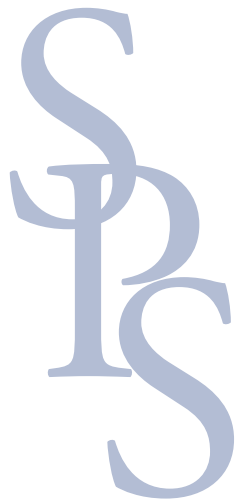


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THE DEVELOPMENT OF MUNICH AND  
CAMBRIDGE THERAPEUTIC BIOTECH  
FIRMS: A CASE STUDY OF INSTITUTIONAL  
ADAPTATION

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## **Abstract**

Defying institutional stereotypes which state that the German capitalist model does not support the formation of entrepreneurial high tech industries in technologically disruptive markets, Munich entrepreneurs have succeeded in building up a significant biotech industry since the late 1990s. Using recruitment, citation and financial data this paper contrasts the development of therapeutic biotech firms founded after 1993 in Munich and Cambridge and analyzes how despite their comparative institutional disadvantages, Munich's biotech firms have been able to develop the capabilities required to deal with a biotech firm's key organizational challenges. This paper's findings shed valuable insights on the mechanisms through which entrepreneurs in new industries are able to defy national institutional settings that could constrain the development of key organizational capabilities and find alternative institutional paths to sustain the development of their firms

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## 1. Introduction

Recent comparative studies on the German economy suggest that many of Germany's national political and social institutions such as rigid labor markets, a system of firm financing dominated by regional banks and a shareholder unfriendly corporate governance system seriously impede the formation and development of entrepreneurial firms in technologically volatile and risky markets, which require firms to adopt 'radically innovative' product strategies (Crouch and Streeck, 1997, Hall and Soskice, 2001, Hollingsworth and Boyer, 1999, Kitschelt and Streeck, 2004). Rather than a small entrepreneurial firm in a technologically disruptive market, the typical German firm is generally considered to be a firm in a more stable, established industry in which this firm is able to benefit from the support of Germany's stable institutional environment for firms following more incrementally innovative, long term strategies.

Since the late 1990s however, German entrepreneurs in the biotechnology sector seem to have managed to defy institutional stereotypes by building up a rapidly growing biotech industry. In fact, according to Ernst and Young (2003) the German biotech industry is currently Europe's largest, measured in the number of firms. The aim of this paper is to understand better how despite their supposed comparative institutional disadvantages, German biotech entrepreneurs have been able to build up their firms' key capabilities and tackle organizational challenges.

A commonly cited problem with much of the neo-institutional literature, which attempts to enhance our understanding of how institutions affect the behavior of economic actors, is the static and deterministic nature of the frameworks which are developed in this literature and the difficulties these frameworks have in accounting for institutional change inside socio-economic systems. The development of a vibrant biotech industry in Germany over the last decade constitutes an interesting case study in the context of which to examine some of the institutional mechanisms, which lead to change in national capitalist systems in general and the German capitalist system in particular.

In order to understand better the development of the therapeutic biotech firms in the Munich region, Germany's largest and most successful biotech cluster, this paper contrasts the development of Munich based therapeutic biotech firms with the development of therapeutic biotech firms in the Cambridge region, in the United Kingdom. The United Kingdom is considered to be the prototype of the European liberal market economy and is regarded to offer all the institutional settings which are required to support the development of entrepreneurial radically innovative high tech firms, which the German economy lacks (Hall and Soskice, 2001, Casper and Glimsted, 2001).

Moreover, this study focuses on therapeutic biotech firms in the Cambridge and Munich regions that focus on the discovery and development of new pharmaceutical drugs, which is a very risky, long and costly process. These therapeutic biotech firms have been identified in the comparative institutional literature, as being especially reliant on the type of institutions such as venture capital and "hire and fire" labor markets that are present in the liberal market economies of the United Kingdom and the United States but are absent in Germany (Casper, 2000, Casper, Lehrer and Soskice, 1999). Therefore, focusing on therapeutic biotech firms is particularly appropriate in the context of this study, which attempts to examine the extent to which entrepreneurs are able to defy institutional settings that constrain the

pursuit of certain innovative strategies and find alternative institutional paths to sustain the development of their firms.

This paper finds that German biotech entrepreneurs have been remarkably creative in finding alternative institutional paths, bypassing potential institutional obstacles that could have prevented them achieving their goals. Although this study confirms that 'rigid' German labor markets and the system of firm financing which heavily relies on local banks have indeed posed formidable challenges for Munich's biotech entrepreneurs in dealing with key organizational challenges in building up their firms, these obstacles did not prevent German biotech entrepreneurs from developing their firms' capabilities to effectively deal with these challenges.

In the absence of open, flexible German industry labor markets, biotech entrepreneurs have relied on the German academic community to recruit scientists and on international labor markets to recruit their most senior managers; In the absence of a German domestic venture capital industry and German equity markets, which are accessible to young high tech firms, German entrepreneurs have relied for financing on international venture capital firms that have proven to be all too eager to profit from investment opportunities in Munich based biotech firms, which were not taken up by private German financial institutions. Interestingly, the isolation of Munich based biotech firms from labor markets for professionals entrenched in established industry practices and their close ties to academic communities, moreover seem to have pushed Munich biotech entrepreneurs towards the pursuit of product strategies that are more rather than less technologically disruptive and 'radically innovative' than the product strategies of their Cambridge based counterparts.

