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Article

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RESEARCH

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The role of the state in the entrepreneurship ecosystem: insights from Germany

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Abstract

The performance of new ventures is strongly impacted by something much larger than the business itself: the surrounding ecosystem. In this network of actors, the role of the state has been underestimated up to this point. This article investigates the nature and composition of the German entrepreneurship ecosystem and suggests a new framework for assessing the role of the state in the entrepreneurial ecosystem. This framework is applied using data from a meta-analysis of existing research as well as qualitative interviews to assess the government influence on the different phases of the science-based innovation process. By analyzing different public initiatives in Germany, this paper provides insights into how governments can influence the attractiveness of an ecosystem, but it also highlights various improvement opportunities. Germany already features a dynamic entrepreneurship ecosystem and has a distinct political agenda to promote entrepreneurship. Improvements have been made in the regulatory environment and in entrepreneurship education, especially tertiary education, and publicly funded programs support the early stages of new ventures. The incentive schemes for scientific staff should be aligned to encourage more tech transfer activities, and more later stage financing is needed, through the involvement of private investments, in order to exploit the full growth potential of new ventures. Germany also needs policies that affect social values and attitudes towards entrepreneurship in order to reduce the stigma of failure and enhance the appreciation of entrepreneurial activity in the society.

Keywords: Entrepreneurship ecosystems; Government support; New venture creation; Innovation; Framework

Resumen

Los resultados de las nuevas empresas están fuertemente condicionados por un factor que es mucho más importante que el propio negocio: el ecosistema. En esta red de actores, la función del estado ha sido, en gran medida, subestimada. Este artículo investiga la naturaleza y composición del sistema emprendedor alemán y sugiere un nuevo marco para valorar la función del estado en él. Este marco está conformado por datos extraídos del meta-análisis tanto de investigaciones previas como de entrevistas cualitativas realizadas para valorar la influencia del gobierno en las diferentes fases del proceso de innovación científica. Mediante el análisis de diversas iniciativas alemanas, el presente artículo ofrece varias ideas sobre la manera en que los gobiernos pueden influir sobre el atractivo de un ecosistema, a la vez que sugiere algunas oportunidades de mejora. Alemania cuenta con un ecosistema emprendedor dinámico y con una clara agenda política para la promoción del emprendimiento. Se han conseguido mejoras en el campo regulatorio y en la formación para el emprendimiento, especialmente en el campo de la educación superior, y se han puesto en marcha programas financiados públicamente destinados a apoyar las fases iniciales de las nuevas empresas. Los esquemas de incentivo para los profesionales científicos deberían alinearse para alentar más actividades de transferencia tecnológica, de la misma manera que se requiere más financiación para fases posteriores en la creación de empresas, lo que se lograría involucrando a financiadores privados que permitieran la máxima explotación del potencial de las jóvenes empresas. Alemania también necesita políticas que influyan en los valores sociales y actitudes respecto al emprendimiento con el propósito de reducir el estigma generado por el fracaso, además de mejorar la percepción de la actividad emprendedora en la sociedad.

Résumé

Les résultats des nouvelles entreprises sont fortement conditionnés par un facteur beaucoup plus important que le commerce lui-même : l'écosystème qui les entoure. Dans ce réseau d'acteurs jusqu'à présent le rôle de l'État a été sous-estimé. Cet article analyse la nature et la composition de l'écosystème entrepreneurial allemand et suggère un nouveau cadre pour évaluer le rôle de l'État dans l'écosystème entrepreneurial. Ce cadre est appliqué à partir des données d'une méta-analyse des recherches existantes ainsi que d'entretiens qualitatifs pour évaluer l'influence du gouvernement sur les différentes phases du processus d'innovation basé sur la science. En analysant les différentes initiatives publiques en Allemagne, l'article fournit un aperçu de la façon dont les gouvernements peuvent influencer l'attractivité d'un écosystème, mais il souligne également les différentes possibilités d'amélioration. L'Allemagne dispose déjà d'un écosystème entrepreneurial dynamique et d'un agenda politique en vue de promouvoir l'entrepreneuriat. Des améliorations ont été apportées dans les domaines de la régulation et de la formation des entrepreneurs, en particulier dans l'enseignement supérieur, et des programmes de financement public soutiennent les premières phases de développement des nouvelles entreprises. En outre, des programmes d'incitation pour le personnel scientifique devraient aussi être mis en place pour encourager les activités de transfert de technologie, et le financement des stades ultérieurs par des investisseurs privés s'avère nécessaire pour exploiter le potentiel de croissance des nouvelles entreprises. L'Allemagne a également besoin de politiques influant sur les valeurs sociales et les attitudes envers l'entrepreneuriat afin de minimiser la stigmatisation de l'échec et d'augmenter l'appréciation positive de l'activité entrepreneuriale au sein de la société.

Абстракт

Результативность новых инновационных проектов в значительной степени зависит не столько от бизнеса как такового, но и от окружающей его экосистемы. В рамках подобной сети участников роль государства остается недооцененной. Настоящая статья посвящена исследованию природы и структуры предпринимательской экосистемы Германии, на основе которой предложена новая модель для оценки роли государства в ней. Данная модель апробирована на основании данных мета-анализа существующих исследований, а также качественных интервью с целью оценки влияния государства на различные фазы инновационного процесса, инициированного знаниями. Сравнивая различные общественные инициативы, реализуемые в Германии, в настоящей работе систематизирован опыт воздействия правительства на привлекательность экосистемы, а также выделены различные возможности для улучшений. Германия в настоящее время обладает динамичной предпринимательской экосистемой и при этом руководствуется четкой политической стратегией продвижения идей предпринимательства. Улучшения были сделаны в условиях законодательной регламентации и обучения предпринимателей с акцентом на высшее образование, а также реализации программ с общественным финансированием, направленных на поддержку инновационных проектов на ранних стадиях развития. Стимулирующие схемы для научных кадров должны быть согласованы с активизацией трансфера технологий; кроме того, необходимо финансирование проектов на более поздних стадиях с привлечением частного капитала, т.к. это позволит достичь максимального развития новых проектов. Германия также нуждается в новых программах, в которых будут задействованы социальные ценности и связи в сфере предпринимательства в целях снижения рисков, позволяющие улучшить восприятие предпринимательских инициатив в обществе.

摘要

新创企业的绩效表现深受比生意业务本身大得多的东西的影响,即周围的生态系统。在这个创新主体的网络中,到此时为止国家的作用一直被低估。本文研究了德国创业生态系统的本质和组成,并提出一个新的框架来评估在创业生态系统中国家的作用。通过对现存研究的基本分析及定性访谈,我们利用这个框架评估政府在以科学为基础的创新过程的不同阶段的影响。在分析了德国的不同公共举措后,本文提供了对政府怎样能影响一个生态系统的吸引力的深入了解,但同时也强调各种各样的改进机会。德国素以充满活力的创业生态系统著称,且具有鲜明的促进创业的政治议程。她在环境监管和创业教育方面已有所改进,尤其是高等教育,公共资助计划支持新创企业的早期阶段。对科研人员的激励机制应该和鼓励更多的技术转移活动相一致;并且需要私人投资参与企业发展较后期的融资

Resumo

O desempenho de novos empreendimentos é fortemente impactado por algo muito maior do que o próprio negócio: o ecossistema ao redor. Nesta rede de atores o papel do estado tem sido subestimado. Esse artigo investiga a natureza e a composição do ecossistema empreendedor alemão e sugere uma nova estrutura para sua avaliação. Este método utiliza dados de uma meta-análise de pesquisas existentes, bem como entrevistas qualitativas para avaliar a influência do governo nas diferentes fases do processo de inovação com base científica. Ao avaliar diferentes iniciativas de políticas públicas na Alemanha, esse artigo fornece insights sobre como os governos podem influenciar a atratividade de um ecossistema, mas também de destaca várias oportunidades de melhorias. A Alemanha já dispõe de um ecossistema empreendedor dinâmico e possui uma clara agenda política para promover o empreendedorismo. As melhorias têm sido implantadas no ambiente regulatório e na educação para o empreendedorismo, especialmente na educação superior, e em programas de financiamento público no suporte aos estágios iniciais de novos empreendimentos. O regime de incentivo ao pessoal da área científica deve estar alinhado para encorajar atividades de transferência de tecnologia, sendo necessário financiamento no estágio final, através da participação de investimentos privados, a fim de explorar todo o potencial de novos empreendimentos. A Alemanha também necessita de políticas públicas que afetam os valores sociais e as atitudes em relação ao empreendedorismo, de forma a reduzir o estigma do fracasso e aumentar a valorização da atividade empreendedora na sociedade.

