-Stage Funding

- Create alumni investment networks for university spin-offs
- Combine public and private expertise to build partnerships for scale
- Cultivate a "NextGen" sovereign wealth fund for deep tech
- Drive legal reform to enable easier exists of Germany originated ventures by way of acquisition

By comparing and contrasting entrepreneurial environments surrounding Germany's and California's higher-education institutions through a broad "innovation ecosystem" lens, this study provides one of the most comprehensive analyses of the many elements that encourage or restrict IP commercialization, technology transfer, and startup formation. Copying and pasting Silicon Valley's model onto German institutions is neither desirable nor helpful, but these recommendations, when tailored to Germany's unique environment, could expand the university-to-business pipeline. As such, this study should serve as a foundation for further research into the intricacies of implementing these recommendations, as well as ways to bridge the higher education and entrepreneurial ecosystems more closely in California and Germany.

2. Introduction And Methodology



2.1 Rationale And Objective Of The Study

Traditionally, higher education institutions focused almost exclusively on education and research. A third mission, always present but rarely emphasized in Europe and Germany, pertained to the contributions institutions made to the economic and societal development of their communities. With the explosion of IP commercialization and high-tech innovation since the 1980s, first in the U.S. and later in Europe, this "third mission" gained new prominence, extending the perceived role of educational institutions to include activities such as technology transfer and societal engagement, with the fostering of entrepreneurship at its core. As such, higher education institutions have become change agents that are expected to dynamically respond to greater economic and societal demands.[2]

This study focuses on this third mission, based on the hypothesis that higher education institutions in the U.S., especially in Silicon Valley, have a particularly successful track record when it comes to the promotion of technology transfer and entrepreneurship—and that Germany can learn from these successes and adopt them in ways appropriate for their unique institutional and cultural context. This study does not seek to transpose Silicon Valley onto Germany, which is neither possible nor desirable. Rather, it aims to generate ideas for how Germany and its higher education institutions might enhance their tech transfer and entrepreneurial ecosystem to better capitalize on university-generated intellectual property (IP) and the entrepreneurial energy of their faculty, researchers, and students – and thus progress toward greater third mission successes.

However, testing the above hypothesis poses a significant challenge. Varying criteria in different databases, such as inconsistent definitions of "students" (in terms of the different levels of education) and the lack of differentiation between spin-offs (IP-based startups) and stand-ups (startups without IP transfer) made proper comparisons difficult. The limited data on entrepreneurship in German higher education institutions in general, especially when contrasted with the U.S., compounded the difficulties. However, these data challenges could not obscure the fact that every ranking paints a similar picture and confirms the hypothesis. German universities lag far behind in both the number of startups per student and the quality of startups, as measured by the imperfect but available metric of "unicorn" status (i.e. a valuation of US$1 billion or more). Furthermore, the number of knowledge-based startups emerging from German universities has declined over the last 20 years, despite media reports

[2] Berghaeuser, H.; Hoelscher, M. (2019): Reinventing the third mission of higher education in Germany: political frameworks and universities' reactions. Tertiary Education and Management. Accessible at: https://d-nb.info/1198529369/34 (accessed last 03 April 2024).

about blockbuster successes such as BioNTech, Flix Mobility, Celonis, Lilium, or Koppla (see Chapter 4.1).

Germany's comparatively moderate level of entrepreneurial activity reflects a weakness not just at its universities, but across the country's broader startup ecosystem. Although the total value of German startups increased more than fivefold since 2018 and amounted to €168 billion in 2022, their economic contribution (4.7% of gross domestic product, GDP) lagged far behind the U.S. (16.0%), the United Kingdom (13.5%) and France (6.9%).[3] The same applies to unicorns. As of February 2024, Germany's 39 unicorns ranked fifth internationally.[4] In terms of unicorns per capita, Germany ranks only 11th, with Singapore, Israel, USA, and Ireland hosting more than four times as many unicorns per 1 million inhabitants.[5]

In a 2022 position paper, the Federal Agency for Disruptive Innovation (SPRIN-D) argued that Germany's traditional technology transfer model does not generate significant financial returns from the exploitation of research results. The majority of patents are not valuable enough to finance the operation of technology transfer offices, the report found, with the current forms of technology exploitation particularly unsuitable for spin-offs. While the success of a startup does not depend on patents alone, reforming existing regulations on state aid, budgets, and insolvency law could help remove some obstacles and promote more IP exploitation by spin-offs, the paper said.[6]

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[3] BVDS; McKinsey (n.D.): Startup Nation Deutschland - Dashboard,based on data from the European Patent Office and the International Monetary Fund. Accessible at: https://www.startupnation-deutschland.de/ (accessed last 05 April 2024)

[4] Statista Research Department, (2024): Number of unicorns globally February 2024, by country. Statista. Accessible at: https://www.statista.com/statistics/1096928/number-of-global-unicorns-by-country/ (accessed last 03 April 20204)

[5] Own calculation

[6] Bundesagenur für Sprunginnovation (2022): Gesucht: Koalition der Willigen in Politik, Forschungseinrichtungen und Hochschulen für einen IP Transfer 3.0. Bundesagenur für Sprunginnovation.

Zoom In: Definition "Entrepreneurship" In The Context Of Higher Education

Universities and research institutions play a crucial role in fostering entrepreneurship and startup formation. We categorize startups from these institutions into two types: spin-offs and stand-ups. Spin-offs utilize IP transferred from academic contexts, are often formed before patent registration, and their use of the IP is governed by contracts with the originating institution. Mainly defined by the external transfer of IP, they may or may not include the researchers themselves. Stand-ups emerge primarily from the involvement of current or former institution members, with the educational institutions serving as incubators rather than merely transferring IP to an outside spin-off. This category is less uniformly defined, a problem that affects data reliability. A study conducted by British and Swedish researchers in universities in those countries[7] divided these categories further, depending on the founders' institutional ties and post-founding involvement: direct spin-offs (full transition from institution to venture); part-time founding (balancing research and venture roles); indirect spin-offs (former members using institutional knowledge); and external founding (ventures developed by others with the founder in an advisory role).

2.2 Methodology And Approach

This study explores what Germany can learn from the higher education institutions, related entrepreneurial environments, and relevant policy in Silicon Valley, California and the U.S. to foster locally appropriate, knowledge-based entrepreneurship through spin-offs and stand-ups from German universities. To help make comparisons possible, the report takes into account the countries' differing legal and institutional frameworks. However, these differences can make otherwise promising recommendations unrealistic or impractical.

In the U.S., federal and state governments share oversight of higher education, with the federal government focusing on accrediting agencies, financial aid, civil rights enforcement, and research funding, and the state governments responsible for accreditation, licensing, and

[7] Dahlstrand, Å; et al (n.D.): Academic Entrepreneurship: spin-offs in Sweden and the UK. University of London. Accessible at: https://dora.dmu.ac.uk/server/api/core/bitstreams/d905c1ea-b8c4-4864-a001-cf174c38e201/content (accessed last 03 April 2024)

state-specific financial aid. Accreditation of universities in the U.S. (both public and private) is generally overseen by regional accrediting agencies, with individual universities governed by their Board of Trustees or equivalent, e.g., in California, the ten-campus University of California (UC) system is governed by a constitutionally-established Board of Regents.[8] For the 2019-2020 academic year, the U.S. Department of Education listed approximately 4,000 degree-granting institutions of postsecondary education, of which 41% were public non-profit, 42% were private non-profit, and 17% were for-profit institutions.[9] Nearly three of every four students were enrolled in public non-profit universities,[10] so this study most frequently references the 10-campus University of California (UC) system and Silicon Valley's UC Berkeley in particular. Although Germany has growing number of private for and non-for profit universities — 115 today compared with just 49 two decades ago,[11] which means that almost 342,600 students attended private universities in 2021/22 (2.9 million students were enrolled in all universities). This was almost twelve times as many as in the winter semester of 2001/02, when just under 29,400 students were still studying at private universities (1.9m total number of students).[12] Still, private institutions play a smaller role in the German university landscape.

One can find even sharper differences in the programs and institutions designed to promote technology transfer and entrepreneurship. The U.S. features a set of solid and professional association structures for Technical Transfer Offices (TTO), including the Association of University Technology Managers (AUTM) and the AUTM Foundation. With more than 3,000 members the AUTM empowers, advocates for, and promotes structured knowledge exchange and data collection. This creates a support infrastructure for technology managers, facilitating richer corporate engagement and stronger IP protections. The AUTM Foundation

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[8] U.S. Department of Education (n.D.): College Accreditation in the United States. Accessible at: https://www2.ed.gov/admins/finaid/accred/accreditation.html (accessed last 10 April 2024).

[9] Moody, J. (2021): A Guide to the Changing Number of U.S. Universities. U.S. News and World Report. Accessible at: https://www.usnews.com/education/best-colleges/articles/how-many-universities-are-in-the-us-and-why-that-number-is-changing (accessed last 11 April 2024).

[10] Integrated Postsecondary Education Data System (n.D.): Fall Enrollment Survey. Accessible at: https://nces.ed.gov/ipeds/survey-components/8 (accessed last 11 April 2024).

[11] Hachmeister, C. D. (2024): Nicht staatliche Hochschulen im Innovationssystem – Strukturanalyse und Clusterung privater und kirchlicher Hochschulen. CHE. Accessible at: https://www.che.de/download/nsh-inno-cluster (accessed last 03 April 2024)

[12] Destatis (2023): Pressemitteilung Nr. N054 vom 11. Oktober 2023. Destatis. Accessible at: https://www.destatis.de/DE/Presse/Pressemitteilungen/2023/10/PD23_N054_21.html (accessed last 02 April 2024)

facilitates the exchange of ideas between AUTM and public/private entities to promote initiatives that benefit the technology transfer community and ultimately improve people's lives. In contrast, Germany puts control of higher education largely in the hands of individual states. This approach aims to promote healthy competition, but it also leads to a more fragmented approach to technology transfer and entrepreneurship initiatives. Although the Basic Law allows the Federal Government and the Länder to cooperate in cases of supra-regional importance for the promotion of science, research, and teaching, this is always subject to the agreement of all states (Basic Law, Art. 91). This differs for non-university research organizations in which the federal government has direct influence, such as the Max Planck Society, the Helmholtz Association, and the Fraunhofer Society. Without a central governance body, we find less uniformity and inconsistent data on entrepreneurship in German higher education. A body like the AUTM also exists in Germany with the name of TransferAlliance e.V., but plays a much less prominent role in strengthening the role of TTOs than its counterpart in the US.

Given these different norms in the U.S. and German higher education landscapes, this analysis employs an "innovation ecosystem" lens that reaches beyond legal and institutional frameworks to examine the wide array of factors that enable or hinder entrepreneurship in higher education. Innovation ecosystems involve the interplay of the academic, private, and public sectors and their collective focus on developing inventions and scaling them into innovations that potentially shape how economies and societies evolve. The permeability and mutual enhancement of these three sectors, along with their ability to attract (international and diaspora) talent and funding, are what constitute an ecosystem. This requires a conducive policy framework, but also a more elusive component: an entrepreneurial culture and mindset among the participants. The Silicon Valley ecosystem remains the classic case of an innovation ecosystem[13] that captures the value of research and ingenuity in industry and society, leveraging diasporic connections and a widely shared entrepreneurial spirit in the process.

With this broader innovation ecosystem perspective as its baseline, the study first examines factors that promote knowledge-based entrepreneurship on a macro level, including policy frameworks created by the government and public sector (Chapter 3). It then moves to the meso level, looking at the organizational capacities at universities and at the networks between universities and industry that facilitate the transfer of research into the commercial

[13] Randolph, S.; Groth, O. (2012): The Bay Area Innovation System. Bay Area Council Economic Institute. Accessible at: http://www.bayareaeconomy.org/files/pdf/BayAreaInnovationSystemWeb.pdf&sa=D&source=docs&ust=1712236717192509&usg=AOvVaw3mh5K8n39iubGURsseUFrP (accessed last 03 April 2024)

economy (Chapter 4). From there, the study explores the micro level, focusing specifically on two factors: a) how the permeability of IP between university research and entrepreneurial activity can attract and retain talent (Chapter 5); and b) an examination of the "softer" factors of mindset and culture that shape risk tolerances and ignite inventions, innovation, and ultimately entrepreneurship in these ecosystems (Chapter 6). The final section of the analysis focuses on funding (Chapter 7), assuming that investment funds follow innovations shaped by preceding factors.

Based on literature reviews, public databases, and semi-structured interviews with individual experts, each chapter compares the Silicon Valley, California and/or U.S. landscape with Germany to derive learnings and recommendations.

3. Intellectual Property And Personnel Law

3.1 IP Law

Key Takeaway:

The U.S.'s post-WWII acknowledgment of university research as a critical contributor to national welfare began a long process of experimentation around best practices to facilitate the transfer of publicly funded university research to the private sector for commercialization. In 1980, the Bayh-Dole Act realized the fruits of that experimentation, creating clear incentives for universities to become active participants in the technology transfer process. This revolutionized the commercialization of academic research in American universities.

Germany's efforts to shift IP management from individual researchers to universities in 2002 tried to mirror the Bayh-Dole Act and its success. However, it has not produced similar results because it has been hampered by limited financial incentives and a lackluster emphasis on IP commercialization. This remains a critical factor in the divergent success of the nations' technology transfer policies, and it continues to limit the effectiveness of the German innovation ecosystem.

Through the early 1900s, research rarely moved from U.S. universities and academic laboratories to industrial commercialization. By the end of World War II, however, the U.S. Office of Scientific Research and Development began touting the critical importance of university research to the national welfare, citing the contributions of university-based labs to national defense initiatives (e.g., radar technology and the Manhattan Project) as proof for broader economic and societal benefits. In support of this strategy, the U.S. government established, and dramatically increased federal funding of multiple agencies tasked with promoting and overseeing basic scientific research – including the National Institutes of Health (NIH), the National Science Foundation (NSF), and the Office of Naval Research (ONR). Because of its interest in expanding access to academic research for the sake of industrial application, the federal government opted to retain title to any inventions created with federal funds and to make those inventions available through non-exclusive licenses. However, the lack of exclusivity dampened corporate motivation to develop new products based on academic research, and by 1980 the U.S. had very little to show for all of the investment dollars it had funneled into academic research – fewer than 5% of patents held by the federal government

had been licensed for development of commercial products.[14] Congress sought to rectify this limitation in 1980, with the passage of the Bayh-Dole Act (officially, the Patent and Trademark Law Amendments Act). This new law allowed universities, non-profits, and small businesses to own and, crucially, issue exclusive licenses for research supported by federal funding. The act also stipulated that inventions must be intentionally and diligently transferred to the marketplace in the interest of the public good and with the understanding that resulting products would be manufactured in the U.S.

Subsequent amendments and court rulings clarified questions about IP ownership and assignment at universities. In 2011, the U.S. Supreme Court ruled that Bayh-Dole did not establish automatic university ownership of faculty research inventions.[15] The court also ruled that the law did not alter the fundamental principle that patent rights initially vest in the inventor, even when those inventions result from federal funding. As a result, an institution would need an explicit and immediate assignment of rights from the inventor to claim ownership under Bayh-Dole. The University of California system, Stanford University, and other top research universities quickly revised faculty employment contracts to stipulate that ownership of faculty inventions would automatically be assigned to the institutions, often without regard to the source of funding.

Researchers estimate that the Bayh-Dole Act has generated more than US$1.3 trillion in U.S. economic growth, more than 4.2 million jobs, and more than 11,000 new startups from U.S. universities since its passage.[16] However, one should read these numbers as guideposts. New laws, shifting business and political cycles, and any number of other factors make it exceedingly difficult to measure the law's precise impact on broad economic and technological growth. As such, researchers have developed a variety of new metrics to gauge the impact of Bayh-Dole, leading to a series of other useful measures one can use to compare

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[14] Council On Governmental Relations (2021): "The Bayh-Dole Act: A Guide to the Law and Implementing Regulations." Accessible at: https://www.cogr.edu/sites/default/files/COGR%20Bayh%20Dole%20V.2.pdf (accessed last 11 April 2024).

[15] Board of Trustees of the Leland Stanford Junior University v. Roche Molecular Systems, Inc. Although the central issue in this case revolved around whether a federal contractor university's statutory right under the Bayh-Dole Act in inventions arising from federally funded research could be terminated unilaterally by an individual inventor through a separate agreement assigning the inventor's rights to a third party, the decision had far-reaching effects on IP practice at universities and research institutions in the U.S.

[16] Bhatti, P.; Tridandapani, S. (2021). Academic Entrepreneurship. IEEE potentials, 40(3). Accessible at: https://doi.org/10.1109/mpot.2021.3055198 (accessed last 03 April 2024)

the impact of different legislation across different jurisdictions (e.g., growth in university patent applications, or the establishment of the university infrastructure required to process and manage new inventions). The report covers these alternative metrics more extensively in Chapter 4.

Regardless of Bayh-Dole's precise impact, it is widely recognized that the implementation and interpretation of the Act had two closely related but profound effects on the current structures and practices of technology transfer in the U.S. First, universities secured ownership of inventions that originated within their institution. Seeing the potential financial value of IP licensing and sales, universities capitalized on Bayh-Dole and subsequent court interpretations to alter established IP ownership agreements. They began to view professors as inventors and amended employment and other IP-related policies to favor the university. Second, universities gained a strong financial incentive to enhance and expand technology transfers. With the possibility of reaping significant financial gains from IP produced by their faculty and students, universities added more internal expertise and infrastructure to help patent and license federally funded research and invention. This encouraged university employees to promote the commercialization of federally backed research, thereby dramatically broadening the number of individuals and institutions working to facilitate technology transfer.

Zoom In: Challenges In Sequencing Patent Applications And Research Publication On New Discoveries In The U.S.

Researchers seeking to navigate the dual objectives of publishing their work and securing patents for their innovations face a complex array of challenges in the U.S., primarily centered around the need for careful timing and strategic disclosure. The imperative for novelty in patent applications means that any public disclosure of the research, including academic publications, can jeopardize the patentability of an invention. According to U.S. patent law, inventors have a one-year grace period from the date of their first public disclosure of an invention to file a patent application with the United States Patent and Trademark Office (USPTO). Public disclosure can include various forms of communication to the public, such as publishing research findings in a journal article, presenting the invention at a conference, posting it online, or selling the product. The significance of the one-year rule lies in its allowance for inventors to test the commercial waters before fully committing to the relatively long and expensive patent process, enabling them to gauge interest in their invention, seek funding, or further refine their innovation.[17,18]

In Germany, IP ownership also resides with the universities, but this wasn't always the case. Until February 2002, the "Hochschullehrerprivileg" (university teacher privilege) remained in effect. According to the Law on Employee Inventions, IP developed by professors, lecturers, and research assistants in the course of their duties were considered "free inventions," allowing them to exploit their own innovations. Yet, because inventors typically sought to publish their research as quickly as possible, and because publication eliminated the novelty of an invention required by patent law, they rarely commercialized their work.[19] When the Law Amending the Law on Employee Inventions passed on January 18, 2002, universities were granted the opportunity to protect all economically exploitable inventions in their field

[17] Tietze, F. (2023): The patenting versus publishing dilemma. Nature Communications 14. Accessible at: https://doi.org/10.1038/s41467-023-37243-z (accessed last 11 April 2024).

[18] Mohan-Ram, V. (2001). Patent First, Publish Later. Science. Accessible at: https://www.science.org/content/article/patent-first-publish-later-how-not-ruin-your-chances-winning-patent (accessed last 11 April 2024).

[19] BVerfG (2004): Beschluss der 2. Kammer des Ersten Senats vom 12. März 2004 - 1 BvL 7/03 -, Rn. 1-17. Accessible at: https://www.bverfg.de/e/lk20040312_1bvl000703.html (accessed last 03 April 2024)

and to facilitate their industrial exploitation more effectively than before.[20] While this did not invalidate the "patent first, publish later" rule of thumb, it essentially allowed universities to replace individual researchers as owners of the IP (with universities remunerating inventors with 30% of the gross revenue generated by the exploitation). Unlike in the U.S., however, this amendment has not led to any significant development of internal university capacities for exercising this function and for systematic commercialization of IP. Studies indicate three reasons for this comparatively immature tech transfer infrastructure at German universities. First, institutions have not yet reaped significant windfalls from commercialized IP, so they don't have the same economic incentive to expand the pipeline. Second, the federal states that oversee university functions have not placed significant emphasis on IP commercialization. Third, the public nature of universities in Germany brings into play concerns about violating budgetary requirements (Haushaltsrecht), aid laws (Beihilferecht), and insolvency laws when commercializing IP – challenges that private universities in the U.S. do not face.[21] We will explore these three reasons in the following sections.

The lack of significant windfalls: The German government's "WIPANO – Knowledge and Technology Transfer through Patents and Standards" program sought to boost IP licensing revenue and general patent activity in universities by covering some of the patenting costs.

However, a 2017 evaluation of the program[22] concluded that the 167 universities surveyed still had limited financial leeway because IP-related revenues did not offset the cost of securing the patents, even with the subsidies included. According to the study, revenue from patent exploitation contributed, on average, just 15.9% of the budgets that universities had allocated for patenting. That percentage varied widely from one institution to the next, but the study concluded that government funding had no significant impact on the universities' personnel resources to support the patenting process. The study painted a dire picture of patenting resources. Because the average amount spent to pursue a patent application ran around

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[20] Deutscher Hochschulverband (n.D.): Kurzinformation - Das sog. Hochschullehrerprivileg und die Regelung des § 42 Arbeitnehmererfindungsgesetz. Deutscher Hochschulverband. Accessible at: https://www.hochschulverband.de/fileadmin/redaktion/download/pdf/info_blaetter/Hochschullehrerprivileg.pdf (accessed last 03 April 2024)

[21] Bundesagenur für Sprunginnovation (2022): Gesucht: Koalition der Willigen in Politik, Forschungseinrichtungen und Hochschulen für einen IP Transfer 3.0. Bundesagentur für Sprunginnovation.