This paper continues as follows. First, this paper discusses how this comparative case study on the development of recent therapeutic biotech firms in and around Munich and Cambridge, will increase our understanding of the mechanisms through which entrepreneurs in a new industry are able to overcome pre-existing institutional barriers to their firms' development. Second, the main organizational challenges are outlined with which biotech entrepreneurs in Cambridge and Munich have been confronted in building up a biotech firm. Third, this paper analyzes how Munich's and Cambridge's therapeutic biotech firms have relied on their institutional environments differently to develop their firms' capabilities to deal with these organizational challenges. Fourth, it is discussed how the different institutional paths which Cambridge's and Munich's biotech entrepreneurs have followed to deal with key organizational challenges have affected the development of these firms. Finally, the main findings of this paper are summarized and some implications of this study for broader debates in the comparative institutional literature are suggested.

## **2. Framing of research**

A significant literature has emerged since the late 1980s which has attempted to develop 'institutional' explanations for economic performance differences across capitalist societies. Early groundbreaking studies in this neo-institutional literature have tended to focus on linking national institutions to macro-economic performance differences across economies and more specifically have analyzed how important cross-national differences in the organization of industrial relations, firm financing, corporate governance and industrial policy lead to different patterns of industrial organization across capitalist societies (Albert, 1993, Crouch and Streeck, 1997, Goldthorpe, 1985, Hollingsworth and Boyer, 1999, Nelson, 1993, North, 1990, Whitley, 1999). Building further on these studies, more recently scholars have worked

on detailing the micro-economic foundations linking institutions to the behavior of economic actors (Aoki, 2001, Hall and Soskice, 2001).

A problem, which has generally been associated with the institutional frameworks developed in the neo-institutional literature, is the deterministic nature of these frameworks in describing the effect on the behavior of firms and the inability of these frameworks to account for processes of change. Rather than taking for granted the limitations, which institutions pose on them, entrepreneurs, by their nature constantly try to deal with the organizational challenges they are confronted with in innovative, creative ways, altering and redefining their institutional environment in order to pursue new opportunities.

For example, a wide range of recent studies on the German economy have reached a consensus that German institutions, while providing significant support for established firms in technologically stable markets that follow more incrementally innovative product strategies, at the same time significantly inhibit the development of small, entrepreneurial high tech firms in new technologically volatile markets. The inability of the German economy (as opposed to the more liberally organized market economies of the United States and the United Kingdom) to foster the development of Silicon Valley type high tech firms has widely been attributed to a number of well defined institutional factors (for example Casper, Lehrer and Soskice, 1999, Hall and Soskice, 2001, Streeck, 1997, Katzenstein, 1997, Kitschelt and Streeck, 2004).

First of all, German rigid labor markets, while providing incentives for firms in technologically stable markets to make long term investments in firm specific skills of employees, significantly impede the development of German firms in technologically volatile markets which rely on their ability to rapidly hire and fire employees for their organizational and strategic flexibility.

Second, even though allowing established firms to take a more long term look at their product development strategies, Germany's financial system, with its strong local banks and underdeveloped equity markets, significantly impedes the formation of high tech firms that rely on equity investments to finance their growth.

Within recent debates in the political economy literature on the state of the German capitalist 'model', disagreement exists on the extent to which efforts to make the German 'model' more liberally oriented, would improve the current dismal state of the German economy (see for opposing views Kitschelt and Streeck, 2004 and Hall and Soskice, 2001). However, a consensus does exist within these debates regarding the immobile and self-reinforcing nature of the current German capitalist model.

In contrast, this consensus has not been shared by policy makers eager to position Germany at the frontier of the so-called knowledge based economy and high-tech entrepreneurs determined to build up profitable enterprises in new rapidly growing markets. Concerned by the comparatively weak performance and relative absence of German firms in new high tech industries in which innovation is driven by small entrepreneurial 'radically innovative' firms, German policy makers since the early 1990s have tried to design policies aimed at challenging entrepreneurs to defy the outlined institutional barriers and find creative ways to build up successful new high tech firms. In particular, the biotech industry was identified by the federal government as a high tech industry of great strategic importance for the future competitiveness of the German economy and significant policy resources have been dedicated to creating an internationally leading German biotech industry.

A first set of initiatives focused on streamlining the process of transferring potentially valuable scientific 'founding ideas' from scientific institutions to entrepreneurial spin-off firms. One important step has been to reform Germany's



intellectual property legislation governing university research and model this legislation on American legislation, primarily the Bayh-Dole Act of 1981, which attributes intellectual property over publicly funded research to the universities, in which this research is conducted, and thereby gives these institutions an incentive to invest in the commercialization of their research. Another important step to support the transfer of research from scientific institutions to entrepreneurial biotechnology start-ups in Germany has been the BioRegio program through which coalitions of local governments, business associations and university administrators were provided generous funding to develop support services and start-up subsidy programs for German scientist entrepreneurs.

