

**Venture Capital Revolutions:  
Germany and the United States in the Post-War Era**

**Caroline Fohlin\***

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**Abstract:**

This paper explains the disparate paths of venture capital organizations in the United States and Germany over the post-World War II period—the early emergence and burgeoning of the sector in the U.S., and the lagging of development in Germany. The paucity of venture capital institutions and financing in Germany is often seen as a result of that country’s post-war system of large, powerful universal banks combined with small and inactive capital markets. Lack of acceptance may additionally appear to result from cultural or social differences that make Germans suspicious or skeptical of such risk taking and disdainful of the capitalistic drive it represents. I argue instead that a complex of political, social, and economic factors explain the evolution of financial systems over the last half century. These factors differed radically between the US and Germany and produced divergent paths for venture capital institutions. I put particular emphasis on the less commonly noted role of demand: the available pool of qualified, potential entrepreneurs and the incentives that either drive or hinder high-technology venturing.

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\* Department of Economics and Institute for Applied Economics and the Study of Business Enterprise, Johns Hopkins University. E-mail: [fohlin@jhu.edu](mailto:fohlin@jhu.edu). <http://www.econ.jhu.edu/people/fohlin/index.html> and <http://ssrn.com/author=138621>. For their research assistance I thank Johanna Francis, Boriana Handjiyska, Niklas Hellmich, Jacek Kazimirek, Carmine Petrone, Arnd Plagge, and Steffen Reinhold. For helpful comments and advice, I thank Lou Galambos, Geoffrey Jones, Henry McCance, Howard Stevenson, Bill Sahlman, Josh Lerner, Paul Gompers, and other participants at the Business History Seminar at HBS (November 2003) as well as participants at the JHU symposium on “Balancing Public and Private Control: Germany and the United States in the Post-War Era” (October 2004).

## **Venture Capital Revolutions: Germany and the United States in the Post-War Era**

**Caroline Fohlin**

Venture capital gained widespread popular recognition in the United States in the 1990s, as a spate of innovations in biotechnology and information technology spurred the creation of new companies and the public offering of their stocks on the market. Many of these new firms came into being with the backing of venture capital firms, who provided not just key financial capital, but human capital—advice, mentoring, monitoring, and business connections—as well. While the boom of the 1990s marked a wholly new level for the venture capital industry, that wave represented the latest in a series of smaller growth spurts dating back to the end of World War II. In Germany, as in most other countries, venture capital as a distinct financial sector arose several decades later than in the United States, and even then, they possessed a substantially different character. As the success of the U.S. venture capital industry increased over the 1980s and especially 1990s, entrepreneurs, financiers, and policy-makers elsewhere renewed their attempts at emulation. While a small number of countries eventually built up venture capital industries of roughly similar size to that in the United States—proportional to the size of their economies—Germany did not. And whereas venture capital institutions emerged and then evolved endogenously within the American institutional setting, they appeared as transplants, imports, and copies in the German context. To be sure, some venture capitalists have succeeded in Germany, but the broader effort to graft the American venture capital model onto the German financial system has encountered difficulty.

On the face of it, the paucity of venture capital institutions and financing in Germany may seem to stem naturally as a result of that country's post-war system of large, powerful universal banks combined with small and inactive capital markets.<sup>1</sup> Lack of acceptance may additionally appear to result from cultural or social differences that make Germans suspicious or skeptical of such risk taking and disdainful of the capitalistic drive it represents. Such views are at least too simplistic if not entirely unfounded. I argue instead that a complex of political, social, and economic factors explain the evolution of financial systems over the last half century.

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<sup>1</sup> Key to this point is the understanding that Germany's post-World War II financial system, particularly the moribund financial markets, differed markedly from that in place before the war. See Fohlin (2005, 2007) for extensive details.

These factors differed radically between the US and Germany and produced divergent paths for venture capital institutions. While I identify numerous supply and demand influences that surely work in concert, I put particular emphasis on the less commonly noted role of demand: the available pool of qualified, potential entrepreneurs and the incentives that either drive or hinder high-technology venturing.

In building this argument, I also expose the institutional contexts in the more distant past that influenced the subsequent developmental patterns of venture capital during the post-World War II era. Taking a longer-term perspective, reaching back to the first industrial revolutions, reveals a pattern of financial and industrial revolutions in which many venture capital-like institutions have appeared. During the second industrial revolution, Germany developed at least as sophisticated a financial system, with lively markets for equity issues. Moreover, the educational system produced some of the best scientists and engineers, and the triad of academia, industry, and government worked together to create and apply knowledge for innovation. In the US, these developments budded before WWII, but came into bloom after the Great Depression and WWII. Thus, the interwar years represent a negative structural break for German high-tech innovation, just as they represent a positive watershed for the US. Understanding these distant roots of institutions, preferably also reaching back before WWII, helps to see why certain institutions evolved in some places and not in others and also helps to clarify the reasons for the success or failure of institutional transplants and government policies, as well as major transitions in the sources of growth.

To set the stage, I examine the evolution of the venture capital industries in the two countries over the post-war era, providing a quantitative comparison particularly for the past 25 years. The exercise produces the unsurprising conclusion that the German venture capital market lags the US market by a significant amount—even when figures are weighted by GDP. Whether venture capital availability should be weighted by a country's output is not obvious, however, since the type of financing applies to a limited segment of the economy. Under other weighting schemes—such as total publicly-traded equity—Germany's private equity sector appears to exceed that of the US. Along the way, the analysis demonstrates the shortcomings of existing published data for both countries, particularly early on in their respective periods of development. The German data pose particular problems, and untraceable coverage changes

even for the last few years undermine statistical inference—particularly the evaluation of trends—based on the official figures.

While the main goal of this chapter is explaining why venture capital institutions evolved along different paths in Germany and the United States, the study also raises some questions about the consequences of the institutional structures that emerged. It is clear that by many metrics, the German economy performed on par with the US economy over much of the post-war period, even despite its lack of a well-defined venture capital industry. The US outperformed Germany after reunification, particularly during the technology boom of the late 1990's, but venture capital activity has slowed dramatically since then. The prognosis for the two economies, and the role of venture capital in their growth, is naturally difficult to determine. The more we know about past experiences, both in the United States and abroad, the better we can develop appropriate policies to achieve an effective balance between public and private control and promote economic prosperity.

## **I. Setting the stage: venture capital ‘revolution’ or ‘evolution’ in the US and Germany**

The emergence of new technology raises problems of information acquisition and dissemination: investors have difficulty assessing the viability and progress of projects, and entrepreneurs can therefore take advantage of investors—misusing funds, taking excessive risks, misreporting returns. In order to overcome principal-agent problems, venture capitalists have devised a series of mechanisms that are ultimately meant to help align the behavior of a portfolio company with the preferences of the venture capitalists. Typically, these devices include various forms of intensive screening (*ex ante* monitoring) as well as close interim and *ex post* monitoring that is generally associated with equity stakeholding and board membership.<sup>2</sup> In portfolio companies that perform poorly, founders typically lose most of their control over their firm.<sup>3</sup> On the other hand, if the portfolio company does well, the venture capitalists mostly hold on to their cash-flow rights, but loosen their grip over other control rights. In addition, venture capitalists usually stage their investments; gradually infusing funds as the portfolio company matures—

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<sup>2</sup> For a compact overview, see Kaplan and Strömberg (2001).

<sup>3</sup> See Kaplan and Strömberg (2000) and Kaplan and Strömberg (2003).

often once a milestone has been reached.<sup>4</sup> This limits the risk of losing high sums and also helps VCs exert influence over their portfolio companies. Should an investment not perform as planned or should continuing arguments over the company's further direction arise, then the VCs can simply turn off the supply of money and thereby potentially force the portfolio company's management team to alter its stance. Finally, close monitoring via board membership is an essential component of venture capitalists' activities and can add considerable value to the portfolio company.<sup>5</sup>

As a general rule, venture capital institutions comprises financial intermediaries with both of the following two identifying characteristics.

1. Targets: high risk, innovative, start-up firms; expecting high growth and high returns; primarily, not solely, high-tech.<sup>6</sup>

2. Methods: close relationships, monitoring (formal & informal), mentoring and advising, equity stakes or options on them, extended, but well-defined, horizons and planned exit strategies (usually trade sales or IPO). The first three characteristics, those involving managerial advice and oversight, constitute the key features that give venture capital its advantage over traditional bank lending or other sources of start-up funding.

## **The Development of American Venture Capital**

By now, the spectacular cycles in the US venture capital industry are well known. Superimposed on these aggregate patterns, a small number of celebrated success stories comprise what is considered the early history of American venture capital. These first post-war venture capitalists intermediated between a small number of wealthy investors and a few technologically-advanced entrepreneurs seeking to innovate—transforming a range of scientific inventions into marketable products. American Research and Development, founded in 1946, is usually held up as the first modern venture capital firm, though Whitney and Co., also founded in 1946, claims that honor as

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<sup>4</sup> See Gompers (1995) and Sahlman (1990) for more detailed discussions of this point.

<sup>5</sup> See Lerner (1995) and Bergemann and Hege (1998).

<sup>6</sup> On the order of one-third of US venture capital firms consider financing traditional, customer service enterprises such as home goods, food service, and entertainment. See (<http://www.nvca.org>) as cited in Eleni Chamis' article on Maggie Moo's Ice Cream of Columbia, MD in the Washington Business Journal: <http://www.bizjournals.com/washington/stories/2001/05/14/story8.html>. The famous non-tech examples of FedEx, Home Depot, and Starbucks's relate to IT, biotech, and software in their innovative processes and organization, instead of high-technology products.

well.<sup>7</sup> Either way, we can date the birth of modern venture capital to that year. In the case of ARD, however, the investment for which the company is most famous, and the one that produced ARD's main source of profits—the \$70,000 invested in Digital Equipment Corporation—came only in 1957.<sup>8</sup> That year happened to be the same one in which Arthur Rock intermediated the formation of Fairchild Semiconductor: bringing together the financial backing of Sherman Fairchild and the now-famous refugee scientists from Shockley's semiconductor company. Fairchild semiconductor ultimately spawned—directly and indirectly—a number of subsequent venture capital backed companies in high-tech sectors.

Still, from WWII to the 1960's, and even into the mid-1970s, venture capital remained meager. Even with the accelerating activity in the 1960's—and perhaps because of the economic stagnation of the 1970's—this new sector of financial intermediation truly blossomed only in the 1980's.<sup>9</sup> Thus, one could argue that the venture capital 'revolution' was instead more of an 'evolution' from a small, relatively disorganized band of break-away bankers with connections to wealth to a highly-professionalized, diverse, and specialized industry of its own. The earliest venture capitalists gathered together funds from individuals; but by the late 1970s, commitments began to pour in from institutional investors, banks, insurance companies, public corporations, and foreign investors. After the "Prudent-Man" rule was amended in 1979, pension funds immediately boosted their participation and became the predominant suppliers of financing to venture capitalists.<sup>10</sup> The targets of venture capital funding adjusted over time as well, as new technologies appeared and produced potential for high returns to innovation—albeit with substantial risk.

Business cycles and the overall state of the public equity markets are important determinants of venture capital activity—at least in the past few decades—giving rise to a "boom

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<sup>7</sup> According to the company website, "On February 1, 1946, John Hay ("Jock") Whitney wrote a single check for \$5 million dollars to J. H. Whitney & Co. and, in so doing, founded the first venture capital investment firm in the United States." Gupta (2000) also refers to J. H. Whitney & Co. as the first venture capital firm, and the first manager of the company, Benno Schmidt, relates a story of the creation of the term "venture capital" in his firm's discussions of how to describe itself (in light of the fact that the *New York Times* had repeatedly referred to Whitney & Co. as an investment banking firm).