[22] Kulicke, M.; et al. (2019): Evaluation des Programms WIPANO - Wissens- und Technologietransfer durch Patente und Normen. Fraunhofer-Gesellschaft. Accessible at: https://publica.fraunhofer.de/entities/publication/7fe35529-c9ef-44c6-81bf-3076cc078e5c/details (accessed last 03 April 2024)

EUR 33,500, two-thirds of the 132 universities that provided detailed budget information could not afford more than just three applications a year. With such limited resources, universities such as the Freie Universität Berlin said they must weigh the possible scope of patent protection (including circumvention possibilities), the market situation for a potential product, and the possibilities for further development – a slow and laborious process that often requires external expertise.[23] The scarcity of funding and expertise has led to low numbers of patent applications, but it also meant that research results could be commercialized more effectively in other countries with faster filing processes. As a result, the topics of patenting and IP exploitation never gained significant prominence in German universities, and ownership of many university-originated patents now resides with companies able to bear the costs of patenting.

The lack of emphasis on IP commercialization: Despite the reform of German IP law, the Federal Government's lack of influence on university governance has limited the amendments' ability to spur increased patenting and commercialization capacity at the university level. Indeed, because governance of universities falls under the jurisdiction of the states (Länder), relevant IP-related regulations and guidelines, including those issued by the Federal Ministry of Education and Research (BMBF), apply only to non-university research organizations, such as the Max Planck Society or Frauenhofer. An analysis conducted by the Fraunhofer Institute revealed that current higher education laws in 15 federal states give little thought to or support for IP transfer and spin-offs.[24]

Concerns about budgetary, aid, and insolvency laws: While not directly related to IP law, other regulations that govern matters such as these create significant uncertainty for the university staff who shape contract conditions, raising major obstacles to the commercialization of IP in Europe and Germany. State aid law requires a realistic, not overvalued assessment of IP in spin-offs in order to avoid subsidies. Budget law requires the avoidance of gratuitous transfer of IP, which makes commercialization more difficult. Insolvency law impairs IP licensing, as the know-how of the founding team is often lost in the event of insolvency. As a result, universities

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[23] Freie Universität Berlin (n.D.): Leitlinien zum Schutz und zur Verwertung von geistigem Eigentum der Freien Universität Berlin. Freie Universität Berlin. Accessible at: https://www.fu-berlin.de/forschung/service/patente-und-lizenzen/media/IP-Leitlinien_PuLS_Version_AS.pdf (accessed last 03 April 2024)

[24] Kulicke, A. (2023): Spin-offs aus Hochschulen und Forschungseinrichtungenin Deutschland und weiteren Ländern. Fraunhofer Gesellschaft. Accessible at: https://www.stifterverband.org/sites/default/files/2023-11/spin-offs_aus_hochschulen_und_forschungseinrichtungen_in_deutschland_und_weiteren_laendern.pdf (accessed last 03 April 2024)

take a highly hesitant and risk-averse approach to IP commercialization. With no uniform standards and university capacities constrained, the negotiation processes and conditions for IP licensing or sales remain piecemeal, disorganized, and working against spin-offs.

Recommendation:
Establish A National Priority List Of Innovation Spaces And Incentives For Länder And Their Universities To Generate IP

IP-driven, university-based entrepreneurship should be a national priority. The U.S. made it one, but Germany has not been able to because of constitutional deference to the Länder. Absent a constitutional change empowering the federal government to mandate IP generation top-down, Germany should use workarounds to get the states to do this with their local universities. The council of economic advisers, jointly with the Expertenkommission Forschung und Innovation can define national priorities and lead the Länder in their own attempts to focus IP and IP-based venture generation. The joint recommendations would be tied to additional funding, administered through a steering committee staffed by the Federal Ministry for Education and Research and the Ministry of Economy and Climate Change. Funding would only be disbursed if states align and coordinate local universities accordingly. As part of the annual Ausgleichsfinanzierung, the German Chancellery and Federal Ministry of Finance should require states to establish applied IP commercialization as a priority amendment for state laws. Requirements should include provisions to leverage locally generated IP in solutions to local problems, recognizing that government procurement is an important driver of innovation.

Recommendation:
Establish Fast Track And Additional Funding For Promising Patents

University researchers need to move rapidly to secure patent protections for their inventions, but they also need to move quickly to publish and disseminate their research results. They currently struggle to balance those needs, in large part because the universities lack the resources (and often the expertise) to quickly secure a steady stream of patents. Given that conundrum, the creation of a mechanism to identify and prioritize promising patents that should be given priority and additional funding for the patenting process is crucial. This could be as straightforward as a dedicated funding line within WIPANO to provide additional financial support for particularly promising patents. Such a measure would enable universities to obtain additional resources and deploy them where they can have the greatest impact, which would then promote more innovation and research progress. To select high-priority patents, WIPANO would establish a commission of commercialization experts (e.g., current

and former entrepreneurs, venture capitalists, and new venture executives) alongside national and regional economic development professionals.

Recommendation:
Central Advisory Unit For IP Commercialization

To address the challenges faced by German universities regarding IP commercialization, establish central contact and advisory centers (e.g., under the umbrella of DATI). These centers can guide universities and their Technology Transfer Offices (TTOs) to help them navigate legal constraints beyond mere IP law, such as the state aid, budget, and insolvency laws that can hinder IP commercialization efforts. By offering expert advice and support, these centers can help mitigate risks associated with commercialization, thereby encouraging universities to engage more confidently in entrepreneurial activities and innovation. To define priorities for the TTOs, DATI should consult with SPRINT, the Federal Ministries of Education & Science, and Economy & Climate Change.

3.2 Personnel / Employment Law

Key Takeaway:

German and U.S. labor policies that govern how academic staff engage in entrepreneurship present a study in contrasts. German universities, bound by the prevalence of short-term contracts for research staff and stringent employment laws like the "Nebentätigkeitsrecht," operate in a risk-averse environment that restricts the motivation and ability of researchers and professors to engage in entrepreneurial activities. While the university innovation ecosystem in Germany remains far more constrained than the flexible and encouraging U.S. approach, an emerging shift among some German states, including Bavaria, has begun to foster more academic entrepreneurship. This potential transformation, while gradual, could help produce an academic culture that embraces more entrepreneurial risk and incentivizes a mindset of IP commercialization.

The U.S. has no major federal or state laws that restrict professors and students from engaging in entrepreneurship or participating in spin-offs, although such activity varies with each institution's formal policies and the university community's informal social context. Beyond policies governing ownership of intellectual property (see Section 3.1 above), universities also require designated employees to acknowledge and act in accordance with policies related to conflicts of commitment, conflicts of interest, and the use of university resources. At universities in California, these formally articulated policies serve as guardrails to ensure good judgment and transparency from faculty and students, rather than as didactic rules that limit entrepreneurial behavior.

Specific policies governing conflicts of commitment at California's public and private universities aim to balance the value of outside professional activities with the primary professional responsibilities to the school. At the UC System and other public universities in the state, such policies expect faculty to maintain a significant presence on campus, be accessible to students and staff, and share service responsibilities. External professional activities, whether compensated or uncompensated, must be consistent with the faculty member's professional obligations to the university. UC System policy requires disclosure of certain outside activities and limits the amount of time a faculty member may devote to these activities. Private universities like Stanford University have similar policies. For staff members, conflicts of commitment and interest are managed with department and/or division heads to avoid actual or apparent conflicts between their university obligations and outside interests. This process typically involves disclosure of potential conflicts and requests for exceptions when necessary. Stanford policy bars faculty and staff from using university resources for personal gain and from participating in business transactions between the university and an entity in which the individual holds a significant financial interest.

Policies like these intend to underscore the universities' commitment to maintaining integrity and trust in their academic and research missions. However, the reality of professorial engagement with outside firms and secondary employment in the private sector may ultimately depend more on the employing institution's social context around academic entrepreneurship. For example, as documented in Jeannette Colyvas and Walter Powell's "From Vulnerable to Venerated: The Institutionalization of Academic Entrepreneurship in the Life Sciences," Stanford's presence in the field of technology transfer began more than a decade before the passage of the Bayh-Dole Act. Less than a decade after passage of the Act, the message at Stanford from senior scientists to new researchers was that "commercial activity was an appropriate complement to basic science" and the rewards of entrepreneurship "were no

longer viewed as exceptional but as components of routine professorial activity."[25] Relatedly, as the institutional value of IP becomes increasingly clear, the UC System and other public universities are moving to revise their policies around academic entrepreneurship, now rewarding a professor's entrepreneurial spirit and technology transfer success as part of tenure and promotion decisions (an approach that is amply supported by academic literature on the topic of technology transfer).[26] Finally, the California Institute of Technology has also recently eased its conflict of interest and commitment policies to facilitate academic entrepreneurship, working with their Office of the General Counsel to make it permissible for a Caltech-developed spin-off company to sponsor research at the university itself, even within the startup faculty member's own lab. In short, as universities recognize the valuable role academic entrepreneurship plays in both campus life and funding/revenue generation, they are moving to modify overly restrictive policies that limit professorial activities and opportunities.

Unlike their counterparts in the U.S., professors and researchers at German universities have little leeway, let alone incentive, to engage in entrepreneurial activities outside their teaching and research. To climb the academic career ladder in Germany, aspiring professors often have to spend years as research assistants during and after their doctoral studies. These positions come in the form of a series of short-term contracts – an arrangement made possible because scientific fields in Germany are governed by much more liberal regulations when it comes to chaining short-term contracts, unlike in other societal and economic sectors. While a certain liberality in employment relationships can be a positive factor, the possibility of chaining temporary employment relationships tends to chill entrepreneurship in the German scientific system. Most researchers do not want to jeopardize their path to a professorship, so they rarely deviate from the prescribed career path by engaging in entrepreneurial activities. A 2016 amendment to the "Wissenschaftszeitvertragsgesetz" (Academic Fixed-Term Contract Act) tightened the rules on endlessly extending short-term contracts with researchers by more explicitly tying them to their careers. Even so, the rate of temporary contracts for full-time academic staff at German universities, including professors, still stood at 67% in 2022. Non-PhD holders were employed on temporary contracts at a rate of as high as 93% at

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[25] Colyvas, J. and Powell, W. (2007): From Vulnerable to Venerated: The Institutionalization of Academic Entrepreneurship in the Life Sciences. Research in the Sociology of Organizations, Volume 25.

[26] See for example Siegel, Donald S. and Wright, Mike (2015). University Technology Transfer Offices, Licensing, and Start-Ups. In Albert Link, Donald Siegel, and Mike Wright (Eds.): The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship: The University of Chicago Press.

universities and 63% at HAW.[27,28] According to one survey, more than 85% of faculty and staff on chained contracts continued to renew them because they needed more time to continue or finalize their research projects. The precarious situation allows no deviation from established academic career paths – in fact, researchers commonly sacrifice their family planning in order to devote time to research. According to a study by TU Dortmund University,[29] a startling 75% of academic staff at German universities are childless. If these experts are willing to sacrifice a family in favor to preserve their carefully managed and restrictive career path in the German academic system, why would they risk their career to pursue an uncertain venture in the German startup ecosystem, which in itself leaves a lot to be desired?

While full-time or permanent employees at academic institutions in Germany enjoy a contract and salary structure that provides stability and work-life balance, most universities take critical attitudes towards professors who also work for private-sector businesses. Universities allow most tenured professors to engage in side jobs, but they must receive prior approval from the administration and might be subject to mandatory reporting – all under requirements that vary from one federal state to another.[30] Public universities in Germany have clear priorities when it comes to approving side jobs for professors, with the primary focus on teaching and research duties. If these responsibilities are jeopardized by the side job (usually, if this is more than 8 hours per week), universities must reject the request. While universities do not heavily scrutinize most applications for side activities, students and student representatives often view a professor's side job with skepticism, expressing concerns about potential conflicts of interest and the potential limitation of academic freedom. A 2014 report in Die Zeit illustrated these

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[27] Sommer, J.; et al. (2022): Evaluation des novellierten Wissenschaftszeitvertragsgesetzes. INTERVAL GmbH & HIS-Institut für Hochschulentwicklung e. V. (HIS-HE). Accessible at: https://www.bmbf.de/SharedDocs/Downloads/de/2022/abschlussbericht-evaluation-wisszeitvg.pdf?__blob=publicationFile&v=2 (accessed last 03 April 2024)

[28] In the same evaluation, more than a third (37.2%) of those with a fixed-term contract indicated that it was already clear to them at the time of concluding their current contract that a longer contract duration would have been necessary to achieve the agreed-upon qualification goal.

[29] Nezik, A.K.(2011): Wissen: Forschen ohne Kinder - Hochschulen sollen familienfreundlicher sein. Tagesspiegel. Accessible at: https://www.tagesspiegel.de/wissen/forschen-ohne-kinder-6719941.html (accessed last 03 April 2024).

[30] Overview of regulations on secondary employment by federal state (German only): https://www.academics.de/ratgeber/nebentaetigkeit-beamte-oeffentlicher-dienst (accessed last: 16 April 2024))

concerns, further reducing incentives by professors to engage in paid side projects.[31] Even the professors themselves often express reluctance about engaging in full-time business activities, often citing concerns about salary or job loss. According to qualitative interviews conducted in Nordrhein Westfalen, most professors and researchers strive to maintain their positions in research organizations for the security, prestige, connections, and funding that come with those positions, preferring temporary arrangements for outside ventures or side jobs.[32]

Fortunately, some individual federal states are reconciling this dilemma and have relaxed their rules so professors can take time off from academic work for entrepreneurial activities without losing their secure and reputable jobs and salaries. For example, the Higher Education Innovation Law in Bavaria, the federal state home to the Technical University of Munich, one of the country's most entrepreneurial universities, says: "A leave of absence while retaining salary payments for a period of usually two semesters can also be granted to professors for economic activities including company startups." While the law stipulates that the activities undertaken during the startup sabbatical must be consistent with the tasks of the relevant university's research, artistic development, and knowledge and technology transfer,[33] the more liberal policy established Bavaria as a pioneer in this regard. Similar provisions are not found in the higher education laws of other German states, such as Bremen or Hamburg.

Signs of more flexible arrangements to support entrepreneurial activity have emerged elsewhere, too. For example, a 2018 qualitative analysis of technology transfer offices (TTOs) in North Rhine-Westphalia found that TTO research managers are increasingly aiding the development of creative, pragmatic employment arrangements that enable professors and

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[31] Lobenstein, C.; Oppong, M. (2014): Drittmittel an Universitäten - Im Verborgenen. ZeitOnline. Accessible at: https://www.zeit.de/campus/2014/04/drittmittel-universitaeten-forschung-finanzierung (accessed last 03 April 2024)

[32] Leišytė, L.; Sigl, L. (2018): Academic institutional entrepreneurs in Germany: navigating and shaping multi-level research commercialization governance. Triple Helix - A Journal of University-Industry-Government Innovation and Entrepreneurship. Accessible at: https://triplehelixjournal.springeropen.com/articles/10.1186/s40604-018-0057-5 (accessed last 03 April 2024)

[33] Bayerische Staatskanzlei (2022): Bayerisches Hochschulinnovationsgesetz (BayHIG) Vom 5. August 2022 (GVBl. S. 414) BayRS 2210-1-3-WK. Art. 61 Freistellung von Dienstaufgaben. Accessible at: https://www.gesetze-bayern.de/Content/Document/BayHIG-61 (accessed last 03 April 2024)

researchers to engage in extramural commercial ventures and IP commercialization efforts.[34] These arrangements aim to reduce the risks associated with uncertain startup employment and facilitate smooth career transitions for scientists between sectors. However, this does not change the fact that the legal frameworks continue to limit the creative freedom of research managers at TTOs in many federal states.

Recommendation:
Establish Federal Professional Development And Similar Career Path Opportunities

Professors who want to engage in entrepreneurial activity, whether as a founder or an adviser, should be rewarded for doing so, if for no other reason than to create connections between IP creation and the German economy through a "bridge of relevance." This could be accomplished by creating Federal IP Professorships, the awards of which should factor into Länder-based professional development and advancement paths for faculty.

Recommendation:
Make Entrepreneurial Activities A Component Of Academic Careers

Engagement in entrepreneurial activities should be perceived as an opportunity rather than a risk, similar to the approach in the U.S. To facilitate this, adjustments should be made to the Academic Fixed-Term Contract Act to include an exception clause for entrepreneurial activities. Education ministries across the states should follow Bavaria's example and enable professors who seek to engage in entrepreneurial activities, and states should liberalize regulations on secondary employment to resemble and encourage the practices typically found at U.S. institutions.

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[34] Leišytė, L.; Sigl, L. (2018): Academic institutional entrepreneurs in Germany: navigating and shaping multi-level research commercialization governance. Triple Helix - A Journal of University-Industry-Government Innovation and Entrepreneurship. Accessible at: https://triplehelixjournal.springeropen.com/articles/10.1186/s40604-018-0057-5 (accessed last 03 April 2024)

Recommendation:
Promote Entrepreneurial Skills And Exchange With The Private Sector

The highly permeable boundary between the U.S. academic and private sectors ensures that professors and researchers can acquire entrepreneurial skills. The relative lack of such skills among German professors and researchers creates yet another obstacle to entrepreneurial activity in the country. In order to strengthen entrepreneurial skills, the academic training for prospective professors should include options for entrepreneurship courses and exchange programs with companies.

4. Organizational Capacities & Networks

The principles governing intellectual property (IP) policies and laws in the U.S. and Germany are fundamentally similar. In both cases, ownership of IP resides with the universities rather than professors or researchers. However, notable distinctions emerge, particularly in the realm of labor law, where Germany's public universities enforce stricter regulations. Nevertheless, these differences alone do not fully explain the varied performance of universities in terms of entrepreneurship. To gain a better sense for the divergence between the countries, one must also consider the meso level, especially the role organizations play in tech transfer and entrepreneurship. This chapter explores differences between universities and their Technology Transfer Offices (Section 4.1), as well as other institutional platforms for university-industry collaboration (Section 4.2).

4.1 Technology Transfer Offices (TTOs)

Key Takeaway:

The roots of the countries' divergent results in the fields of academic innovation and commercialization go deeper than the policy level. The success of technology transfer also hinges on the organizational capacities and strategic agility of TTOs. While TTOs in the U.S. have become dynamic conduits for commercializing research, German universities struggle with a more passive and narrow approach to patenting, reflecting broader systemic and cultural challenges. This contrast serves as a reminder that institutional strategy and support play a key role in supporting policies that seek to turn academic breakthroughs into real-world solutions.

TTOs are pivotal in bridging academia and the market. In the U.S., TTOs and Technology Licensing Offices (TLOs) proliferated after the 1980 passage of the Bayh-Dole Act, eventually integrating into the entrepreneurial ecosystem as the primary managers of university IP and facilitators of technology transfer. In contrast, German TTOs only gained prominence around 2002 with IP law reform, and even then attracted only limited attention and resources. While learning and exchange platforms similar to the U.S. Association of University Technology Managers exist in Germany (e.g. TransferAllianz), they remain relatively weak. The following assessment of U.S. and German TTOs contrasts their strengths and weaknesses across the three main TTO service areas: IP Management, Patenting, and Licensing; Corporate and Industry Partnerships; and Startup Incubation (the latter being increasingly addressed by dedicated entrepreneurship centers).

IP Management, Patenting, And Licensing

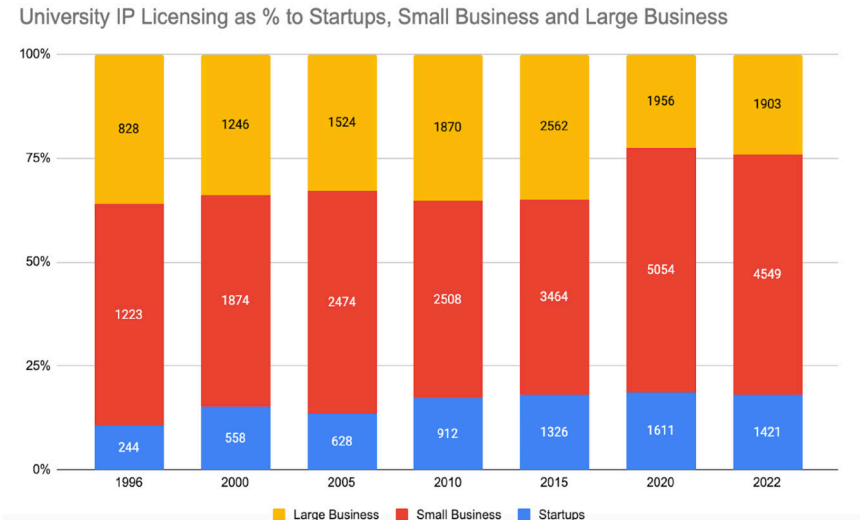
Much of the literature about the rise of TTOs in the U.S. reflects a certain degree of historical revisionism, often suggesting that universities immediately embraced the spirit of the Bayh-Dole Act and quickly professionalized the technology transfer industry. However, most institutions viewed the Act as another regulatory obstacle to navigate. Outside the largest, best funded, and most active research universities, most schools established TTOs reactively, and licensing of IP focused on compliance rather than the achievement of strategic priorities. Over time, however, TTOs embraced their mandate to broaden the role of the university – beyond teaching, research, and social engagement – to include knowledge transfer for the betterment of society. For TTOs, that goal meant developing significant competencies in both the translation of research results to the market, as well as ongoing revenue generation to support future research and academic entrepreneurship. TTO staff became increasingly professional, shifting from attorneys to experts in IP Management, Patenting, and Licensing.

Today, TTO staff typically possess extensive scientific knowledge, often holding PhDs, and they blend that with deep expertise in business and finance. More and more of these professionals receive specialized academic training in fields directly pertinent to academic technology transfer, including areas such as IP law and management, technology evaluation, and business plan development. Many of them hold adjunct faculty positions to support entrepreneurship curricula in business and engineering schools, and increasingly in other university departments, as well. As a result of this increased professionalization and university support for TTOs, the last two decades have seen impressive growth across what the Association of University Technology Managers (AUTM) calls its Big 6 measurements – total research expenditure, invention disclosures, new patent applications, total licenses and options executed, gross license income received, and new startups formed.[35] In its most recent annual survey of TTOs in the U.S., AUTM reported strong growth in all six metrics over the past three decades.