Multilingual abstract

Please see Additional file 1 for translation of the abstract into Arabic.

Introduction

For decades now, entrepreneurial ventures have been a major force driving economic growth. A study of the Kauffman Foundation (Kauffmann 2012) showed that between 2000 and 2010, almost all new jobs in the USA have been created by fast-growing tech start-ups. While in some cases these ventures may lead to huge successes, it is a reality that most start-up businesses fail along the way (Nobel 2011). This can be evoked by a variety of reasons such as wrong business assumptions, premature scaling, too little or too much financing, illiquidity, among others (Nobel 2011). These rather slim chances of success are even lower outside of the established start-up hubs - places serving as incubators for creativity, innovation, and entrepreneurship (Porter 1998). As a result, almost all of the widely successful company formations of the last decades (e.g., Apple, Yahoo, Google, Facebook) took place in one of the two longtime start-up hubs in the USA - Silicon Valley and Boston. However, we do observe an increased number of tech start-ups and a rise of new entrepreneurship hubs all over the world: in the USA, New York, Chicago, Austin, and Seattle; and globally, Tel Aviv, Singapore, London, and Berlin have been establishing themselves in recent years.

However, of particular interest to scholars has yet only been the progress of the efforts towards venture emergence, but not the supportive landscape and especially the role of the state in the entrepreneurship ecosystem. Just recently, scholars (e.g., Mazzucato 2011) have started to see the state as an entrepreneurial agent active in those risky fields the private sector would never engage in and, thus, as actively shaping and creating

markets. Many ecosystems and regions, such as Silicon Valley, have strongly benefited by this active role of the state. As an example, most of the innovations that laid the basis for the iPhone of Apple were funded by state money (SIRI, Internet, GPS). Even more surprisingly, most of these innovations funded by the state are from the USA, the country that is often argued to most represent the 'free market system' but seems to have a very interventionist government when it comes to innovation.

Even though entrepreneurial activity is on the rise in many metropolitan areas around the world, many scholars argue that Europe, especially, lacks entrepreneurial activity and needs a stronger focus on entrepreneurship-driven innovation to compete globally (European Commission 1998a). But is that really the case? Is Europe in such a strong demand to support its entrepreneurship culture or does it already have a strong and self-sustaining ecosystem *with a strong entrepreneurial state*? What can governments do to support the process of turning science-based 'inventions' into commercially viable 'innovations'? We shed some light on the government's role in innovation ecosystems by taking a closer look at Germany. Being the largest economy of Europe, Germany traditionally was characterized by more interventions in the market, in particular compared with liberal countries such as the USA. By analyzing the status quo and the development of the ecosystem in Germany in terms of the role of the state, we address these questions.

In the next section, we provide the theoretical background that guides our research, by introducing the concept of entrepreneurship ecosystems and highlighting the role of the state within this context. Thereafter, we generate an analysis framework that will be used to explore the role of the government in the German entrepreneurship ecosystem and explain the research methodology. In the next step, the results are presented, addressing the research questions identified, and our findings are discussed. The final section concludes by summarizing the key findings and providing recommendations for policy makers in Germany.

Theoretical background

The performance of most new ventures has been found to depend on other factors beyond the business itself: the surrounding entrepreneurship ecosystem. However, despite being increasingly central to modern business, entrepreneurship ecosystems are yet not well understood.

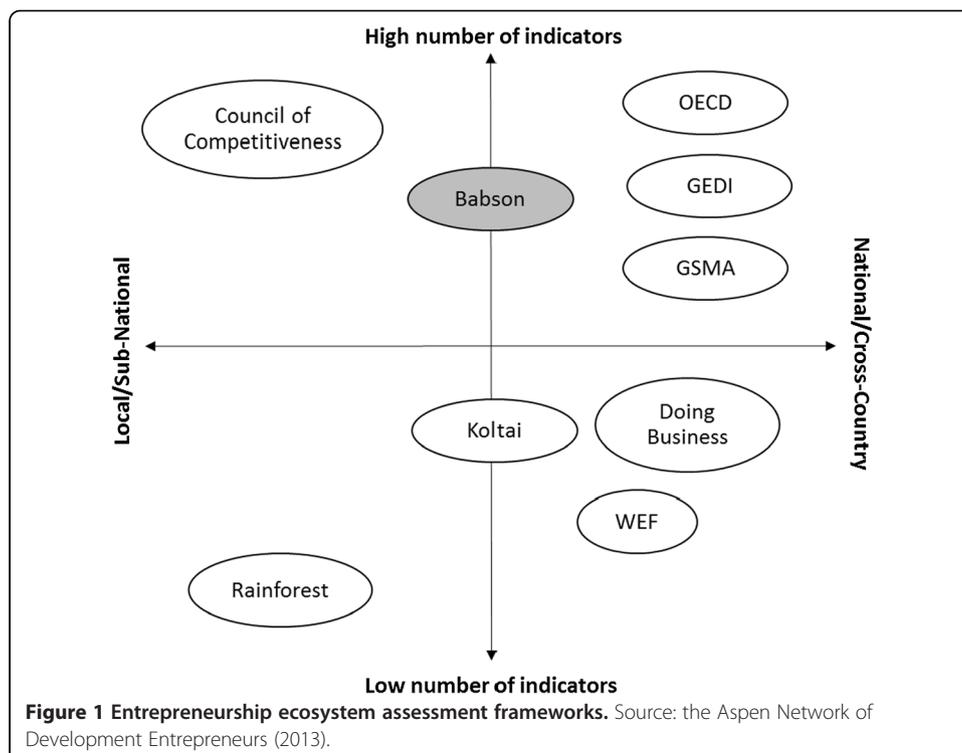
What is an entrepreneurship ecosystem and how can it be assessed?

Like any individual species in a biological ecosystem, each member of an entrepreneurship ecosystem ultimately shares the fate of the network as a whole and is influenced by its comparative strength or weakness. The decisions and moves of a new venture will, to varying degrees, affect its ecosystem health, which in turn will affect the venture performance - for ill as well as for good. More recently, different scholars and practitioners have started attempts to describe and/or measure the nature and sustainability of entrepreneurship in a specific geographic area. The systems of innovation approach emphasize the importance of interactions among different kinds of actors and technology policy for innovation success (Freeman 1978; Lundvall 1988; Lundvall 1992; Fischer 2006). This notion underlines the importance of knowledge exchange among industry and the academic system. Furthermore, the Triple helix (Etzkowitz 2002; Etzkowitz 2008)

concept highlights the importance of the relationships between industries, universities, and governments. In order to achieve sustainable economic development in a region, these three institutional spheres need to collaborate across institutional boundaries through loosely coupled reciprocal relationships and by starting joint initiatives. Wilson (2012) argues that one of the most important prerequisites for innovation in a certain area is the interrelated cooperation of the four major sectors: government, business, civil society (cp. not-for-profit organizations), and *academia* - the so-called 'quad' (or quadruple helix). The basis for such cross-sector networks between public and private institutions is formed by mutual trust, which can be gradually built by a 'social infrastructure,' like associations and clubs.

Whereas some studies/approaches are focused on the macro level, describing factors influencing the level of entrepreneurship on a national level, others are dealing with the micro level, focusing on interpersonal relationships and communities in smaller geographic areas (e.g., cities or organizations). The Aspen Network of Development Entrepreneurs (2013) summarized the research that has been conducted in this new field of study so far and identified several studies developing an entrepreneurship ecosystem's assessment framework^a. In Figure 1, the different approaches are compared according to the geographic unit of analysis and the complexity of the model (number of indicators). Some of the models list an extensive list of indicators (OECD: 57 indicators, Asset mapping roadmap: 157 indicators), while others are more conceptual and allow more flexibility in assessing entrepreneurial ecosystems (Babson, Koltai).