<sup>8</sup> See Hsiao and Kenney (forthcoming) on the evolution of ARD. See also Fohlin (2005) on the early development of ARD, Greylock, and the Small Business Investment Companies (SBICs).

<sup>9</sup> The data for the period prior to 1970 is particularly uncertain. But even if the available figures substantially underestimate the amount of venture capital available at that time, one can still date a turning point in the volume of venture capital (either fundraising or disbursements) to sometime between 1977 and 1979.

<sup>10</sup> This change allowed pension funds to invest in high-risk assets, including venture capital funds.

and bust” pattern.<sup>11</sup> For example, following the first VC boom in the late 1970s and early 1980s, the VC supply expanded faster than the supply of experienced managers and innovative products, resulting in a number of failed ventures and a decline in returns on investments, finally culminating in negative annual returns for the industry in 1984.<sup>12</sup> As profitable opportunities returned, VC’s built up a new supply of funds, creating a second VC boom and leading to a dramatic growth spurt that began in 1997 and reached its peak in 2000. The end of this cycle is all-too-familiar to most: the boom ended abruptly—in bubble-like fashion—with a dramatic reduction in both commitments to and investments by venture capital funds. The decline in US venture capital financing since late 2000 mirrors the closing of the IPO window and the overall decline of stock market valuations. While market valuations have rebounded in some segments, IPO and venture capital activity remains far below its heights of 1999-2001.

A few simple figures sum up the post-1979 revolution.

***Numbers and volume:***

*Table 1: The US Venture Capital Market, 1980-2002*

*Table 2: Capital Commitments to Private Equity Funds by Fund Type 1979-2002*

*Figure 1: US Private Equity and Venture Capital Commitments and Disbursements*

***Targets:***

*Figure 2: Venture Capital Investments in the United States from 1980-2002 by Industry*

*Table 3: Description of sectors*

***Sources:***

*Figure 3: Venture Capital Commitments in the United States by Limited Partner Type 1979-2002*

*Figure 4: Returns to Equity Investing in the US*

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<sup>11</sup> Two good overviews based on recent history are Gompers and Lerner (2001) and Rosenberg (2003).

<sup>12</sup> See Gompers and Lerner (2001), p. 118, figure 6-1.

## The German venture capital revolution

Modern venture capital arrived quite a bit later in Germany than in the United States, and the industry has taken on far smaller proportions and less of the qualitative nature of its US counterpart. Many identify 1965, the year that four *Kapitalbeteiligungsgesellschaften* (KBGs - equity stake companies) were created, as the birth of German venture capital, while some point to the 1975 formation of the Deutsche Wagnisfinanzierungsgesellschaft (WFG) as the true starting point.<sup>13</sup>

The KBG's represented the closest institution to American-style venture capital, but they targeted their investments predominantly at profitable medium-sized companies.<sup>14</sup> Moreover, they provided funds but no management assistance and did so within narrow geographical proximity.<sup>15</sup> In contrast to modern venture capital companies, KBGs worked nearly exclusively with companies that were already established, were able to generate a positive cashflow, and had an annual return on equity of up to 12 to 15 percent. KBGs were never really successful in fostering economic activity in Germany, having contributed no more than 0.03 percent to German GNI.<sup>16</sup> In 1987, there were less than fifty KBGs in Germany, and their average annual investments were about DM 1 billion (EUR 511 million), invested in an estimated total of 1,250 firms.<sup>17</sup> The main reason for the (at best) modest successes of the KBGs stems from their bank-like business policy, which puts strong emphasis on security and steady interest payments rather than increases in equity value.<sup>18</sup>

The Deutsche Wagnisfinanzierungsgesellschaft (WFG) took a few further steps toward modern venture capital. Founded in the German banking center of Frankfurt, the WFG was organized by a consortium of twenty-nine German financial institutions and initially capitalized at DM 50 million (EUR 25.56 million) (common equity shares).<sup>19</sup> More than half of the initial shares were held by private banks, 35 percent by regional banks, and the remaining 11 percent

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<sup>13</sup>Harrison (1990, p. 127) argues that the origins of the German VC market reach back to the business start-up programs of the Marshall Plan, though she recognizes that the government shifted its focus toward small business only during the 1950s and 60s.

<sup>14</sup> Grisebach (1989), p. 13.

<sup>15</sup> See Harrison (1990, p. 130) and Jeng and Wells (2000: 282).

<sup>16</sup> Albach, Horst. 1983, p. 6.

<sup>17</sup> Wilms and Schmidt, "Venture Capital in Germany", 1987, p. 36.

<sup>18</sup> Nevermann and Falk (1986: 25).

<sup>19</sup> See Gaida (2002: 235-245) for an extensive case study of the WFG.

shared among the Bank für Gemeinwirtschaft, the Deutsche Genossenschaftsbank and the Landeskreditbank Baden-Württemberg.<sup>20</sup>

Beset by adverse selection, incentive-incompatible contract designs, and intervention by government and its founding banks, the WFG was doomed to failure even before it funded its first investment. And it was hardly alone. A number of other venture capital firms formed in the early 1980's, and most struggled to produce the kinds of returns expected on venture investing.<sup>21</sup> The involvement of the government, however, meant that in some cases (the WFG, most notably), the investors—primarily the large commercial/investment banks—in actual fact bore little risk. In the case of the WFG, the government agreed to absorb 75 percent of all future losses, while the WFG partners would absorb the remaining 25%.<sup>22</sup> Losses eventually did mount up to DM 32.4 million (EUR 16.57 million) by September 30, 1981, and the WFG actually underwent two major restructuring events: first in 1981, and again in 1984, when a “new” company was formed.<sup>23</sup> “The differences between the “new” and the “old” WFG included a larger fund pool and a visible change in investment policies: later stage investments took priority over early stages and start-ups; no longer were specific branches preferred over all others; non-tech investments were more frequent; and foreign investment and co-venturing were introduced.”<sup>24</sup> Finally, in 1988 Deutsche Bank bought out the other four remaining partners Dresdner Bank, Commerzbank, Bayerische Landesbank, and West LB, and merged the WFG into its own subsidiary, the *Deutsche Beteiligungsgesellschaft mbH*, which had already been founded in 1965.<sup>25</sup>

Another German VC company, the *Hannover Finanz GmbH*, was founded in 1979. Three years later, the first public venture capital fund, administered by the *Senator für Wirtschaft und Arbeit in Berlin*, the *Innovationsfonds des Landes Berlin*, was founded. This 1982 fund of the Berlin senate succeeded rather well. By the end of 1984, the fund already held stakes in 27 companies, 18 of which were newly founded. The total amount of capital available was at least

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<sup>20</sup> Karl-Heinz Faselow, “Die Situation des Venture-Capital-Marktes in Deutschland.” Faselow was CEO of WFG from 1978 until it dissolved. See the case study of WFG by Becker and Hellmann (2000) for an in-depth discussion of this failed attempt to kick-start the German venture capital scene.

<sup>21</sup> See Leopold et al. (2003), who state that of the 33 VC companies that were founded between 1965 and 1972, only 20 or so remain in business today. Strikingly, eight of the nine VC companies that received private backing only are now defunct.

<sup>22</sup> Harrison (1990: 131) cites Faselow (1983: 5).

<sup>23</sup> Nevermann and Falk cite Albach, p. 88.

<sup>24</sup> Harrison (1990: 132).

<sup>25</sup> Harrison (1990: 132-33).

DM 100 million (EUR 51.13 million), and almost all Berlin banks and a series of large insurance and industrial companies (among them Siemens, Nixdorf, SEL, and BMW) held shares in the fund. Not long after, 200 technology-oriented companies in Berlin received venture capital funding.<sup>26</sup>

Other programs and institutions focusing on the promotion of innovation (in small and medium-sized businesses) that sprang up at around the same time include the *Siegerlandfonds 1*, which was founded by the local savings and loan bank in Siegen in November 1983, and that provided *Chancenkapital* (risk capital) for medium-sized companies as well as management assistance. Notably, the German Ministry of Research and Technology (*Bundesministerium für Forschung und Technologie* (BMFT)) started a program to promote new companies directly and thus the VC companies indirectly (“Programm zur Förderung technologieorientierter Unternehmensgründungen (TOU)”).<sup>27</sup>

Thus, the German version of venture capital revolution meant highly organized and coordinated programs by large institutions and the government, rather than break-away actions by pioneer individuals: no Comptons or Doriots, Rocks or Davises, Kleiners or Perkins emerge in the German venture capital history. To be sure, purely commercial venture capital funds did appear: the *GENES-Gründungs- und Management Service GmbH*, for example, was founded in 1978. Interestingly, however, this company stemmed from the founder’s experiences in the US, turned to investors from the US and UK for fundraising purposes, and was affiliated with an American venture capital firm from 1980 to 1985.<sup>28</sup>

#### *Aggregate figures on the early venture capital market in Germany*

Data shortages and irregularities raise substantial barriers to comparisons between the US and German venture capital industries. The most obvious difficulty in analyzing the long-term patterns of development in German venture capital is the fact that the main data source on venture capital activity in Germany, the yearly reports provided by the German Venture Capital Association (BVK), begins its yearly data series in 1991 or later. Unfortunately, the few datasets that exist for the pre-1991 period often conflict with each other, and therefore permit only a

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<sup>26</sup> Nevermann and Falk cite “Wettbewerb der VC-Gesellschaften”, in *FAZ*, October 24, 1984.

<sup>27</sup> Nevermann and Falk (1986: 26, 68), Gaida (2002: 275-276).

<sup>28</sup> See the Genes website: <http://www.genes-ventures.de/hist.htm>.

rough idea of the magnitudes and change over time. The need for further data gathering is clear but must be based on new archive-based initiatives using rigorous historical methods.<sup>29</sup> With these caveats in mind, the following presents the existing numbers as coherently as possible.

*Table 4: Fundraising and investment activity in the German private equity market in the 1980s*

*Figure 5: Early fundraising and investment activity in Germany*

*Table 5: Overview of the Early development of the German Private Equity Market*

These two sets of figures differ noticeably, and the Leopold et al. (2003) figures for the 1990s also differ from those reported by the BVK (reported in the next section).<sup>30</sup> According to contemporary observers, Nevermann and Falk (1986, p. 30ff.), approximately 30 venture capital companies were founded in 1983 and 1984, and the funds available to these companies were estimated to be DM 700 million (EUR 357.90 million) in 1984/85. However, they estimate that by 1985/86 only 10 percent of these funds had been invested. Harrison (1990), by contrast, estimates a cumulative amount of funds raised at €284.53 million by 1984, with €111.21 million invested (cumulative) to that point. Leopold et al estimate €438 million invested as of 1984—nearly four times the Harrison estimate and more than ten times the Nevermann and Falk figure. Moreover, the Leopold et al numbers apparently consider only funds still invested, though few exits would have come before 1984.

By 1989, the number of venture capital companies in Germany had only grown to approximately 40. The available funds, however, nearly doubled in the three years since 1984: based on a 1987 estimate by the *Venture Capital Journal*, these companies had access to approx. DM 1.2 billion (€613.55 million), of which approx. DM 540 million (€276.10 million) had been invested, indicating explosive growth from 1983 on, when total available funds stood at only DM 30 million (€15.34 million), and when just DM 19 million (€9.71 million) had been invested. Already by 1985 DM 785 million (€401.36 million) were available to German venture capital

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<sup>29</sup> One primary goal for advancing this study is to push the data back to the true start of the modern venture capital industry in Germany and to gather more accurate figures that will allow believable statistical analysis. We are starting archival work in Germany and expect to have early reports in the coming months.