[35] "The Big 6" statistics were highlighted to assist TTOs with benchmarking performance against other offices because, per AUTM, they "broadly capture the overall performance of tech transfer offices."

Category	1991	2022	CAGR
Total Research Expenditure	US$12.3B	US$92.7B	6.7%
Invention Disclosures	6,087	24,299	4.7%
New Patent Applications	1,584	16,966	8.2%
Total Licenses and Options Executed	1,229	9,930	7.2%
Gross License Income Received	US$0.2B	US$3.8B	10%
New Startups Formed	212[36]	1,018	6%

The fastest growth came from the revenues generated by licensing IP – the most popular approach to technology transfer for U.S. higher-ed institutions. Within that field, small businesses accounted for the largest share of the revenues paid to universities (up from 53.3% of licensing revenue in 1996 to 57.8% in 2022). Revenues paid by startups grew especially rapidly (up from 10.6% of licensing revenue in 1996 to 18.1% in 2022), while the share contributed by large businesses declined (down from 36.1% in 1996 to 24.2% in 2022). Given that annual licensing revenue comes from a combination of existing and new contracts, these shifting percentages suggest that the innovation ecosystem has shifted toward innovation at startups and spinoffs – a trend anecdotally supported by interviews with TTO leaders at several major U.S. research institutions.



[36] Data from 1994, the first year AUTM reported new startup activity in its survey.

Total revenue generated through the licensing of university IP nearly tripled to US$3.8 billion in 2022 from US$1.3 billion in 2000. Despite that large sum, the average income per individual IP active license agreement generates only small amounts of revenue for universities, with only a few blockbusters generating more than US$1 million in licensing revenue.[37] Rather, the sheer volume of contracts accounts for the impressive revenue totals, and it typically takes five to seven years before a TTO builds an IP portfolio large enough to fund its operations from licensing revenue. Finally, while average revenue per license rose to US$76,385 in 2022 from $66,575 in 2000, the increase actually lagged inflation. Even in the U.S., the formal management of IP portfolios remains a relatively new undertaking at most universities, and TTOs there can benefit from ongoing experimentation around best practices, including startup incubation and new types of industry partnerships.

Compared with the U.S. and the UK, German universities generate a relatively low number of patent applications – a concern given the American universities' continued reliance on volume and breakthrough discoveries. Between 2010 and 2019, 178 universities and 102 affiliated institutions produced at least one patent application, leaving nearly a third of the more than German 400 universities with essentially no presence in the patent licensing and IP commercialization marketplace. Even among the universities and institutions that take an active role in commercialization, about half of the 8,800 patents filed came from just 15 universities.[38] Germany continues to post above-average rates of overall inventiveness – in 2021, German inventors registered 121 patents per 10 million residents, more than double the per capita rate in the U.S. and higher than France and the UK[39] – so the low patent activity at universities appears directly linked to the institutions themselves.

The proponents behind the 2002 repeal of the "Hochschullehrerprivileg" (university teacher privilege) hoped that transferring IP rights from professors to universities would incentivize the

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[37] Wissenschaftliche Dienste (2020): Zu Lizenzerträgen aus Patentierungen an Hochschulen. Deutscher Bundestag. Accessible at: https://www.bundestag.de/resource/blob/691798/fb1202fa2a5e1937eb403b8b0ebae3f9/WD-8-016-20-pdf-data.pdf (accessed last 03 April 2024)

[38] Kulicke, A. (2023): Spin-offs aus Hochschulen und Forschungseinrichtungenin Deutschland und weiteren Ländern. Fraunhofer Gesellschaft. Accessible at: https://www.stifterverband.org/sites/default/files/2023-11/spin-offs_aus_hochschulen_und_forschungseinrichtungen_in_deutschland_und_weiteren_laendern.pdf (accessed last 03 April 2024)

[39] BVDS; McKinsey (n.D.): Startup Nation Deutschland - Dashboard, based on data from the European Patent Office and the International Monetary Fund. Accessible at: https://www.startupnation-deutschland.de/ (accessed last 05 April 2024)

schools to professionalize their IP commercialization. To further encourage universities, states began to establish and fund a series of regional patent exploitation agencies (Patentverwertungsagenturen, PVA) that same year. Every German state established at least one PVA, which operated as an autonomous service provider that helped regional university consortia organize and coordinate their patenting processes in ways that would generate economies of scale and scope. In their first three years, the PVAs generated a sharp increase in patent applications, but then both applications and licensing agreements slowed.[40] Making matters worse, the PVAs did not generate enough revenue to offset their costs. A 2012 study concluded that PVAs are not cost-effective and probably will not become profitable in the future, suggesting that universities will not gain additional income from patent revenues[41]. A more recent 2020 report from the Scientific Service of the Bundestag concluded that little had changed in the years since – despite the establishment of PVA, patent activity at German universities remained modest, and these efforts have not significantly enhanced patent engagement in the academic sector.[42]

The emergence of TTOs over the same time span did little to accelerate IP licensing and commercialization. In theory, the PVA and TTO would complement each other. The PVA would work with a range of TTOs to help manage and accelerate patent utilization and commercialization processes, while the TTO would support the researchers at its individual university or research institution with a wider range of technology transfer services. Unfortunately, there is no evidence that this division of labor had any significant positive impact, and the organizational structure at German TTOs remains ill-equipped to handle patenting activity. A 2013 study on TTOs, which measured performance by the number of invention disclosures, found that neither the size nor academic composition of a TTO's staff significantly influenced its disclosure volume. Instead, offices with more effective structures for task specialization and a clear division of labor produced the most disclosures, the study found, but most TTOs lacked the proper strategic organization and struggled to recruit skilled personnel.

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[40] Cuntz, A.; et. al. (2012): Hochschulpatente zehn Jahre nach Abschaffung des Hochschullehrerprivilegs, Studien zum deutschen Innovationssystem, No. 13-2012, Expertenkommission Forschung und Innovation (EFI), Berlin. Accessible at: https://hdl.handle.net/10419/156576 (accessed last 03 April 2024)

[41] Cuntz, A.; et. al. (2012): Hochschulpatente zehn Jahre nach Abschaffung des Hochschullehrerprivilegs, Studien zum deutschen Innovationssystem, No. 13-2012, Expertenkommission Forschung und Innovation (EFI), Berlin. Accessible at: https://hdl.handle.net/10419/156576 (accessed last 03 April 2024)

[42] Wissenschaftliche Dienste (2020): Zu Lizenzerträgen aus Patentierungen an Hochschulen. Deutscher Bundestag. Accessible at https://www.bundestag.de/resource/blob/691798/fb1202fa2a5e1937eb403b8b0ebae3f9/WD-8-016-20-pdf-data.pdf (accessed last 03 April 2024)

While specialized courses and graduate degree programs for technology managers exist in Germany, they do not share the same scale and level of professionalization as U.S. programs.[43] Additionally, many universities appear to lack the "entrepreneurial spirit" crucial for proactive technology transfer.[44] A 2017 survey evaluation of the WIPANO program revealed that the 167 responding universities reported limited staffing for patent commercialization. With an average of only 1.7 full-time employees dedicated to these activities – from 2.3 at universities to 0.9 at Fachhochschulen/HAWs – the staffing level fell far below most American universities.[45]

Partnerships With Industry

The second TTO service area involves efforts to establish and nurture the types of industry partnerships (e.g. joint R&D activities or contract research and consultancies) that are vital for technology commercialization. Crucially, these partnerships help address what a 2020 study called the "Outcome Impact Gap."[46] According to that report, collaborations between universities and industry often produce interesting outcomes – an insightful technical paper, a proposed process, or a new computer code – but those outcomes have little or no impact on company productivity or competitiveness. Of the analyzed projects, about half yielded new IP or methods, but only around 20% significantly impacted the partnering company's productivity or competitiveness. While the IP generated from these partnerships could produce game-changing rewards, their success rate was roughly the same as riskier startup ventures. University-industry partnerships in the U.S. typically take the form of industry-sponsored research, industry membership or affiliate programs, or the establishment of industry-sponsored institutes. Sponsored research is typically conducted according to a project-based or

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[43] Training offerings by Transferallianz are accessible at https://www.transferallianz.de/en/services/training-courses (accessed last 03 April 2024)

[44] Hülsbeck, M.; Lehmann, E. (2013): Performance of technology transfer offices in Germany. The Journal of Technology Transfer. Accessible at: https://link.springer.com/article/10.1007/s10961-011-9243-6 (accessed last 03 April 2023)

[45] Kulicke, M.; et al. (2019): Evaluation des Programms WIPANO - Wissens- und Technologietransfer durch Patente und Normen. Fraunhofer-Gesellschaft. Accessible at: https://publica.fraunhofer.de/entities/publication/7fe35529-c9ef-44c6-81bf-3076cc078e5c/details (accessed last 03 April 2024)

[46] Pertuzé, J. A.; et. al. (2010): Best Practices for Industry-University Collaboration. MITSloan Management Review. Accessible at: https://sloanreview.mit.edu/article/best-practices-for-industry-university-collaboration (accessed last 03 April 2024)

long-term relationship agreement, and the IP developed through these deals almost always remains the property of the university. Because tense negotiations over project terms, IP licensing, and NDAs can sour industry-university relationships, long-term relationships have gained favor in recent years. These deals provide the university with access to research funds and jobs for its graduates, while the industry partner gains closer access to emerging ideas, newly developed IP, and ambitious graduate and undergraduate talent.[47]

Another collaborative approach involves industrial affiliate programs, in which companies pay a membership fee for facilitated access to faculty and students conducting research of common interest to private industry. Affiliate programs encourage knowledge exchange through networking events and meetings/workshops with researchers. Some affiliate programs also offer companies the possibility of engaging in collaborative research projects that often lead to commercializable innovations. These programs are instrumental for corporate talent recruitment, as well, offering direct avenues for companies to engage with and recruit top students. Some membership/affiliate programs also feature customized education and training tailored to industry-specific requirements, along with preferential access to licensing opportunities for new technologies.

Finally, industry-sponsored institutes at research universities play a pivotal role in advancing scientific and technological innovation, acting as hubs where academia's theoretical expertise meets the practical demands of industry. Like some of the industrial affiliate programs mentioned above, these institutes actively support cutting-edge research that is directly informed by and applicable to real-world industry challenges, thereby accelerating the development of market-ready solutions. However, institutes also provide a unique platform for interdisciplinary collaboration, bringing researchers, industry experts, and students together to work on joint projects. This symbiosis drives technological advancements and economic growth, but it also offers students experience and exposure to industry practices, preparing them for future careers.

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[47] Lutchen, K. R. (2018): Why Companies and Universities Should Forge Long-Term Collaborations. Harvard Business Review. Accessible at: https://hbr.org/2018/01/why-companies-and-universities-should-forge-long-term-collaborations (accessed last 03 April 2024)

Zoom In: Industry-Sponsored Institutes At The University Of California, Berkeley

The C3.ai Digital Transformation Institute is a research consortium established by C3.ai, Microsoft, and leading universities to accelerate the impact of AI in business, government, and society.

The California Research Alliance (sponsored by BASF) is a multidisciplinary research institute with an emphasis on new inorganic materials and their applications, biosciences, and related technologies.

The Energy and Biosciences Institute (sponsored by BP) combines industry-sponsored research and entrepreneurial support to facilitate the advancement of clean energy technologies that lead to a reliable, economical, and sustainable energy future.

The Immunotherapeutics and Vaccine Research Initiative (sponsored by Aduro Biotech) is a center for basic and early applied research in immunology, microbial pathogenesis, and vaccinology aimed at improving the treatment of human disease.

The Laboratory for Genomics Research (sponsored by GSK), a collaboration among UC Berkeley, UC San Francisco, and GlaxoSmithKline, is a state-of-the-art functional genomics laboratory for CRISPR technologies within the Innovative Genomics Institute.

In Germany, the TTOs focus primarily on patenting and licensing and play a minimal role in establishing and managing industry partnerships. However, university-industry collaboration remains a key component of the prevailing cluster policies of both the German government and the government of the states. The strategic initiatives promoted by these cluster policies seek to concentrate industrial, academic, and governmental resources in specific geographical areas, fostering innovation and economic development by geographical proximity and exchange platforms, with the hope of facilitating permeability between the different sectors (see Section 4.2).

As in the U.S., the funding and number of professorships sponsored by industry-related foundations in Germany expanded in recent years. As of 2021, there were 746 privately funded professorships at German colleges and universities.[48,49] The Dieter Schwarz Foundation has endowed a total of 41 professorships at the Technical University of Munich (TUM) since 2018, with 32 of them located on the TUM Campus in Heilbronn. At RWTH Aachen University, a computer science professorship funded by the auto manufacturer BMW will be filled this year. According to the Federal Statistical Office, RWTH Aachen led in third-party funding per professor in 2021 with €932,100, followed by TUM with €799,800 per professor and the University of Stuttgart with €763,600.[50] It is no longer a rarity in this country for university buildings to be financed by businesses or for business representatives to be represented on university boards. But while companies and universities emphasize that the private sector has no influence on research results and that academic freedom remains untouched, institutions and professors still face cultural aversion, doubts, and negative public reports about the industry's influence on their research and teaching, as examples show.[51] Nevertheless, the increase in privately financed professors and the involvement of the business community in university research is encouraging in light of the positive impact that industry-university permeability has had in the U.S. Despite the public skepticism, 78% of the 73 university mission statements reviewed in a 2018 study referred to knowledge and technology transfer, highlighting universities' ambition to support economic development and entrepreneurship.[52] Around two-thirds of the responding universities mentioned collaborations with non-scientific partners, referring primarily to research projects or partnerships with companies from industry. Strengthening public trust by expanding transparency and engagement with all stakeholders could further enhance the positive outcomes of industry-university partnerships.

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[48] Stifterverband (2021): Stiftungsprofessuren. Accessible at: https://www.stifterverband.org/stiftungsprofessuren (accessed last 03 April 2024)

[49] Of 746 funded professorships, 52% (386) were funded by industry, 48% (360) by foundations

[50] Matera, E. (2024): Endowed professors and sponsorships: the creeping privatization of Germany's universities. Science Business. Accessible at: https://sciencebusiness.net/news/universities/endowed-professors-and-sponsorships-creeping-privatisation-germanys-universities (accessed last 03 April 2024)

[51] Kästner, S. (2020): Wie die Wirtschaft die Wissenschaft beeinflusst. Deutschlandfunk Kultur. Accessible at: https://www.deutschlandfunkkultur.de/forschungsfinanzierung-wie-die-wirtschaft-die-wissenschaft-100.html (accessed last: 03 April 2024)

[52] Berghaeuser, H.; Hoelscher, M. (2019): Reinventing the third mission of higher education in Germany: political frameworks and universities' reactions. Tertiary Education and Management. Accessible at: https://d-nb.info/1198529369/34 (accessed last 03 April 2024).

Zoom In:
TUM Trailblazing Entrepreneurship In Higher Education

In the arena of higher education entrepreneurship, the Technical University of Munich (TUM) and its synergistic partnership with UnternehmerTUM stand out as top examples of entrepreneurship promotion and collaborative ecosystems in Germany.

TUM's success is rooted in its commitment to academic and research excellence, a pillar reinforced by its designation as a university of excellence within the German Excellence Strategy framework. This distinction is further underscored by its global ranking, securing the 30th position in the 2023 Times Higher Education (THE) ranking and holding the top spot among German universities.[53] Notably, TUM's adeptness in fostering industry collaborations and upholding rigorous research standards, as recognized in the THE ranking, contributes to its allure, attracting top-tier students and fostering an environment conducive to entrepreneurial pursuits. This environment has incubated unicorns such as Flix Mobility, Celonis, and Lilium that serve as important examples and inspirations for aspiring entrepreneurs.

The support of university leadership has been integral to the development of TUM's entrepreneurial ecosystem, said Philip Prestele, the Startup and Ecosystem Evangelist at UnternehmerTUM.[54] Under the guidance of university President Thomas Hofmann, TUM prioritizes its role as Germany's premier entrepreneurial university, continually refining and expanding its offerings. These efforts encompass a comprehensive suite of support services that cater to every stage of the entrepreneurial journey, spanning from inspirational programs like the Academy of Innovators to ideation, prototyping assistance, Xpreneurs, a format for incubation services, and corporate and venture capital (VC) matchmaking. Moreover, TUM's leadership advocates for universal participation in entrepreneurship education, striving to ensure that every student, regardless of their field of study, undergoes at least one entrepreneurship course during their academic tenure—a goal that remains aspirational yet vital.

At the core of TUM's support infrastructure lies UnternehmerTUM, a non-profit organization affiliated with a for-profit VC fund and an institute of TUM. Founded by Helmut Schoenenberger and overseen by industry luminary Susanne Klatten, along with academic figures

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[53] Times Higher Education (2023): Technical University Munich. Accessible at: https://www.timeshighereducation.com/world-university-rankings/technical-university-munich (accessed last 03 April 2024)

[54] Interview with the report's authors (April 2024)

such as the President of TUM, UnternehmerTUM maintains a neutral stance crucial for fostering effective collaboration within Bavaria's innovation ecosystem. Despite sporadic seed funding injections from philanthropists like Klatten, UnternehmerTUM predominantly relies on the returns of its VC fund, securing grants, contracts, and partnerships with industry players, foundations, and the Bavarian state government to sustain its operations and drive ongoing innovation. This adaptability is further fueled by competitive pressures arising from the burgeoning startup landscape and the university itself, both vying for these funding sources and thereby motivating UnternehmerTUM to continuously evolve and validate its relevance in the Bavarian entrepreneurship ecosystem. Further contributing to TUM's success, though not at its core, is the supportive state law and policy framework noted in Chapter 3.2, which outlines employment laws for professorships. Additionally, the state allocates €2 million annually to support venture labs, enhancing the entrepreneurial environment and fostering collaboration between academia and industry.[55]

The collaborative efforts of TUM and UnternehmerTUM yield a clear track record of success, with 810 startups originating from TUM between 2014 and 2022—nearly double the number from the next leading university in Germany within the same period. However, TUM's entrepreneurial activity still lags behind that of many universities around the world, particularly in the U.S.[56] As such, TUM should continue to refine and strategically enhance its programs to bolster its entrepreneurial standing on the international stage.

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[55] Bayerische Staatsregierung (2022): Freistaat fördert Gründungen und Forschungstransfer: jährlich 2 Millionen Euro für TUM Venture Labs - Pressemitteilung. Accessible at: https://www.bayern.de/freistaat-frdert-grndungen-und-forschungstransfer-jhrlich-2-millionen-euro-fr-tum-venture-labs/ (accessed last 05 April 2024)

[56] Fiedler, M., et. al. (2023): Entrepreneurship Performance Deutscher Hochschulen 2023. Chair for Strategy and Organization (TUM). Accessible at: https://www.entrepreneurshipranking.com/german-entrepreneurship-ranking (accessed last 03 April 2024).

Despite the expansion of their relationships with industry, universities have yet to translate that interest into a more proactive positioning of TTOs and tech transfer activities. Instead, research managers within German TTOs see themselves as passive service providers, supporting scientists' self-driven commercialization activities rather than actively managing tech transfer, patenting, and licensing as their U.S. counterparts do.[57] The German Startup Strategy aims to change this performance. Among other things, its EXIST program provides for a "Lighthouse Competition for Entrepreneurship Centers," which would promote five to ten long-term projects that seek to establish cross-university ecosystems with international appeal and strong integration into regional and national value chains.

Incubation For Startups

Over the years, TTOs evolved to include business and legal counseling for professors, researchers, and students interested in spinning off or standing up their own ventures. Many TTOs contribute resources, funding, and connections, and some have established incubators and startup programs to foster a culture of entrepreneurialism among faculty and students. The potential inefficiency of IP licensing to industry has increased the scrutiny surrounding this historically popular commercialization pathway. Indeed, over the past decade, U.S. companies have increasingly demonstrated a preference to acquire developed technologies and companies, rather than commit internal resources to develop IP licenses from a university, according to multiple interviews with TTO directors at leading institutions in the U.S. As a result, universities are adopting a more proactive role in nurturing startups beyond their initial IP or pre-launch phase. In some cases, TTOs are serving as early-stage advisors or connecting aspiring entrepreneurs with incubators and accelerators to help grow their companies.

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[57] Leišytė, L.; Sigl, L. (2018): Academic institutional entrepreneurs in Germany: navigating and shaping multi-level research commercialization governance. Triple Helix - A Journal of University-Industry-Government Innovation and Entrepreneurship. Accessible at: https://triplehelixjournal.springeropen.com/articles/10.1186/s40604-018-0057-5 (accessed last 03 April 2024)

[58] Cambrian interviews with TTO managers.

Zoom In:
Incubators Vs. Accelerators

In the landscape of startup development, incubators, and accelerators are two distinct models designed to support early-stage companies. Incubators are akin to a nurturing ground for fledgling startups, providing a supportive ecosystem that typically includes office space, mentorship, and access to a network of potential investors and partners. Incubators generally do not have fixed timelines, allowing startups to develop at their own pace. This model is particularly beneficial for startups still refining their business models or developing their products, as it provides the flexibility and resources needed for gradual growth. Incubators often operate under the auspices of academic institutions, government entities, or private organizations, which may not necessarily require equity in the startup, focusing instead on fostering innovation and economic development within a community or specific industry.

Accelerators, on the other hand, offer a more intensive growth program that is time-bound, usually lasting between three to six months. These programs are designed to accelerate the growth of startups through mentorship, education, and networking opportunities, culminating in a pitch event or demo day that connects companies with investors. Accelerators sometimes require equity in participating startups, reflecting their focus on rapidly scaling business operations and facilitating quick market entry. The structured curriculum and access to a wide network of mentors, alumni, and investors make applications for accelerators highly competitive.