Daniel Isenberg, leading the Babson Entrepreneurship Ecosystem Project, defines an entrepreneurship ecosystem as 'a set of networked institutions [...] with the objective of aiding the entrepreneur to go through all the stages of the process of new venture

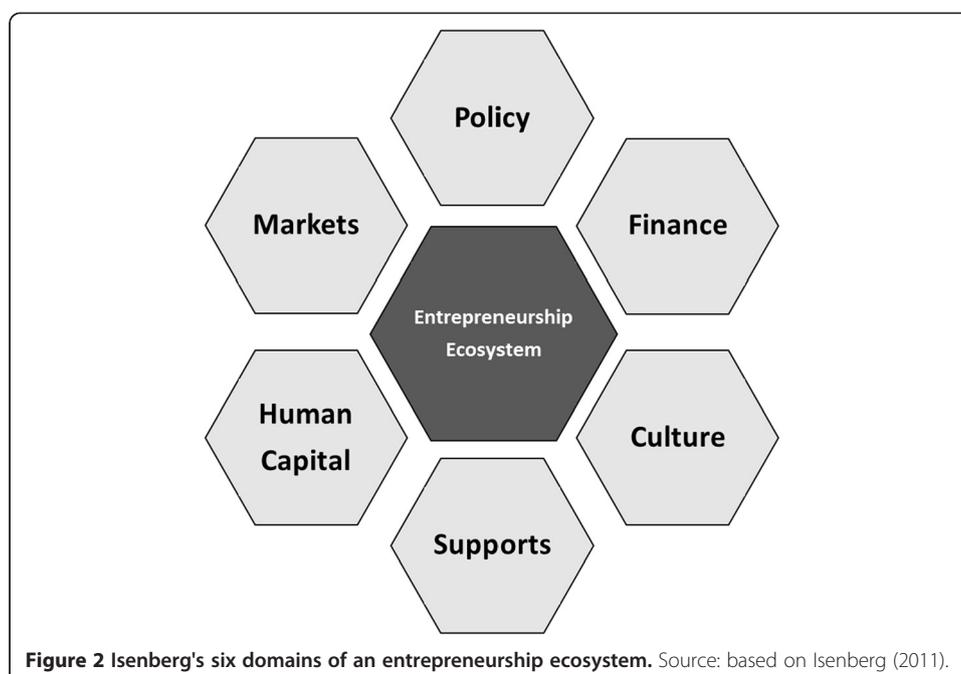


development^b. It can be understood as a service network, where the entrepreneur is the focus of action and the measure of success.' (Isenberg 2010; Isenberg 2011). He further characterizes an entrepreneurship ecosystem fourfold: (1) It consists of six domains (policy, finance, culture, supports, human capital, markets) (see Figure 2). (2) Each entrepreneurship ecosystem is unique - that is why Silicon Valley cannot be replicated. (3) Specifying generic root causes of the entrepreneurial ecosystem has limited practical value due to multi-dimensional cause-effect relations that are impossible to track down to one or two key roots. (4) Entrepreneurship ecosystems become (relatively) self-sustaining as soon as all six domains are strong enough.

What is the role of the state in an entrepreneurship ecosystem?

The special effect of entrepreneurship and the entrepreneurship policy on the development of an economy and especially the positive impact on economic growth has been highlighted by numerous scholars (Audretsch et al. 2002; Gilbert et al. 2004; Acs and Szerb 2007; Baumol et al. 2007). Hence, government plays an essential role in promoting innovation and entrepreneurship throughout the country or in a certain region. However, *'a broad search of the literature reveals that the fundamental and general question of how, and if, governments are able to influence positively entrepreneurial activity is far from being resolved'* (Minniti 2008).

According to Fiona Murray, there are two logics as to how to create an entrepreneurship ecosystem (Regalado 2013): The governmental logic says that it needs specialized inputs, such as technology parks and innovation centers (cp. Skolkovo near Moscow) to promote the emergence of such an ecosystem. Following this logic, however, it can happen that the market is distorted by an excessive public commitment and might halt the development of a sustainable dynamics. The other logic is based entirely on the people and their personal networks. New companies are created by a constant recombination of ideas, talent, and capital, embedded in a supportive culture or



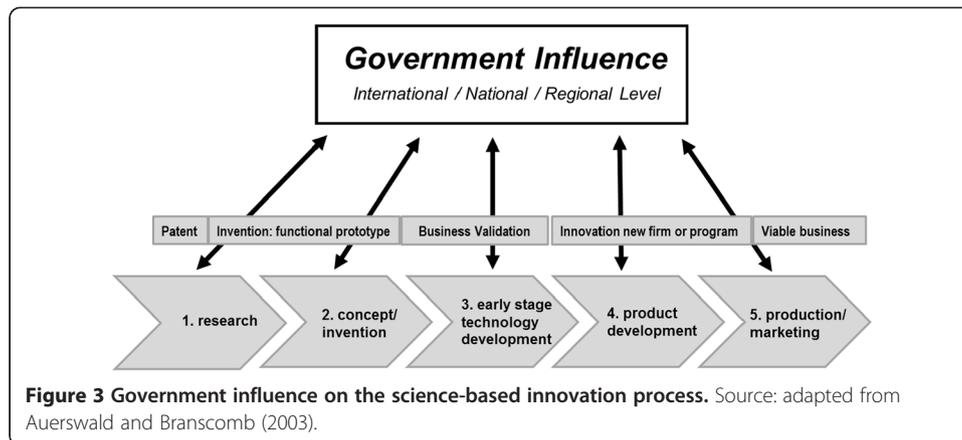
community. Governments must understand those basic mechanisms in order to create a framework that supports such initiatives, rather than prevents them. Hence, the government is given the difficult task of finding the right balance. It has to support an environment that incites people to think outside the box and start a new business. On the other hand, the government should not overestimate its potential for creating a self-sustaining entrepreneurship ecosystem and should rather act as a supporting force ('feeder'), rather than leading the movement (Feld 2012).

Mazzucato (2011) describes the important role of the state in the innovation ecosystem: Many young companies benefit from early stage financing and state-sponsored technologies, which often form the basis for their new products and services^c. Through a high level of investment in research and development of new technologies, mostly through public investment or development banks, the state has the opportunity to actively shape the markets of the future. Hence, financial public support is essential to jump-start and fund new business, especially the earlier stages of a new venture. Furthermore, governments in ecosystems with less maturity in venture capital funding provide capital to close the financing gap and allow start-ups to expand their production and increase their business reach. However, by doing this too excessively, the marketplace for venture financing gets distorted and private equity investors eventually move to other markets. Establishing a link to the private investment market is important, as the market applies the law of natural selection (Isenberg 2010, 2011).

Entrepreneurs innovate. Innovation is the specific instrument of entrepreneurship. It is the act that endows resources - things in nature with economic value - with a new capacity to create wealth. Innovation is an economic or social term, rather than a technical term, and can be defined as changing the yield of resources^d (Drucker 1985). So, it is not the quality of an invention that counts but its impact on the market.

Now, most economic growth in most industrial economies comes from incremental improvements in existing products, processes, and services. In the USA, those incremental changes are mostly financed by private investment, whereas government funding for this kind of R&D has been almost flat in the last decade^e. But sustainable growth can only occur with the continuous introduction of new products and services and radical technological innovations disrupting markets and creating new industries (Lucas 1988, 1993). For that reason, governments have to understand and support the process of turning science-based 'inventions' into commercially viable 'innovations' in order to spur radical technological change. Figure 3 presents the processes from publicly funded research to successful market entry - the transition of 'invention to innovation' (Auerswald and Branscomb 2003): The process starts with research (phase 1) leading to a technical concept of commercial value that is protected, perhaps by a patent (phase 2). Phase 3 is the most critical phase in the transition from invention to innovation: The technology is adapted to industrial practice, the production process is defined, costs are estimated, and a market is identified and quantified. Once early stage technology development work is completed, product development (phase 4) begins. A pilot line is produced and the company is ready to enter the market, and in phase 5 - through customer feedback and further product development - a business is created, which is ready to be financed or perhaps acquired.