<sup>30</sup> The discrepancies for the later years come as a surprise, particularly since one of the authors, Holger Frommann, is the current chairman of the BVK and oversees the compilation of the *BVK Statistiken*. Again, this casts major doubts on the validity of both widely cited statistics (Harrison) and the official BVK data, whose unqualified use even the BVK chairman does not seem to endorse.

firms, of which DM 139 million (€71.07 million) had been invested by then.<sup>31</sup> Thus, according to this source, within five years the funds available grew forty-fold, while investments soared by more than 28 times. However, as the data reported by Leopold et al. (Table 4) indicates, these figures almost certainly far overstate the growth rates of German venture capital in the mid-1980s.

Another study counts only 21 active venture capital companies in the late 1980's and measures their available capital at DM 1 billion (€511.29 million), yet investments only reached DM 276 million (€141.12 million).<sup>32</sup> Harrison (1990) in turn counted 29 venture capital companies in 1988/9 and asserts, "Since 1975, this segment of the venture capital market has raised over DM 1,480 million [€756.71 million], and had invested approximately 56 percent of it by January 1, 1988 in an estimated 119 projects. Although this figure is substantially less than that amount invested by the KBGs, it carries significantly more long-term impact as the effects of the project, process, and structural innovations supported through venture capital work their way through all levels of economic activity."

#### *Venture capital in Germany in the 1990s and beyond*

The current state of the data prevents much in the way of clear-cut conclusions on trends for the 1990s and beyond as well: it is not truly evident when the second stage of the venture capital revolution may have transpired, which may say something about how dramatic a revolution it has been. Two serious problems loom. First, the term "venture capital" is used differently on the two sides of the Atlantic: in the US only seed, start-up, and expansion financing are subsumed under the VC heading; in Europe, VC is normally understood to include later-stage financing, such as buyouts and turnaround financing, as well. We can control for this distinct usage, but only for part of the time. The second problem, that the figures are inconsistent both within years and over time, is harder to overcome.

An "unadjusted" overview of the size of the US and German venture capital markets in 1999 and 2000, as they are commonly reported, gives a stark picture of the size differentials.

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<sup>31</sup> Quoted in Grisebach (1989), p. 15.

<sup>32</sup> Grisebach (1989), p. 16, citing Schmidt and Wilms (1989).

*Table 6: Private Equity data for the US and Germany (average of 1999 and 2000)*

*Figure 6: Private Equity in Germany as a Percent of the US (average of 1999 and 2000)*

A closer look at the categories of data reported in the NVCA Yearbook reveals four main categories: early stage financing, expansion financing, later stage financing, and acquisition/buyout. Only the former two comprise true venture capital. Similarly, the *BVK Statistiken* report the data for Germany for early stage, expansion, specialized later stage, and MBO/MBI/LBO. The first two categories constitute true venture capital of the U.S. type.

### ***Numbers and volume:***

*Figure 7: German Private Equity and Venture Capital Commitments and Disbursements*

*Table 7: Venture Capital Commitments in the US and Germany*

*Figure 8: Venture Capital Commitments in the US and Germany as a percent of GDP*

*Table 8: Venture Capital Disbursements in Germany and the US*

*Figure 9: Venture Capital Disbursements in Germany and the US as a percent of GDP*

Not surprisingly, compared to Germany, the US supports far more VC firms, collects far more capital in commitments, and distributes far more to firms. The situation is worse when trying to consider “true” venture capital. In the mid-1990’s, the BVK estimated that there were only ten venture capital companies in Germany that focused on supporting companies in the early phase and which, accordingly, could be called VC companies. Commitments averaged 15.15 times and disbursements averaged 19.47 times higher in the US compared to Germany. Controlling for the size of the overall economy shows Germany in considerably better light. US commitments averaged nearly six times (5.7) that in Germany in 1999 and 2000, and, in the case of disbursements, averaged more than five times higher.

A closer look at the German data reveals further problems. Most unsettling is the influence membership changes, mostly exogenous shocks, in the BVK have on the reported figures. Some VC firms only join the BVK after a few years; others join as soon as they are founded; yet others drop out because they went belly up. Moreover, non-member VC firms

might have reported their data or they might not. These reporting changes cause most significant trouble in evaluating changes over time. One of the worst examples comes in 2001. The BVK reports that the total portfolio value that German PE firms held year-end (Dec. 31) 2000 was € 10,701.3 million, while the value of the portfolio of all BVK members stood at €13,264 million just one day later (Jan. 01, 2001). This jump of €2,562.7 million in total portfolio size was simply due to the fact that new members joined the BVK, but does not reflect any real activity in the market. In contrast, the market witnessed some real investment activity over the course of 2001, amounting to €2,580 million. If we now compute the ratio of the shock due to membership changes relative to real investment activity, this yields a value of 99.33%. In other words, relative to real activity, nearly as much of the “change” from year-end 2000 to year-end 2001 is due to a more or less random event.

Equally troubling is the fact that the numbers in the BVK statistics rarely add up in a way that standard arithmetic would suggest; simply unexplainable gaps in the data are unfortunately often the rule rather than the exception. Together, the membership changes and the unexplainable incongruities, make econometric analysis largely futile until better datasets are available. In other words, the findings here raise serious doubts about the validity of the few existing statistical and econometric studies on the German VC market. Unless both the data that the BVK provides is interpreted correctly and unless exogenous shocks are properly controlled for, we have to be very skeptical of any alleged results that such studies produce.

#### *Targets:*

By now, it may be difficult to believe any sort of analysis based on the official German VC data. Still, it is possible to offer a broad-strokes overview of the types of firms and industries that engage most actively with German venture capital firms—and to juxtapose that against similar data for the US. German venture capital flows into quite different areas from those taking the most investments in the US. The latter funds more high-technology firms and industries, and also put far more investments into internet-based organizations. German venture capitalists are more likely than Americans to fund less cutting-edge technology or marketing devices.

*Figure 10: Venture Capital Investments in Germany from 1998-2002 by Industry*

*Sources:*

*Figure 11: Venture Capital Commitments by Limited Partner Type 1999-2002*

The sources of funds for German venture capital differ markedly from those of their US counterparts. While pension funds take first place in the US since 1979, and they were already a noticeable presence before that, these sorts of institutions play a much smaller role in the German market—largely because they simply do not exist to nearly the same extent. Continuing the pattern of the first wave of venture capital in Germany, and reinforcing the common notions of bank dominance in the German financial system, the banks are very active investors in venture capital.

The dominance of banks raises one final important area of comparison—or contrast—with the US: public equity. The US supports the largest public equity market in the world, with capitalization peaking around 17 trillion (dollars) in 1999. The same is far from the case in Germany, where capitalization maxed out around 1.6 trillion (euros) the same year and then fell below 650 billion (euros) in 2002. Since public equity markets are very small in Germany, the ratio of private to public equity is actually in the same neighborhood for the two countries. This point raises a number of other questions that take center stage in the next section—particularly, explaining the lagging development of venture capital in Germany and how that relates to the inactive equity markets in that country over the past several decades.

*Table 9: Germany and United States Public and Private Equity Market Capitalization*

*Figure 12: Private Equity under Management as a share of Public Equity Market Capitalization for Germany and the US*

## **II. Institutional Contexts and the Evolution of Venture Capital Institutions**

Political, legal, social, and economic factors together create the context within which financial institutions develop. Differences in these environments naturally create varying outcomes—that is, financial intermediaries that may take on different forms but that nonetheless serve similar

purposes in addition to significant disparities in the kinds of financial arrangements needed to fund industrial growth. The divergent paths taken in Germany and the United States over the last half century and before resulted in just this sort of differentiation in economic and financial systems and in the venture capital segment specifically.

## **The United States**

Venture capital institutions emerged in the US due to a combination of supply and demand factors; some represented widespread, generalized phenomena, while other very important ones emerged from context-specific historical accidents. Venture capital also blossomed in at least two distinct phases, and these waves emanated from different underlying causes.

### *Supply factors*

Limits to traditional banking: Traditional commercial banks, funded primarily from deposits, and providing low-risk investments for those depositors, could not and would not take the risks associated with funding high-tech industries. The costs of screening, monitoring, and advising make small firm finance inefficient for large intermediaries. Traditional banks may have also taken a more cautious approach to lending in the post-depression era. Limits on equity stakeholding prevented certain classes of institutions from engaging in venture capital type contracts, even if they had wanted to.<sup>33</sup>

Emergence of New York as the world financial center: While the New York stock exchange was a relatively large and active market long before the advent of venture capital, the London market clearly led the world in the pre-World War I era. As the dust from World War I settled, it became apparent that London had lost its preeminence and that New York had taken over as the world's banker and financial market.<sup>34</sup> The re-emergence of active stock markets

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<sup>33</sup> On the 1933 Glass-Steagall Act and the Banking Holding Company Law of 1956 see the text of the law at <http://www.fdic.gov/regulations/laws/rules/6000-100.html>. Also see the brief overview of the Graham-Leach-Bliley law at <http://minneapolisfed.org/pubs/region/00-06/kroszner.cfm>. Even with Gramm-Leach-Bliley, passed in 1999, many restrictions remain on commercial banking activities. For a discussion of the law, from the Securities Industry Association point of view, see [http://www.sia.com/gramm\\_leach\\_bliley/](http://www.sia.com/gramm_leach_bliley/).

<sup>34</sup> The consensus of the literature holds that the US dominated international lending by 1919. On the changing international order, particularly relating to the gold standard, see Eichengreen, *Golden Fetters*.

after the war provided a ready outlet for VC investments via IPOs, and facilitated the use of significant equity stakes by venture capitalists.<sup>35</sup>

Market expansion and integration and markets for VC-backed firms: By the end of World War II, and continuing rapidly thereafter, financial and product markets increased in size and liquidity and became highly integrated across the country. These dual processes provided venture capitalists with an unusually good exit vehicle for their investments.

Impersonal exchange: Following World War II, and continuing the pre-WWI trends, increasingly impersonal exchange created greater potential for asymmetric information between investors and entrepreneurs and resulting problems that make traditional banking practices less suitable for innovative new businesses.

Surplus funds to invest: the economic and financial prosperity of the war years created a renewed supply of investment capital from wealthy individuals and institutions. The end of the war, and the loosening of government controls on the economy, permitted the release of pent-up funds: retirement savings, large public pension funds, university endowments, and other institutional investors that are large enough to handle (diversify) the risk of VC investments.

Government policy and programs: The US is unusual, if not unique, in its enthusiasm for unbridled competition and the willingness of its government to go to great lengths to defend it. One key example for the story of venture capital is the Small Business Administration (SBA)—founded in 1953 with the purpose of aiding entrepreneurs wishing to start or grow their companies. The SBA succeeded the Reconstruction Finance Corporation (RFC), founded by President Hoover in 1932, and pushed by President Roosevelt, as one of the many programs created to aid businesses hurt by the Great Depression. In the fifty years since its initiation, the SBA has directly or indirectly financed almost 20 million small businesses.<sup>36</sup>

### *Supply factors in sum:*

The early supply factors sum up to a situation in which existing financial institutions could not or would not provide small-scale, venture-type financing based on equity participation contracts.

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<sup>35</sup> See Black and Gilson (1997). I differ with their assessment that a strong *domestic* IPO market (as opposed to some other exit option) is necessary for a strong venture capital market. It surely does not pose a limitation.

<sup>36</sup> See SBA's website at [www.sba.gov](http://www.sba.gov). In 2003, the SBA's business loan portfolio included over 200,000 loans worth more than \$45 billion. The agency backed more than \$12 billion in loans to small business in 2002, and more than \$40 billion in federal contracts was secured by small businesses with SBA's help.

At the same time, new initiatives by individuals and the government succeeded in picking up the slack: stocks of wealth held by individuals willing to invest, the US government ideology to encourage small-scale business both directly and indirectly, and the return of newly-vigorous and integrated markets following the depression and war. Later on, favorable returns to venture capital, compounded by the boom in pension funding, accelerated the growth of venture capital in numbers of institutions and volume of funding.