In addition to its many renowned accelerators, such as Y Combinator and 500 Startups, Silicon Valley is home to several university-affiliated startup incubators that play a crucial role in nurturing early-stage companies toward growth and success. For example, UC Berkeley's CITRIS Foundry is a prestigious year-long incubation program that supports startups at the intersection of technology and society by providing access to design, manufacturing, business development tools, and a community of entrepreneurs and experts. Similarly, the Santa Clara University Leavey School of Business runs CAPE (the California Program for Entrepreneurship), which offers an incubator-like environment that fosters innovation through education, mentorship, and resource allocation.

UC Berkeley's SkyDeck and Stanford University's Launchpad programs embody elements of both incubators and accelerators. Established as a partnership between Berkeley's Haas

School of Business, the College of Engineering, and the Office of the Vice Chancellor for Research, SkyDeck brings together a deep network of industry partners, accredited investors, and advisors, many of whom are professors at Berkeley.[59] But while SkyDeck is based on campus, it also works with startups founded, funded, or advised by affiliates from any of the UC campuses, as well as international student teams looking to connect with Berkeley students and faculty. This structure fosters a globally open and scalable model of innovation with roots in Silicon Valley. Stanford's Launchpad supports and launches businesses like an incubator, but it does so in just 10 weeks, establishing a time limit like an accelerator. Under the tutelage of Stanford Design School adjunct professor Perry Klebahn, Launchpad-incubated companies have raised US$600 million in venture funding and created thousands of new jobs since its founding in 2009.

Stanford also went the more direct accelerator route with StartX, a non-profit entity that supports the university's top entrepreneurs through an extensive network, educational programs, and funding opportunities. Unlike traditional accelerators, though, StartX stands out for its emphasis on a founder-centric philosophy, providing tailored support without taking any equity from the participating companies. This unique approach underscores its commitment to fostering innovation and entrepreneurship within the Stanford ecosystem without the direct financial incentives that typically characterize accelerator programs. The program boasts a notable track record of success, having incubated a wide array of startups across the high-tech, healthcare, education, and environmental industries.

German higher-education institutions have little to show in the form of incubator or accelerator programs. In fact, efforts to simply assess and compare spin-off versus licensing activity in Germany falter because of the lack of comprehensive qualitative and quantitative data on TTOs' involvement with startups. Efforts by the federal government to introduce uniform reporting of spin-offs and stand-ups are primarily applied to non-university research organizations such as the Max Planck Institute and Fraunhofer, with little to no standardized data collection from universities. The best comparison available, which did not differentiate between spin-offs and stand-ups, was an international ranking of startup activity that placed only one German university, the Technical University of Munich (TU München), among the 40 universities with the most startups founded by alumni. It ranked 31st. Unsurprisingly, the U.S. placed 19 of the 40 universities on the ranking, with four of those based in Silicon Valley. Even when evaluating the per-capita number of alumni-founded startups, which allows for

[59] In the interest of transparency, Olaf Groth, Cambrian Futures' CEO and Co-Founder, serves as a mentor at Skydeck.

a comparison across smaller and larger universities, the U.S. accounted for 18 of the top 40 – and the four in Silicon Valley produced more than a third of all startups to come out of the American universities. Although there are 14 European universities (not including the UK) in the per capita ranking, none from Germany made that list.[60]

Even when considering both the quality and the quantity of startups originating from research-intensive universities, Germany does not fare well. As of mid-2022, the top ten universities in Europe had collectively produced 91 unicorns. In Germany, only TU München contributed to this tally, with nine unicorns, representing just under a tenth of the total.[61] Other analyses paint an even more complicated picture, noting that the annual number of knowledge-based startups per 10,000 employees has decreased over 20 years, from 6.9 to 4.2 in the old federal states, and from 5.7 to 3.7 in the new federal states.[62] While quantitative and comparable data on spin-offs are lacking, it is widely understood that the majority of the aforementioned startups are not IP-based spin-offs.

Given the constraints of existing TTOs and related entities, structural changes within university departments not immediately associated with IP commercialization might help spur greater spin-off and stand-up activity. For example, an analysis of the impact of cross-faculty proximity on academic entrepreneurship in German universities – particularly the closeness of business schools to other faculties – suggests that academic networks are a useful precondition for fostering entrepreneurship in higher education. In particular, closer proximity between business schools and science departments significantly influenced the emergence of entrepreneurial ideas among science faculty, according to the study, which analyzed 2007 to 2014 data on the emergence of business ideas and structural characteristics of universities.[63] While the

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[60] Fiedler, M., et. al. (2023): Entrepreneurship Performance Deutscher Hochschulen 2023. Chair for Strategy and Organization (TUM). Accessible at: https://www.entrepreneurshipranking.com/german-entrepreneurship-ranking (accessed last 03 April 2024).

[61] Nugent, T. (2022): Europe's top 10 'unicorn universities' 2022. sifted. Accessible at: https://sifted.eu/articles/unicorn-universities (accessed last 03 April 2024).

[62] Bertschek, I. et al. (2020): Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2020. EFI. Accessible at:https://www.e-fi.de/fileadmin/Assets/Gutachten/EFI_Gutachten_2020.pdf (accessed last 03 April 2024).

[63] Goethner, M.; Wyrwich, M. (2019): Cross-faculty proximity and academic entrepreneurship: the role of business schools. The Journal of Technology Transfer. Accessible at: https://link.springer.com/article/10.1007/s10961-019-09725-0 (accessed last 03 April 2024).

study did not find convincing evidence that the same phenomenon occurred with engineering faculty, it underscored the fact that interdisciplinary interactions, especially those that involve business schools, are crucial to foster academic entrepreneurship in scientific fields. (Interestingly, the proximity of a natural science faculty to a business school showed a much stronger positive correlation than the proximity between a natural science faculty and a TTO.)

The German Startup Strategy has recognized the importance of knowledge-based startups and the role of higher education in their development. However, compared with other dimensions in the Startup Strategy, knowledge-based entrepreneurship is characterized by a relatively low level of ambition – a fact that reflects the limited scope for action of the Federal Government in Germany's higher education system.

Recommendation: Strengthen The TTO Network In Germany And Establish Exchange Platforms With TTO Networks In The U.S.

To advance technology transfer efforts in Germany and promote learning and exchange with the U.S., it is crucial to strengthen the TTO network (e.g. TransferAllianz) and establish exchange platforms. This entails enhancing TTO capacities through investment in resources and training, fostering partnerships between German and U.S. TTOs, and supporting cross-border innovation initiatives. By facilitating knowledge sharing and collaborative opportunities, Germany can accelerate technology transfer and drive innovation, benefiting both domestic as well as international stakeholders and in the process foster a broader service offering by TTOs.

Recommendation: Develop And Promote Specialized Programs For Technology Managers

As this study's overview of the three TTO service areas has illustrated, Technology Managers in these offices must possess both comprehensive and specialized skills. In the U.S., there are comprehensive and professional training programs for this. In Germany, such offerings are still underdeveloped and should be expanded, for example by the emerging DATI or against a revision of the German Startup Strategy.

Recommendation:
Create Programs Between TTOs And Business, Science, And Engineering Schools

Business schools offer comprehensive training for managing both for-profit and not-for-profit organizations, both on the graduate program and executive education fronts. They could be incentivized to extend this training to TTO managers, science/engineering students, and non-business faculty to support the creation of standups and spin-offs. Since some German business schools have VC and corporate networks, they could bring those to the table for applied clinics on the acquisition of IP or spin-offs sourced from within all of a university's partnering divisions. These clinics could be run as mock simulations or real-world "raw cases," in which a VC comes to the university with a discrete "hunting agenda" and the business school pre-selects a range of IP or ventures, the acquisition of which then gets evaluated and negotiated in the program. This process would be guided by professors experienced in corporate and financial venturing, innovation strategy, and portfolio design. This collaboration would simultaneously (a) enhance TTO craft and responsiveness to VC and startup needs; (b) foster acquisition of IP-based startups; and (c) train science and engineering students in the spin-out and stand-up processes. Since thoughtful program development and fine-tuning takes time, business schools should be compensated through longer-range tuition and license revenues, and faculty could mentor TTO managers and students for design and teaching fees.

Recommendation:
Create A Global Partnering And Bridging Network With Industry Incubators And Accelerators Instead Of Building Isolated University Programs

Cultivating strategic alliances between German universities and established industry-based incubators and accelerator programs both domestically and internationally would bridge resource gaps. These partnerships could focus first on programs in Europe, the UK, the U.S., Canada, Mexico, Colombia, UAE, Israel, Kenya, India, South Korea, Japan, and Australia—a group that includes the largest incubator hubs and steers clear of most Geotech and geopolitical issues. This bridging network also provides students and researchers who are selling IP or spinning out with a venture an opportunity to scale beyond the limited size of DACH markets. (Venture capital firms will likely appreciate the greater scale effects for their return on investment.) Ultimately, the objective is to cultivate a stronger, more globally networked and scaled entrepreneurial ecosystem for German science and engineering talent and forge closer industry partnerships between academic institutions and global innovation and incubation hubs.

4.2 Mechanisms To Promote University-Industry Collaboration

Key Takeaway:

The U.S. and Germany have developed contrasting approaches to fostering collaboration between business, research, the public sector, and higher education. In the U.S., the focus is on federal programs like SBIR and STTR, state initiatives like those in California, and university-driven collaborations. Germany, conversely, emphasizes regional cluster development and federal initiatives, recently complemented by a holistic policy and institutional framework solely dedicated to technology transfer. While both countries aim to enhance university-industry collaboration, they face unique challenges such as funding and integrating research with industry needs. The differences and similarities in the two countries' approaches highlight the importance of multi-sectoral collaboration for innovation and economic growth.

Efforts to foster deeper networking between business, research, the public sector, and higher education need to encompass far more than TTOs or other individual administrative units at universities. It is a task for society and the economy as a whole. In California, particularly in Silicon Valley, these interactions across fields are both expected and encouraged as a natural part of one's research, teaching, business, or education. Dozens of university-industry collaborations exist to facilitate these crossovers, but they generally break down into three categories: federal programs, state programs, and university programs.

At the federal level, the Small Business Administration (SBA) administers the primary programs encouraging university-industry collaboration. The SBA pools funding from federal agencies with extramural R&D budgets exceeding US$100 million, and then it distributes grants and contracts to small businesses. In 2019, the pool of grant funds was just over US$3.7 billion, nearly half of which was provided by the Department of Defense, which includes notable advanced technology research groups like the Defense Advanced Research Projects Agency (DARPA) and technology transfer initiatives like the Rapid Defense Experimentation Reserve. Among entrepreneurs, the SBA's two headline initiatives are the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. SBIR is a competitive program that provides funding to small businesses for internal R&D projects

that have the potential for commercialization. The STTR program has a specific emphasis on fostering partnerships between small businesses and universities/research institutions, including efforts to smooth the transfer of technology to the marketplace. Another distinction between them derives from their treatment of data and IP – the SBIR grantees own the data and IP they develop during the project, while STTR requires that the small business and the university negotiate IP ownership terms on their own. In both cases, however, these collaborations help leverage the expertise and resources of universities to drive technological advancements and promote economic growth.

The National Science Foundation (NSF) administers two key programs in addition to their contributions to SBIR/STTR funding, both aimed at bolstering innovation and research collaboration with industry. The first program, Grant Opportunities for Academic Liaison with Industry (GOALI), was established in 1990 with the primary objective of facilitating the exchange of knowledge, technology, and expertise between academia and industry, thereby promoting the development of innovative technologies and new products, processes, or technologies with commercial potential. The second program, Partnerships for Innovation (PFI), was launched in 2000 and seeks to bridge the gap between research and commercialization. It offers funding and support for projects poised to stimulate economic growth and competitiveness.

A third federal agency, the U.S. Economic Development Administration (EDA) also plays a significant role in making grants to support economic development initiatives across the U.S. As a federal agency under the U.S. Department of Commerce, the EDA's primary mission is to promote economic growth, job creation, and regional competitiveness. As such, some of their recent grant programs have relied on the initial work of Harvard Business School's Institute for Strategy and Competitiveness around clusters of innovation. Two recent examples are the EDA's Cluster Grants for Seed Funds program and The Tech Hubs Strategy Development Grant program. The Cluster Grants seek to bolster regional economic development by funding efforts to create seed funds that provide early-stage capital to startups and small businesses in specific industrial clusters. The program encourages collaboration among various stakeholders, including local governments, universities and research institutions, and industry associations. The Tech Hubs Strategy Development Grant, enacted as part of the CHIPS and Science Act of 2022, was designed to support the growth and development of technology hubs and innovation centers within specific geographic regions. The grant provides funding to eligible entities – local governments, nonprofit organizations, or universities and research institutions – to establish tech hubs that will foster collaboration among startups, businesses, and academia to catalyze technological innovation, entrepreneurship, and economic growth.

At the state level, California has launched numerous initiatives in the last two decades to encourage industry-university research collaborations. For example, the California Institutes of Science and Innovation were launched in 2000 to support interdisciplinary research in fields that were deemed critical to the state's economic future. Organized as four multicampus consortia to address distinct technologies – biotechnology, nanotechnology, and computer and wireless technologies – the Institutes were initially funded by the state with US$100 million apiece, along with the expectation of a 2:1 industry or federal government match. Since their launch, the Institutes have secured nearly US$1 billion in additional research funding and have developed multiple successful incubators and accelerators responsible for the launch of hundreds of startups and spin-offs that have created thousands of jobs in California. Further, these Institutes have become global models of innovation, with the Institute for Quantitative Biosciences (QB3) conducting collaborative research with institutes around the world and the Center for Information Technology Research in the Interest of Society (CITRIS) leading research and innovation partnerships in Singapore.

Another successful California state-level initiative was the Innovation and Entrepreneurship Expansion fund, which was launched in 2016 and provided US$2.2 million to each of the ten UC campuses to support entrepreneurship through the startup stages of discovery, validation, commercialization, and scaled growth. The fund's investments have led to more than US$279 million in follow-on investment, along with support for about 600 startups, and the establishment of multiple incubators, accelerators, and makerspaces.

Germany's federal and state policies and mechanisms to promote university and industry collaboration mirror the U.S. in several respects, including a focus on the creation of clusters. Following the development of cluster theory in 1990 by Harvard's Michael Porter, additional research and innovative programs have emerged to support the efficacy of such arrangements, which seek to establish a geographical concentration of interconnected businesses, suppliers, and associated institutions in a particular field.d Germany has long since adopted them as a key facet of its efforts to stimulate regional economic development. While this approach has been pivotal in the country since the 1990s, the formal adoption of cluster policies in Germany began in the early 2000s, propelled by government initiatives such as "Kompetenznetze Deutschland" and the "Spitzencluster-Wettbewerb" under the BMBF. European Union policy significantly influenced this strategy, promoting clusters as a tool for regional development. Today, cluster policies are central to Germany's innovation strategy, with various federal states developing initiatives tailored to their unique industry strengths. Covering sectors like automotive, biotechnology, energy, IT, and engineering, these hubs aim to leverage geographical proximity and sectoral specialization to foster innovation, investment, and high-quality job creation. Although they are recognized globally for their

effectiveness, cluster models face challenges such as sustainable funding and maintaining competitiveness, along with debates about their real impact on regional economic growth.

Many of Germany's clusters have emerged around economic activity, but some also center on science. In 2016, the country launched a new funding program to permanently support top-tier research at universities, aiming to enhance their international competitiveness and visibility. Building on its predecessor, the Excellence Initiative from 2007 to 2017, which boosted outstanding research and collaboration with external partners, the new Excellence Strategy includes two funding lines – Excellence Clusters and Excellence Universities. The Excellence Clusters, funded for up to 14 years in two seven-year periods, promote competitive research fields at universities or consortia, fostering cross-disciplinary collaboration, training young scientists, and attracting international talent. Universities with Excellence Clusters can also apply for an additional organizational grant. Excellence Universities, funded continuously but evaluated every seven years, require participation in at least two or three Excellence Clusters for individual universities or consortia, respectively, to enhance their global research standing. On November 4, 2022, the Joint Science Conference (GWK) decided to develop the strategy further, allocating €539 million annually for up to 70 Excellence Clusters in the second funding period that begins in 2026, increasing the total annual funding to €687 million, with 75% from federal and 25% from state sources.[64] While research and science are at the forefront of the Excellence Strategy, "the quality of the proposed measures for idea and knowledge transfer" is included as an optional criterion for funding of Excellence Clusters. However, the transfer between university and industry is completely absent in the second funding lines for Excellence Universities. The failure to link funding from the Excellence Strategy to the successful creation of spin-offs or stand-ups, or a unified reporting system for tracking such startup creation, represents a missed opportunity to transfer and scale IP for economic and social benefit, especially considering the problematic data situation.

While Clusters serve as the backdrop of university-industry collaboration, the federal level has taken concrete steps to shape knowledge and technology transfer beyond policy and regional development measures, as well. Under the current government, the future strategy (Zukunftsstrategie) of the German Federal Ministry of Education and Research (BMBF),

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[64] Verwaltungsvereinbarung zwischen Bund und Ländern gemäß Artikel 91b Absatz 1 des Grundgesetzes zur Förderung von Spitzenforschung an Universitäten – „Exzellenzstrategie" – gemäß Beschluss der Regierungschefinnen und Regierungschefs von Bund und Ländern vom 16. Juni 2016 (BAnz AT 27. Oktober 2016 B6) zuletzt geändert durch Beschluss der Gemeinsamen Wissenschaftskonferenz vom 4. November 2022 (BAnz AT 10. Februar 2023 B5). Accessible at: https://www.gwk-bonn.de/fileadmin/Redaktion/Dokumente/Papers/Verwaltungsvereinbarung_Exzellenzstrategie_2022.pdf (accessed last 03 April 2024)

adopted in February 2023, seeks to support innovation funding, tech transfer, and the strengthening of start-up activities. Universities, non-university research institutions, start-ups, and innovative small and medium-sized enterprises (SMEs) play a key role in this. Together with the broader innovation policy framework of the BMWK, four key approaches and institutions emerge: DATI, SPRIN-D, Transferbrücken and Innovationsregionen.[65]

The DATI holds particular significance within this study for its agile development approach that leverages existing structures. Currently in its early stages, this DATIPilot includes two modules: a) innovation sprints that provide €150,000 to transition ideas from science to implementation; and b) innovation communities that offer up to €5 million in funding over four years, along with coaching and networking support. Innovation sprints facilitate swift implementation through streamlined processes, while innovation communities autonomously develop themes and goals, fostering strategic partnerships for sustainable innovation over four years. The DATIPilot for the innovation sprints is ongoing, with funding decisions made in April 2024 on which of the nearly 3,000 submitted ideas would receive funding from the Federal Ministry of Education and Research (BMBF). Out of the 3,000 submissions, 600 ideas generally qualified for funding based on the criteria outlined in the DATI pilot guidelines, and 300 were selected.[66] The 300 projects address a wide range of topics, including AI/machine learning, medical technology/pharmaceuticals and healthcare, and social services. Around 20% of the projects focus on social innovations. The submission of funding applications for Innovation Communities is scheduled to begin in May 2024. The DATIPilot is closely monitored as the learnings will inform the final design of the organization. To what extent DATI is capable of supporting the shortcomings of the TTOs remains to be seen. However, the generally slow progress and the ongoing lack of a viable concept for DATI have garnered criticism from groups such as the Expertenkommission Forschung und Innovation (EFI). According to the expert commission, DATI faces challenges due to its narrow focus on specific types of universities and regional projects, which could limit its impact on broader innovation ecosystems and technology transfer. To enhance its effectiveness, EFI recommends that DATI adopt a more inclusive and flexible approach, including a diverse range of innovation stakeholders and not

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[65] Bundesministerium für Bildung und Forschung (n.D.): DATI - Deutsche Agentur für Transfer und Innovation. Bundesministerium für Bildung und Forschung. Accessible at: https://www.bmbf.de/bmbf/de/forschung/dati/deutsche-agentur-fuer-transfer-und-innovation_node.html (accessed last 03 April 2024).

[66] Bundesministerium für Bildung und Forschung (n.D.): DATIpilot – Fördern & Lernen für Innovation und Transfer: Ein Experimentierraum im Umfeld der DATI. Bundesministerium für Bildung und Forschung. Accessible at: https://www.bmbf.de/bmbf/de/forschung/datipilot/datipilot_node.html (last accessed 03 April 2024).

restricting itself to regional initiatives. This would enable better utilization of synergies across different funding measures and extend its reach and impact in fostering innovation.[67,68]

Zoom In: The Emerging Policy Framework And Institutions For Technology Transfer In Germany

DATI (Deutsche Agentur für Transfer und Innovation) – BMBF and BMWK are pursuing three goals with the establishment of the DATI, which are linked to each other in the key issues paper. The first seeks to promote cooperation between universities of applied sciences (HAW) and small and medium-sized universities (kmUni) with start-ups, small and medium-sized enterprises (SMEs), and social and public institutions, all with a view toward social and technological innovation. The second goal focuses on the promotion of application-oriented research, the transfer of knowledge, and technology acceleration. The third aims to strengthen regional innovation ecosystems. The concept for DATI is thus characterized by combining a stakeholder-related funding goal with two systemic funding goals.

SPRIN-D (Agentur für Sprunginnovationen) – Established by the German government in 2019, SPRIN-D focuses on leap innovations in Germany. Leap innovations are characterized by their potential to fundamentally change existing markets or create entirely new ones. SPRIN-D's central mission is to identify and support these highly innovative ideas. By definition, such innovations are often rooted in basic research, which is why SPRIN-D has close ties with universities and research organizations. The program employs various funding instruments to facilitate breakthroughs in radically disruptive developments in Germany.

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[67] Bertschek, I.; et. al. (2023): Gutachten zu Forschung, Innovation und Technologischer Leistungsfähigkeit Deutschlands. Expertenkommission Forschung und Innovation (EFI). Accessible at: https://www.e-fi.de/fileadmin/Assets/Gutachten/2023/EFI_Gutachten_2023.pdf (accessed last 03 April 2024).