There are different components of means and instruments governments can use to support the science-based innovation process and foster an entrepreneurship ecosystem. Those components were summarized in a guidance paper of the United Nations (United



Nations Conference on Trade and Development 2012) and include the legislation and regulatory environment (IP rights, immigration laws (Wadhwa et al. 2007; Zachary 2000), tax law, labor rights, bankruptcy laws, business formation process, etc.), the educational system (esp. universities) and awareness building, access to finance and financial support (research grants, tax benefits, etc.), and technology exchange and networking (cp. publicly funded research institutions and initiatives like Fraunhofer in Germany).

Framework and research design

This study investigated how the determining factors of the domestic entrepreneurship ecosystems evolved in Germany over time. In order to derive an analysis framework (see Figure 4) to examine the role of policy means and instrument in the different phases of the science-based innovation process, we applied two steps. In the first step, the concept depicted in Figure 3 is used, in a more aggregated way. We consolidated phases 1 and 2 (usually taking place in the research institution) into ‘research and invention’ and phases 4 and 5 into ‘product and business development.’ Phase 3 is considered the ‘most critical phase in the transition from invention to innovation’ (Auerswald and Branscomb 2003); we maintained as ‘early stage technology development.’ These different phases of the innovation process are listed on the horizontal axis. In the

Policy Analysis Framework		Science-based Innovation Process		
		Research & Invention	Early Stage Technology Development	Product & Business Development
Policy Means and Instruments	Regulatory Environment			
	Entrepreneurship Education & Awareness			
	Access to finance			
	Tech Exchange, Innovation & Networking			

Figure 4 Policy analysis framework. Source: own depiction.

second step, we list the components of means and instruments governments can use to support the science-based innovation process and on the vertical axis. The derived framework allows us to allocate specific policy instruments, trends, and phenomena in Germany to the different phases in the innovation process.

To study the role of policy in the creation of an entrepreneurial ecosystem, we synthesized existing studies and performed qualitative interviews. First, we used data of a meta-analysis of existing research in order to assess the role of the state on the science-based innovation process and the entrepreneurship ecosystem following our analysis framework. In a second step, the methodological efforts were of a qualitative nature. We conducted ten semi-structured interviews (30 to 60 min each) with investors, policy makers, and entrepreneurs, as well as scientists and scholars in the field of entrepreneurship (see Table 1 for the list of interviewed experts) following a purposeful sampling approach (Patton 1980). To assure confidentiality, the names of the respondents are not disclosed. Through content analysis, we can systematically examine the changing role of the state on entrepreneurship activity, detect shortcomings, and derive recommendations on how the German government can further improve their support of the entrepreneurship ecosystem overall.

Results

The analysis framework presented before is adopted to analyze how the German government supports science-based entrepreneurship in its different stages.

Overview of entrepreneurial activity in Germany

Germany is the largest economy in Europe and the fourth largest economy in the world. In Table 2, some additional key facts of Germany are presented and compared to the USA for reference.

Historically, the basic understanding of governmental market interventions differed strongly between Germany and, for example, the USA. There are several cultural and historic foundations to these differences. For one, American attitudes and values differ considerably from those of Germany when it comes to individualism and the role of

Table 1 List of interview partners

Position/role	Institution/organization
Professor for Innovation and Technology Management	University of Bielefeld
Professor for Entrepreneurship	University of Trier
Executive Team	German Center for Research and Innovation
Director	Technology Park in Aachen
Executive Team	GESIPA Blindniettechnik GmbH
Deputy Head of Division	Division Start-Ups and Entrepreneurship, Federal Ministry for Economic Affairs and Energy
Head of the Information Point 'Business Start-up'	Section Labour Market Policy Institute for Social and Pedagogical Research
Manager	New Ventures, 3M
Associate Professor for Economic Geography	University of Giessen
Head of Section	UnternehmerTUM, Technical University Munich

Table 2 Germany's key facts compared to the USA

	Germany	USA
Size (CIA 2014)	357,022 km ²	9,826,675 km ²
Population (World Bank 2014a)	80.62 million	316.1 million
GDP (absolute, 2013) (OECD 2014)	\$3.504 trillion	\$16.800 trillion
GDP growth (2013) (OECD 2014)	0.4%	1.9%
GDP per capita (current, 2012) (OECD 2014)	\$41,098	\$51,689
Smartphone penetration ^a	40%	62%

^aCitizen older than 14 years. Source for Germany: Bitkom: Presseinformation 'Neuer Rekord bei Smartphones,' http://www.bitkom.org/de/markt_statistik/64042_77345.aspx. Source for USA: <https://www.comscore.com/Insights/Press-Releases/2013/11/comScore-Reports-September-2013-U.S.-Smartphone-Subscriber-Market-Share>.

the state. A study found that 58% of Americans say it is more important to be free and to pursue your life's goals without interference from the state, while only 35% believe that the state should have an active role and make sure that nobody is in need. These numbers, however, change in the younger population to 47% and 46%, respectively. These opinions are basically inverse to those from people in Germany, where 62% say the state should take care for the ones in need - with no significant differences in the age groups. In the USA, only 36% agreed to the statement 'Success in life is determined by forces outside our control,' whereas in Germany, this number was 72%. These attitudes become even more distinct when you look at groups with different educational levels. Even 74% of less-educated respondents in Germany agree with the statement mentioned above, whereas this is the case with only 55% of college graduates. In the USA, these numbers change to 41% and 22%, respectively.

The German government, in comparison to the USA government, always played a very active role in the economy, as industry was often state-owned or closely guided by the state. The social security of the population is a main focus of government action. Higher and progressive taxation allows the establishment of a 'social safety net' that mitigates risks such as unemployment or illness through a state insurance system. In addition, most of the employees enjoy a regulated number of working hours a week and a high number of vacation days. Because of this favorable position of employees, entrepreneurship was often associated with high risk and appeared as a worse alternative.

The tendency in the population to get self-employed is still marginal. Despite governmental efforts, the number of people interested in and thinking about starting their own business has declined since 2004 in 23 of the 27 Member States of the European Union to 37% of the population. In comparison, in the USA, this number is 51%. In Germany, 78% do not find it desirable to start a business (EU Commission Flash EB 2012). Also, newly established companies in the USA are growing faster than in the EU, and more start-ups develop into large companies in the USA than in Europe (European Commission 2013).

Our interviews have shown that the role of the government has changed over time: About 10 years ago, the focus of the government was to decrease unemployment (there were more than five million unemployed at that time) by supporting entrepreneurship and, more specifically, company formation out of unemployment, especially in Eastern Germany. Today, the employment situation in Germany is very positive, and due to a

shortage of people with academic qualifications, the career opportunities in a dependent employment for academics are good. This employment option is often preferred to a comparatively unknown development path as an entrepreneur. For this reason, new company formation is more restrained and even declining slightly since the last few years. Hence, we can observe a trend away from necessity entrepreneurship and towards opportunity entrepreneurship.

Regulatory environment

There are certain characteristics in the regulatory environment in Germany that influence the different phases of science-based entrepreneurship.

Research and tech transfer

In the research phase, the *Pact for Research and Innovation* (Pakt für Forschung und Innovation) is designed to give financial planning security to institutions that are jointly funded by the federal government and the federal states (Fraunhofer Society, Helmholtz Association, Max Planck Society, and Leibniz Association) as well as the German Research Association (as a research funding organization). Their funding is to increase by 5% every year between 2011 and 2015.

Germany (and several other countries, including the UK, Denmark, and Belgium) has introduced legislation that supports the commercialization of publicly funded research at universities. In Germany, an amendment to the German Employed Inventor's Act in 2002 revoked the long-standing privilege for employees of universities, which allowed university researchers to take possession of patent rights to their inventions ('professor privilege'). Now, universities can lay claim to inventions created by their employees with government funding on their campuses. Even though Germany and other European countries were aiming at a similar positive effect on spin-off creation as the Bayh-Dole Act (1980) in the USA^f, the effect remained far behind expectations (Siepmann 2004).