A second set of initiatives focused on increasing the financing opportunities open to biotechnology entrepreneurs in Germany. In particular, German policy makers have attempted to help German biotech entrepreneurs overcome the lack of financing available for starting up a firm in Germany through a broad range of subsidy schemes. Various publicly funded agencies such as the Kreditanstalt für Wiederaufbau (KfW), the Technologiebeteiligungsgesellschaft (tbG), the regional BioRegio offices and various state owned investment agencies have since the mid-1990s made available significant funding to help German biotech entrepreneurs financially through the first growth phases of their firms. Moreover, in order to stimulate the development of financial products and services such as venture capital, geared towards the financing needs of small risky high tech startups during the early stages of their development, the Neuer Markt was created in 1997. Modeled after the American Nasdaq exchange the Neuer Markt was meant to provide an incentive for investors to provide financing for small high tech firms by creating an early exit option for these investors. With the creation of the Neuer Markt as a specialized separate equity market for risky high tech firms, German investors would be able to sell their investments to the public, something which was not previously possible since young high tech firms generally could not meet the stringent listing requirements of the main German Frankfurter Stock Exchange on which Germany's large established firms are traded. However, due to the disappointing performance of the companies listed on the Neuer Markt, the exchange was closed in 2003.

Although indeed taking away important sector-specific barriers to the formation of a German biotech industry (Adelberger, 1999, Lehrer, 2000), German biotech policies have not changed the defining features of the overall German socio-economic system such as its rigid labor markets and its bank based financing system, which have been considered to impede the formation and development of entrepreneurial German high tech firms. Nevertheless, German biotech policies have resulted in a rapid increase in firm formations in the biotech industry. From being a practically nonexistent industry during the early 1990s, the number of biotech firms in Germany grew to 380 in 2002 (Ernst and Young, 2003).

The formation and rapid growth of a number of clusters of entrepreneurial biotech firms of which the Munich cluster has become the most successful seems to pose a serious challenge to the consensus in the political economy literature that Germany's capitalist model does not support the formation and development of competitive firms in new technologically disruptive high tech industries.

One hypothesis, which has been proposed to account for the formation of a biotech industry in Germany that would be compatible with the orthodoxy on the German economy, is that German biotech entrepreneurs have adopted sub-sector specializations in the biotech industry that avoid particularly science intensive areas where technological risks are high such as the market for therapeutic products. Instead,

German biotech firms are expected to specialize into more technologically stable sub-sectors such as those for platform biotechnologies and ‘service and support’ activities (Casper, 2000). However, empirical data on the activities of German biotech firms clearly dismisses this hypothesis.

An examination of the product strategies of Munich based biotech firms founded after 1993 indicates that therapeutic biotech firms which have been identified in the neo-institutional literature as firms in the most technologically disruptive sub sector of the biotech industry, focused on the development of new therapeutic drugs are very well represented; the Munich region houses fifteen therapeutic biotech firms which is only slightly less than the nineteen therapeutic biotech firms founded after 1993 which are located in Cambridge, Europe’s largest biotech cluster, in which biotech firms are able to rely on the ‘liberal market’ institutions of the British economy.

Moreover, although performance data is difficult to obtain on young firms in an industry in which product development trajectories span up to ten years, there seems to be no clear indication that the Munich based therapeutic biotech firms, which have been founded after 1993 are less sustainable than their Cambridge based counterparts as the existing neo-institutional literature on the German economy would suggest. Among the 10 Cambridge firms and 11 Munich firms which made available to the public financial performance data for the year 2003, revenues of Cambridge and Munich firms were almost the same, namely 4.4 million euro for the average Cambridge firm and 4.5 million euro for the average Munich firm. In addition, in terms of the numbers of employees the average Munich firm, which employs 65 employees even appears to be larger than the average Cambridge firm, which employs 46 employees.

This paper aims to understand the paths German entrepreneurs have followed to support the development of their firms while surrounded by German national labor market and financial institutions, which are considered to impede the formation of such firms. Rather than attempting to reconcile the behavior of German biotech entrepreneurs with the national institutional settings, which define the ‘German model’ of capitalism, this paper takes a broader look at the interplay between the development of Germany’s biotech firms and their institutional environment and examines in-depth how biotech entrepreneurs, relying on their institutional environment have been able to develop the capabilities required to deal with each of the key organizational challenges that are related to building up a sustainable biotech firm.

### **3. Research design**

The examined group of 19 Cambridge and 15 Munich based biotech firms has been identified with the help of the comprehensive PharmaProjects database, which tracks the progress of therapeutic product development projects in the pharmaceutical industry and identified these firms as having at least one therapeutic product in a preclinical or clinical testing phase by the beginning of 2004. As has already been indicated, at first sight, the populations of Cambridge and Munich based therapeutic biotech firms in this study are well suited for a comparative study since these firms are on average more or less of the same size and generate similar revenues. Moreover, the examined Cambridge and Munich based therapeutic biotech firms are on average of the same age; the average firm in both Cambridge and Munich was founded in 1998.

Three key organizational challenges are identified with which Cambridge's and Munich's biotech entrepreneurs have had to deal in order to turn a good founding idea into a sustainable business. Moreover, it is outlined how this paper analyzes how Cambridge's and Munich's firms have dealt with these challenges.