### *Demand factors*

Without demand from entrepreneurs, venture capital supply has no outlet. Thus, demand is a necessary condition for the proliferation of a venture capital industry, and it is the side of the equation that appears to truly set the United States apart from other countries. As the United States emerged from World War II, it was enjoying an enormous war-production boom that had finally ended a long period of stagnation and crisis. The ‘new economy’ of the post-depression/post-war era brought structural and institutional changes that created the need for finance of the new venture capital type. This incipient demand provided just the niche the first venture capitalists needed.

Technology: The companies funded by the first venture capitalists—DEC, Fairchild, and Intel, for example—provide some clue to the technological factors in the demand side of the venture capital market. Massive government research and production efforts during the Second World War promoted novel fields of science and technology, and the backlog of inventions and possible innovations not applied during the depression and war suddenly could be brought to production with the hope of finding a ready market. New technologies raise new information divides between researchers or potential entrepreneurs on the one hand and financiers and potential investors on the other; increasing the standard information-related problems and producing new, higher levels of risk.<sup>37</sup> The true key for venture capital is strong growth

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<sup>37</sup> The technology factor combines two separate issues: First, there were new technologies that the public—that is, existing financial institutions and investors—did not understand and whose marketability they could not easily assess. Second, it may be that the new technology differed significantly from past technological revolutions in the potential for laypeople to grasp or for financial experts to assess. The latter point is far more difficult to assess than the former but deserves further exploration as a factor that created a need for a new sort of financial institution that combined much deeper knowledge and experience in science and technology with expertise in finance, markets, and management.

potential, so technology is neither necessary nor sufficient to explain the adoption of venture capital.<sup>38</sup>

**Industrial organization:** New levels of domestic and international market integration, faster transmission and adaptation of ideas and products, and earlier competition for market share, combined with technological economies of scale and scope, increased minimum efficient scale for firms and demanded more sudden investments to help seedling firms take off ahead of their potential competitors but often before the new products were proven. New types of organization emerged, where research and development (as well as advertising) comprised the majority of firm costs while product manufacturing costs were minimal.<sup>39</sup> In “networked” goods (such as the Windows operating system), adoption and dissemination must be fast, or else the product could not be widespread. How radically these industry structures truly differed from their pre-war state remains a fruitful avenue for further investigation.

**Government programs and spending:** The era of big government brought the New Deal, social security, WWII science research, cold war spending incentives, space exploration programs (NASA/JPL), other government-funded science agencies (such as the NIH, Lawrence-Berkeley Labs), and funding to state and private universities. It also begat programs like small business grants (SBIC’s and the SBIR), tax incentives, and funding for technology research and development. In addition, the government passed specific legislation aimed at transferring research out of labs and into the marketplace (Stevenson-Wydler Technology Innovation Act and Bayh-Dole University and Small Business Patent Act in 1980).<sup>40</sup>

**Culture:** It is often claimed that the US harbors a particularly active entrepreneurial culture and one in which “greed is good.” Successful entrepreneurs are heralded for their achievements and even attain celebrity status in some cases. Perhaps even more importantly, failures are hardly held against the unsuccessful entrepreneur, and those who decide to return to

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<sup>38</sup> Indeed, perhaps the first venture capital target of all—Spencer Chemical Company in Kansas—bears little resemblance to the common modern perception of this sort of financing. The facts appear in the interview by Gupta (2000) of Benno Schmidt, who was one of the first partners of J. H. Whitney & Co. This case suggests the need for further exploration of the early contracting forms, financing methods, and contracting terms used by early venture capitalists. It is also important to determine whether low and medium-technology investments represent an exception to a high-tech rule of venture capital; or if high-technology is simply a coincident feature of the American venture capital revolution.

<sup>39</sup> Moore’s Law coined in 1965 from a paper by Gordon Moore (co-founder of Intel) where he observed an exponential growth in the number of transistors per integrated circuit and predicted that this trend would continue for the foreseeable future.

<sup>40</sup> See Feldman 2001.

previous employment face little social stigma from having made the attempt at starting up an independent business.

Higher education and research: Following World War II, the US increased the quantity and quality of potential science and engineering innovators and tightened the links between academia and industry. In a preemptive strike against the expected post-war recession, the Congress passed the GI Bill of Rights, and thereby prompted an unprecedented wave of college attendance that produced, in turn, an ‘army’ of educated workers as well as a far larger pool of potential scientists and engineers to go on to tertiary education. Prior to the 1920’s, collaboration and mutual interest between industry and academia remained minor in the US. The war effort focused government attention on weapons, computing, and communications technology and accelerated the movement toward harnessing basic academic research. Collaborative work continued to grow after the war, and the termination of the war economy then permitted a redirection of efforts toward connecting basic scientific research to marketable innovations. Moreover, the system of world-class private post-secondary education and the active competition between and among both private and public universities for research funding and the best students yields exceptional performance in both education and research. Several key individuals, such as Frederick Terman, a Stanford engineering dean sometimes referred to as the “Father of Silicon Valley,” forged strong links between academic science and industry needs. On the business side, the advent of formal business education to produce more and better quality managers—beginning early in the twentieth century, but accelerating after WWII—produced the necessary mix of raw materials for innovative, entrepreneurial firms.<sup>41</sup>

Low costs and high benefits of (risk-based) entrepreneurship: However important the entrepreneurial culture is in explaining the consistently strong demand for venture capital, there are important economic, political, and legal factors that form the basis for that ‘culture.’ First, US employees enjoy a great deal of labor mobility, but they also hold relatively less power through unionization and weaker job security, compared to most other highly-developed economies. As a result, potential entrepreneurs have a lower expected value of staying with a given firm for an extended career—a lower probability of keeping their jobs, in many cases, less generous benefits, and a lower opportunity cost of leaving voluntarily. Among academic

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<sup>41</sup> Some support for the importance of MBA education, and the associated networking opportunities, can be found in the educational background of many venture capitalists. Harvard and Stanford—both in the heart of active technology clusters—have produced more than their share of high-tech entrepreneurs and venture capitalists.

entrepreneurs, the situation is even more comfortable: academics can hold down an academic position and simultaneously start a new business. If the business fails to take off, the academic researcher can go back to the drawing board and continue to earn, by European standards at least, the high salary paid by top American research universities. If the business succeeds, the entrepreneur stands to gain from a trade sale, or more impressively during the 1990s. Since entrepreneurs and the top tier of management in a new venture receive their majority of compensation as equity rather than wages, relatively low and falling capital gains tax rates provide additional impetus to quit a salaried job and start an entrepreneurial venture. Gompers and Lerner (1999) present additional evidence that capital gains taxes work predominantly through the demand side.

#### *Demand factors in sum:*

Technology, industrial organization, higher education quality, academic-industry collaboration, government programs and regulation all changed after World War II. These shifting institutional structures together increased the quality and quantity of entrepreneurs seeking and offering venture capital funding. Of crucial importance was the political-economic system characterized by low expected costs and high expected benefits of high-risk/high-growth entrepreneurship.

#### *Supply and Demand Together*

Limits to the supply of traditional finance combined with strong demand for risk capital in high-growth sectors, all in an environment conducive to institutional change, prompted a small number of entrepreneurs to create a new form of intermediary. Subsequent economic, legal, and political factors, particularly those from the demand side of the equation, fueled the further takeoff of this new institution.<sup>42</sup> While existing studies clarify the factors involved in the two

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<sup>42</sup> Poterba (1989) and Gompers and Lerner 1999 determine that one of the main factors causing a significant increase in the supply of venture capital was the ERISA change to the prudent man law in 1979 impact the supply of venture capital. The ERISA was founded in 1974, to safeguard worker's pensions. At that point, employer contributed pensions were just beginning to become an important benefit provided in addition to salary. There is also some evidence the entrepreneurship may be positively impacted by down-turns in the economy as they reduce

significant waves of venture capital in the 1980s and 1990s, there is clearly far more to learn about the more distant past and the impetuses for the original institutional changes that came immediately following World War II.

## **Germany**

The delayed and muted venture capital revolution in Germany resulted largely from weak demand for the US-type package of venture capital services (specific methods and services with accompanying high costs). The shortages stem to some extent from the limited pool of qualified potential high-tech entrepreneurs but also from the scarcity of individuals willing to take on the risk of a high-tech start-up venture, since the expected costs often exceed the expected benefits. The inferior net benefits to risky innovation in turn result largely from strong historical influences that found reinforcement in the post-war political economy.

### *Supply Factors*

In Germany, as in the US, demand side factors appear to dominate the supply side in explaining the timing and nature of the venture capital revolution.<sup>43</sup> But to the extent that supply factors help explain Germany's weak venture capital industry, they range far wider and deeper than the typical ones raised in the modern financial literature—such as the lack of active markets for new issues.

*Banking system structure:* One might argue that the German banking system provided close substitutes for venture capital and therefore failed to create pressure for new forms of institutions. Until very recently, the German banking system was held out as an exemplar of the benefits of close bank-firm relationships for the financing of risky investments. More recent assessment of German banking paints a picture resembling that of the US system: traditional commercial banks invested conservatively and favored larger, established firms to smaller-scale, risky ventures. At the same time, the quasi-state savings institutions, the *Sparkassen*, actively promoted and funded small business in their local communities. The structure and mandate of

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the opportunity cost from switching to entrepreneurial employment from wage employment (See for example, Gompers and Lerner 1998 “Venture capital Cycle” or Feldman 2001).

<sup>43</sup> Gaida (2002), p. 225 points out the excess supply but does not explain the lack of demand.

these banks, however, meant a focus on relatively safe firms and industries, traditional bank lending methods, and little in the way of mentoring and monitoring that is typically associated with American-style venture capital. To the extent that the banking system deserves any blame for lagging venture capital markets, it stems from their *over-involvement* in the operations of the early German venture capital firms.

*Destruction of financial (and other) markets:* The political upheaval of the Weimar years, followed by the authoritarian political regime of the Nazi era, had the concurrent effects of increasing family ownership of firms and decreasing the role of the financial markets in allocating ownership and control rights.<sup>44</sup> Comparatively weak protections for investors decreased incentives for (outsider) shareholding. Thus eviscerated in the wake of WWII, stock markets offered no high-value exit strategy for VC's via IPO's. Many favor the IPO market explanation for the fate of venture capital; yet beyond 'grandstanding,' there is little theoretical reason to believe that IPO's are crucial for venture capitalists to operate, or that such markets must be situated in the same country as the venture capital targets. Thus, it is doubtful that the IPO situation explains much of Germany's lagging VC industry.

*Market Disintegration, coordinated capitalism, and family ties:* Germany's rapid pre-WWI progress in market integration was quickly reversed during and after the war. The loss of territory in the two wars uprooted businesses and displaced networks. During this time, big business built up large-scale corporate groups, pyramids, and cartels—creating widespread coordination of business activities. In addition, the Nazi political agenda promoted family ownership and undermined market interaction; yielding a situation in which a large proportion of financial and business interactions took place within networks of insiders and within extended families. These trends ran opposite of those taking place in the US, where information asymmetries appear to have been growing. Limited information problems within financial-industrial networks and within communities based on family firms and local financial institutions can provide some explanation for the lack of emergence of new venture capital financial institutions outside of the coordinated, insider system in place.

*Markets for trade-sales:* The German system supports relatively active markets in equity stakes. Whether these sales extend to the purchase of whole start-up firms is less clear. The

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<sup>44</sup> For a long-run view of economic, legal, and political influences on German corporate ownership patterns, see Fohlin (2003).

limitation would stem from the hesitance of founders to sell out, given the pervasive preference for retaining family control. This issue relates more to demand factors and therefore receives fuller attention in that section.