[68] Bertschek, I.; et. al. (2022): DATI - Wenn schon, denn schon! Policy Brief Nr. 2-2022. Expertenkommission Forschung und Innovation (EFI). Accessible at https://www.e-fi.de/fileadmin/Assets/Policy_Briefs/EFI_PolicyBrief_02_2022.pdf (accessed last 03 April 2024)

Zoom In Continued: The Emerging Policy Framework And Institutions For Technology Transfer In Germany

Transferbrücken – This initiative aims to structurally strengthen spin-off activities at universities and other research institutions. Many scientific ideas fail to reach the market because would-be founders lack both financing and partners for transitioning from academia to entrepreneurial practice. The Transferbrücken plan expands the support measures provided by the BMBF during the pre-seed phase (i.e., the stage before company formation) to better assist founders on their journey to establishing their businesses.

Innovationsregionen – This initiative aims to establish beacons of top-tier research by creating open, innovative, and experimental spaces that have a strong international impact in cutting-edge research. These regions are intended to attract students and researchers from around the world, in part by making them appealing for the establishment of new startups, companies, or institutes. Building on the BMBF's successful cluster funding, these innovation regions are centered around networks of universities, other research institutions, industry, SMEs, and public administration. The goal is to reduce bureaucratic obstacles, accelerate administrative processes, and incorporate elements of smart regulation. This approach is designed to transform regional innovation spaces into incubators for creative research and development, as well as successful knowledge and technology transfer.

While providing a holistic and laudable framework, these initiatives were launched too recently to analyze their impact and effectiveness. Unlike in the U.S., however, this otherwise promising push toward improved cooperation between universities and industry is primarily driven by policies at the federal level, with federal states and universities struggling to prioritize and translate these initiatives into meaningful action on the ground.

Recommendation: Experiment With Government Funding Of Multi-University And Interdisciplinary Collaborations:

Initiatives like the California Institutes of Science and Innovation have fostered collaboration both across university campuses and across academic disciplines. For example, two or more German universities with especially talented researchers and strong ties to specific industries

or technologies might be paired as an institute with the explicit direction to drive breakthrough innovation that could be commercialized in the interest of society.

Recommendation:
Set Up DATI As A TTO-Like National Service Platform

Respecting the agile approach with which DATI is to be developed, we recommend testing and piloting DATI as a "TTO as a Service" platform. As the analysis shows, most TTOs in Germany lack the resources and capabilities to organize effective technology transfer. This is made particularly difficult by the fact that each university is currently trying to maintain its own TTO. DATI could reduce those barriers by offering universities all the services of a comprehensive and professional TTO via a key account manager structure. This would bundle the capacities and learnings and support the universities at a reasonable price. In addition, DATI's local and regional mandate could become an asset on a national level, as it could connect the innovation and commercialization dots across regions.

Recommendation:
Connect Venture Capital And Corporate Venturing Groups To DATI

It is imperative that Germany overcome the problem of lagging returns on investment for IP. The most effective mechanism is to connect local TTOs and regional innovation initiatives like DATI to the smart capital that is scouting for new ideas or for ways to shore up existing venture portfolios. These institutions would pair application relevance with deeper financial resource pools and national and global market networks. Networks drive scale, and scale drives ROI. In this way, the needs of local and regional development meet with global scaling.

5. Talent Pool And Practices

Although legal and organizational frameworks heavily influence a country's efforts to promote entrepreneurship, success ultimately hinges on whether universities can attract the right talent. This chapter delves into the micro-level, focusing primarily on individuals, with a particular emphasis on migrants due to their prominent role in U.S. entrepreneurship (Section 5.1). We then further analyze talent attraction and retention ability in the U.S. and Germany, with a specific focus on women, as a proxy for the attractiveness of university locations (Section 5.2).

5.1 Role Of Migrants In Entrepreneurship

Key Takeaway:

Migrant or transnational entrepreneurs play a prominent role in entrepreneurship around the world, especially in the U.S. While Germany has a higher percentage of migrants compared to the U.S., it struggles to fully capitalize on this demographic for entrepreneurial endeavors. This chapter delves into the reasons behind this phenomenon, including an exploration of the language, mentorship, and business-location challenges that hinder Germany's efforts to harness its migrants' entrepreneurial potential.

Over the past several decades, U.S. policies and attitudes toward foreign-born workers, particularly in the science, technology, engineering, and math (STEM) fields, have shifted to reflect broader political, economic, and social dynamics. In periods of economic growth and technological innovation, the U.S. has often adopted more welcoming policies to attract talented immigrants. This openness is underpinned by the recognition of the substantial contributions immigrant researchers, workers, and entrepreneurs make to U.S. technological advancements and the broader economy.

As of 2017, foreign-born workers accounted for 29% of the overall STEM workforce in the U.S. and 44% of the doctoral workforce in those fields. In 2019, their outsized presence in high-growth fields such as computer/information sciences and computer/electrical engineering helped contribute an additional US$367 billion to US$409 billion in labor value to the U.S. GDP.[69] Beyond their educational achievements and contributions to the

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[69] Crane, K. et al. (2021): Economic Benefits and Losses from Foreign-Born STEM Talent in the United States. The Institute for Defense Analyses' Science and Technology Policy Institute. Accessible at: https://www.ida.org/research-and-publications/publications/all/e/ec/economic-benefits-and-losses-from-foreign-stem-talent-in-the-united-states (last accessed 12 April 2024).

workforce, immigrants play a crucial role in U.S. research and entrepreneurship. Nearly 40% of American Nobel laureates in chemistry, physics, and medicine since 2000 have been immigrants.[70] Immigrants also contribute significantly to innovation, with firms founded by immigrants being 35% more likely to hold patents compared to those without immigrant founders.[71] Foreign-born workers have accounted for 23% of the country's total innovation output, despite constituting only 16% of all U.S. inventors.[72] Immigrants have shown a strong entrepreneurial orientation, with approximately a quarter of all U.S. firms having an immigrant founder or co-founder.[73] This number rises to more than 40% for California. Immigrant-founded companies contribute significantly to employment and offer comparable or higher wages than those established by native-born entrepreneurs. They're also prevalent among the leadership of cutting-edge technology firms, with a significant number of top AI companies and unicorn startups being founded or co-founded by immigrants or their children.[74]

Given such broad evidence of immigrant success in STEM fields, leaders in government, universities, and private industry are increasingly aware of how critical immigration is to national innovation, productivity, and access to global knowledge. However, because of increasing labor mobility and international competition for top STEM talent, the U.S. must strive for continuous improvement in how it attracts, integrates, and retains foreign-born students, researchers, and workers.[75] If the country wants to maintain its position as the

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[70] National Foundation for American Policy (n.D.): Immigrants and Nobel Prizes: 1901-2023. Accessible at: https://nfap.com/studies/immigrants-and-nobel-prizes-1901-2023/ (last accessed 12 April 2024).

[71] Azoulay, Pierre, Benjamin F. Jones, J. Daniel Kim and Javier Miranda. 2022. "Immigration and Entrepreneurship in the United States." American Economic Review: Insights, 4 (1): 71-88.

[72] Bernstein, S. et al. (2022): The Contribution of High-Skilled Immigrants to Innovation in the United States. National Bureau of Economic Research. Accessible at: https://www.nber.org/papers/w30797 (last accessed 12 April 2024).

[73] Kerr, S. and Kerr, W. (2020): Immigrant entrepreneurship in America: Evidence from the survey of business owners 2007 & 2012. Research Policy, Volume 49, Issue 3. Accessible at: https://dash.harvard.edu/bitstream/handle/1/37366633/kerr%2Ckerr_immigrant-entrepreneurship-in-america.pdf (last accessed 12 April 2024).

[74] Anderson, S. (2023): AI and Immigrants. National Foundation for American Policy. Accessible at https://nfap.com/studies/ai-and-immigrants/ (last accessed 12 April 2024).

[75] Harnoss, J. et al. (2023): A New Migration Strategy for Growth and Innovation. Boston Consulting Group. Accessible at: https://www.bcg.com/publications/2023/new-migration-strategy-for-growth-and-innovation (last accessed 12 April 2024).

dominant hub in the circulation of global talent and truly capitalize on the entrepreneurial potential that "brain circulation" affords, it needs to improve on weaknesses, such as the equitable integration of all immigrants into the nation's social and economic fabric. While 78% of immigrants say their financial situation has improved since moving to the U.S. and 60% believe their children's standard of living will be better than theirs, immigrants continue to face significant challenges.[76] Discrimination is widespread, with about half of all working immigrants experiencing discrimination in the workplace and a third facing criticism for speaking a language other than English.

Zoom In: Brain Drain, Brain Gain, Or Brain Circulation?

For a long time, it was assumed that the migration of talent was a loss for the home country (brain drain) and a gain for the host country (brain gain). This binary view has given way to the understanding that migrants are not only a gain for the receiving country, but also for the home country, for example through the return flow of capital (remittances) or knowledge transfer (brain circulation). Experts now have a much more nuanced understanding of the complex interaction between migrants and their host and home countries. Being embedded in two countries gives transnational or immigrant entrepreneurs the opportunity to gain access to economic resources, education, social networks, and social lifestyles that they can use to their business advantage. However, this advantage may be used more by highly skilled workers (e.g., in the technology industry or in consulting) than by less privileged workers (e.g., in nail care). While several studies agree on the importance of networks for the success of transnational entrepreneurs, critics highlight transnational migrants' risk of disconnection from home country networks. Also more fluid aspects, such as culture and entrepreneurial motivation can curb the impact that migrant entrepreneurs can add through brain circulation.[77]

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[76] KFF (2023): Understanding the U.S. Immigrant Experience: The 2023 KFF/LA Times Survey of Immigrants – Findings. Accessible at: https://www.kff.org/report-section/understanding-the-u-s-immigrant-experience-the-2023-kff-la-times-survey-of-immigrants-findings/ (last accessed 12 April 2024).

[77] Sandoz, L.; et. al. (2022): A Review of Transnational Migrant Entrepreneurship - Perspectives on Unequal Spatialities. ZFW – Advances in Economic Geography. Accessible at: https://www.degruyter.com/document/doi/10.1515/zfw-2021-0004/html?lang=en (accessed last 03 April 2024)

Germany has a higher percentage of foreign-born population (16.1% in 2019) than the U.S. (13.6% in 2019)[78], a share expected to expand further with the surge in immigration due to the war in Ukraine.[79] Although emigration from Germany was elevated at the same time, exceeding an astonishing 1.2 million mainly high-skilled individuals, net migration is still at a record high of 1.45 million, exceeding its previous peak of about 1 million in 2015.[80] As in the U.S., immigrants in Germany are more likely than natives to start companies. Foreign-born entrepreneurs founded 21.5% of German startups in 2021, and immigrants represented 25.9% of the working population. Among all the startup founders in Germany, foreign-born entrepreneurs accounted for six out of every 10 startups that reached unicorn status.[81] Still, there is further potential to enhance the role of immigrants in the startup ecosystem. Many are held back from pursuing an entrepreneurial venture by a lack of networks and limited access to funding.[82]

However, two relevant aspects distinguish German startup founders from their peers in the U.S. – the origins of its immigrants, and the different scale of overall entrepreneurial activity in the two countries. Regarding origin countries, Germany sees a significant influx of refugees from impoverished and war-torn countries, including Ukraine, Turkey, Syria, and Afghanistan.[83] In contrast, the U.S. predominantly attracts immigrants from other North American

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[78] OECD (n.D.): Foreign-born population. OECD Data. Accessible at: https://data.oecd.org/migration/foreign-born-population.htm (accessed last 03 April 2024)

[79] Germany saw a record inflow of more than 2.6 million immigrants in 2022

[80] Probst, J. (2023): Net Migration Surges, But Germany is Still Missing Skilled Workers. Recruitonomics. Accessible at: https://recruitonomics.com/net-migration-surges-but-germanys-still-missing-skilled-workers/#:~:text=However%2C%20this%20leaves%20net%20migration,high%2084.5%20million%20last%20year (accessed last 03 April 2024)

[81] Startup port (2023): Migrant Founders Monitor 2023 - Universities attract international start-up talent. Startup port. Accessible here: https://startupport.de/en/migrant-founders-monitor-2023-universities-attract-international-start-up-talent (accessed last 03 April 2024)

[82] Friedrich Naumann Stiftung; Startup Verband (2022): Migrant Founders Monitor. Friedrich Naumann Stiftung; Startup Verband. Accessible at: https://startupverband.de/fileadmin/startupverband/mediaarchiv/research/migrant_founders/Migrant_Founders_Monitor_2022.pdf (accessed last 03 April 2024)

[83] Statista Research Department (2023): Number of immigrants in Germany 2022, by country of origin. Statista. Accessible at: https://www.statista.com/statistics/894238/immigrant-numbers-by-country-of-origin-germany/#:~:text=The%20largest%20number%20of%20immigrants,to%20permanently%20reside%20in%20another (accessed last 03 April 2024)

countries, Asia, and Europe.[84] Skilled professionals from outside the European Union are less inclined to migrate to Germany, where efforts to enhance the country's appeal have suffered against deep-rooted cultural preferences. Consequently, a recent report by the Organisation for Economic Cooperation and Development (OECD) ranks Germany as only the 15th-most attractive destination for foreign workers, trailing Portugal, Denmark, and Ireland and lagging far behind New Zealand, Sweden, and Switzerland.[85] The FDP party floated a proposal in 2021 to eliminate some of those barriers by making English the second official language – a proposal that was shut down by the Civil Servants' Association (DBB) in February 2023.

Secondly, the successes of foreign-born entrepreneurs in Germany can be obscured by the vastly smaller scale of startup activity than in the U.S. Total early-stage entrepreneurial activity (TEA) is much lower in Germany – according to a 2021 study, 7-8% of Germany's 18- to 64-year-old population had started a business in the previous 3½ years; that ratio was more than doubled in the U.S., at 16-18%.[86] In other words, Germany's much smaller overall cohort of founders means fewer mentors, role models, and experienced entrepreneurs who have run the cycle of scaling a company, exiting, and then returning as advisers or angel investors for the next generation of founders. Making the entire startup ecosystem more vibrant will lead to a larger number of immigrants involved in entrepreneurial activities. The movement of unicorns and their founders' underscores Germany's lack of appeal. According to a 2022 study, 1,089 unicorns were founded by entrepreneurs living in the U.S. However, the total number of unicorns based in the U.S. stood at 1,729 – China, India, and Israel all contributing significant numbers to that total. In Germany, the flow went in the opposite direction. While 110 unicorn founders came from Germany, only 98 of those billion-dollar firms registered their companies there. Germany is losing stronger founders to the more attractive positioning of the U.S. and other countries.[87]

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[84] USAFACTS (2022): Immigration & Border Security. USAFACTS. Accessible at https://usafacts.org/topics/immigration-border-security (accessed on 03 April 2024).

[85] OECD (2023): Talent Attractiveness 2023. OECD. Accessible at: https://www.oecd.org/migration/talent-attractiveness (accessed last 03 April 2024).

[86] Stemberg, R.; et. al. (2022): Global Entrepreneurship Monitor. Unternehmensgründungen im weltweiten Vergleich. Länderbericht Deutschland 2021/22. GEM. Accessible at: https://www.gemconsortium.org/report/gem-germany-national-report-20212022 (accessed last 03 April 2023).

[87] Kutsenko, E.; et. al. (2022): Relocation as a Driver of Innovative Activity - A Global Study of Unicorn Founders' Migration. Foresight and STI Governance, 16(4), 6–23. Accessible at: https://foresight-journal.hse.ru/data/2023/01/19/1717849529/1-Kutsenko-6-23.pdf (accessed last 03 April 2024)

The German government is addressing the issue of diversity as part of its startup strategy, albeit with a greater focus on women than on people with a migrant background (although women with a migrant background are particularly hard hit by the challenges posed by the intersectoral lens). Accordingly, the funding program EXIST – Start-ups from Science expects to receive a new funding line that will focus on female founders and bolster the participation of women in investment companies and the investment committees of state funds. In order to improve access to financing, the Emerging Manager Facility (EMF) module was set up in 2023 as part of the Future Fund, which provides financial support for "first-time" venture capital funds that are aimed in particular at women and founders with a migration background. An evaluation is not yet possible due to the short duration. However, according to the first interim report on the implementation of the startup strategy, 56% of the agreed measures have already been implemented, and concrete, substantial preparations have been made for the implementation of all others.

Recommendation:
Introduce English As A Second Official Language In Germany

The lack of a constitutionally defined national language and the de facto acceptance of English removes some of the barriers to migrant entrepreneurship in the U.S. In Germany, however, language is a major barrier, especially for highly skilled immigrants. Germany should reconsider the FDP's 2021 proposal to establish English as the second official language, a move that would better facilitate interactions with German authorities and make the country more attractive amid labor shortages.

Recommendation:
Induce Founders In The U.S. To Open A Second HQ For Europe In German

In many instances, Europe is the second market U.S. entrepreneurs try to conquer. However, many use the UK as their initial beachhead. Germany should consider a bridging alliance with U.S. and UK economic development offices to bring founders to Germany under special consideration of IP in ventures that align with national priorities.

Recommendation:
Design A Program For Scientists Of German Origin In The U.S. And Elsewhere To Become Mentors For The Next Generation Of German Entrepreneurs

Berlin should also consider offering part-time paid mentoring contracts that allow seasoned scholar-entrepreneurs to help advise German talent and TTO offices on processes and best practices. As an additional benefit, such a program would open Germany's global diaspora channels across geographies. A particular focus of this program should be the matching of mentors and mentees with overlapping IP portfolios.

5.2 Talent Attraction And Retention At Universities

Key Takeaways:

Financial and legal conditions for students in Germany are better than those in the U.S. However, since U.S. research institutions are reputationally superior to those in Germany, the U.S. tends to attract superior talent and, notably, a higher number of economically affluent students, even if it involves more effort for them. Despite the existence of legal and financial incentives in Germany, such as lower tuition fees, they alone are insufficient to position the country as a magnet for talent, mainly due to missing entrepreneurial infrastructure, capital, and upside. Despite facing greater hurdles in the U.S., the country remains considerably more popular among top talent.

The importance of attracting and retaining international students has been underscored by accelerating labor and skill shortages, particularly in entrepreneurship, where they play an especially crucial role. Establishing successful spin-offs hinges on universities' ability to attract and retain top talent. In the U.S., universities operate in a highly decentralized and fiercely competitive environment, which enhances their agility and responsiveness to societal economic needs and demands. Universities in California, renowned for their strong reputations, comprehensive educational offerings, and world-class research programs, have become talent magnets.

OECD data shows that international student enrollment in post-secondary programs in the U.S. remained flat over the last decade at around 5% of the total student population. However, the U.S. has for many years attracted more international students than any other country worldwide, hosting 18% of the global international student population.[88] Among all students at U.S. universities, those holding temporary visas accounted for just 7% of STEM-related bachelor's degrees in 2019 (just under 50,000 students). However, when compared with U.S. citizens and permanent residents, these undergraduate students enter STEM-related majors at disproportionate rates – 49% of all foreign-born bachelor's degree candidates pursue studies in these disciplines, compared with 35% of their non-immigrant peers. At the master's level, the trend is even more pronounced, with international students on temporary visas claiming an increasing share of STEM degrees. In 2019, they earned 36% of all such degrees (~75,000), up from 26% in 2011, with growth especially pronounced in engineering (50%) and computer science (57%). Finally, while trends among doctoral students on temporary visas did not change much from 2011 to 2019, the percentages of total degrees granted mirrors that of master's degrees – graduate students on temporary visas earned about one-third of all STEM doctorates in 2019, including more than half of all the doctoral degrees awarded in the U.S. in economics, computer science, engineering, and mathematics and statistics.[89]

Beyond the prestige of America's top public and private universities, faculty and researchers with entrepreneurial inclinations are drawn to schools in major metropolitan areas like California's San Francisco/Silicon Valley and San Diego; Boston, MA; Austin, TX; and Raleigh-Durham, NC because of their vibrant entrepreneurial ecosystems, welcoming and diverse cultures, exposure to the expressed market needs of local firms, access to industry knowledge and technical advice, and/or their spectacular natural surroundings and leisure offerings. In addition, universities attempt to attract academic entrepreneurs by supporting faculty engagement with technology transfer, especially through the significant funding of TTOs and entrepreneur-friendly tenure and promotion policies.

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[88] OECD (2022): Education at a Glance 2022 - OECD Indicators. OECD Publishing. Accessible at: https://doi.org/10.1787/3197152b-en (accessed last 03 April 2024).

[89] National Science Foundation (2022): Science and Engineering Indicators 2022: The State of U.S. Science and Engineering." Accessible at: https://ncses.nsf.gov/pubs/nsb20221 (last accessed 12 April 2024).

In terms of attracting foreign-born students and researchers, there is already ample evidence that the majority of STEM students on temporary visas wish to stay in the U.S. to work, but the greatest impediment to retaining this talent is the challenging and uncertain immigration system in America at the time of this report's publication.[90] Currently, undergraduates can find few opportunities to stay past the expiration of their student visas, but there has been a recent push to prioritize the retention of immigrants with advanced STEM degrees. For example, the federal government administers the Optional Practical Training (OPT) extension program to provide excellent international STEM students with practical work experience and to keep their technical expertise in the U.S. workforce for an additional two years following their graduation. As a significant pull factor for international students, the OPT program also functions as a funnel toward long-term employment and retention of top foreign-born talent, since many are sponsored by their OPT employers to receive an H-1B visa, which allows U.S. employers to hire foreign workers for jobs that require the theoretical and/or practical application of highly specialized knowledge. Moreover, while there is an annual cap of 65,000 H-1B visas, the U.S. government exhibits a clear policy preference for highly educated, foreign-born workers by setting aside an additional 20,000 H-1B visas for people with PhDs and waiving H-1B limits for those employed at institutes of higher education and nonprofit and government research organizations. Finally, the federal government will occasionally implement special immigration policies intended to bolster its strategic research objectives, such as President Joe Biden's 2023 "Executive Order on the Safe, Secure, and Trustworthy Development and Use of Artificial Intelligence."[91]

Universities play a key role as an entry launchpad for migrant founders in Germany, as well. According to the Migrant Founders Monitor 2023, a third of the first-generation migrant

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[90] Han, X. and Appelbaum, R. (2016): Will They Stay or Will They Go? International STEM Students Are Up for Grabs. Ewing Marion Kauffman Foundation. Accessible at: https://www.kauffman.org/wp-content/uploads/2019/12/STEM_Students_FINAL.pdf (last accessed 12 April 2024).