#### *Financing the firm*

A first key challenge for biotech entrepreneurs is to attract investments to finance the different growth stages of their firm. Usually biotech start-ups have few tangible assets or income that could be used as collateral for loans and therefore biotech firms' ability to rely on banks for financing their growth is very limited. Instead, during the initial growth stages of their development biotech start-ups rely on equity investments of venture capitalists who are experienced in assessing the high risks associated with early stage biotech ventures and monitoring the development of these firms. During later growth stages after having proven the viability of their products and after having generated their first income, successful biotech firms generally rely on public equity markets to finance their further development.

This paper analyzes how Cambridge and Munich based therapeutic biotech firms have been able to rely on their institutional environment to attract the financing necessary for implementing their business plans. Using information obtained from Thomson Financial's SDC Platinum database which provides information on which investors participated in the different investment rounds of all but two of the 39 examined Munich and Cambridge biotech firms, this paper analyzes which financial institutions played a role in funding the growth of Munich and Cambridge based biotech firms. As a result, it is possible to determine the extent to which the absence in Germany of the type of liberal market institutions such as venture capitalists and easily accessible equity markets for high tech firms has formed an obstacle to the growth of Munich based firms.

#### *Finding a professional management team*

A second key challenge for biotech entrepreneurs attempting to build up a therapeutic biotech firm is to attract a senior management team with the skills and expertise, which are required to turn the firm's founding ideas into a set of marketable products. Developing therapeutic innovations often involves bringing together insights from the frontier of science in complex therapeutic product development projects and moving these projects through highly complicated clinical testing processes, in which these innovations are tested on their effectiveness and safety in treating targeted human diseases. Moreover, biotech firms need to embed themselves in a web of research, marketing and licensing alliances with other biotech – and pharmaceutical – firms as a way of generating early revenues and accessing critical knowledge input required in the product development projects of the firm. Dealing with these challenges requires the presence of senior managers in a biotech firm with extensive pharmaceutical industry experience.

This paper examines how Cambridge and Munich based therapeutic biotech firms have attracted their most senior managers. Analyzing the career histories of key managers of Cambridge and Munich based therapeutic biotech firms, obtained from company websites, this paper is able to determine on which recruitment networks Cambridge and Munich based firms relied to attract their senior managers. Both Germany and the United Kingdom house significant national pharmaceutical industries on which biotech firms can potentially rely for their recruitment efforts. However, studies on the career trajectories of professionals in German labor markets

indicate that these career trajectories are largely organized inside firms, and that professionals who have achieved a certain level of seniority within an established German firm are rarely willing to move to another firm (Hall and Soskice, 2001, Mayer and Hillmert, 2004, Sorge, 1988). If German labor markets for professionals are as closed as they have been portrayed to be in comparative institutional studies on Germany, Munich's biotech firms likely have encountered significant problems in attracting managers with industry experience. In contrast, in the United Kingdom, professional labor markets are often seen as more open, suggesting that Cambridge based biotech firms are in a more advantageous position than their Munich based counterparts to recruit professionals with pharmaceutical product development expertise. By analyzing from which institutions Munich – and Cambridge - based therapeutic biotech firms recruit their management this paper is able to determine to what extent the organization of German national labor markets for professionals put Munich's biotech firms in a comparatively disadvantageous position in their ability to attract skilled managers.

#### *Linking the firm to research and development networks*

A final challenge for biotech entrepreneurs is to embed their firms in therapeutic research and development networks which will enable these firms to attract the right skills and knowledge input in their drug discovery and development programs. Drug discovery and development programs often require input from the frontier of science and demand a wide range of skills which biotech firms are not able to develop internally. As a result, a key challenge for biotech entrepreneurs is to embed their firms in a web of relationships (i.e. consultancy relationships, corporate alliances, academic collaborations, licensing agreements, etc.) to academic laboratories, pharmaceutical firms and biotech firms to access these skills (Liebeskind et al 1996, Powell, 1998, Powell et al, 1996, Zucker et al, 1998).

Analyzing the collaborators that are listed on the scientific publications published by scientists affiliated with the studied Cambridge and Munich based firms, this paper analyzes the extent to which entrepreneurs have been able to rely on their institutional environment to access the skills and knowledge required in their drug discovery and development programs. In particular, this paper is interested in analyzing how the earlier observed limited ability of German entrepreneurial firms to entice research scientists from established German pharmaceutical firms to join risky start-ups (Casper et al, 2004) has affected the ability of these entrepreneurs to access the drug development expertise networks in the pharmaceutical industry.

#### **4. Building up a biotech firm in Cambridge and Munich**

Beneath, this section discusses how Cambridge and Munich entrepreneurs, relying on their institutional environment, have dealt with the key challenges that have been associated with building up a therapeutic biotech firm.

#### *Financing the firm*

Confirming expectations formulated in comparative studies on firm financing in Germany, Munich based firms seem to have been positioned in a comparatively disadvantageous position in attracting equity financing. Both in Cambridge and Munich, local banks, which have been considered to be the main source of financing for German small and medium sized firms, have not played a significant role in financing biotech enterprises. For the rest, an analysis of information on investors in

Munich and Cambridge based biotech firms shows stark differences in the types of investors on which Munich and Cambridge based biotech firms have relied.

Whereas public funding has played practically no role in the formation and early development of Cambridge based therapeutic biotech firms, Munich based therapeutic biotech firms which have been set up without the support of multiple public funding agencies are an exception. The average Munich based biotech firm has attracted investments or soft loans from 2.7 publicly funded investment agencies. The most active public investor in Munich based biotech firms has been the federal Technologie Beteiligungs Gesellschaft (tbG) and has made investments in at least eight Munich based biotech firms. Among the other public funding agencies, which have several investments in Munich based therapeutic firms are the BioRegio Munich, and Bayern Kapital, an investment firm, in which the state of Bavaria has a significant stake.