*Government policies:* Worry over the lack of venture capital in Germany grew most rapidly once the post-war economic miracle began to fade. A long line of failed government programs bear witness to the great hope politicians placed in the ability of a venture capital market to stimulate innovation and economic growth past the reconstruction boom and through the reintegration of the eastern states.

Some of the political and regulatory roadblocks in Germany do come out of fundamental differences in the legal system that played out through policies relevant to financial markets and capital investment: weak (equity) investor protections already discussed and strong protection of creditors in bankruptcy law. Government programs failed for a number of reasons relating to bad design, but the failure of these initiatives have at their core some of the same fundamental factors that directly suppressed the endogenous emergence of a venture capital industry.

*Social welfare state policies:* In Germany, the pay-as-you-go social security system, based on the principal of paying current claims with contemporary payroll taxes, was created in 1957. In Germany, as opposed to the US, little more than five percent of retirement income came from private pension funds in the early 1990's.<sup>45</sup> Government dominates pension payments, and many companies pay nothing into pension funds for the claims they owe, but rather build reserves in their balances to pay future claims.<sup>46</sup> The same centralization of institutions under government control means that universities have no endowments of the American type, and much of the work that is done by foundations in the US is subsumed under the federal and state governments. Thus, the strong governmental role in areas of social policy, may have crowded out the supply of capital that could be used to fund high-risk investments. Instead, banks took up the slack in funding the VC's that did form (recall the WFG), and they adhered too closely to traditional banking principles rather than to US-style venture capital contracting.

*Culture:* Germany is often criticized for its lack of investor culture and its general conservatism in financial matters. The dearth of wealthy individuals and resource-rich

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<sup>45</sup> Schmähl (1994). Cited in O'Sullivan (2000), p. 263.

<sup>46</sup> According to the "Arbeitsgemeinschaft für betriebliche Altersversorgung eV." (cited in: [www.bma.bund.de/neuerente/48.htm](http://www.bma.bund.de/neuerente/48.htm)).

institutions willing to take risks on new technology and other possible high-growth areas is often seen as limiting the supply of venture capital. Moreover, some argue that venture capitalists did not appear in the first decades after the war, because society took a dim view of what it saw as greedy, ostentatious behavior. Given the excess supply of venture capital, these factors could only have constrained the German venture capital industry in its adoption of risky strategies.

#### *Supply factors in sum:*

After the post-war reconstruction, Germany emerged with powerful universal banks, radically weakened securities markets, and close-knit webs of corporate ownership and governance. Although different from the US structure, the power and size of the German banks tended to produce some of the same problems for small-scale risk finance that the more constrained American banks faced. The strong political power of labor during the post-WWII reconstruction and beyond encouraged government programs that crowded out private pension funds and other private initiatives. Still, capital is fairly plentiful in Germany, and savings rates are much higher than in the US. Moreover, money is quite quick to flow into lucrative areas, and high-quality investments readily attract funds from the US and UK. In contrast to the US after 1979, investment in venture capital firms came mainly from banks. Critically, however, the first generation of VC firms, nor their closest substitutes, provided the level of mentoring and monitoring that US venture capitalists do. Resulting failures to gain strong returns likely created a negative feedback mechanism, suppressing further interest and encouraging greater conservatism in venture capital investing. Thus, the main supply problem in Germany lies in the shortage of high-quality, *non-financial* services for potential high-growth, risk-taking entrepreneurs.

#### *Demand factors*

Whereas the demand factors in the US spurred on the venture capital industry, the opposite has been true in Germany. The country's political and economic history offers a number of compelling explanations for these patterns. After 1913, Germany was thrown into a long period of chaos, beginning with World War I, continuing into the Weimar Republic, and culminating

with the Nazi period and defeat in World War II. The cold war was also played out most vividly on German soil.<sup>47</sup> As costly as the country's division was, reunification in 1991 imposed enormous costs on western Germany, having only recently caught up to its previous economic position vis a vis the United States. It is difficult to fathom the disruption wrought on the economy, on individuals, and on the institutions that support the development of new technology and innovation in industry.

*Technology:* Several forces contribute to a weaker interest in and focus on high-technology industries in Germany. Most important in the early years, when the US was first creating venture capital institutions, was the fallout of World War II. The destruction of the war certainly forced Germany to rearrange its national priorities, funneling vast amounts of investment into reconstruction and provision of basic needs for the population. In stark contrast to the US, Germany could not pour large portions of its national resources into risky investments in research and development of new technologies. Moreover, after the war, the Allies actively sought to destroy the military potential of the defeated Germany and therefore restricted production and research in military goods in 1945.<sup>48</sup> Thus, one significant impetus for the US technology boom was eliminated for Germany right at the outset. To the extent that Germany's intense focus on reconstruction increased the power of basic and established industries compared to insurgent technology sectors, the implications have persisted over a longer run. Even throughout the high-tech boom of the 1990's, automobiles and specialty machine tools remained Germany's lead market for innovative activity.<sup>49</sup> Germany was clearly not left as a low-tech economy after World War II, but it has poured its intellectual, economic, and financial resources rather more into medium-high technology than in the frontier technologies. The dominance of the settled industries, and their ability to shift resources towards themselves, tended to retard the development of breakthrough industries, such as genetics and computer technology, for which venture capital makes the most economic sense.<sup>50</sup>

*Industrial organization:* The relative lack of high-tech industries in Germany, and the tendency of established firms to perform most of the innovative activity, restrains the creation of

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<sup>47</sup> Berlin officially remained the capital of Germany, but the seat of government (*Regierungssitz*) was moved to Bonn.

<sup>48</sup> The aircraft industry provides a good example. See Bandraß, Krienen and Prott, 1999:466-529.

<sup>49</sup> Bericht der Bundesregierung zur Technologischen Performance der Bundesrepublik, 2001. Patent counts by industry underscore this point, with automobiles and other vehicles taking the top places in patent rankings.

<sup>50</sup> See Patente-Aktuelle Entwicklungen und längerfristige Strukturänderungen bei industriellen Innovationen..., June 2003; <http://www.isi.fhg.de>.

small, start-up firms that need to grow fast to compete. This industrial organization, that has characterized German industry at least for the post-WWII era, limits the need for knowledgeable outsiders with capital and industry-specific advice. While there is a very significant sector of small and medium-sized enterprises in Germany, they are heavily involved in traditional or medium-tech sectors, such as specialized machine tools, and they face little of the high-risk investment prospects that high-tech startups face. They make active use of the readily available capital from their local bankers, particularly from the state-backed savings institutions (*Sparkassen*).

*Higher education and research:* While the US university system blossomed in the post-war era, the German university system stagnated. Having been rolled into the social-democracy movement following the war, academics became government employees with neither the pressure of private incentives nor the competition from private universities to spur research agendas. The additional lack of meritocracy probably diminished the urge for academic advancement, and 'brain drain' posed additional problems for creating a highly-educated pool of scientists and engineers. The latter problem has its own deeper roots in the persecution of Jews in Germany and the flight of intellectuals out of Germany in the Nazi period. This phenomenon simultaneously drained Germany of many of its strongest human capital resources and boosted those of the United States and also took its toll on connections and cooperation between German academia and industry.<sup>51</sup> These ties did not redevelop in the post-war era: researchers at universities were not willing or able to commercialize their ideas, and technology transferred slowly or not at all from universities to industry.<sup>52</sup>

The post-war university education system has also played a part in the small pool of highly-skilled technology-oriented entrepreneurs. Graduates from the natural sciences, engineering, and the computer sciences are the most important group for foundations in high-

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<sup>51</sup> It should be obvious that the economic implications pale in comparison to the human tragedy it represents. See [http://www.nature.com/cgi-taf/DynaPage.taf?file=/NATURE/journal/v398/n6725/full/398274a0\\_fs.html](http://www.nature.com/cgi-taf/DynaPage.taf?file=/NATURE/journal/v398/n6725/full/398274a0_fs.html) and [http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v425/n6959/full/425650b\\_fs.html](http://www.nature.com/cgi-taf/DynaPage.taf?file=/nature/journal/v425/n6959/full/425650b_fs.html) on the corruption of German science during the Nazi period. Ernst-Otto Fischer, who won the Nobel Prize for chemistry in 1970, argued that "the emigration of Jewish scientists led to a crucial decrease of Germany's intellectual competitiveness from which we still have not recovered completely."

<sup>52</sup> The legal provisions contrast to those in the United States, and the recent reform in the Act Concerning Inventions by Employees (*Arbeitnehmererfindungsgesetz*) could even move incentives in the wrong direction. European Trend Chart on Innovation, 2002: p. 36.) Hellmann, 2000, p.14, notes that employment stability in the research sector and the high social status of university professors and researchers provided little incentive for scientists to commercialise their discoveries.

technology sectors, and the number of freshmen in the field of engineering is one of the determinants of future demand for VC. Germany has a lower percentage of graduates in the sciences and engineering than other European countries and is continuing to fall behind.<sup>53</sup> Compounding the problem, the unusually long course for education (with average university studies of longer than six years) and long secondary education makes German graduates much older than in other countries. The low number of scientists and engineers has a doubly negative impact: first, there are fewer potential innovators overall, and second, higher competition for them raises the opportunity cost of an independent company foundation, all else equal.

Lack of managerial competence presents yet another problem for potential founders, and the evidence from Germany points to serious problems with the management of new companies, especially in marketing and distribution.<sup>54</sup> The post-war German education system provided essentially no counterpart to the US business school education.

*Government policy and programs:* The post-World War II socialist-oriented labor movement produced a range of government policies and institutions that stymied the evolution of many of the kinds of demand-side factors for venture capital that did appear in the US.<sup>55</sup> Protection of labor meant high costs of labor regulation in Germany versus the US: it is more expensive to fire workers, employment conditions are more regulated, and the flexibility in hiring is lower.<sup>56</sup> The German focus on labor, directly and indirectly forces up wages and benefits, mandating limits on work hours paid at regular wages. These influences further raise the opportunity cost of starting up or joining a new business and can make high-risk ventures seem all the more unappealing by comparison.

On the positive side, the German government has made numerous attempts to directly stimulate and support the creation of new firms. Since the early 1980s ‘*Gründerzentren*’ (startup center) have provided a major tool in economic policies. Besides a limited number of larger ‘technology parks’ there are approximately 200 ‘technology centers.’ With a total of 1,800

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<sup>53</sup> European Trend Chart on Innovation, 2001.

<sup>54</sup> See the WFG study in Hellmann (2000), p. 11. See also Lessat et al. (1999) and Nevermann and Falk (1986) who point to the lack of experienced VC managers as the biggest problem.

<sup>55</sup> Germany gave rise to a long line of socialist thinkers, including some of the most prominent voices on the self-destruction of capitalism and replacement by socialism: Karl Marx, whose life spanned the industrial revolution (1818-1883), is just one of many. Germany’s post-WWII emphasis on social democracy therefore represents less of a radical political-philosophical shift than might otherwise appear. Still, the post-war incarnation represented a structural break in the government’s direct role in the economy—but one that was hardly unique and probably more muted than those that transpired in other European countries following the war.