Several interview partners mentioned that the federal states, by running their own initiatives and programs, are important players in the innovation landscape next to the federal government^g. Furthermore, university laws are also a matter of each federal state and, thus, regulated differently across the country (cp. Framework Act for Higher Education, dt *Hochschulrahmengesetz*). This fact leads to considerable differences in entrepreneurial activity in the individual states and their universities. In Hesse, for example, a university employee is allowed to earn more through sideline activities than, for example, in Lower Saxony. One of the respondents explained that '*as a professor in Germany, you are allowed to work only a certain number of hours per week on non-academic projects. Hence, it is simply not possible to stay a professor and found a company at the same time; it is seen as a conflict of interest. Professors enjoy a lifetime appointment and, especially in the engineering field, are definitely well paid since the salary is negotiable. They do not want to risk their position. So this is a major factor in terms of why spin-off creation is often not happening.*'

The University Freedom Law (*Universitäts-Freiheitsgesetz*) grants universities more freedom in setting their strategies for research and also in terms of spin-off creation and support. On the other hand, there are public agencies on the state level (e.g., *Provedes* in North Rhine-Westphalia) that deal with the IP rights in each state, which is '*contradicting to the freedom to operate for universities*,' as one respondent concerned

with tech transfer at a major university explained. Strong and renowned universities like RWTH Aachen are able to act more independently, but other universities still have to deal with agencies like Provendes regarding the IP rights.

New company formation

By setting regulations, the state actively defines the ease of registering a new business. The vast majority of Europeans (72%) rated the founding process to be too complex and too bureaucratic (EU Commission 2012). On average, it takes 12 days in Germany to found a sole proprietorship (*Einzelunternehmen*) and 24 days to form a GmbH (cp. limited) (EU 2003). In contrast to this, the process of setting up a start-up in the USA is perceived as very simple: *'I think in the USA it is super easy to found a company, assuming you have the Green Card'* (Dömötör et al. 2013). Founding a company, on average, takes just 5 days and includes only six operations (World Bank 2014b). In this context, one of the respondents argued that *'having a strong regulatory environment [...] can also lead to a kind of selection effect: Only those who have a good idea and believe in that idea will start the firm when you have a little bit more complex founding structures than in other countries.'*

Nevertheless, European governments are starting to respond to this by streamlining the process, and compared to the mid-1990s, the time to set up a business has therefore been reduced by as much as 80% (EU 2003). The overall rank of Germany in the Doing Business study of the World Bank is 21 (World Bank 2014c). However, a look into the detailed analysis shows various possibilities for improvements. Less encouraging is the performance in the category 'Starting a business,' which contains the duration, number, and costs of procedures for starting a company. Here, Germany only ranks 111 - whereas the USA ranks 20 (World Bank 2014d).

Brockmann (2011) provides an overview of the results of various studies examining the relationship between bureaucratic rules and start-up activities. In a nutshell, bureaucratic regulations, although they are a barrier to new company formation, are less significant in comparison to other constitutional barriers. Still, possibilities are being discussed in terms of how those negative effects of bureaucratic rules on start-up activities can be reduced, for example, the reform of bureaucratic rules, institutions, and procedures. The results of the studies showed no reason to prioritize the reform of rules and institutions in the funding policy agenda of Germany^h.

One way to shield the founder of the founding inhibitory effects of bureaucratic rules is to create one-stop agencies (Organization for Cooperation and Development (OECD) 2010). Those single-point-of-contact agencies function as a mediator to the authorities without changing their given distribution of responsibilitiesⁱ. In Germany (and other EU countries), such mediators were introduced by the end of 2009, associated with the implementation of an EU Services Directive^j. Furthermore, introduced in 2008, the entrepreneurial company with limited liability (*Unternehmersgesellschaft haftungsbeschränkte* or UG) can be established with only 1 Euro of share capital - compared to a minimum of 25,000 Euros for a limited liability corporation (*Gesellschaft mit beschränkter Haftung* or GmbH). As one respondent said: *'this is a very good and important step to found a company with less costs and less time than the normal German GmbH.'* Currently, over 10,000 UGs are founded every year.

In general, the influence of the European Union in the legislation can be felt more than ever, and depending on the industry, more regulations are coming from this supranational authority. One of the respondents was complaining about the regulatory frenzy (*Regelwut*), especially in the IT industry. Especially in the field of private data protection, there is a much stronger government involvement, based on pressure from the European level. Whereas IT regulation has become stricter, one of the interviewees stated that *'A very positive aspect [in Germany] is the FDA approval. The other day, I talked with a woman in New York who works in the biotech area, and she is interested in getting some of these companies to Germany, because regulations in the health areas are not as strict as they are in the US. Some of these companies say they can move faster if they go to Europe.'*

Tax regime and labor laws

The total corporate tax rate in Germany is 49.4%. This is higher than the 41.3% of all OECD high-income countries and still slightly higher than the 46.3% of the USA (World Bank 2014). Additionally, the personal income tax and the value-added tax are considerably higher in European countries compared to countries like the USA. Nevertheless, with the revenue generated from a relatively high tax regime, a tight support system for start-ups and innovation projects is funded.

In order to enhance the situation for venture capital, the capital investment grant venture was introduced in 2013, giving business angels investing in innovative companies a 20% subsidy on their investment to lower the risk. However, a respondent stated that *'tax regulations for venture capitalists and investors have not changed.'* Also, the IESE Venture Capital Index shows mixed results (IESE-VCI 2013): Germany ranks especially well in security of property rights as well as legal compared to its peers. On the other hand, the country still ranks poorly in other categories due to labor market rigidities and the ease of starting a business (IESE-VCI 2013). One of these shortcomings, according to a respondent, is the introduction of the minimum wage. Whereas this new regulation may be good for employees, *'it has a bad influence on start-ups who want to hire interns, for example, since they simply cannot afford it anymore'*, as one respondent explained.

Entrepreneurship education and awareness

Risk-taking and failure are integral components of entrepreneurship. Failure, especially when it is quick, redeploys factor inputs, like people, money, and other resources, back into other high potential ventures. The risk people tend to fear the most is not financial loss or wasted time, rather it is the risk to their pride, status, and prestige: to what their peers will think of them if they fail (Bernstein 1996). Hence, there is a link between a society's stigma of failure and the amount of entrepreneurial activity within it (Johansson 2006). Countries situated in Europe are in general characterized by a low tolerance towards failure in business, and a serious social stigma is attached to bankruptcy. Those who fail and go bankrupt tend to be considered as 'losers' by their peers, and furthermore, it is a great challenge to obtaining financing for a new venture, since investors are reluctant to invest in 'failed entrepreneurs' (European Commission 1998b; Aho 2006; EIT 2012; OECD/European Commission 2013) and tend to avoid risks overall: *'This [Germany] is not a haven of risk takers they still do not exist here. In my*

eyes, venture capitalists here [in Germany] think like bankers, that is, they try to avoid risks' (Neufeldt 2013).

One respondent suggested that *'the general public probably differentiates between "general" and science-based and tech-oriented ventures.'* Because of the high knowledge density and many unknowns involved in the latter, people are more likely to ascribe failure to external causes in such a case and less likely to stigmatize the entrepreneurs involved. Still, even though some researchers develop very interesting technologies, they do not think about starting a company or joining a startup, because they feel more comfortable with a permanent position (*Festanstellung*).

Deficits exist in the field of risk tolerance or inclination to accept uncertainty, as well as the confidence in their own (entrepreneurial) skills. On the other hand, some other characteristics conducive for entrepreneurship, such as commitment and motivation, are particularly strong in comparison to those of other countries. Hence, there is a mixed picture showing both weaknesses and strengths (Block 2011). One of the respondents heard voices from abroad saying that *'nagging'*, a Germany cultural characteristic, is also a driving force of innovation.