Not only for seed funding and early stage financing, but also for later stage financing, Munich based therapeutic biotech firms have not been able to rely on a German domestic venture capital industry as their Cambridge based counterparts have been able to rely on British venture capitalists. While investments and soft loans provided through various (semi) public federal and state agencies have satisfied most early stage financing needs of Munich biotech firms, foreign venture capital firms have played an important role in satisfying the financing needs of Munich based biotech firms during the later stages of their development. 63% of the private investors in the average Munich biotech firm is foreign (predominantly British or American) as opposed to 36% of investors in the average Cambridge based firm. In fact the most active private investor in the Munich region with investments in six privately held firms is the British venture capital firm 3i with a stake in six of the thirteen privately held therapeutic biotech firms in the Munich region.

Moreover, the proximity of well developed and accessible equity markets for young high tech firms in the City of London seems to have put Cambridge based biotech entrepreneurs in an advantageous position in terms of accessing these equity markets as an important source of financing for expansion beyond the initial privately funded growth phases. Having reached similar growth stages, Munich based therapeutic biotech firms are much less likely to have accessed public equity markets for financing than their Cambridge based counterparts; of six Cambridge based therapeutic biotech firms with revenues over one million euro, five are publicly traded firms; only two out of seven Munich based therapeutic biotech firms with revenues above one million euro are publicly traded firms<sup>1</sup>. In contrast to their Cambridge counterparts, successful Munich based biotech firms seem to have largely relied on their predominantly international group of private investors to finance their expansion after their initial growth phases instead of attempting to acquire a listing on a stock exchange. Only three of the privately held Cambridge based therapeutic firms have relied on private investors for their financing beyond a second round of financing and none beyond a third financing round; In contrast ten Munich based biotech firms have relied on private investors to finance either a third or fourth investment round. Figure 1 shows the contrasting financial development of Cambridge based and Munich based therapeutic biotech firms.

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<sup>1</sup> Statement based on revenue data on the 2003 fiscal year which was available for 11 Munich firms and 10 Cambridge firms and was obtained from the Amadeus financial database

[Figure 1 to be inserted here]

Thus, despite efforts by policy makers to stimulate the formation of a German venture capital industry, problems for young high tech firms in attracting private equity financing in the context of the German socio-economic system, have persisted. Munich based biotech firms however, seem to have found a creative way to sidestep these financing constraints by relying to a large extent on foreign private institutions for their equity financing needs.

#### *Finding a professional management team*

Confirming expectations formulated in comparative institutional studies on career trajectories of professionals in the German economy, Munich based firms seem to have been positioned in a comparatively disadvantageous position in their ability to recruit an experienced management team from German industry labor markets. While analyzing the career histories of the CEO's of Cambridge and Munich based therapeutic biotech firms, the relative absence of managers heading Munich based therapeutic biotech firms, who were recruited from the German pharmaceutical industry is striking. Munich's biotech firms seem to have experienced significant difficulties finding managers at German pharmaceutical companies who were willing to leave the internal labor markets in these companies and join a risky biotech firm. Whereas all but one of the CEO's of Cambridge based therapeutic biotech firms, before accepting their posts at these biotech firms, worked in the British pharmaceutical industry, only three of the fourteen CEO's of Munich based therapeutic biotech firms worked in the German pharmaceutical industry<sup>2</sup>. Rather than relying on German labor markets to recruit their CEO's, Munich based therapeutic biotech firms overwhelmingly went abroad to attract their most senior managers.

Thus, the German labor market environment and in particular the closed nature of labor markets for professionals in the German pharmaceutical industry seems to have isolated Munich's therapeutic biotech firms from German markets for management expertise in the pharmaceutical industry. However, Munich based therapeutic biotech firms have largely managed to deal with their inability to attract experienced managers from pharmaceutical firms by tapping into international labor markets.

#### *Linking the firm to research and development networks*

Citation data obtained on the institutional affiliations of the research collaborators of scientists of Cambridge – and Munich – based therapeutic biotech firms uncovers the very distinctive knowledge networks in which the research organizations of Cambridge – and Munich based firms have embedded themselves. Figure 2 shows a breakdown of the collaborative ties underlying the scientific production of Cambridge and Munich firms.

[Figure 2 to be inserted here]

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<sup>2</sup> Of all 19 analyzed Cambridge therapeutic biotech firms, 12 had a CEO recruited from large pharmaceutical firms in Britain, 6 had CEO recruited from biotechnology firms in Britain and one had a CEO recruited from an American based biotechnology firm. Of all 15 analyzed Munich therapeutic biotech firms, one did not have a CEO, seven had a CEO recruited from foreign pharmaceutical firms, three had a CEO recruited from a large pharmaceutical or a biotech firm in Germany, two had a CEO coming from academia, one had a CEO recruited from a chemical company in Germany and one had a CEO recruited from the German office of an international management consultancy firm.