<sup>56</sup> See [www.worldbank.org/doingbusiness/](http://www.worldbank.org/doingbusiness/).

enterprises and 10,000 employees, their influence has been limited.<sup>57</sup> Here again, the much earlier shaping of the regions by older industries plays a crucial role; successes have come in areas already orientated around small and medium enterprises.<sup>58</sup>

*Society & culture:* Perhaps due to greater cultural cohesion, extreme wealth is viewed with suspicion, and community-orientation is encouraged. Mavericks are not seen as heroes or role models, and risk-taking is discouraged. The purported bad public image of entrepreneurship and envy of successful founders is viewed as one of the keys in deterring foundations: it was not as socially accepted as pursuing a career within a company.<sup>59</sup> These factors tend to reduce the available pool of entrepreneurs to start up high-risk ventures and to make use of relatively risky, US-style venture capital funding. These issues also limit the managerial labor market for start-ups: the people who could work in these companies seem to prefer the status coming from more secure career paths at already established companies.<sup>60</sup> Much of this perceived problem stems from the notion that Germans are generally more risk averse than others. The evidence here, though, is weak.<sup>61</sup>

Perhaps a more important impediment to the venture capital industry is difficulty venture capitalists face in replacing bad management. This rigidity arises because families play such a predominant role in entrepreneurial ventures, and that typically leads founders to resist giving up control. These problems are compounded by low labor mobility: until very recently, the best talent was not brought together in close proximity, making it difficult to create economies of agglomeration that seem to support the proliferation of high-technology entrepreneurship that provides the core business of venture capital.

*High costs and low benefits of risky entrepreneurship:* In Germany, the direct and indirect costs of starting a high-tech, high-growth business exceed those in the US.<sup>62</sup> The costs of failing in Germany are also higher; possibly deterring potential founders facing a higher probability of insolvency as well as bankruptcy law that favors creditors. The failed entrepreneur may even

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<sup>57</sup> See Beate Scheidt (1994).

<sup>58</sup> See Heidenreich M. and G. Kraus (1996).

<sup>59</sup> Fiedler and Hellmann (2001)

<sup>60</sup> This point is raised also by Fiedler and Hellmann (2001), p. 11, who argue that “Ten years ago the idea of leaving a good management position at a prestigious company (e.g. Siemens) to join a start-up would have been thought absurd.”

<sup>61</sup> Lesser et al.

<sup>62</sup> For example, it takes 9 procedures and a total of 45 days to start a business in Germany, yet it only takes 5 procedures to and four days to start a business in the US. See Djankov et al., “The regulation of entry” ([rru.worldbank.org/doingbusiness/](http://rru.worldbank.org/doingbusiness/))

find it difficult to return to a previous employer in the event of a failure or of being replaced by a venture capitalist. The higher the risk of the venture—and these are the ones for which venture capital would make sense—the higher the chance of failure, and the higher the likelihood these costs come into play. Opportunity costs are also high, due to Germany’s labor-oriented, ‘social-market’ policies: workers are well compensated in salary, job security, work conditions, vacation time, and benefits. The German labor-favoring system raises the expected return that has to be offered by venturing out on one’s own. As Germany has seen far fewer of the spectacular IPO’s witnessed in the US (mainly in the 1990s), any rational entrepreneur must place a fairly low probability on a windfall that would overwhelm the capital gains taxes (if realized quickly). Demand for venture capital comes from individuals who, by definition, have assessed the relative costs and benefits of staying with the alternative form of employment and have opted to forego it. In the German system, the pool of such individuals is seriously constrained, even without considering cultural explanations.

*Demand factors in sum:*

For various reasons, some imposed exogenously, Germany focused on medium-tech industries following the war. The higher educational system produced fewer world-class scientists and engineers and also failed to foster close ties with industry. At the same time, high expected costs of setting up risky ventures and comparatively low expected benefits of the same tended to dampen incentives for the types of startups that benefit from venture capital.

*Figure 13: Biology and Chemistry PhDs in the US and Germany*

*Figure 14: Electrical Engineering and Computer Science PhDs in the US and Germany*

*Figure 15: Nobel Prizes in Chemistry for the US and Germany*

*Figure 16: Patent Applications by class in Germany in 2002*

*Supply and Demand Together:*

The lack of venture capital supply only binds if there is even greater demand for such finance—this market gap is the real motivation for the development of VC. In Germany, lagging high-tech

development and a small pool of qualified and willing risk-taking entrepreneurs has meant weak demand for VC services and therefore both delayed and less successful introduction. To the extent that supply-side factors contribute to the weak venture capital sector, it is more likely a shortage of mentoring and monitoring for young, high-growth firms and sectors. The view that demand for VC is the key determinant of the lack of a VC scene in Germany finds further support in the sentiments of VC investors who bemoan the lack of good projects to invest in. (Lesser et al. 1999: 87)

### **III. The Long-Term Perspective**

The post-WWII emergence of modern venture capital is one in a series of similar financial revolutions that have arisen in response to structural breaks in the economy and in related political, legal, and even social or cultural institutions. Disruptive, new technologies resulting in product and process innovations often require new organizations to provide them and new financial intermediaries to fund them. Technology, industrial organization, market structure, higher education and research, and government agendas have clearly played critical roles in shaping our current systems. Those factors have always influenced patterns of financial and economic development, so that studying the deeper roots of modern institutions helps in understanding how those institutions changed in the post-war era.

The second industrial revolution brought technological advances in mining, steel, chemicals, electrical technology, automobiles, machines, aeronautics, engineering, food processing, and many other areas. The industrial responses to new technology differed markedly between the US and Germany in some respects but paralleled each other to some extent as well. For the United States, Rosenberg (1994) explains the direction and character of technological innovation over time as directly dependent on the American system of manufacturing. This system is characterized by use of specialized machines, high standardization and use of interchangeable component parts. During the first half of the 19<sup>th</sup> century, the U.S. was still largely a frontier-land. At that time, Britain was the industrial power and the U.S. for the most part adopted technological innovations that had been already produced in Britain. The U.S. however had special attributes and needs that the established European countries did not: the population was rapidly growing, land was abundant and there was a large resource endowment.

Moreover, the egalitarian social structure (rather than the class based structure which remained in Europe) enabled individuals to gain easy access to land. Improvements in transportation, preservation, refrigeration and sanitation combined with the increasing demand for consumer goods provided a stimulus to developing large-scale efficient means of production.

Germany emerged as an industrial power at the end of the 19<sup>th</sup> and beginning of 20<sup>th</sup> century. A high concentration of economic power in advanced industries with an increasingly well-developed financial system promoted Germany to leadership in world innovation and production. The rapid rise of new industries such as steel, chemicals, electricity, and some branches of engineering in the late 19<sup>th</sup> century allowed Germany to capture technological leadership. Typical of Europe, Germany also had a number of important industry cartels (See Cho 2003). In Germany, as elsewhere in Europe, cartels were recognized as legitimate by courts and governments who were distrustful of unregulated competition. Concentration and cartelization increased rapidly in the interwar years, and in 1930, there were over 3,000 cartel arrangements in Germany.

In both countries, many sectors benefited from technology-based economies of scale and of scope, and the introduction of electrical power into production raised the minimum efficient scale and scope of several industries. Some new technology lent itself to small firms (certain chemicals), but those that did not, usually required significant external financing.

For most of the 19<sup>th</sup> century, limited markets—poorly integrated markets, production for regional markets, tariff protection—let firms start small. The lighter pressure for growth allowed entrepreneurs to control their companies and use plowed back profits for new investment. In both the US and Germany, improvements in communications, transportation and regional integration of currency, tariffs and standards for products turned poorly integrated regional markets populated by non-specialized small firms into efficient large scale markets. The introduction of advertising and marketing which exposed individuals to new and purportedly better products, along with expanding market size, increased the range and numbers of products available. In the US, the assembly line system of manufacturing promoted industry consolidation, as larger firms could take advantage of the economies of scale involved with large-scale production. Even during the late 19<sup>th</sup> century in the U.S., large firms had the advantage when it came to licensing inventions, and bringing them to market because they could absorb the costs of marketing and distribution while producing the inventions at lower cost than

small run production lines could do. The domestic and international upheaval from 1913 to WWII set the clock back severely on market integration for both countries, but the process of concentration remained largely still in force.

The movement towards limited liability and general incorporation gained strength in the last quarter of the nineteenth century. This institutional change begat subsequent changes in the means for controlling and governing businesses. Equity shares and markets to trade them facilitated horizontal and vertical integration and the merger movement. The need for skilled entrepreneurs to run these complex organizations spurred on the managerial revolution, training in entrepreneurship and management (particularly formal business school education), and at least a partial or gradual decline of family control—particularly among larger-scale firms.

#### *Higher education and research:*

Innovation in industry stemmed both from internal inventions and adoption of others' ideas, and the changes created new products, processes, and whole sectors of the economy. The ability of industry to innovate hinged critically on the creation of knowledge and the availability of individuals educated in science and engineering.

Germany's fast rise to the top in technology rested on a well-developed system of scientific and technical education. In Germany, institutional support for knowledge production and inventive activity—from private firms, universities, and government—blossomed in the late-nineteenth century up to the inter-war years. The German university system provided a range of studies, from classical liberal education to highly technical, practical studies in science, technology, and business management. In Germany, the government created some of the first technical universities, including some of the first dedicated engineering schools. At the Technical University in Darmstadt, for example, the government set up a Chair in Electrical Engineering (similar to a small American department) in 1882. Darmstadt was the first polytechnic to have its own Electrical Engineering faculty and used that advantage to take the lead in that rapidly developing field.

Connections between inventive individuals and formal institutions aided the application of new ideas to business. University professors communicated actively with entrepreneurs, large and small; often becoming entrepreneurs themselves (von Linde, the inventor of the refrigerator

and creator in 1879 of the first company to produce and sell them, provides just one prominent example). Industrial firms build sophisticated research laboratories, and hired highly-trained scientists—often university professors—to direct them. Carl Bosch—one of a long string of German nobel laureates in chemistry—provides yet another pinnacle example of the marriage of academia, industry, and government in the pre-World War II system: leading the research efforts and then the business of BASF, running the chemical industry concern IG Farben, joining a German delegation surrounding the negotiations following World War I, and presiding over the government-founded scientific research institution that became the Max Planck society.

In the US, the university system played a more limited role in technological development during the pre-World War II period, and a highly-decentralized political and economic order slowed the type of coordination that appeared so readily in the German system. For the US, the significant change came during World War II, when many universities (MIT, American University, for example) had secret government defense contracts for producing breakthrough technologies that could help the US win the war. During and following the war a number of Federally Funded Research and Development Centers were set up (today there are 36 such centers), many of them run by universities or non-profit organizations.

### *Government involvement*

The government in both Germany and the U.S. was instrumental in creating the context within which innovative activity could flourish—or not. Each national system of innovation was unique to the history of the respective country and to factors such as level of educated workforce, resources for research and development among others. Several components of national systems of innovation are critical: patent systems, availability of grants or loans for research or new enterprise creation, the tax system and the incentives it provides individuals to become entrepreneurs, the legal system and how it protects inventors, entrepreneurs and investors determines what types of organizations are likely to form and the type of contracts observed, culture of the educational institutions is important for determining the mixture of basic and applied research as well as for facilitating or inhibiting patenting out of labs.

Political unification in Germany came in 1871, and federal policies aimed at cementing the union grew in its aftermath. Public finance of large-scale projects, nationalization of

railroads, central banking to support risky investment all contributed actively to the successful industrial and economic growth in Germany. Generous funding of wide-ranging higher education, along with the patent system and other government initiatives to support invention and innovation helped put Germany at the forefront of technology and its adoption in industry.

In the 1870's, the US was still opening up much of its territory and would not have unified national institutions, policies, and programs for education and business innovation (with the notable exception of the patent system) for many decades. The urge for competition and decentralization, while stymying business on certain fronts, on the whole promoted a great deal of innovation—sometimes resulting from attempts to circumvent or overcome regulation. The venture capital industry itself may trace its origins to the strict government regulation of banks and the strictures it created in the US market for financial services.