The approach of fostering an entrepreneurial culture is a unique characteristic of Germany and derives from the specific organizational and scientific cultural prerequisites in this country (Egeln et al. 2010). To have more people start their own business, public authorities and economic experts stress the importance of promoting entrepreneurship among young and highly educated people and shift their attention towards entrepreneurship education at the university level (Franke and Lüthje 2002). Raising the awareness of entrepreneurship education is not an easy endeavor^k, and chairs of entrepreneurship in particular play an important role for the development of the entrepreneurial spirit at universities (Egeln et al. 2010). Also, in order to support economic growth through entrepreneurship, universities must increasingly create programs and a culture that make entrepreneurship widely accessible to students (Roberts and Eesley 2009). Whereas before 1998, entrepreneurship was not a topic in the Germany higher education system; 15 years later, one can observe the establishment of support structures and qualification measures among many universities, universities of applied arts, and non-university research institutions throughout Germany (Egeln et al. 2010). As one respondent stated, *'I was in Germany 20 ago, but then I think entrepreneurship was not even discussed. [...] we see more awareness since the last 3 years.'*

The majority of the universities in Germany are publicly funded. Tuition fees in the USA are constantly on the rise, whereas in Germany, higher education is comparatively inexpensive (tuition is less than 1,000 Euros per year). It is true, however, that almost all of the highest ranked universities (Leidenranking (n.d); THE (n.d)) are based in the USA, and only two universities in Germany made it to the top 100 (Leidenranking (n.d)). To tackle this issue, the German state and federal governments started the Excellence Initiative, endowed with 1.9 billion Euros (\$2.4 billion) to boost competition over the next 5 years^l.

Moreover, the university's role in Germany has evolved to an *'entrepreneurial university'* due to its *'third mission'* of economic and social development, in addition to research and teaching (Etzkowitz 2004; Etzkowitz et al. 2000; Etzkowitz 2003). Commercialization of technologies out of universities by creating new companies represents an important part of the overall entrepreneurial activity in a country (Harhoff 1999) and has a positive

impact on the economic development and job creation. One example from a university in Munich highlights the impact such spin-offs can have: *'the main focus is not IT, but rather biotech, medtech, cleantech and hightech. So it is more likely that you will not notice the success stories. For example, the University the interviewee belongs to sold a spin-off two years ago for 1.3 billion to an American pharmaceutical giant, but these are things that do not go through the "Founders Press"'* (Neufeldt 2013).

Access to finance

The analysis of the interviews suggests that the government should be openly funding the research phase and should also play an active role in early stage technology development. Then, it should gradually reduce its influence the closer the development of a new product or service comes to the market, in order not to distort it. As one respondent said: *'If you don't find a private sponsor, then it also tells you if the market is there or not.'* Still, some other respondents notice the lack of VC funding in the later development stage and argued that the government should take action during this phase as well.

Public research funding

In the EU, the 'Europe 2020 strategy' of the European Commission formulated the target to invest 3% of the annual gross domestic product in all member states into research and development. In 2010, the gross domestic expenditure on R&D amounted in the EU-27 states to 245.7 billion Euros. This represents an increase of 3.8% compared to 2009 and of 43.5% compared to 2000 (Eurostat 2012). In Germany, compared to that in the USA^m, federal research funding is constantly rising and already close to reaching this 3% goal. The contribution from the German government has increased constantly over these years from 7.8 billion Euros (2005) to 10.9 billion Euros (2011).

Limited availability of funding has also been recognized by German politicians. Both topics consequently play an important role in the coalition agreement between CDU and SPD, which outlines goals for the executive branch for the years to come (German Federal Government 2013). The German Federal Government plans a new venture capital law, with the goal to make the country internationally more attractive for venture capital investments. The use of venture capital is additionally promoted through several government investment grants.

Moreover, the 'High-Tech-Gründerfonds' (in the following, HTGF) supports high-tech start-ups that operate in a field with a very high exposure to risk: It was launched in a public-private partnership by the federal government, the KfW banking groupⁿ, and private companies. The fund was launched in 2005 with a total amount of 272 million Euros and provides venture capital for the start-up phase of capital-intensive technology start-ups. In a 6-year period, around 250 companies have been successfully launched, and the number of liquidations and bankruptcies among the funded enterprises was low. The companies in the portfolio grew disproportionately well in terms of the employment development in comparison to other newly started businesses. The largest share of the portfolio of the fund consists of in-house developments and spin-offs from universities (BMWⁱ 2010). The HTGF has made a significant impact on early stage financing in Germany, and as a direct consequence, the number of high-tech start-ups has risen. A respondent stated that it *'is a very good tool in the start-up phase [...] managed by I by a good team of really entrepreneurial people with some investor entrepreneurial background.'*

He further recommended to establish a *'high-tech incubation fund in the pre-seed phase'* and suggested that the involvement of private investors should be higher than at HTGF.

But especially in regard to those individual investors, as another respondent argues, *'that is where there is still room to grow'*, 15 years ago, during the 'Neuer Markt', access to finance was easy in Germany - until 13 or 14 years ago, when the bubble bursts. Still, today, the 'Neuer Markt' is not forgotten and potentially deters some investors from investing in new ventures. That might also be the reason why *'especially finding business angels seems to be difficult.'*

Growth stage

Furthermore, there is still a bottleneck in later stage financing that harms the exploitation of the full growth potential of start-ups (Pinkwart 2013). Whereas it is still possible to raise rounds of 3 to 5 million Euros (e.g., through support programs), there is little funding available in Germany between 5 to 30 million Euros - in the growth stage of the venture. Furthermore, as one respondent stated, universities are *'not perfectly lined up with the VC firms - at least not a typical average university. As a positive example one could look at Unternehmertum at TU Munich, which has a very large start-up department. They have set up their own VC fund to tackle this problem.'*

Also, the employee of a corporate venture fund underlines the 'series A crunch' in Germany *'because you have so many incubated start-ups, but not all of them will get a series A funding. So they have anticipated a lot of start-ups failures.'* Furthermore, he observes a structural change in a way that you *'don't have the middle-sized funds anymore. You just hear that it's difficult to raise a fund these days. And if, it's usually focused on some kind of software-related industry or software in general, and finding investment for non-software start-ups is difficult.'* He explains further that *'software is preferred, because it's easier to scale and there are some inflated prices for software start-ups - there is the bubble in the software space.'* In 2013, 254.8 million Euros of venture capital were invested in 262 IT start-ups. About 50% of the money was invested in start-ups based in Berlin, Bavaria, Hamburg, North Rhine-Westphalia, and Brandenburg. Only 17.4 million Euros were invested in hardware companies (Bitkom 2014).

About 200 of the approximately 250 private German investment companies are organized in the Federal Association of German Equity Investment Organisation ('Bundesverband Deutscher Kapitalbeteiligungsgesellschaften' (BVK)). At the end of 2012, the total assets held by all BVK members amounted to 42.03 billion Euros (BVK 2013). When examining investment by type, it becomes apparent that buyouts are the most common form of investment - 78% of all investments are buyouts. Venture capital accounts only for roughly 9% (BVK 2013). In the USA, risk capital for start-up financing is available to a great extent - the venture capital market there has a total volume of almost 30 billion Euros (NVCA Yearbook 2014). Even considering Germany is roughly one quarter the size of the USA (in terms of inhabitants), that value remains low.

Technology exchange, innovation, and networking

Historically, knowledge and know-how transfer from the universities into the market happened mainly through the cooperation with SMEs in Germany. This is in contrast to the USA, where this rather has happened through the creation of start-ups within the last 10 to 15 years.

Tech transfer through spin-off creation

Now, there is a trend in Germany that focuses on spin-off creation as a means of tech transfer from universities. However, there is also a political discussion going on about whether a focus on commercialization of research results and entrepreneurship could undermine the effects of the other functions (research and teaching) of a university (Egeln et al. 2010).