Reinforcing previous findings by Casper et al. (2004) who found that German biotech firms have been cut off from labor markets for pharmaceutical industry scientists and have instead relied on academic labor markets, in particular on ties of firms to the founding laboratories in academia from which these firms were spun-off, to recruit their scientific personnel, this study finds that Cambridge based therapeutic biotech firms seem to have been more closely linked to industry knowledge networks than their Munich based counterparts. Collaborations with firms formed the basis for 39% of the scientific publications of Cambridge firms; only 21% of the publications of Munich firms were the result of scientific collaborations with firms.

On the flip side, Cambridge based firms seem to have been largely cut off from academic knowledge networks as compared to their Munich based counterparts. The findings of this study seem to confirm findings in the existing literature on the isolation of British universities from industry research networks and illustrate well the problems the British economy is still experiencing in reaping economic benefits from the publicly funded basic research that is conducted inside universities. Especially, the limited extent to which Cambridge biotech firms have developed ties to world renowned scientific institutions which are located in the Cambridge regions such as the various academic departments of Cambridge University, the Sanger Center and the MRC Laboratory for Molecular Biology, which are all world leading in the field of molecular biology research is striking. Of publications by scientists at Cambridge based biotech firms, only 11% was the result of scientific collaborations with academic laboratories located in the region other than founding laboratories. In contrast, in Munich 22% of publications of biotech firms were the result of collaborations with laboratories of regional scientific institutions other than the founding labs.

Thus, confirming insights from the comparative institutional literature the closed nature of labor markets in the German pharmaceutical industry seems to have isolated Munich's therapeutic biotech firms from important drug development expertise which is embedded in pharmaceutical industry networks. However, in their reliance on the academic community as its main recruitment ground Munich's biotech firms have managed to develop relatively strong ties to various knowledge communities in academic fields of relevance to their drug discovery programs.

This section has examined the extent to which the German institutional system has constrained the development of therapeutic biotech firms in the Munich region. It has been argued that although many of the constraints which have been identified in the comparative institutional literature on the German economy exist, entrepreneurs have found alternative 'institutional paths' which enable entrepreneurs to deal with these constraints. The next section addresses how the alternative 'institutional paths' Munich based therapeutic biotech firms have followed, have affected the development of these firms.

## **5. The divergent development of biotech firms in Cambridge and Munich**

As has been discussed above, the lack of open labor markets for scientists with experience in established pharmaceutical firms in Germany forced Munich's biotech firms to recruit predominantly academic scientists to staff their laboratories. These academic scientists coming from a very different background than scientists from pharmaceutical firms brought with them into Munich's firms their distinctive professional networks and research practices, embedding the research organizations of Munich's therapeutic biotech firms in knowledge networks that are distinctive from the knowledge networks in which the research organizations of their Cambridge

counterparts have been embedded. As a result, this section discusses how Munich's firms, being more closely embedded in academic knowledge networks have developed stronger scientific capabilities giving these firms an edge in dealing with more fundamental therapeutic drug *discovery* research problems while Cambridge's firms, being more closely embedded in industry knowledge networks have been proven better at dealing with more conventional organizational challenges in the field of drug *development*.

Data on the quantity and quality of the research output in terms of publications in academic journals indicate that the research organizations of Munich's biotech firms have been more 'in tune' with the latest advances in academia in different therapeutic research fields than the research organizations of their Cambridge based counterparts, which to a much lesser extent rely on collaborative ties to academic research communities in their research activities. Scientists affiliated with Munich's fifteen therapeutic firms published together a total of 211 articles in scientific journals compared to 129 articles published by scientists affiliated with Cambridge's nineteen therapeutic biotech firms.

Not only did Munich based therapeutic biotech firms publish on average more than twice as many articles in scientific journals as their Cambridge based counterparts, the quality of the scientific output of Munich based therapeutic biotech firms was also significantly higher as measured by the average number of citations to these articles by other articles in academic journals; On average publications by Munich firms were cited 12.5 times and publications by Cambridge firms 7.6 times.

While Munich firms have tried to capitalize on their close ties to the academic community by building up superior research capabilities, which focus on developing new disruptive therapeutic innovations, Cambridge firms have tried to capitalize on their experienced teams of pharmaceutical industry managers and scientists by focusing on the rapid identification of potentially valuable therapeutic compounds and pushing these compounds through clinical trials more cost effectively than established pharmaceutical firms. This contrast between the product strategies of Cambridge – and Munich – based therapeutic biotech firms clearly surfaces if the corporate profiles are systematically compared in which firms elaborate on their product strategies that are published on company websites.

Whereas Munich based firms tend to emphasize in their corporate profiles the ability of their research organizations to take a radical new approach to solve certain fundamental therapeutic research problems, Cambridge based firms tend to emphasize the long track record of their management team in bringing therapeutic innovations to the market. For example, the main product strategy of six out of the examined nineteen Cambridge firms is to find new medical uses for already known therapeutic compounds; none of the Munich based firms follows such a strategy. Instead, all but one of Munich's biotech firms have a product strategy that focuses on the discovery of new therapeutic compounds using a newly developed scientific approach<sup>3</sup>. The following two excerpts from corporate profiles published on company websites highlight what Cambridge based therapeutic firms consider to be their comparative advantage in the marketplace. In its corporate profile, Alizyme (2004), Cambridge's most successful biotech firm both in terms of its market capitalization of 200 million Pound and in terms of its number of therapeutic products in clinical trials states:

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<sup>3</sup> The one firm which does not have a main product focus on the discovery of new therapeutic compounds using new scientific insights is Nascacell, a firm which focuses on conducting contract research



‘Alizyme has developed its business with a high emphasis on outsourcing, controlled by its core management team and specialist advisors. Rather than establish its own laboratories and development facilities, it has worked with collaborators and service providers such as contract research organisations. This has the benefit of allowing Alizyme to focus its investment onto its development programmes in a cost effective way.’