[91] Not only did the executive order include provisions to streamline the processing of visa applications for foreign nationals intending to research and work on AI and other critical emerging technologies, but it also recommended the State Department to implement strategies to actively attract potential highly-skilled visa applicants and to expand stateside visa renewal processes for foreign-born students and researchers who would otherwise be subject to a two-year home-country physical presence requirement following expiration of their visa (typically F-1 and J-1).

founders came to Germany to study.[92] While no data is available on the proportion of people with an immigrant background in spin-offs or stand-ups, one study concludes that there is a correlation between international students and teaching staff and patent activity – although the number of patents is a weak indicator for spin-offs in Germany in particular, as noted above. According to the study, low international attractiveness in Germany hurts patent activity, with universities that are less attractive to international students and teaching staff posting lower patent activity. This shows how important international cooperation and diversity are for promoting innovation and academic entrepreneurship.[93]

However, Germany still enjoys a higher ratio of international students among its tertiary education population. The share of students coming into German universities from other countries rose to 11% in 2022 from 7% in 2013 (compared with the flat 5% in the U.S.).[94] However, this obscures the fact that U.S. institutions generally remain more attractive to outside students than German schools. While the Excellence Strategy of the German Government suggests otherwise, hardly any of the German universities rank highly in global rankings. The most renowned universities are in the U.S., making that country the bigger draw for more educated immigrants and more academically adept international students. According to the INSEAD Global Talent Competitiveness Index 2023, American universities ranked first worldwide, while German universities ranked 10th, suggesting a pull factor and a larger pool of applicants from which American universities can choose.[95] In the 2023 INSEAD Index's indicator for "Brain Gain," the U.S. ranked 5th and Germany 21st.

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[92] Startup port (2023): Migrant Founders Monitor 2023 - Universities attract international start-up talent. Startup port. Accessible here: https://startupport.de/en/migrant-founders-monitor-2023-universities-attract-international-start-up-talent (accessed last 03 April 2024) Vergleich. Länderbericht Deutschland 2021/22. GEM. Accessible at: https://www.gemconsortium.org/report/gem-germany-national-report-20212022 (accessed last 03 April 2023).

[93] Lehmann, E.; Stockinger, S. A. E. (2018): Entrepreneurship in Higher Education: The impact of competition-based policy programmes exemplified by the German Excellence Initiative. Higher Education Quarterly. Accessible at: https://onlinelibrary.wiley.com/doi/10.1111/hequ.12188 (accessed last 03 April 2024)

[94] Lanvin, B.; Monteiro, F. (2023) The Global Talent Competitiveness Index 2023 - What a Difference Ten Years Make What to Expect for the Next Decade. Human Capital Leadership Institute, INSEAD and Descartes Institute for the Future. Accessible at: https://www.insead.edu/system/files/2023-11/gtci-2023-report.pdf (accessed last 03 April 2024)

[95] Lanvin, B.; Monteiro, F. (2023) The Global Talent Competitiveness Index 2023 - What a Difference Ten Years Make What to Expect for the Next Decade. Human Capital Leadership Institute, INSEAD and Descartes Institute for the Future. Accessible at: https://www.insead.edu/system/files/2023-11/gtci-2023-report.pdf (accessed last 03 April 2024)

The higher proportion of international students in Germany can be attributed to the fact that Germany excels in areas related to the legal framework for international students, as outlined in the International Migration Outlook 2022 by the OECD.[96] For instance, residence permits for international students in Germany can be issued for up to 10 years (including renewals), compared to a maximum of seven years in the U.S. In both countries, these permits are tied to the ability to access the labor market during studies, albeit with working hour limitations. However, Germany does not require a separate authorization for this, and the U.S. does. Following their studies, both Germany and the U.S. offer paths for limited extensions of residence permits to pursue employment. In terms of tuition fees for international students and access to financial aid, the OECD finds that Germany provides more favorable options than the U.S. However, Germany requires a certificate of German language or proof of intent to attend German language courses for the majority of its programs – a significant barrier compared with the English-language requirements in the U.S. Despite the sixfold increase in English-speaking programs in Germany from 2008 to 2020, they still only account for 8% of all programs. By comparison, 28% of all bachelor's programs in the Netherlands were offered exclusively in English and 15% in multiple languages during the 2018-2019 school year. To attract more student talent, it is essential for Germany to significantly increase its proportion of English-speaking programs.

As the analysis above suggests, a country's attractiveness for outside talent cannot be solely determined by the percentage of international students, nor is the attractiveness of a location for talent dependent only on visa and residency regulations. Other factors, such as language, social inclusion, business environments, and lifestyle options also play a central role. When these factors are considered together, as done by the INSEAD Global Talent Competitive Index, the U.S. ranks third behind only Switzerland and Singapore, and well ahead of Germany in 14th.[97]

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[96] Kamm, E.; Chaloff, J. (2022): International Migration Outlook 2022 - Attraction, admission and retention policies for international students. OECD. Accessible at: https://read.oecd-ilibrary.org/social-issues-migration-health/international-migration-outlook-2022_ee801c11-en#page1 (accessed last 03 April 2024)

[97] Lanvin, B.; Monteiro, F. (2023) The Global Talent Competitiveness Index 2023 - What a Difference Ten Years Make What to Expect for the Next Decade. Human Capital Leadership Institute, INSEAD and Descartes Institute for the Future. Accessible at: https://www.insead.edu/system/files/2023-11/gtci-2023-report.pdf (accessed last 03 April 2024)

Recommendation:
Increase The Share Of English-Language Programs At German (Excellence) Universities

To make Germany more attractive for international talent, the country needs to adopt English as a second official language, However, it also needs to integrate English into more programs at universities in order to make better use of their roles as magnets for talent. Especially at universities with a good reputation, the proportion of programs in English should be increased. This could be achieved by considering the provision of teaching and research in English as a criterion for the Excellence Strategy and its associated funding.

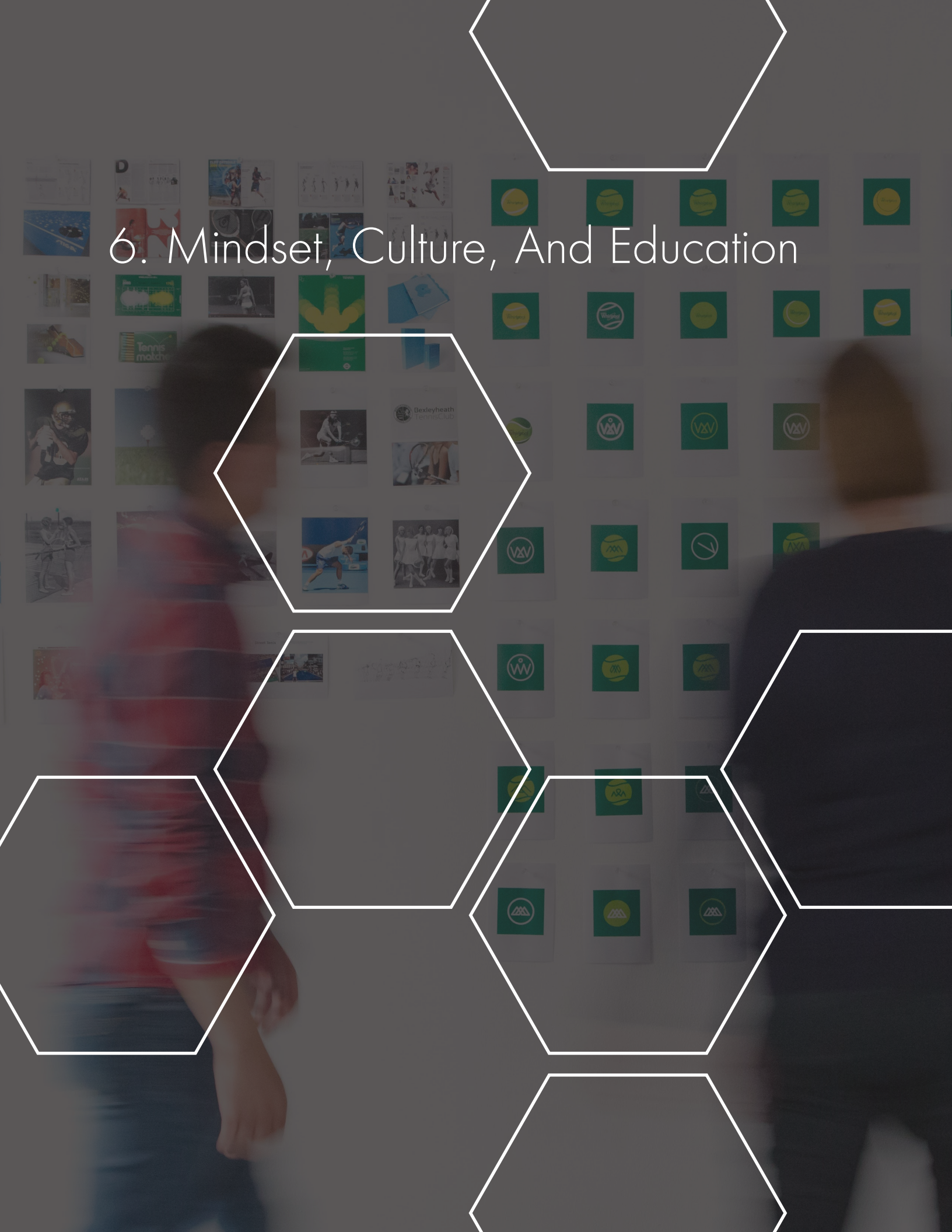
Recommendation:
Foster Student Exchange Between U.S. And German Universities

German universities should pave the way for students to go to other countries through semesters abroad, but supporting programs and resources should also establish outreach activities and scholarships at top California universities to encourage their students to take semesters abroad in Germany. (This could be done in cooperation with the DAAD, for example.) Such an initiative would lead to more entrepreneurial-oriented students settling in Germany in the long term.

Recommendation:
Offer Free Certificates In Entrepreneurship, Venture Finance, And IP Regulations And Processes To Foreign Students

Domestic and foreign students alike should be clear about the advantages of entrepreneurship in Germany as the gateway to a large European common market, and especially the Eastern European markets. Specialized one- to six-week certificate programs that accompany their main degree specialization could function like a portal to greater entrepreneurship in German universities.

6. Mindset, Culture, And Education



The small but meaningful legal, structural, and human capital differences between the U.S. and Germany clearly make a difference in the countries' rates of technology transfer and entrepreneurship. However, just as the wisdom of a university exceeds the lectures within its halls, so too are the innovation ecosystems of the U.S. and Germany more complex, nuanced, and dynamic than these individual factors on their own might suggest. These other mindset and cultural issues – such as flexibility, trust formation, and tacit knowledge circulation – are hard to quantify, but they also help determine success or failure in a thriving entrepreneurial ecosystem.

6.1 Culture & Mindset In Higher Education And Innovation Ecosystems

Key Takeaway:

The contrast between U.S. and German higher education and entrepreneurial ecosystems highlights the significant impact of cultural, historical, and institutional factors on entrepreneurship. In the U.S., a diverse and inclusive higher education system complements a societal ethos that values innovation and risk-taking. Conversely, Germany's education system, which emphasizes theoretical knowledge and takes a less enthusiastic view of entrepreneurship, faces challenges in fostering a dynamic entrepreneurial culture. For Germany, a shift in societal attitudes and educational reforms could be key to enhancing its entrepreneurial ecosystem.

While higher education in both the U.S. and Germany have evolved to meet their societies' needs amid socio-economic challenges, they each have distinct historical traditions. European universities initially served the elite with liberal arts, law, and theology curricula. After World War II, however, they faced pressure to specialize. Even today, though, German universities still favor scientific theory and critical thinking over the applicability of theory to the economy and society. Similarly, many universities in Germany retain outdated administrative processes that inhibit an entrepreneurial culture. A study into competition-based policy programs exemplified by the German Excellence Initiative on entrepreneurship found that universities with well-structured and well-managed systems tended to have higher levels of entrepreneurial output (e.g., patent activity).

In the U.S., streamlined processes and supportive administrative structures facilitate the swift commercialization of research, a phenomenon that might draw from its universities' different historical underpinnings. Initially inspired by the European model, U.S. universities in the 19th century expanded their scope to include more professional programs. Efforts to democratize and broaden the socioeconomic representation within institutions of higher education found more and more traction. Initiatives like the Land Grant College Act of 1862 – of which the University of California was a beneficiary – were explicit appeals "to promote the liberal and practical education of the industrial classes in the several pursuits and professions in life." Today, after more than a century of increasing focus on research, the cultivation of diverse funding sources, and inter-institutional competition for resources and talent, American universities are regularly among the top global institutions of higher education and entrepreneurialism. Despite headwinds past and present (e.g. the political polarization wracking American universities today), this long history of applied domains and the search for greater diversity of people and programs have resulted in a more research-oriented and entrepreneurial ecosystem.

The development of the U.S. university culture has coincided with similar entrepreneurial evolution in the culture at large. Silicon Valley is renowned for its culture, which celebrates risk-taking, innovation, and entrepreneurship, and societal attitudes toward entrepreneurship were at an all-time high in 2021, with 80% of the adult population associating a high status and 76% with a good career with entrepreneurship.[98] That said, ongoing research suggests that Silicon Valley owes much of its success to the quasi-accidental path it took from the establishment of Shockley Semiconductor Labs in 1956 to the world-leading innovation ecosystem it is today. Other regions' efforts to replicate its culture without its history have met, at best, with limited success. Furthermore, Silicon Valley's sheer scale feeds itself, as robust startup communities hinge on mentorship and supportive policies that enable personal agility, knowledge transfer, network trust formation, and cross-domain disruption.

The history of German innovation and entrepreneurship has been no less significant. The "German Economic Miracle" after World War II was primarily driven by the Mittelstand, the small and medium-sized enterprises. Responsibility towards employees, the environment, and sustainable economic growth have become integral to Germany's entrepreneurial activities, shaping the "German way" of founding businesses even today. Today, these values remain

[98] Kelley, D. J.; et. al. (2022): Global Entrepreneurship Monitor - 2021/2022 United States Report. Babson College. Accessible at: https://www.gemconsortium.org/report/202122-usa-national-report-2 (accessed last 03 April 2024)

crucial, with 75% of startups prioritizing social and ecological impacts, and nearly a third contributing to sustainable transformation, especially in climate and environmental protection.[99] The slightly lower importance of this social dimension in the U.S. was documented recently by Global Entrepreneurship Monitor's finding that 69% of entrepreneurs surveyed in 2022 prioritized social and environmental impact over profitability and growth.[100,101] However, unlike the U.S. there is a lack of appreciation for entrepreneurs. In a 2023 survey on which professions have a very high or high reputation in Germany, entrepreneurs are in 20th place. Less than half (40%) of respondents have a positive opinion of entrepreneurs.[102] This translates also into a low appreciation of entrepreneurial success and hence entrepreneurial appetite and demand for risk-taking in Germany. This sentiment is encapsulated by Gloria Seibert, founder and CEO of Temedica, who notes, "In Germany we have to shift away from a strong culture of envy, resulting in entrepreneurs often not talking about their success in public, while in the US, entrepreneurs are celebrated as heroes."[103] If the fundamental preconditions for the successful promotion of entrepreneurship include a societal consensus that entrepreneurship is both a desirable professional future and a key catalyst for economic, business, and societal growth, then Germany will need to re-envision its "social

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[99] Kollmann, T.; et al. (2021): Deutscher Startup Monitor 2021 - Nie war mehr möglich. Universität Duisburg-Essen, PricewaterhouseCoopers and Bundesverband Deutsche Startups e. V.. Accessible at: https://startupverband.de/fileadmin/startupverband/mediaarchiv/research/dsm/dsm_2021.pdf (accessed last 03 April 2024).

[100] Kelley, D. J.; et. al. (2022): Global Entrepreneurship Monitor - 2021/2022 United States Report. Babson College. Accessible at: https://www.gemconsortium.org/report/202122-usa-national-report-2 (accessed last 03 April 2024)

[101] Further reinforcement of the increasing prevalence of social enterprise values in the U.S. was signaled prominently (and somewhat controversially) by Blackrock CEO Larry Fink in 2018 when he wrote that "a company's ability to manage environmental, social, and governance matters demonstrates the leadership and good governance that is so essential to sustainable growth." Fink, L. (2018): 2018 Letter to CEOs. BlackRock. Accessible at: https://www.blackrock.com/corporate/investor-relations/2018-larry-fink-ceo-letter (accessed last 03 April 2024)

[102] Statista Research Department (2024): Ansehen von verschiedenen Berufe in der Gesellschaft in Deutschland 2023. Statista. Accessible at: https://de.statista.com/statistik/daten/studie/163400/umfrage/ansehen-der-berufe-in-der-gesellschaft (accessed last 03 April 2024)

[103] Dörner, K.; et. al. (2021): Entrepreneurship Zeitgeist 2030 - Making start-ups Germany's next economic powerhouse. McKinsey & Company. Accessible at: https://www.mckinsey.de/~/media/mckinsey/locations/europe%20and%20middle%20east/deutschland/news/presse/2021/2021-10-26%20entrpreneurship%20zeitgeist%202030/entrepreneurship_zeitgeist_2030_mckinsey_vf.pdf (accessed last 03 April 2024)

imaginaries" – the ways its people collectively envision their social lives, how they fit in the world, the nature of their social relationships, and their expectations of the social and moral order.

Today's entrepreneurial education landscape is a result of the different social imaginaries that evolved in the U.S. and Germany over the past two centuries. For most of the 1800s, the U.S. fostered independent businessmen aligned with the values of self-governance. While the ultra-wealthy robber barons who emerged during this time were celebrated and loathed by different elements of society, their capitalistic philosophy was embedded in commercial colleges, Lyceums, and magazines nationwide. In contrast, Germany's approach, underpinned by state industrialism, aimed at developing industrial entrepreneurs to counter foreign economic competition, utilizing polytechnical schools and organizing exhibitions and competitions. The paradigm shifted as the 20th century dawned, and two world wars erupted. The U.S. moved towards creating well-rounded entrepreneurial leaders through university-based business schools, reflecting the ethos of corporate liberalism. Germany, addressing a legitimacy crisis in its business class, established higher trade schools with an emphasis on integrating humanist and practical business knowledge. Since World War II and reconstruction, U.S. neoliberalism responded to corporate stagnation by focusing on high-growth companies through initiatives like the Small Business Administration and, later, university programs. Germany, adhering to ordoliberal principles that emphasized the role of government to ensure a market economy operates fairly, concentrated its support on engineering focused Mittelstand SMEs and independent entrepreneurs, with chambers of industry and, later, universities playing a crucial role.

Previous studies and empirical evidence have predominantly supported the idea that the entrepreneurial culture born of societal history and evolution can stimulate entrepreneurialism. However, research also finds that entrepreneurial activity is heavily influenced by social culture in a local context, as well. In Silicon Valley, the sheer scale and density of entrepreneurs, investors, and industry experts provide invaluable support and guidance to university spin-offs. German universities, while having robust academic networks, often lack this integrated entrepreneurial talent networking structure. The fear and stigmatization of failure – worn as a badge of honor in the U.S. – remains one of the strongest entrepreneurial demotivators in Germany.

Recommendation:
Actively Support Bottom-Up Development Of Highly Local Startup Communities

As framed by Brad Feld and Ian Hathaway, the fundamental purpose of a startup community is primarily social in nature (i.e., entrepreneurs helping other local entrepreneurs to succeed), whereas the purpose of the entrepreneurial ecosystem is primarily economic in nature (i.e., to create jobs and economic value).[104] While these two constructs are overlapping and mutually reinforcing, the sine qua none of the entrepreneurial ecosystem is a thriving startup community, which consists of individuals committed to nurturing the community's shared sense of identity as entrepreneurs, and who work assiduously to nurture and support the group's entrepreneurial ambitions and success (e.g., as a peer-to-peer support system and through the mentorship, sharing of knowledge and stories, and offering of resources that early-stage entrepreneurs need to navigate the challenges of launching and scaling their ventures). While startup communities should be developed from the bottom up, governments can support their efforts by liaising with startup founders, asking about (and attempting to meet) the specific needs of the community, and (critically!) avoiding top-down intervention while the community is developing its unique, shared identity.

Recommendations:
Create Strategies To Facilitate And Enhance Trust As The Most Valuable Currency For Professional Transitions And Information Exchange

To facilitate trust formation among professionals, especially those exchanging information or transitioning across employers and sectors to build new ventures, we recommend comprehensive polling and studies to understand trust dynamics that could surface current pain and friction points between parties. A "trust expert panel" could then develop targeted strategies to address identified challenges. These strategies could consist of a variety of interventions, ranging from, for instance: speaker tours and webinars on the integration of German and SV style trust formation and collaboration, learning journeys for senior executives of German industry, entrepreneurs and scientists in the other direction focused on this topic, to a dedicated study on transatlantic trust formation with case study series, etc.

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[104] Feld, B., Hathaway, I. (2020): The Startup Community Way: Evolving an entrepreneurial ecosystem. John Wiley & Sons, Inc.