On a national level, to increase the rate of commercialization of new technologies, especially out of universities, Germany maintains a program called 'EXIST' that promotes '*networks between universities, capital providers, and service companies to facilitate university spinouts*' (The European Union 2002). This program supports annually up to 200 founding teams of technologically ambitious spin-offs of German universities. For a maximum of 1 year, the founders receive up to 2,500 Euros per month for the cost of living, as well as operating expenses and coaching for up to a total of 22,000 Euros. In a thorough evaluation of the EXIST program (2001 to 2006), it was stated that there was no measurable impact on the number of spin-offs compared to the number of non-subsidized institutions. However, there were structural differences in those two groups, relating to scientist-involved spin-offs. The EXIST group had larger founding teams (can increase survival rate), higher technology orientation, closer ties to research institutions, and more science spin-offs (commercializing new research results). Almost all of the interviewed people mentioned the EXIST program and provided a good reference. One downside a respondent could see was the administrative hurdles involved: '*The intention of EXIST is very good, but it's too bureaucratic.*' Also, '*they [the government] should make clear, how they see the future of EXIST program.*' Another respondent suggests to introduce a 'proof-of-concept grant' that can be used before the 1-year EXIST support.

Furthermore, '*there has been a rise of technology parks and support systems at universities that are working on supporting early stage technology development and [...] there is a lot more mentoring and supporting at the university level.*' But not all respondents see the situation for tech transfer at universities as favorable: '*you still have the situation where there is some great technology being developed at universities, but it's not being commercialized.*' Another respondent stated that the larger universities can afford a patent and licensing office and have good working structures in place, but '*especially the smaller ones [universities] really have a problem doing that. They don't have the resources. That is a bit of a structural problem of German universities.*'

Innovation support and networking

Other key elements of a healthy innovation ecosystem are the links between different elements of that system. In Germany, such links are created by Fraunhofer Institutes (Mazzucato 2014). Germany's economy is based on a strong 'Mittelstand' (small and medium-sized enterprises)⁹. Due to this special structural characteristic, this kind of institution was created with the goal of making application-oriented innovation based on basic research. The research budget of about 1.9 billion Euros is funded by approximately one third by the German government and through contract research. Today, 67 Fraunhofer institutes around the country employ about 23,000 people, almost 60% of them have a college degree, including more than 80% in STEM subjects (math, computer science, natural sciences, and technology), and '*especially for small and medium-sized enterprises*

(SMEs) without their own research and development capabilities, the Fraunhofer-Gesellschaft is an important supplier of innovative know-how' (BMBF 2014). This particular position of Fraunhofer in the national ecosystem is also internationally recognized as characteristic for Germany and considered to be very beneficial in terms of innovation (Mazzucato 2014). Also, the USA acknowledges the success of the Fraunhofer Society and has encouraged them to set up seven such research institutes within their borders (Breznitz 2014). From 2011 to 2013, 26 spin-off projects have been funded, with a total of 3.6 million Euros from Fraunhofer itself and an additional 81 million Euros in risk capital.

In order to support new ventures more efficiently in a later stage of their development, one of the respondents mentioned matching programs as viable public initiatives: *'the problem of start-ups, at least in the B2B business, is to get access to large customers. [...] it could be large companies, Mittelstand and public institutions, and this has to be fostered by kind of matching programs.'* Another respondent put it in more general terms: *'One of the things that need to improve is – not just in Germany – the open exchange of ideas and sharing. Because if you have an ecosystem where people are open and discussing – that's where innovation and innovative ideas come from.'*

In a global comparison, the internationalization ratio of German high-tech start-ups is still expandable. Early entry into global markets is important to achieve international leadership; otherwise, there is a risk that companies imitate the technology in other countries and offer it themselves in their home market. The growth opportunities are much higher for start-ups open to international markets than the ones limited on the national market (Pinkwart 2013). One initiative that aims at increasing the chances of international expansions of German start-ups is the German Silicon Valley Accelerator (GSVA). It was founded in 2012 by the German Ministry for Economic Affairs and Energy and aims to bridge the start-up scene in Germany and Silicon Valley (and more recently, New York). Supported entrepreneurs will receive understanding of the US start-up culture and access to the US market and financing opportunities through mentorship and coaching in one of these two global start-up hubs^P.

Conclusion

In this paper, the role of the government in the German entrepreneurship ecosystem was investigated. More specifically, specific policy components, their influence on the science-based innovation process, and their support of the transition from invention to innovation were analyzed. Following our systematic analysis, it is possible to derive certain conclusions and recommendations.

Germany already features a dynamic entrepreneurship ecosystem and has a distinct political agenda to promote entrepreneurship among its population even more. The favorable situation on the job market in Germany is responsible for a trend away from necessity entrepreneurship towards opportunity entrepreneurship. Following this trend, the German government aims to support spin-off creation out of research institutions and especially universities. Numerous initiatives - as depicted in Figure 5 - have been started to support the different phases of the innovation process.

The majority of the German state tertiary education laws are giving more autonomy to the universities. This structural change could be used to re-negotiate the performance agreement between the financiers and the universities, potentially incentivizing them to develop a new reputation in entrepreneurial excellence and spin-off creation,

Policy Analysis Framework		Science-based Innovation Process		
		Research & Invention	Early Stage Technology Development	Product & Business Development
Policy Means and Instruments	Regulatory Environment	- Amendment to the German Employed Inventor's Act - Pact for Research and Innovation	- University-Freedom-Law	- UG - Second Chance - Reduced time for discharge of residual debt - Bankruptcy resilience
	Entrepreneurship Education & Awareness	- University Excellence Initiative - More chairs of entrepreneurship		
	Access to finance	- Aim of 3% Public R&D financing	- Hightech Gruenderfond	- New Venture Capital Law - BVK - KfW
	Tech Exchange, Innovation & Networking		- EXIST - Fraunhofer Society	- State-level agencies - GSVa - German House of Research and Innovation

Figure 5 Germany's policy initiatives to support the entrepreneurship ecosystem. GSVa, German Silicon Valley Accelerator; BVK, Bundesverband Deutscher Kapitalbeteiligungsgesellschaften (Federal Association of German Equity Investment Organisation); UG, Unternehmergeellschaft (Entrepreneurial company with limited liability). Source: own depiction.

next to research or teaching excellence. Even though the University Freedom Law grants universities more autonomy in setting their strategies, there remain issues on the state level (e.g., IP rights, sideline activities of professors), contradicting this freedom to operate. Shifting responsibilities directly to the university leadership team will enable them to manage the whole innovation process more holistically in their organizations. The commitment and support of the universities' management boards, especially, will be decisive for such a change (Egeln et al. 2010).

By establishing one-stop agencies acting as mediators to the authorities, introducing the *entrepreneurial company with limited liability* and reducing the time for discharge of residual debt⁴, Germany has taken important steps in reforming the regulatory environment for entrepreneurs. Also, Germany ranks high in judicial efficiency and bankruptcy resilience^r (IESE-VCI 2013; World Bank 2002). Still, studies have shown that the comparatively high costs associated with certain bureaucratic rules can result in negative effects on company foundation. Furthermore, it is necessary to ensure more flexibility in the labor market, in order to allow young companies to react quickly to changing market conditions.

In terms of entrepreneurship education at higher education institutions, much has changed for the better in Germany. The number of chairs in entrepreneurship, which also plays an important role for the development of the entrepreneurial spirit at universities (Egeln et al. 2010), has increased considerably. But the development has not been equal across the country. Some federal states, and especially the big metropolitan areas, are home to the most entrepreneurial universities in the country acting as lighthouse projects in terms of tech transfer through spin-off formation. On the other hand, the average German university is lacking the structure and funds to foster spin-off creation.

Furthermore, the incentive system for professors and scientific staff at universities has to be aligned with their potential tech transfer activities.

The *High-Tech Gründerfonds* and the *EXIST program* are two successful examples of the German government (co-)financing spin-offs out of universities. The EXIST program supports early stage technology development and the transition into the market. But often, there is capital needed in an earlier stage to validate the technology's benefits and its potential market. 'Proof-of-concept grants' or incubation funds in the pre-seed phase could help to bridge that important gap in the tech transfer process. Also, despite those initiatives, Germany still has a bottleneck in later stage financing ('series A crunch') that harms the exploitation of the full growth potential of new ventures. Establishing a '*high-tech growth fund*' for serious A financing with more involvement of private investors following the HTGF model could be a potential solution.