In its corporate profile Arachnova (2004), a more recently founded Cambridge based therapeutic biotech firm states:

‘With venture capital backing, Arachnova uses a virtual R&D pharmaceutical strategy to incubate novel projects for partnering. Named after the web-building activity of the spider, Arachnova is expert in outsourcing, making use of a huge international network of contractors and specialists to take its projects through to proof of principle in the clinic. A pioneer of therapeutic switching (finding new therapeutic uses for existing drugs) the company has two important projects in early-stage clinical trials.’

The more short term product focus on downstream product development projects of Cambridge based therapeutic firms relative to their Munich counterparts seems also to be reinforced by the distinctive financial system in which Cambridge based firms operate. The opportunity for entrepreneurs and investors, who have built up biotech firms in the Cambridge region, to cash in on their firms’ successes much earlier than their Munich based counterparts through an initial public offering on London’s public equity markets has given investors and entrepreneurs an incentive to adopt product strategies that are more focused on tangible short term payoffs.

Comparative data on the number of drug candidates in clinical trials confirms that the comparative strength and focus of Cambridge based therapeutic biotech firms on the later stages of the therapeutic product development process has put Munich based biotech firms in a significant disadvantage relative to their Cambridge based counterparts in terms of the number of therapeutic compounds in the various clinical testing phases, which is an important indicator of how close firms are to actually being able to sell therapeutic innovations on pharmaceutical markets (see figure 3).

[Figure 3 to be inserted here]

By November 2003, the 19 Cambridge based therapeutic biotech firms had 7 drug candidates in Phase 1 clinical trials, 9 drug candidates in Phase 2 clinical trials and 3 candidates in Phase 3 clinical trials. In contrast Munich firms by November 2003 had only 1 drug candidate in Phase 1 clinical trials, 4 drug candidates in Phase 2 clinical trials and no candidates in Phase 3 clinical trials.

Though it has been argued that the reliance of Munich biotech firms on academic recruitment networks has likely provided these firms with a comparative advantage in creating significant early stage product opportunities based on disruptive technologies, the problem of Germany’s closed pharmaceutical labor markets for scientists and managers with essential skills and expertise to capitalize on these early stage product opportunities has remained an important challenge for Munich based firms. The management teams of Munich based firms seem to have recognized this; While maintaining their headquarters and research facilities with close ties to the academic community in the Munich region, Munich based therapeutic biotech firms have overwhelmingly started to open up facilities abroad where more open labor markets allow Munich based firms to attract industry scientists and managers entrenched in established pharmaceutical industry practices to deal with downstream

product development problems. More than half of Munich's biotech firms had by October 2004 followed this approach to overcome their comparative disadvantage in developing downstream product development capabilities and have opened facilities abroad, predominantly in the major biotechnology clusters in the United States. In contrast, only two Cambridge based firms have opened facilities abroad.

## **6. Concluding remarks**

Although the findings of this paper are based on the development of one relatively small industry in one particular country, some insights developed in this paper seem to be valuable in the context of broader debates on how institutions shape the behavior of economic actors. In particular, the findings of this paper suggest that socio-economic systems are often more dynamic than anticipated by academic scholars and indicate that entrepreneurs are very creative in finding alternative institutional paths to achieve their goals.

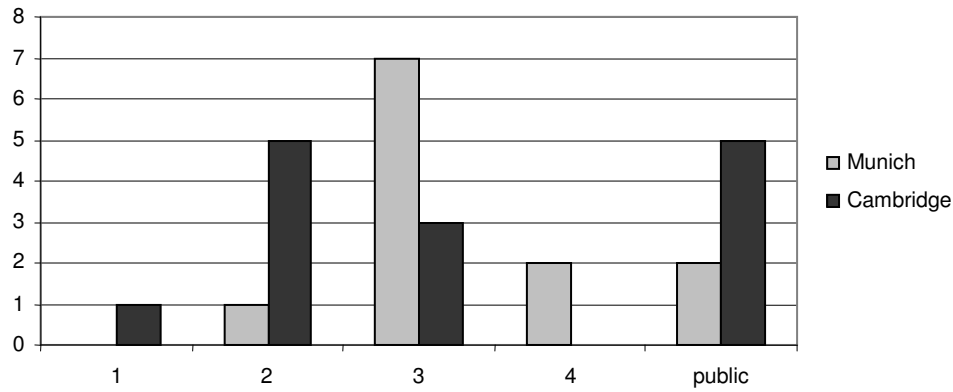
Existing national institutional frameworks often make strong claims about which national political and social institutions matter in determining the behavior of economic actors and how these institutions matter. This paper has attempted to contribute to the development of a more dynamic understanding of the interplay between institutions and economic actors. By analyzing how German biotech entrepreneurs have relied on their institutional environment to deal with key organizational challenges, this paper has highlighted two important mechanisms through which entrepreneurs are able to build up their firms' capabilities in order to deal with key organizational challenges in the absence of existing institutions able to support the product strategies undertaken by entrepreneurs in a new industry.