Recommendations:
Create Networking And Collaboration Platform(s) With Trusted Transaction Mechanisms

In parallel, the establishment of a hybrid physical-digital networking platform is crucial to foster community building and encourage employee mobility between established firms and startups to foster tacit knowledge sharing, thereby accelerating the diffusion of technical know-how that supports a startup community's development and expansion. At a minimum, such a mechanism should include increased transparency around which organizations intend to enforce non-compete agreements, limits on the enforceability of non-compete agreements, and ideally the gradual elimination of such policies. This would serve as a lighthouse model, homed at one university, and could get replicated at or expanded to others. For the early stage of networking, less formality is critical. For the later stage of the emerging dialogues when parties agree to collaborate more concretely, the trusted collaboration platforms could leverage cutting-edge Web 3 technologies that secure ownership rights over key content for a secure and trusted exchange of information and assets. Continuous monitoring and adaptation of these initiatives will ensure their effectiveness and relevance in the ever-evolving professional landscape.

6.2 Interdisciplinary And Entrepreneurial Education

Key Takeaway:

Like higher education as a whole, entrepreneurship education has evolved significantly over the last several decades. The decentralized, context-sensitive development in this field has led to various pedagogical approaches, with an increasing focus on experiential and problem-based learning over traditional content delivery. Central to this pedagogy are social-emotional skills like grit, resilience, adaptability, and networking. A comparative view of the U.S. and Germany reveals differences in educational traditions and approaches, with the U.S. having a longer history of entrepreneurship education programs and more interactive methodologies.

As with higher education as a whole, both interdisciplinary and entrepreneurship studies have evolved over the last several decades. The primary efforts to advance interdisciplinary education have focused on stronger institutional support for such programs, the optimization of interdisciplinary team structures and dynamics, and the breaking down of barriers for students to engage in scholarship across fields. Entrepreneurship education, meanwhile, has become more decentralized, moving away from traditional content delivery toward more experiential and problem-based pedagogies that are tailored for specific contexts, such as entrepreneurship education tailored to academic disciplines such as natural or political science. Social-emotional skills like grit, resilience, adaptability, and networking play a central role in these programs. A comparative view of the U.S. and Germany reveals differences in educational traditions and approaches, with the U.S. having a longer history and therefore more opportunity to learn from past failures, refine efforts, and achieve successful outcomes.

In higher education, the term "interdisciplinary" relates to any research, academic program, degree, certificate, or instruction that blends two or more disciplines around a specific topic or research question. The roots of interdisciplinary education in the United States extend back as far as the early 20th century's experimentation with novel pedagogical approaches for providing holistic educational experiences to K-12 students, as well as to the post-World War II period in which the federal government pushed to increase university technology transfer in the interest of the public good and national security (see Section 3.2 above). This time period was marked by an especially strong push to deepen knowledge and professionalize academic disciplines, however, so it wasn't until the late 20th century that major institutions began reasserting the importance of interdisciplinary programs to foster holistic and multifaceted problem-solving skills in their researchers and graduates. Additionally, demand in the workforce at this time was increasing for graduates who could think critically across disciplines and understand issues from multiple cultural, economic, and ecological perspectives.[105] Higher-education researcher Steven Brint cites Duke University's 1988 publication of "Crossing Boundaries: Interdisciplinary Planning for the Nineties" as the first major push into the deliberate, prioritized development of interdisciplinary education.[106] In the

[105] National Association of Colleges and Employers (n.D.): What is career readiness? Accessible at: https://www.naceweb.org/career-readiness/competencies/career-readiness-defined (last accessed on 11 April 2024).

[106] Brint, S. (2019). Two cheers for higher education: Why American universities are stronger than ever—and how to meet the challenges they face. Princeton University Press. The Duke "Crossing Boundaries" publication is available at https://archive.org/details/dukeuniversityse00duke/page/n349/mode/2up (last accessed 11 April 2024).

following decade, universities such as the University of Southern California and the University of Wisconsin-Madison followed suit and began emphasizing interdisciplinary research and education as essential methods for addressing thorny sociopolitical, economic, and environmental issues. According to an analysis published in the journal Nature, the favoring of interdisciplinary research is reflected in the academic references of papers in both the natural and social sciences. Since the mid-1980s, research paper references to other disciplines have increased in both the natural and social sciences, while references within the same discipline have shown a slight decline.[107]

That said, early responses to cross-disciplinary boundaries were not as successful as proponents hoped due to a variety of university institutional and structural challenges. For instance, traditional academic structures, such as departmental divisions and tenure tracks, were often not aligned with the integrative nature of interdisciplinary studies, posing significant barriers to their development, sustainability, and faculty tenure promotion.[108] Additionally, interdisciplinary initiatives also struggled with not being sufficiently precise in their articulation of the problem researchers were attempting to solve, which resulted in "a nexus of loosely connected individuals searching for intersections, as opposed to cohesive groups tackling well-defined problems."[109] Finally, developing curricula for and assessing interdisciplinary education outcomes presented their own challenges, complicating the accreditation processes.

As a result of these early challenges, a great deal of research and academic literature has emerged in an effort to resolve or mitigate these issues. Factors that contribute to the success of interdisciplinary research collaborations include robust intellectual and organizational leadership, a history of successful teamwork among researchers before they join the collaboration, well-defined project goals, and developing research teams around a small number of extremely high-caliber researchers with complementary academics serving as social

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[107] Van Noorden, R. (2015): Interdisciplinary research by the numbers - An analysis reveals the extent and impact of research that bridges disciplines. Nature. Accessible at https://www.nature.com/news/interdisciplinary-research-by-the-numbers-1.18349 (last accessed 11 April 2024).

[108] Mäkinen, E., Evans, E., & McFarland, D. (2024): Interdisciplinary Research, Tenure Review, and Guardians of the Disciplinary Order. The Journal of Higher Education. Accessible at: https://doi.org/10.1080/00221546.2024.2301912 (last accessed 11 April 2024).

[109] Rhoten, D. (2016): Interdisciplinary Research: Trend or Transition?. Items: Insights from the Social Sciences. Accessible at: http://items.ssrc.org/interdisciplinary-research-trend-or -transition/ (last accessed 11 April 2024).

connectors.[110] For undergraduate students, improved outcomes for the sustainability of inter-disciplinary programs have been noted in institutions that encourage students to pursue their interests, craft their own degree programs, and enable cross-disciplinary enrollment (e.g., by removing pre-requisite or disciplinary restrictions).[111] And, importantly for innovation and academic entrepreneurship, researchers have found that entrepreneurship education is most successful when student exchange is multi-directional, (e.g., science students attend courses in business schools, and business students take courses within specific science domains).[112]

In the German higher education system, the organization of sciences tends toward a separation into discrete fields, not least due to the influence of the Humboldtian university model. However, the German Council of Science and Humanities in 2020 noted that interdisciplinarity represents the dominant perspective in science policy discourse. The Council recommended that universities not consider the question in terms of "either-or," but instead encourage an interplay of both single-disciplinary and interdisciplinary studies and activities.[113] Universities and policymakers have responded to that provocation, emphasizing more cross-field education and research. In fact, a 2022 analysis reveals that all 16 German states promote interdisciplinary studies to varying degrees, either in their higher education laws or in performance agreements between states and universities.[114] While some states adopt a general approach through higher education laws, others employ direct strategies via

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[110] Rawlings, C., McFarland, D., Dahlander, L., & Wang, D. (2015): Streams of Thought: Knowledge Flows and Intellectual Cohesion in a Multidisciplinary Era. Social Forces. Accessible at https://www.researchgate.net/publication/272090604_Streams_of_Thought_Knowledge_Flows_and_Intellectual_Cohesion_in_a_Multidisciplinary_Era (last access on 11 April 2024).

[111] Relihan, C. and Hilpert, Z. (2021): On the Growth and Value of Interdisciplinary Studies. Accessible at https://uc.vcu.edu/media/university-college/AcademicLeaderOntheGrowthandValueofInterdisciplinaryStudies_AcademicLeader.pdf (last accessed on 11 April 2024).

[112] Nelson, A. and Byers, T. (2015): Challenges in University Technology Transfer and the Promising Role of Entrepreneurship Education. In Albert Link, Donald Siegel, and Mike Wright (Eds.), The Chicago Handbook of University Technology Transfer and Academic Entrepreneurship. The University of Chicago Press.

[113] WR (2020): Wissenschaft im Spannungsfeld von Disziplinarität und Interdisziplinarität - Positionspapier. Wissenschaftsrat (WR). Accessible at: https://www.wissenschaftsrat.de/download/2020/8694-20.pdf?__blob=publicationFile&v=3 (accessed last 05 April 2024)

[114] Leišytė, L.; et. al. (2022): Higher education policies and interdisciplinarity in Germany. Tertiary Education and Management. Accessible at: https://link.springer.com/article/10.1007/s11233-022-09110-x (accessed last 05 April 2024)

performance agreements with universities. Prescriptive measures, such as those seen in Mecklenburg-Vorpommern and Berlin, emphasize interdisciplinary research and teaching, whereas enabling approaches, as in Baden-Württemberg, provide legal frameworks without imposing directives. States like Bremen, Hamburg, Rhineland-Palatinate, and Schleswig-Holstein utilize a mix of enabling and prescriptive instruments, while Thuringia, Saxony, and Saarland employ a hybrid approach. Overall, the findings underscore the complex interplay of policy instruments at both state and institutional levels in fostering interdisciplinarity in German higher education.

While experimentation with policy instruments continues, the reality in German universities shows how challenging it can be to implement interdisciplinary research and teaching. According to Ruth Müller, Professor of Science and Technology Policy at the Technical University of Munich (TUM), researchers often perceive interdisciplinary work as costly and a potential hindrance to career advancement. Evaluation systems typically prioritize "high-quality" publications, but for interdisciplinary research, it's beneficial to also give equal weight to other factors, such as societal impacts. This requires well-trained evaluators who can assess interdisciplinary projects based on an array of different indicators. Additionally, providing more time for interdisciplinary research, such as extending funding for interdisciplinary doctoral projects, could facilitate collaboration and innovation.

Entrepreneurial education is assuming an increasingly vital role in academic circles, both as a standalone discipline and as part of an interdisciplinary approach. Entrepreneurship itself is a discipline, so it can be learned and taught.[115] However, entrepreneurship education is a relatively new field of study that developed in a decentralized fashion in response to the perceived need for instruction on entrepreneurial behavior and practice. Because of this bottom-up, localized development, much of entrepreneurship education research has been conducted by instructors on their own students. By default, this makes context a key element in many study designs, the interpretation of results, and the formulation of implications for future teaching practice. As entrepreneurial education has developed, some tension has emerged within the field as to what the primary goals of the field should be. Should researchers assess the impact of these educational efforts as a whole to appraise their effectiveness and broader impact on society, or should they micro-focus on entrepreneurialism as a highly localized and context-specific activity with a primary goal of launching new firms, enhancing startup communities, and bolstering entrepreneurial ecosystems? While we acknowledge that there are many other worthy goals for entrepreneurship education, including the preparation of

[115] Ries, E. (2011): The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses. Crown Currency.

individuals to navigate uncertainty in our globalized economy, the latter view better suits the comparative purposes of this study. So, while questions about the entrepreneurial mindset of resilience, perseverance, flexibility, and calculated risk-taking are critical to entrepreneurial education initiatives, this analysis will set them aside.

From a pedagogical standpoint, startup-focused entrepreneurial education initiatives have gravitated toward experiential and problem-based learning, both of which emphasize the process, rather than the content, of entrepreneurship. By employing techniques such as games and simulations, market analysis and segmentation, product and prototype development, venture creation exercises, pitch practice, and competitions, this problem-based learning approach forces students to grapple with ambiguous situations that develop business acumen in ways similar to startup founders. While there are formal programs that purport to track the depth and breadth of entrepreneurship curricula at the post-secondary level in the U.S., most scholarly publications assume that these entrepreneurship education programs are so widely practiced among institutions that precise data is moot.[116,117] In the Bay Area, there are many postgraduate programs and private institutions that have robust entrepreneurship education curricula. At the forefront, the Stanford Technology Ventures Program (STVP) and UC Berkeley's Sutardja Center for Entrepreneurship & Technology (SCET) stand out as global hubs of extensive resources, courses, and research opportunities focused on entrepreneurship and innovation.

In 2019, the European Union found that participation in entrepreneurship education increased the likelihood of engaging in entrepreneurial activities later in life by an average of 35%.[118] Another study in Germany shows that students who have been exposed to entrepreneurship education programs are more interested in entrepreneurial careers and more inclined

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[116] For example, Dr. Luke Pittaway, O'Bleness Professor of Entrepreneurship at Ohio University, comments in a 2021 working paper that, "Today most US universities offer some form of entrepreneurship education." Pittaway, Luke. (2021). "Entrepreneurship Education in Higher Education: A Review of the US Context."

[117] U.S. News and World Report (2024): Best Undergraduate Entrepreneurship Programs. Accessible at: https://www.usnews.com/best-colleges/rankings/business-entrepreneurship (last accessed 12 April 2024).

[118] European Commission (2019): Education and Training Monitor 2019 - Germany. Publications Office of the European Union. Accessible at: https://education.ec.europa.eu/sites/default/files/document-library-docs/et-monitor-report-2019-germany_en.pdf (accessed last 03 April 2024)

to create a business than those who are not.[119] However, German institutions' entrepreneurial education is generally limited. From 2008 to 2022, the number of professorships related to entrepreneurship and startups increased from 58 to 190, but it's uncertain if this is enough to meet the full potential of students interested in entrepreneurship.[120] (By contrast, Stanford University alone lists roughly 100 faculty, lecturers, and staff members affiliated with its Center for Entrepreneurial Studies.[121]) While business administration is as popular in Germany as in the U.S., a 2021 ranking of entrepreneurial framework conditions in Germany places "Entrepreneurial Schooling" at the bottom of the list.[122] A lack of consistent data on how entrepreneurial courses influence student engagement and success in entrepreneurship, including what content and processes should be included, limits the chances of raising the profile of these programs.

The methodology of entrepreneurial education is also vital. The U.S. has a long tradition of entrepreneurship education, dating back to the 1930s. In Germany, this training was primarily conducted by chambers of commerce, with the first chair for entrepreneurship finally established in 1997.[123] As recently as 10 years ago, half of Germany's entrepreneurial education was lecture-based and focused on theory, rather than practice. In stark contrast to the U.S. approach, hands-on work in actual startup activities constituted just 5% of curricula.

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[119] Högsdal, N.; et. al. (2023): Moving the Needle in Entrepreneurship Education and Bridging the Gaps. FGF Studies in Small Business and Entrepreneurship. Accessible at: https://link.springer.com/chapter/10.1007/978-3-031-28559-2_9#ref-CR25 (accessed last 03 April 2024)

[120] FGF (2022): Entrepreneurship- und gründungsaffine Professuren an öffentlichen und privaten Hochschulen in Deutschland, Stand Oktober 2022 (Sortierung nach Standort). Förderkreis Gründungs-Forschung (FGF) e.V.. Accessible at https://www.fgf-ev.de/wp-content/uploads/2022/10/E-Professuren-23-10-2022.pdf (accessed last 03 April 2024).

[121] Stanford Business, Center for Entrepreneurial Studies. Accessible at: https://www.gsb.stanford.edu/experience/about/centers-institutes/ces

[122] Stemberg, R.; et. al. (2022): Global Entrepreneurship Monitor. Unternehmensgründungen im weltweiten Vergleich. Länderbericht Deutschland 2021/22. GEM. Accessible at: https://www.gemconsortium.org/report/gem-germany-national-report-20212022 (accessed last 03 April 2023).

[123] Schultz, C.; Mietzner, D. (2014): Gründungsausbildung an Hochschulen in Deutschland. Technische Hochschule Wildau. Accessible at: https://opus4.kobv.de/opus4-th-wildau/frontdoor/index/index/docId/340 (accessed last 03 April 2024).

Recommendation:
For Undergraduates, Incentivize And Enable More Openness To Interdisciplinary Studies And IP Collisions

By recognizing that much breakthrough innovation occurs at the intersections of different disciplines, rather than just within discrete fields, German institutions could unlock the potential of cross-boundary IP generation and venturing. As noted in the above analysis of strengths and failures of U.S. interdisciplinary education initiatives, Germany should foster more interdisciplinary work at the undergraduate level by lowering institutional barriers to cross-departmental exchange. This could include the removal of enrollment requirements (e.g., courses that are only open to specific majors) that can channel 18-year-old students into an intellectual straight-jacket of one narrow discipline. Instead, allow students to register for integrated combinations of majors and minors. Give them some leeway to switch those combinations as they experiment with their passions and inclinations (e.g., by allowing an additional year). And let them design their own interdisciplinary degrees by combining areas of interest (e.g., physics with sculpture, or cognitive science with design).

Recommendation:
For Graduates And Researchers, Incentivize And Enable Cross-Functional and Cross-Border Team Formation

At the graduate and researcher level, individuals should be given the option of a parallel track in IP/venture spinout as part of their university careers. Short tutorials that feature techniques for intentional cross-functional and cross-border team design with archetype templates would enable the participants to serve and scale to international demand for certain IP or venture standups. The university would retain an ownership percentage for facilitating the scaling. Term sheets with international investors or execution partners should contain clauses that obligate the investor/partner to contribute to the creation of economic value-add in Germany, which can be achieved in many ways (e.g., by retaining certain high-value R&D or manufacturing functions in the country, sourcing staff from Germany, or creating supplier relationships there).

Recommendation:
Experiential Learning Integration

Inspired by U.S. models like Stanford and MIT, where hands-on learning is emphasized, Germany can establish robust experiential learning programs. This includes project and chal-

lenge-based didactics, involving university-based incubators and accelerators, entrepreneurial hackathons, promoting startup competitions, and facilitating real-world project collaborations with industry partners. This approach mirrors the successful integration of practical entrepreneurship experiences in U.S. institutions.

Recommendation: Interdisciplinary Collaboration And Hubs

Emulate the interdisciplinary approach of U.S. institutions like UC Berkeley, where business schools collaborate closely with tech and engineering departments. Germany can create interdisciplinary hubs within and between universities, encouraging a mix of business, science, and technology students to work together on entrepreneurial projects. This fosters a diversified skill set and innovative thinking, key attributes of the U.S. entrepreneurial spirit. It is important, however, to keep scalability in mind and to seek global connectivity beyond German states. Many digital ventures launched from within the US and China, for instance, are natively global from day one of their existence.

Recommendation: Digital Entrepreneurship Platforms

Drawing from the U.S. trend towards digital education, Germany can develop comprehensive online platforms for entrepreneurial learning. These platforms would offer a range of digital resources, interactive tools, and access to global venture capital, industry experts, and service providers (e.g., business lawyers, accountants, etc.), similar to the digital initiatives in U.S. institutions. This approach ensures flexibility and widens access, preparing students for the digital-centric future of entrepreneurship. At the same time, it could form the foundation for a global network of German or Germanophile entrepreneurs.

7. Funding Landscape For University Venture Stand-Ups And Spin-offs

7.1 Early-Stage Funding

Key Takeaway:

In the U.S., the early-stage funding landscape for university ventures has transitioned from traditional financing to diverse sources such as crowdfunding, university venture funds, and accelerators. Universities, especially through incubators and TTOs, have actively facilitated this shift. In contrast, Germany relies heavily on federal grants for early-stage funding, and its universities face equity investment and IP commercialization challenges, indicating a need for a more standardized approach in the U.S. system.

Over the past decade, the early-stage funding landscape for university-originated ventures transitioned away from conventional financing routes, such as personal savings, angel investors, or state-sponsored grants.[124] Universities traditionally played a pivotal role through their incubators and TTOs, facilitating the commercialization of academic innovations and bridging the gap between university researchers and potential investors. The dense ecosystem of venture capitalists and angel investors in Silicon Valley supported thousands of early-stage ventures, providing a robust foundation for growth and development.

In recent years, however, a host of alternative funding mechanisms (e.g., crowdfunding platforms) have emerged, allowing startups to secure capital directly from the public and validate their market fit early on. While only around 24% of crowdfunding efforts are successful and campaigns only raise an average of roughly US$28,000, the overall market in North America grew by almost 34% in 2022 and is anticipated to return to growth as economic conditions recover.[125] In addition, universities have increasingly established their own venture funds, directly investing in campus-originated startups while offering essential

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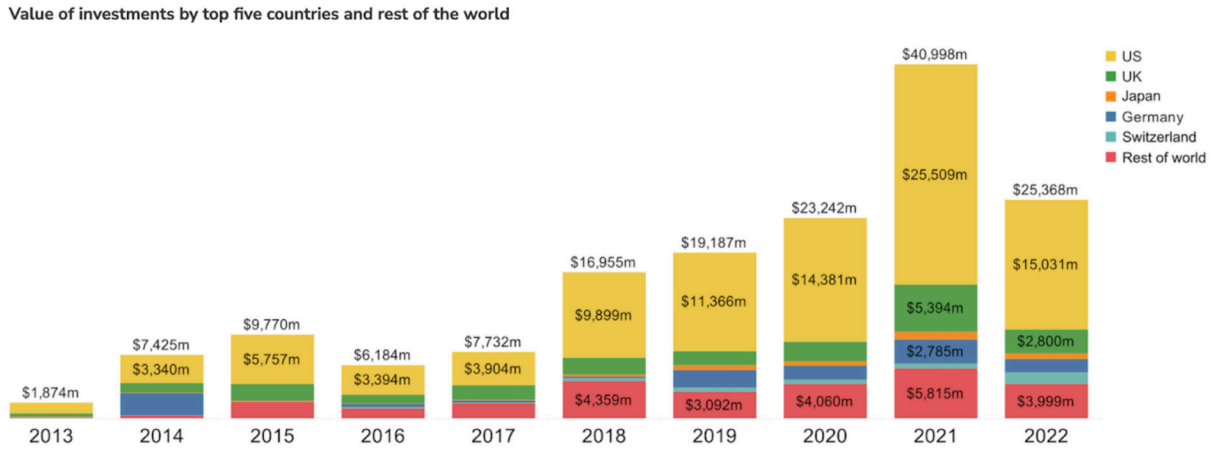
[124] As an example, Oregon launched in 2007 launched its "University Venture Development Fund," which provides proof-of-concept and translational research grants to university spin-offs.