Besides certain shortcomings that have just been discussed, the main issue Germany faces to become a thriving ecosystem for entrepreneurs is its 'cultural barrier': Three quarters of the people in Germany do not find it desirable to start a business. Germany needs policies that affect social values and attitudes towards entrepreneurship. This concerns the field of entrepreneurial culture and the climate for new firm formation (Koch 2001), because the reputation of entrepreneurs or business owners within a society influences the propensity for entrepreneurial activity. Besides influencing the public perception through campaigns, politicians could publicly interact more with German entrepreneurs and present them as role models for young entrepreneurs. Moreover, due to the fact that a person's personality is shaped in particular in school and expert judgments show that the topic 'entrepreneurship' has been positioned very little in German schools, there is still potential in developing an entrepreneur-friendly climate (Block 2011).

To sum up, Germany is already positioned to become the birthplace of new technology-based, fast-growing, and globally acting companies. The government recognizes the importance of entrepreneurship and acts on many levels to build a sustainable ecosystem. The crucial question is if Germany will also succeed to ignite the entrepreneurial spirit in its universities and among its citizen overall to transform itself from a 'land of ideas' into a 'land of entrepreneurs.'

Endnotes

^aList of assessment frameworks for entrepreneurship ecosystems

1. Babson College - Babson Entrepreneurship Ecosystem Project
2. Council on Competitiveness - Asset mapping roadmap
3. George Mason University - Global Entrepreneurship and Development Index
4. Hwang, V.H. - Innovation Rainforest Blueprint
5. Koltai and Company - Six + Six
6. GSM Association (GSMA) - Information and Communication Technology Entrepreneurship
7. Organisation Economic Co-operation and Development - Entrepreneurship Measurement Framework
8. World Bank - Doing Business
9. World Economic Forum (WEF) - Entrepreneurship Ecosystem

^bThe word 'start-up' is regularly being misused. There are various definitions and not even the majority of them mean basically the same. Due to this mismatch, we want to point out that this paper follows the definitions of Steve Blank (2012): 'Start-ups are temporary organizations that are designed to evolve into large companies. Blank distinguished between two Start-ups: a) early stage start-ups that are designed to search for product/market fit under conditions of extreme uncertainty. B) late stage start-ups that are designed to search for a repeatable and scalable business model and then scale into large companies designed to execute under conditions of high certainty.' As explained later on, we focus particularly on science-based technology start-ups that build their business around a new technology or invention with the aim to commercialize it.

^cExample: Each technology that makes the iPhone 'smart' - such as the Internet, GPS, the touch screen display and, more recently, SIRI - was financially supported by the state.

^dSchramm (2008) defines innovation as '*the design, invention, development and/or implantation of new or altered products, services, processes, systems, organizational structures, or business models for the purpose of creating new value for customers and financial returns for the firm.*' (Schramm (2008): January 2008 report of The Advisory Committee on Measuring Innovation in the 21st Century Economy, Innovation Measurement: Tracking the State of Innovation in the American Economy)

^eMeasured in inflation-adjusted dollars, according to data from the Bureau of Economic Analysis (www.bea.gov/briefrm/tables/ebr1.htm, in Auerswald P.E., Branscomb L.M. (2003))

^fIn the USA, it was the Bayh-Dole Act (1980) that regulated the rights of the use of research results in a new way and thus set the stage for increased commercialization of new technologies. This law allowed universities and small non-profit companies the economic use of patents which have been developed by government subsidiaries. The aim was to increase the rate of utilization of patents, which was in the single digits before this act was passed. Before this law was passed, universities had to individually negotiate with federal research agencies to agree on terms of access to patent rights arising from federally sponsored research. According to a report by the OECD, as a result of this act, about 20,000 patent applications were filed at universities, with some universities earning several million dollars in royalties. It has also led to the formation of about 3,000 new businesses. The effects of this law are still being felt today, as the innovation performance and number of spin-offs at American institutions of higher education was significantly boosted

^gAgencies like *Hannover Impulse* are partly funded by the state government and through self-generated profit. These institutions are local contact point for EU funding and '*support networking across different industries to generate synergies and perhaps enable new collaborations among existing businesses or the establishing of new business*,' as one respondent explains.

^hThis assessment relates to the status quo and does not deny that various measures have been implemented to reduce bureaucracy in recent years, without which the status quo may be different in nature. However, noticeable cost for the founding companies associated with certain bureaucratic rules - as it is the case in Germany - can result in negative effects of company foundation. For instance, notarized documentation of elementary company information (shareholders' agreement, legitimization of directors,

etc.) currently costs 1,014 Euros (=€1,314) and lasts 1 day and the entry in the commercial register lasts for 10 days and costs 403.5 Euros (=€523).

ⁱIn Germany and other EU countries, the so-called single point of contact was introduced by the end of 2009 associated with the implementation of the EU Services Directive 2006/123/EC.22.

^jEU Services Directive 2006/123/EC.22.

^kEntrepreneurship education, as a cross-sectional topic across disciplines, is a main element in developing an entrepreneurial culture at a university. Due to communicative barriers and different theoretical approaches across those disciplines, the integration of entrepreneurial elements is often difficult. They have to be intertwined closely with the other existing cultures of research, professorship, and administration. Whether those prevalent cultures will be willing to adopt entrepreneurial principles and practices or not will be decisive for a more thorough penetration of an entrepreneurial culture in higher education institutions.

^lVogel G (2006): A German Ivy League Takes Shape, American Association for the Advancement of Science (<http://news.sciencemag.org/education/2006/10/german-ivy-league-takes-shape>). Eventually 22 universities of the country's 120 publicly funded universities receive extra funding, either for new graduate school programs (€1 million, or \$1.25 million, a year each) or for the so-called excellence clusters (worth €6.5 million, or \$9.75 million, per year) designed to bring together top researchers from several disciplines.

^mHistorically, the US government mainly funded large-scale fundamental research, resulting in strong government-university ties. Business was reluctant to invest in this area because results are highly uncertain and technical and business risk partly not manageable. *'It is an essential role of the United States federal government — in the interest of tomorrow's prosperity — to invest and engage in scientific and technological discovery. After rising steadily for decades, federal financing for research and development peaked in 2009, at \$165.5 billion. It has since sunk, falling to \$133.7 billion this fiscal year'* (Tritch T (2014) America's underappreciated entrepreneur: the federal government, New York Times, Opinion Page, 24th of March 2014).

ⁿMost of the respondents mentioned the KfW Mittelstandsbank - the largest business development bank in the world - as an important institution of Germany's start-up support. In 2012, it supported entrepreneurs and the German Mittelstand with about 17 billion Euros of subsidized loans. There are also various banks at a federal state level (Landesbanken) that offer funding similar to the KfW.

^oHow important entrepreneurship in Germany is can be observed by looking at the performance of SMEs in general. According to calculations by IfM Bonn, they account for 99.7% of all VAT-registered businesses, 60.8% of all jobs that are subject to social insurance contributions, and 83.2% of all apprenticeship training positions. Source: Federal Ministry for Economic Affairs and Energy (2012): *GründerZeiten: Existenzgründungen in Deutschland*, Bundesministerium für Wirtschaft und Technologie.

^pActing as a facilitator for these start-ups to find investors is not the only reason why this bridge to the USA is so important, explained one respondent: *'In the area of marketing is a very big difference between Germany and USA. [...] Often they are very good at talking about the technology and go into too much detail of the technology and they don't answer the question "Why should I invest?" [...] In the US it is really about making*

your science - or whatever business you're doing - accessible and comprehensible to a normal audience and not just to other "techies". [...] that is one of the things that the accelerators need to do – help them and train them to get to that level.'

^qThe time for discharge of residual debt was reduced to 3 years with the obligation to repay at least 35% of your debts - a lower percentage was not possible due to creditor protection.

^rAlso, according to the World Bank Doing Business Report (2014), Germany ranked better than the average of OECD countries in time, costs of insolvencies, as well as a higher than average recovery rate and low total bankruptcy rate.

Additional file

Additional file 1: Translation of the abstract into Arabic.

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