First of all, this study has demonstrated that although comparative institutional frameworks are often correct in highlighting the absence of institutions within a national institutional system which in other national institutional systems play an important role in supporting a given innovative strategy, these frameworks often are wrong not to recognize that firms could rely on other institutions within their national system that play a similar role. As this paper has argued multiple institutions can perform a similar institutional support function. It has been demonstrated how in the absence of German flexible labor market institutions in the pharmaceutical industry, Munich based entrepreneurs have been able to rely on alternative institutions, namely the German academic system within the German institutional system to recruit employees with valuable skills and expertise.

In addition, although national economic and political institutions are an important source of support for the development of firms, these institutions do not constitute the only institutions on which firms are able to rely for support. The findings of this study have once again indicated that also foreign institutions could play an important role in providing support for the development of firms if such support is absent in a given national institutional system. This paper for example has analyzed how the absence of a German venture capital industry and equity markets for high tech firms, did not impede the ability of Munich based biotech firms to attract financing for their growth from foreign institutions, mainly British and American venture capitalists and private equity firms and how the absence of German labor markets for senior pharmaceutical industry managers did not impede Munich based biotech firms to attract these managers from abroad.

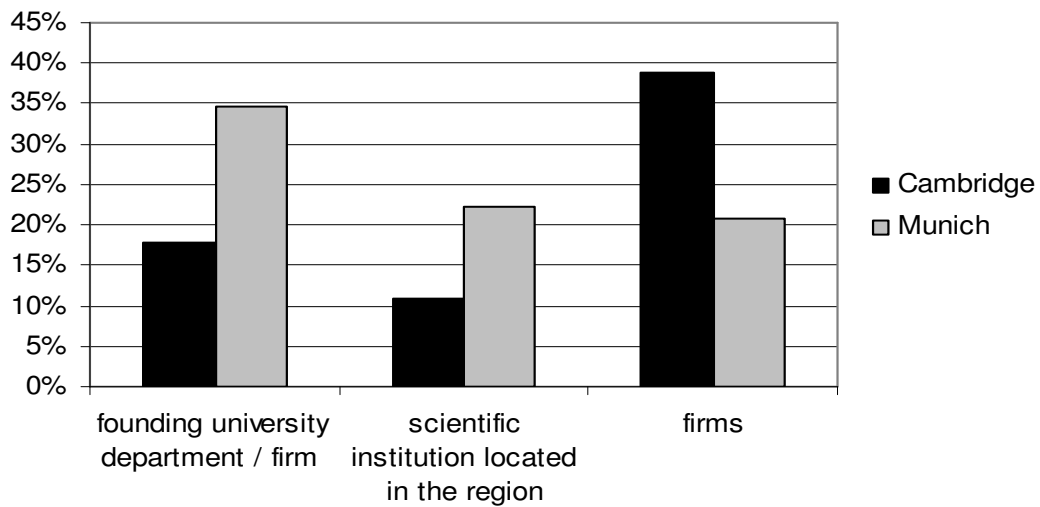
**Figures**

Figure 1: Latest financing round Munich and Cambridge firms<sup>4</sup>



Source: Thomson Financial's SDC Platinum database

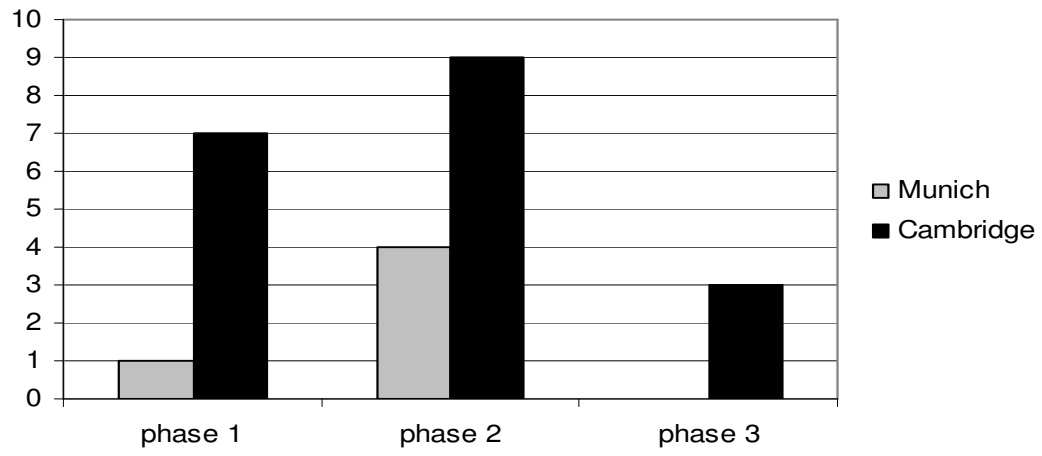
Figure 2: Institutional breakdown of collaborators listed on firm publications



Source: ISI Web of Science

<sup>4</sup> Data on financing rounds compiled from information, which was available on 14 Cambridge based firms and 14 Munich based firms provided on company websites.

Figure 3: Product pipelines Cambridge and Munich based biotech firms



Source: PharmaProjects database, November 2003

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