[125]Shepherd, M. (2023): Crowdfunding Statistics: Market Size and Growth. Fundera. Accessible at: https://www.fundera.com/resources/crowdfunding-statistics (last accessed 12 April 2024).

mentorship and resources. According to Global University Venturing, university spin-offs raised US$158 billion globally across 8,042 investments from 2013 to 2022.[126]



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This period has also seen the rise of accelerators and incubators, both independent and university-affiliated, which offer seed or pre-seed funding, business mentorship, and operational support to nascent companies. As noted previously, the Stanford-StartX Fund and SkyDeck Berkeley both provide seed funding and support to startups affiliated with their respective universities. Cyclotron Road, part of the Lawrence Berkeley National Laboratory, supports science startups and university spin-offs with a focus on transformative energy technologies. A related firm called The House Fund takes a unique approach – although it is not affiliated with a university, it explicitly serves the Berkeley startup community with pre-seed and early-stage funding.

Finally, SAFEs (Simple Agreements for Future Equity) are another instrument in the domain of early-stage venture funding, offering a streamlined pathway for startups to secure investment without immediate company valuation. Crafted by Y Combinator, SAFEs provide investors with the right to future equity under specified conditions, without accruing interest or specifying a maturity date, making them simpler and potentially more favorable for startups than debt

[126] Heles, T. (2023): University spinouts doubled fundraising in the last decade. Global University Venturing. Accessible at: https://globalventuring.com/university/spinouts-double-fundraising-in-ten-years/ (last accessed 12 April 2024).

[127] Ibid.

vehicles like convertible notes.[128] In capital-constrained markets similar to those of recent years, SAFEs became an especially attractive option because they forgo valuations at a time when valuations are under increased pressure, yet still provide the resources startups need to fund operations.[129]

In Germany, grants from the federal government play a central role in early-stage funding, for spin-offs and stand-ups from higher education institutions. The grants primarily stem from the EXIST initiative, which includes two key initiatives to foster entrepreneurship and innovation within academic environments. The EXIST Business Start-up Grant (EXIST Gründungsstipendium) is designed for students, graduates, and scientists in the early stages of transforming innovative ideas into viable business models. It supports the development of business plans by providing individual scholarships for up to three people.[130,131] The EXIST Research Transfer (EXIST Forschungstransfer) targets more advanced scientific projects, especially those involving significant risks in the development phase.[132] A 2021 evaluation of the EXIST Initiative found positive outcomes in terms of relevance, impact, and cost-effectiveness, and it recommended only minor adjustments, such as extending the funding period beyond one year, focusing more on social innovation (which now plays a central role in the Federal Government's startup strategy), and enhancing and refining non-financial support.[133] Some states supple-

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[128] Levy, C. (n.D.): Safe Financing Documents. Y Combinator. Accessible at: https://www.ycombinator.com/documents (last accessed 12 April 2024).[1]

[129] Hodgson, L. (2023): In a capital-constrained market, should more startups play it SAFE? Pitchbook. Accessible at: https://pitchbook.com/news/articles/downturn-safe-increase (last accessed 12 April 2024).

[130] Amounts are based on each team member's level of education. For example, students receive €1,000 per month, members with completed vocational training €2,000, graduates with at least one university degree €2,500, and doctoral entrepreneurs €3,000 per month. Additionally, material expenses, including licenses, software, fees, and other project-specific costs, can be funded up to €10,000 for solo projects and up to €30,000 for team projects.

[131] BmWK (2023): Förderrichtlinie – Förderung von Unternehmensgründungen (EXIST-Gründungsstipendium) im Rahmen des Förderprogramms „Existenzgründungen aus der Wissenschaft". BAnz AT 18.04.2023 B. Bundesministerium für Wirtschaft und Klimaschutz (BmWK). Accessible at: https://www.bundesanzeiger.de/pub/de/amtlicher-teil?2 (accessed last 03 April 2024)

[132] Aimed at research teams, it offers a two-phase funding scheme to bridge the gap between research and market entry. The first phase concentrates on applied research and development towards a prototype, while the second phase is geared towards start-up preparation and market launch activities.

[133] BMWK (2022): Die Start-up-Strategie der Bundesregierung. Accessible at: https://www.exist.de/SUS/PDF/start-up-strategie-der-bundesregierung.pdf (accessed last 29 April 2024).

ment the EXIST support with additional funding. For example, Baden-Württemberg created a program called "Junge Innovatoren" for spin-offs and stand-ups that either graduated from the EXIST program or had their applications declined.[134]

Unlike the U.S., university equity investments in Germany are underutilized and inhibited by the constraints of under-resourced TTOs and the budgetary, aid, and insolvency laws related to IP commercialization. Furthermore, the unfortunate lack of valid data about the agreements and conditions between German academic institutions and their spin-offs leaves universities with no benchmark of market-based conditions. While the German government's 2022 startup strategy aims to close this information gap, the lack of a database leads universities to inflate the prices of IP when selling or licensing it to spin-offs – which, of course, makes those firms less attractive to other investors. Domestic university pioneers have proposed solutions, including TU Darmstadt's virtual equity concept, which addresses these challenges and is now being scaled as part of the IP Transfer 3.0 initiative. However, Germany might do well to create something similar to the U.S. AUTM database, which collects data on deal terms and makes them accessible to universities in the form of market-standard terms.

Zoom In: Virtual Shares

Spin-offs often struggle to find the funding they need to acquire or license the IP their founders and/or employees created as part of university-based research projects. This is where the idea of virtual shares comes in. By transferring the IP, the universities receive virtual company shares instead of money. The virtual shares, a non-equity financial incentive that offer beneficiaries a future cash payout based on company performance, are commonly used in startups to incentivize employees and investors without diluting ownership. Unlike traditional shares, they do not confer ownership rights or voting power, but they align interests by tying rewards to the company's valuation. The university does not have to set up a comprehensive investment management system, which keeps its efforts and costs to a minimum. And since the university has no right to intervene in spin-off decisions, the firm remains attractive to investors.

[134] Startup BW (n.D.): Von der Hochschule an den Markt - Zuschüsse für Hochschul-Ausgründungen. Startup BW. Accessible at: https://www.startupbw.de/finanzierung/zuschuesse-hochschul-ausgruendungen (accessed last 03 April 2024)

Recommendation:
Foster Academic Entrepreneurship Through Tailored University Venture Funds And Regulatory Adaptations

Encourage German universities to create tailored venture funds that specifically cater to the unique needs of academic entrepreneurs and startups originating from their campuses. Introduce the use of SAFE (Simple Agreement for Future Equity) agreements within these funds, providing a more adaptable and less cumbersome alternative to traditional equity financing. This approach suits the early-stage, high-risk nature of academic startups and aligns with the risk-reward calculus essential for budding academic entrepreneurs. Concurrently, work with regulatory bodies to adapt stock option regulations, ensuring they are more aligned with the academic setting. These regulations should be streamlined to facilitate equity participation for academic staff and students, making it more attractive and less bureaucratically intensive.

Recommendation:
Implement A Standardized Framework For Financing IP Transfers Into Spin-Offs

Germany should further prioritize the SPRIN-D and the Foundation Association's Transfer 3.0 initiative to create a standardized framework for IP commercialization. In particular, this effort should pay special attention to the use of virtual shares to finance IP transfers to university spin-offs. These efforts must go hand-in-hand with the startup strategy's measure to set up a deal database focused on spin-offs and stand-ups along the lines of the AUTM database in the U.S. This would streamline the tech and IP transfer process, reduce legal and bureaucratic hurdles, and make spin-offs more attractive to investors.

7.2 Late-Stage Funding

Key Takeaway:

Startups in the U.S. have various funding avenues, such as venture capital, but they must weigh equity trade-offs. Alternative financing options like venture debt provide capital without dilution, though challenges persist in the venture debt market. Conversely, Germany's late-stage VC market lags behind the U.S. due to economic challenges and despite government initiatives. While funding programs aim to support startups, attracting domestic investment remains a hurdle. Recent reforms in Germany's capital markets seek to boost competitiveness, yet critical issues persist. Attention is needed for domestic investment and diversification of funding sources to address these challenges. Thus, while government initiatives show commitment to fostering innovation, further action is necessary to overcome hurdles and ensure sustained growth in the startup ecosystem.

U.S. startups seeking late-stage funding have several avenues to explore, each with its own set of advantages and strategic implications. One of the primary options is venture capital (VC) firms that specialize in late-stage investments. These firms typically invest in companies with proven business models, strong market presence, and a clear path to profitability or exit. Late-stage VC funding is often substantial, aimed at scaling the business, expanding into new markets, or even preparing for an initial public offering (IPO). Startups considering this route benefit from the expertise, network, and credibility that established VC firms bring, although they may have to relinquish more equity and control. Until the recent market downturn, late-stage funding had been recovering from the post-2008 financial crisis, in terms of both deal size and deal quantity.[135] To weather the storms, however, startups needed to incorporate more agility in their capital structures.

Venture debt and revenue-based financing have become more popular alternatives to traditional equity financing for startups, offering the benefits of capital infusion without the signifi-

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[135] National Venture Capital Association (2023): Venture Monitor, Q3 2023. Accessible at: https://nvca.org/wp-content/uploads/2023/10/Q3_2023_PitchBook-NVCA_Venture_Monitor.pdf (last accessed 12 April 2024).

cant dilution of ownership. Venture debt is provided to startups that might not be profitable but have promising growth potential and existing VC support. Venture debt infusions – typically 25 to 45% of the most recent VC fundraise – serve as complementary financing that enables startups to extend their runway, finance growth initiatives, or manage cash flow without substantially diluting existing equity holders.[136] The market for venture debt grew from just over US$8 billion in 2013 to US$34.1 billion in 2022, but higher interest rates and skittishness following the March 2023 collapse of Silicon Valley Bank – which accounted for 20% of the overall venture debt market in the U.S. prior to its failure – set the industry back. Analysts expect the market to reach just US$14 billion in 2024.[137] Still, venture debt is anticipated to rebound in line with the recovery of the VC market and as other financial institutions step in to fill the gap in venture debt funding.[138]

In addition, several tax policies support the ongoing development of startups and might be considered indirect funding mechanisms. For example, at the federal level, the Research & Development Tax Credit – first launched in 1981 and made permanent in 2015 – incentivizes companies to invest in research and development by allowing them to claim a portion of R&D expenses as credits against their income tax or to claim up to US$250,000 annually of R&D expenses against Social Security-related payroll liabilities.[139] This latter credit option is specifically available to startups that are less than five years old, have not yet become profitable, and generate less than US$5 million in annual revenue. California also offers an R&D tax credit equal to 24% of basic research expenses for university-based research for any given taxable year. Recent research examining the effectiveness of such tax policies found that a 10% reduction in the user cost of R&D spending led to an 11% average increase in a firm's

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[136] Deloitte (2024): Accelerating growth with venture debt. Accessible at: https://www2.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2024/technology-venture-debt-prediction.html (last accessed 12 April 2024).

[137] Deloitte (2024): Accelerating growth with venture debt. Accessible at: https://www2.deloitte.com/us/en/insights/industry/technology/technology-media-and-telecom-predictions/2024/technology-venture-debt-prediction.html (last accessed 12 April 2024).

[138] The Economist (2023): What the loss of Silicon Valley Bank means for Silicon Valley. Accessible at https://www.economist.com/finance-and-economics/2023/03/14/what-the-loss-of-silicon-valley-bank-means-for-silicon-valley (last accessed 12 July 2024).

[139] U.S. Internal Revenue Service (n.D.): Qualified Small Business Payroll Tax Credit for Increasing Research Activities. Accessible at: https://www.irs.gov/businesses/small-businesses-self-employed/qualified-small-business-payroll-tax-credit-for-increasing-research-activities (last accessed 29 April 2024).

research intensity. Similarly, another study found that US$1 of R&D tax credit on average results in US$4 of R&D spending.[140]

In addition to R&D tax credits, the U.S. federal government offers tax credits to encourage startups and small businesses to provide healthcare benefits to their employees (up to 50% of healthcare premium expenses for eligible employers); to start company-wide retirement plans (up to US$5,000 per year); and to hire individuals for historically underrepresented or marginalized communities (up to US$9,600 per employee). Finally, both federal and California tax code support startups through the favorable treatment of incentives or qualified stock options paid to employees. Under current law, employees do not face taxation when the options are granted or exercised, and they benefit from substantially lower long-term capital gains taxes if the stock is held for at least one year.

The German late-stage VC market is less present and not as well capitalized as in the U.S. While Germany has long been touted as the next big European tech hub and its VC activity grew steadily until 2021, deal volume has a percentage of GDP has barely remained on par with France and still lags far behind the UK and U.S.[141] However, it must be noted that the presence of VC investors varies from state to state. Berlin leads the way, followed at a distance by Bavaria, Hamburg, Lower Saxony, and Baden-Württemberg, according to an assessment based on the aggregated volume of invested venture capital from 2012 to 2022.[142] Even in a challenging 2022, when global VC activity experienced a downturn, deal volume in Germany suffered more than elsewhere – its deal volume amounted to just 0.30% of GDP, which trailed France (0.57%), the EU-27 (0.33%), the UK (0.97%), and the U.S. (0.96%).[143]

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[140] Nirupama Rao, N. (2016): Do Tax Credits Stimulate R&D Spending? The Effect of the R&D Tax Credit in its First Decade. Journal of Public Economics 140. Accessible at: https://www.sciencedirect.com/science/article/abs/pii/S0047272716300482 (last accessed 12 April 2024).

[141] Viete, S.; Metzger, G. (2023) KfW Venture Capital Dashboard Q2 2023. KfW. Accessible at https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Dashboard/KfW-VC-Dashboard-Q2-2023_EN.pdf (accessed last 03 April 2024)

[142] Davies, K. (2024): Volume of venture capital investments in Germany 2023, by state. Statista. Accessible at: https://www.statista.com/statistics/1421956/venture-capital-investments-state-germany/ (accessed last 03 April 2024)

[143] Viete, S.; Metzger, G. (2023) KfW Venture Capital Dashboard Q2 2023. KfW. Accessible at https://www.kfw.de/PDF/Download-Center/Konzernthemen/Research/PDF-Dokumente-Dashboard/KfW-VC-Dashboard-Q2-2023_EN.pdf (accessed last 03 April 2024)

Even in 2023, geopolitical risks, high inflationary pressure, and weak economic development curbed VC investments in Germany. According to a November 2023 PwC study, the number and volume of deals decreased from 2022, with a notable preference for investments in B2B business models.[144] The expected Internal Rate of Return (IRR) for early and growth-stage companies diminished, a trend particularly relevant for new spin-offs and startups. (Expected IRR increased for late-stage companies, however.) PwC also observed a shift towards more conservative investment strategies, indicative of caution in the current economic climate. This trend is marked by heightened due diligence and a lean towards more established startups with proven business models, a further blow for spin-offs from the higher education sector. In the absence of a competitive VC landscape, as it exists in the U.S., the financial framework for startups in Germany predominantly revolves around public funding. In addition to the EXIST Program, the German government's startup strategy has adopted a multifaceted approach, with the Zukunftsfonds, or Future Fund, managed by Kreditanstalt für Wiederaufbau (KfW), at its core. With an allocation of €10 billion for investments until 2030, this fund is a cornerstone in the strategy, aiming to mobilize a total of €30 billion of combined private and public capital. The focus lies predominantly on supporting innovative, technology-oriented start-ups in their growth phase, with a keen interest in sectors such as artificial intelligence, quantum technology, hydrogen, medicine, sustainable mobility, bioeconomy, circular economy, and climate, energy, and environmental technology. While innovations in these sectors rely heavily on research, including university research, the funds target the broader startup ecosystem in Germany and do not include any special provisions for spin-offs and stand-ups.

The same applies for the Zukunftsfonds with its various modules, each tailored to meet the diverse financial needs of start-ups at different stages of development. These modules offer a range of financing options, including equity, debt, and mezzanine capital. Notably, this support is extended through both direct investment funds and indirect avenues such as fund-of-funds and venture debt instruments. Key modules include the European Tech Champions Initiative (ETCI), which collaborates with European partners to establish large-scale funds for late financing phases. The DeepTech & Climate Fund (DTCF), which focuses on high-tech companies in their growth stage, is pivotal in bolstering technological sovereignty and supporting climate-related deep-tech companies. The Wachstumsfonds Deutschland, or Growth Fund Germany, is a fund of funds for growth capital, specifically targeting institutional

[144] Honold, D., et al. (2023): Der deutsche Markt für Venture Capital verliert an Widerstandskraft. VC-Marktstudie 2023 - Die richtige Selektion ist entscheidend. PwC Germany. Accessible at: https://www.pwc.de/de/deals/venture-capital-marktstudie.html (accessed last 03 April 2024)

investor groups to expand the German venture capital market. Additionally, the strategy encompasses large-scale growth financing facilities within the framework of the Zukunftsfonds, leveraging the ERP-Sondervermögen (European Recovery Program Special Assets) to strengthen the financing of growth companies in Germany and the EU. The High-Tech Gründerfonds (HTGF) Growth Fund is dedicated to supporting follow-on and growth financings in the HTGF portfolio. Lastly, the Venture Tech Growth Financing (VTGF 2.0) Module focuses on providing venture debt to young technology-oriented growth companies, particularly in their later stages of growth, thus nurturing the venture debt market in Germany. The September 2023 progress report on the German Federal Government's startup strategy highlights substantial advancements, with 42% of planned measures already implemented and 53% in substantial preparation. The report reveals a €3.75 billion commitment to the ETCI, including €1 billion from Germany. The DTCF made its first two investments, and the Growth Fund is active, investing in more than 10 VC funds to date. Although we have limited data on the ERP mechanism, the fourth generation of the HTGF, launched in February 2023 with nearly €500 million, surpasses all previous funds. Private investors contributed approximately one-third of the fund's volume.

However, the most notable action taken under the umbrella of the German Startup Strategy is the country's approval of a comprehensive set of reforms to its capital markets frameworks, which took effect on January 1, 2024. These reforms brought significant changes to Germany's systems for stock-based compensation at startups, company listings, and taxation, aiming to bolster the country's technology industry and enhance its competitiveness with Silicon Valley. Key changes include reforms to employee stock ownership plans (ESOPs), addressing previous administrative burdens and tax disadvantages. Under the new rules, taxes on employees' stock options will be deferred until sale, with a widened scope allowing more growth companies to benefit. The threshold for companies eligible for ESOP plans will rise, and capital gains tax rules will be revised to reflect the risks associated with startup investments. Additionally, the legislation will permit companies listing in Germany to issue dual-class shares, enabling founders to retain control. Despite these ongoing reforms in Germany's capital markets frameworks, however, critical issues persist. For example, companies with group structures are excluded from applying for ESOP rules, hindering their ability to fully benefit from the reforms and limiting their employees' incentives to dedicate themselves to high-risk, high-growth projects or units. Looking ahead, there are calls for a pan-European framework to streamline startup stock regulations across EU countries, addressing concerns about the dominance of North American pension funds in German tech companies by making it easier for domestic and European pension funds to invest in these firms. Additionally, greater domestic investment is needed to ensure successful exits, an area requiring additional attention from policymakers.

The German government has strengthened collaborations between the private sector and universities with initiatives such as the German Act on Tax Incentives for Research and Development (FZulG). Effective January 1, 2020, the FZulG offers subsidies up to 25% of eligible R&D activities, with a maximum subsidy of €1,000,000 yearly under COVID-19 measures. Notably, tax credits under this act have positively impacted Germany's chemical and pharmaceutical industry.[145] The Growth Opportunities Act, effective January 1, 2024, enables companies to categorize certain costs as eligible R&D expenses, with increased support for EU contractors, rising from 60% to 70%. These reforms underscore Germany's dedication to fostering innovation and research, driving enhanced competitiveness and growth in the tech sector.

Recommendation:
Create Alumni Investment Networks For University Spin-offs

Utilize the potential of university alumni networks as a key resource for funding and mentoring university spin-offs, especially in later stages of development. In the U.S., alumni networks play a crucial role in providing capital and expertise to emerging ventures. German universities should actively engage their alumni, encouraging them to invest in and support spin-offs through mentorship, industry connections, and valuable expertise. To facilitate this, universities could establish platforms for alumni to connect with current research and entrepreneurial activities, organize networking events, and develop targeted communication strategies to showcase investment opportunities in university spin-offs.

Recommendation:
Partnerships For Scale

Combining public and private expertise: encourage the formation of public-private partnerships (PPPs) focused on the late-stage growth of university spin-offs. This model would combine governmental financial support with the expertise and resources of the private sector. Drawing inspiration from successful U.S. models, these partnerships could effectively scale university-originated ventures. Policymakers should consider creating frameworks and incentives that facilitate collaboration between universities, government agencies, and private investors, including joint funding initiatives, shared risk mechanisms, and regulatory support to streamline the scaling process of spin-offs.

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[145] https://www.zew.de/en/press/latest-press-releases/rd-tax-credit-is-an-asset-for-germanys-innovation-landscape

Recommendation:
Cultivate A "NextGen" Sovereign Wealth Fund For Deep Tech

Explore the establishment of a European Sovereign Wealth Fund (SWF) dedicated to supporting deep tech ventures emerging from universities. Following the example of countries like Norway, Germany could take a leading role in collaborating with other European nations to create a "NextGen" SWF. Such a fund would focus on investing in high-potential deep-tech startups, particularly those spun out from academic institutions. The fund could prioritize sectors like climate technology, education, transportation, and healthcare, providing not only capital but also strategic support to nurture these ventures from university startups to market leaders.

Recommendation:
Drive Legal Reform To Enable Easier Exits Of German-Originated Ventures By Way Of Acquisition

Enabling easier sales of ventures in Germany would motivate entrepreneurs and VCs to invest in venture building and scaling from within Germany, rather than relocating headquarters to the U.S. Such a reform could increase the longevity of a venture within the country, which would in turn mean more jobs created and more ecosystem benefits, including collaborations with the wider university-based science and technology landscape.

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