### **Financial revolution: funding and promoting innovation in industry**

The second industrial revolution raised new problems of funding for research and development, support for inventors and entrepreneurs, and creation of new firms and industries in both Germany and the US. Family firms and family wealth remained a critical link in funding inventive activity and new businesses, but external pressures from the industrial revolution spurred on something of a financial revolution as well. The types and availability of commercial credit and market finance increased rapidly as the nineteenth century—and its industrial revolution—wore on. Relationship banking, based largely on informal relationships, appeared in Germany at least by the mid-nineteenth century. More formal advising, as well as formal monitoring and controlling of equity stakes came much later—mostly after the first phases of the second industrial revolution. Some think Germany was ahead of the US in efficiency of finance and corporate governance institutions in the pre-World War I period. German universal banks of the mid 19<sup>th</sup> century may even look something like the American VC's of the mid- to late- 20<sup>th</sup> century. As Landes (2003) puts it, late 19<sup>th</sup> century Germany is a good illustration of what can be achieved by systematic investment in a backward economy of high potential. In the United States, by contrast, small-scale finance dominated outside of a few large cities. Local bankers, patent intermediaries, and local contacts for credit played a crucial role in turning new ideas into marketable products.

*Figure 17. Financial Institutions Assets as a Percentage of GNP*

#### IV. CONCLUSIONS

The German economy ranked among the most innovative and productive in the pre-World War I era, and its financial system—both banking institutions and securities markets—channeled prodigious amounts of capital into industry. The educational system led in the sciences and engineering, attracting many of the brightest minds from around the world and producing more than its share of knowledge for use in industry. Connections among academia, industry, and government worked smoothly and created an effective system of innovation; often including adoption and adaptation of foreign inventions. The US was also among the wealthiest economies before World War I, but its financial system was hemmed in and its educational system was not yet on par with that in Germany. Its ascent to financial-market primacy following World War I, its rapid institutional change in academic and government-based science and engineering especially during World War II, as well as its promotion of entrepreneurial incentive, set the stage for a third round (or more) of industrial revolution and a financial revolution to support it.

In both Germany and the United States, the 1930's and 40's represent a structural break in a wide range of institutions. The period itself was traumatic for both countries and led to enormous dislocation and unwanted change. For the United States, however, the developments following World War II produced largely positive results, with increasing sophistication in finance, education, industry, and government programs. The combined forces placed the United States at the forefront of high-technology. History played out much differently in Germany. The destruction of institutions during the Nazi era—from financial markets, to education and research, to political processes—proved exceedingly difficult to overcome. While the country repaired physical damage to infrastructure, the intangibles recovered more slowly. The cleaving of the country into two, the post-war political agendas favoring socialist-based labor policies, and the government's control of key components of the economic system set up barriers to the creation of high-technology entrepreneurs and businesses. After the initial jubilation, reunification with the eastern Laender brought severe economic and political problems, requiring

a second round of reconstruction, and causing Germany to lose some of the economic power it had regained in the previous forty years.

Despite the many and varied setbacks, Germany has proven remarkably resilient; remaining among the wealthiest, most productive, and most innovative countries in the world. These facts point to a number of important questions about the consequences of financial system design for innovation and economic growth. Little work has been done in establishing an impact of specific institutional designs on innovation and growth, so that many questions remain unanswered. Recent US experience might suggest the hypothesis that certain, narrowly-defined types of institutions are necessary for high productivity and rapid growth. The historical investigation and German case study in this paper raises serious doubts about such a supposition. Over the longer history, Germany fares well in comparative perspective; having developed successful mechanisms to finance innovative technologies and help spur past industrial revolutions. This longer view of the history underscores the havoc wreaked on the German financial and economic system by the events of the 1930's and 40's and by their enduring repercussions. Moreover, despite all the institutional differences between the US and Germany, comparative study shows remarkable parity in measures of output and productivity growth and innovation, relative to population or labor force. The relative positions have shifted back and forth over time—often for the obvious reasons. But the evidence to this point refutes claims about enduring superiority of one system over the other.

***Figure 18. Patents per Labor Force.***

***Figure 19. GDP per worker in the US, United Kingdom and Germany***

***Figure 20. GDP per capita in the US and Germany***

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**Table 1. The US Venture Capital Market, 1980-2002**

Year	Total Cumulative Funds	Total Cumulative Firms	Total Cumulative Capital (\$B)	Net New Funds	Net New Firms	Existing Funds	Existing Firms	Capital Managed (\$B)	No. Principals per Firm	Estimated Industry Principals	Avg Fund Size \$M	Avg Firm Size \$M	Avg Mgt Per Principal \$M
1980	179	109	\$5.3	45	21	124	87	\$3.0	13	1131	\$24.2	\$34.5	\$2.7
1981	243	146	\$6.8	64	37	183	122	\$4.6	11.8	1440	\$25.1	\$37.7	\$3.2
1982	312	180	\$8.6	69	34	241	153	\$6.6	11.1	1698	\$27.4	\$43.1	\$3.9
1983	427	223	\$12.4	115	43	351	199	\$10.5	10.5	2090	\$29.9	\$52.8	\$5.0
1984	544	273	\$15.9	117	50	458	251	\$13.9	10.4	2610	\$30.3	\$55.4	\$5.3
1985	635	306	\$19.4	91	33	542	289	\$17.4	10.3	2977	\$32.1	\$60.2	\$5.8
1986	717	338	\$23.1	82	32	606	321	\$20.5	10.1	3242	\$33.8	\$63.9	\$6.3
1987	824	375	\$27.3	107	37	692	355	\$24.3	10.1	3586	\$35.1	\$68.5	\$6.8
1988	906	394	\$31.1	82	19	727	368	\$26.9	10.1	3717	\$37.0	\$73.1	\$7.2
1989	999	423	\$36.5	93	29	756	383	\$30.7	10.2	3907	\$40.6	\$80.2	\$7.9
1990	1061	438	\$39.4	62	15	749	386	\$31.6	10.2	3937	\$42.2	\$81.9	\$8.0
1991	1104	446	\$41.7	43	8	677	368	\$29.8	10.2	3754	\$44.0	\$81.0	\$7.9
1992	1182	468	\$45.5	78	22	638	363	\$30.2	10.4	3775	\$47.3	\$83.2	\$8.0
1993	1276	496	\$51.2	94	28	641	373	\$32.2	10.3	3842	\$50.2	\$86.3	\$8.4
1994	1379	528	\$59.9	103	32	662	386	\$36.1	10.2	3937	\$54.5	\$93.5	\$9.2
1995	1533	592	\$69.1	154	64	709	422	\$40.9	10.1	4262	\$57.7	\$96.9	\$9.6
1996	1678	649	\$81.1	145	57	772	464	\$49.3	10	4640	\$63.9	\$106.3	\$10.6
1997	1900	743	\$101.8	222	94	901	540	\$63.2	9.9	5346	\$70.1	\$117.0	\$11.8
1998	2135	824	\$133.8	235	81	1074	612	\$91.4	9.8	5998	\$85.1	\$149.3	\$15.2
1999	2475	953	\$192.7	340	129	1371	734	\$145.9	9.7	7120	\$106.4	\$198.8	\$20.5
2000	2861	1076	\$277.6	386	123	1679	840	\$227.2	9.7	8148	\$135.3	\$270.5	\$27.9
2001	3087	1153	\$310.0	226	77	1811	894	\$254.3	9.6	8582	\$140.4	\$284.5	\$29.6
2002	3177	1173	\$316.5	90	20	1798	892	\$253.2	9.5	8474	\$140.8	\$283.9	\$29.9

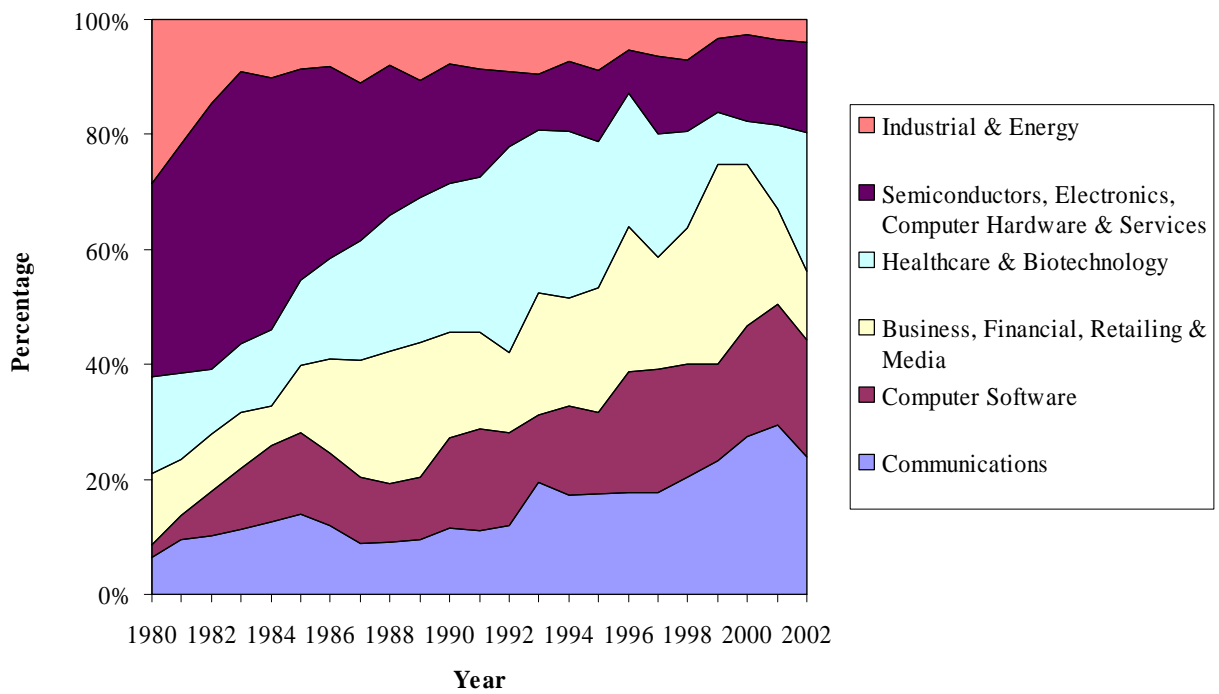
Source: Figure 1.04, *National Venture Capital Association Yearbook, 2003 ed.*

**Table 2. Capital Commitments to Private Equity Funds by Fund Type 1979-2002**

Year	Venture Capital (\$M)	No. Funds	Buyouts and Mezzanine Capital (\$M)	No. Funds	Other Private Equity Capital (\$M)	No. Funds	Private Equity Capital (\$M)	No. Funds
1979	558.9	18	50	1	33.3	1	642.2	20
1980	2092.7	56	183.5	4	0	0	2276.2	60
1981	1595.6	76	126.8	4	164	3	1886.4	83
1982	1694.3	87	611.3	13	636.5	3	2942.1	103
1983	4135	144	1384.6	17	354.3	6	5873.9	167
1984	3146	120	3482.5	22	202.3	3	6830.8	145
1985	3983.4	119	2992.7	22	347.9	6	7324	147
1986	3895.7	106	4707.6	29	301.1	5	8904.4	140
1987	4435.3	122	15611.1	41	1174.4	10	21220.8	173
1988	4893.7	107	11703.9	52	2044.2	19	18641.8	178
1989	5599.4	112	11695	77	473.4	10	17767.8	199
1990	3531	91	7669.7	61	2204.5	13	13405.2	165
1991	2059.2	46	4354.1	29	1554	6	7967.3	81
1992	5384.5	80	11073.2	60	1964.2	17	18421.9	157
1993	3902.8	92	16575.8	78	2005.2	14	22483.8	184
1994	7827.3	140	20503.1	103	5164.9	19	33495.3	262
1995	9973.2	168	26063.9	103	7409.1	34	43446.2	305
1996	12159.6	167	32463.3	101	8412.1	41	53035	309
1997	19043	242	42578.8	135	13762.5	45	75384.3	422
1998	29676.3	296	60171.2	153	26751.5	74	116599	523
1999	62776.7	454	56075.2	146	31074.5	95	149916.4	695
2000	105800.9	641	72669.6	157	31119.1	105	209589.6	903
2001	37937.3	288	44086.2	115	29597.8	88	111621.3	491
2002	7666.4	151	22275.3	58	20125.1	60	50066.8	269

Source: Figure 2.03, *National Venture Capital Association Yearbook*, 2003 ed.

**Figure 1. Venture Capital Investments in the United States from 1980 to 2002 by Industry**



Source: Figure 3.10, *National Venture Capital Association Yearbook*, 2003 ed.

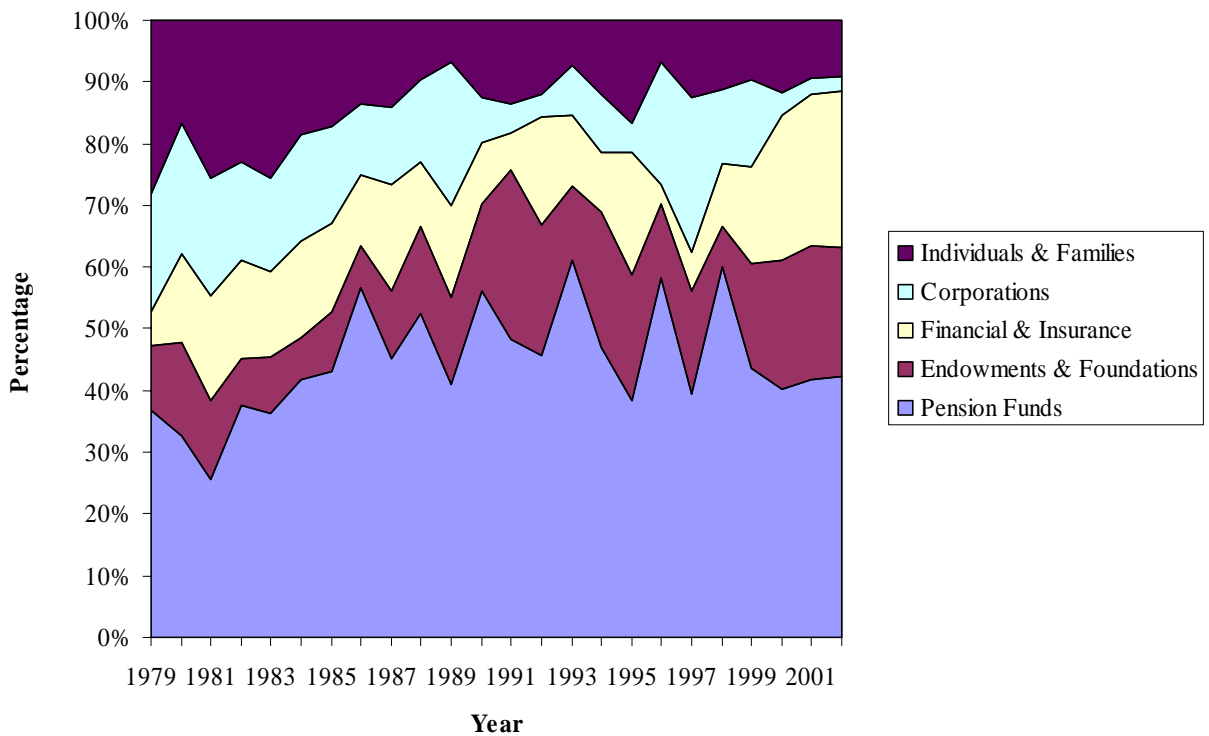
**Table 3. Germany & United States Industry Classifications for Venture Capital Investments**

<u>Classifier</u>	<u>Description</u>
Communications	Telecommunications and Networking Equipment
Computer Software	Software
Biotechnology & Healthcare Related	Biotechnology, Medical Devices and Equipment, and Healthcare Services
Semiconductors, Electronics, Computer Hardware & Services	Computers and Peripherals, IT Services, Semiconductors and Electronics Instrumentation
Business, Financial Retailing & Media	Business Products, Financial Services, Media and Entertainment, Retailing Distribution, and Consumer Products
Industrial / Energy	Industrial and Energy
Chemical	Chemical Products*

\*Chemicals is only classified in Germany and is statistically significant

Source: Appendix F, National Venture Capital Association Yearbook 2003

**Figure 2. Venture Capital Commitments in the United States by Limited Partner Type 1979-2002**



Source: Figure 2.04, *National Venture Capital Association*, 2003 ed.

**Table 4. Fundraising and investment activity in the German private equity market in the 1980s**

in €M	Yearly				Cumulative			
	Year	Raised	Invested	Projects	Per Project	Funds Raised	Invested	% Invested
	1980	€0.00	€1.53	5	€0.307	€30.68	€11.76	38.30%
	1981	€0.00	€2.56	6	€0.424	€30.68	€14.32	46.70%
	1982	€1.02	€1.48	13	€0.112	€31.70	€15.80	49.80%
	1983	€79.25	€21.88	29	€0.757	€110.95	€37.68	34.00%
	1984	€173.43	€73.52	62	€1.186	€284.53	€111.21	39.10%
	1985	€168.16	€71.99	92	€0.782	€452.54	€183.20	40.50%
	1986	€130.84	€77.36	109	€0.711	€583.38	€260.55	44.70%
	1987	€173.33	€103.54	119	€0.869	€756.71	€364.09	48.10%

Source: Harrison (1990)

**Table 5. Overview of the Early Development of the German Private Equity Market**

Year	# of VCs Reporting Data	# of Investments			Total Funds Invested (€M)			Disbursements (€M)
		Total	Private	ERP-backed	Total	Private	ERP-backed	
1975	24	340	194	146	190	168	22	NA
1979	NA	684	208	476	286	198	87	NA
1980	NA	910	220	690	317	215	102	NA
1981	NA	978	233	745	346	243	102	NA
1982	NA	1,055	255	800	385	259	126	NA
1983	NA	1,069	246	823	401	266	135	NA
1984	31	1,127	302	825	438	314	124	NA
1985	44	1,277	380	897	516	382	134	NA
1986	52	1,429	467	962	695	545	150	210
1987	60	1,583	578	1,005	814	652	162	215
1988	NA	1,683	597	1,086	1,125	866	143	298
1989	NA	1,752	735	1,017	1,318	1,130	188	377
1990	NA	2,111	890	1,221	1,739	1,538	201	511
1991	80	2,410	1,136	1,274	2,113	1,853	260	551
1992	84	2,665	1,283	1,382	2,623	2,325	299	628
1993	84	2,758	1,266	1,492	2,748	2,411	337	517
1994	85	2,942	1,306	1,636	3,158	2,731	427	740
1995	87	3,093	1,313	1,780	3,204	2,717	487	583

Source: Leopold, Frommann and Kühr (2003).

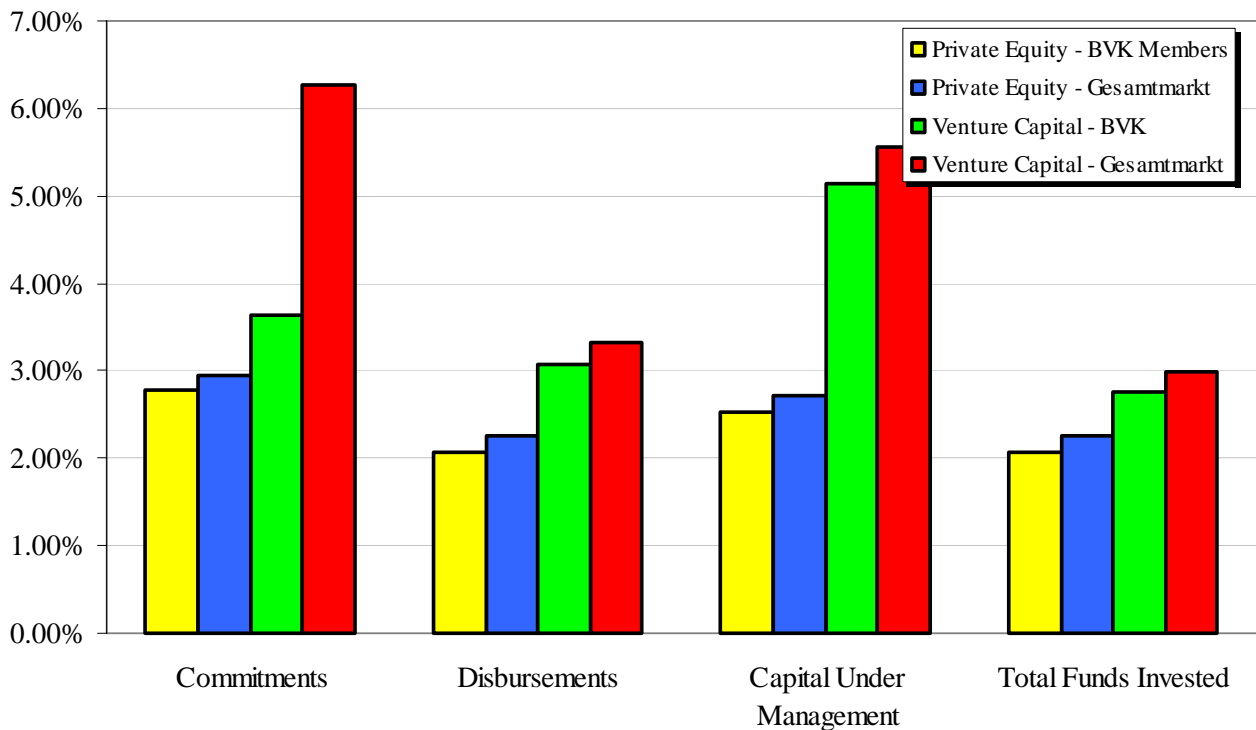
**Table 6. Private Equity data for Germany and the US (average of 1999 and 2000)**

\$M	United States		Germany							
	Private Equity	Venture Capital	Private Equity BVK	% of US	Private Equity Gesamtmarkt	% of US	Venture Capital BVK	% of US	Venture Capital Gesamtmarkt	% of US
Commitments	\$179,753	\$84,289	\$4,977	2.77%	\$5,291	2.94%	\$3,072	3.64%	\$5,291	6.28%
Disbursements	\$171,907	\$80,610	\$3,556	2.07%	\$3,885	2.26%	\$2,482	3.08%	\$2,675	3.32%
Capital Under Management	\$608,366	\$240,750	\$15,417	2.53%	\$16,564	2.72%	\$12,384	5.14%	\$13,365	5.55%
Total Funds Invested	\$420,866	\$209,250	\$8,732	2.07%	\$9,509	2.26%	\$5,783	2.76%	\$6,255	2.99%

Notes: FX rate used for 1999 is \$1 = €0.938262, for 2000 is \$1 = €1.08272. Total Funds Invested for the US is calculated by subtracting estimated uninvested funds (Figure 2.10 NVCA Yearbook, 2003) from Capital Under Management. To calculate Capital Under Management for US Private Equity and for all categories in Germany, we sum the last eight years of commitments, a common method utilized by Venture Economics when no actual numbers are reported.

Source: Germany: *BVK Statistik*. United States: Figure 3.09 *National Venture Capital Association Yearbook*, 2003.

**Figure 3. Private Equity data for Germany and the US (average of 1999 and 2000)**



Notes: FX rate used for 1999 is \$1 = €0.938262, for 2000 is \$1 = €1.08272. Total Funds Invested for the US is calculated by subtracting estimated uninvested funds (Figure 2.10 NVCA Yearbook, 2003) from Capital Under Management. To calculate Capital Under Management for US Private Equity and for all categories in Germany, we sum the last eight years of commitments, a common method utilized by Venture Economics when no actual numbers are reported.

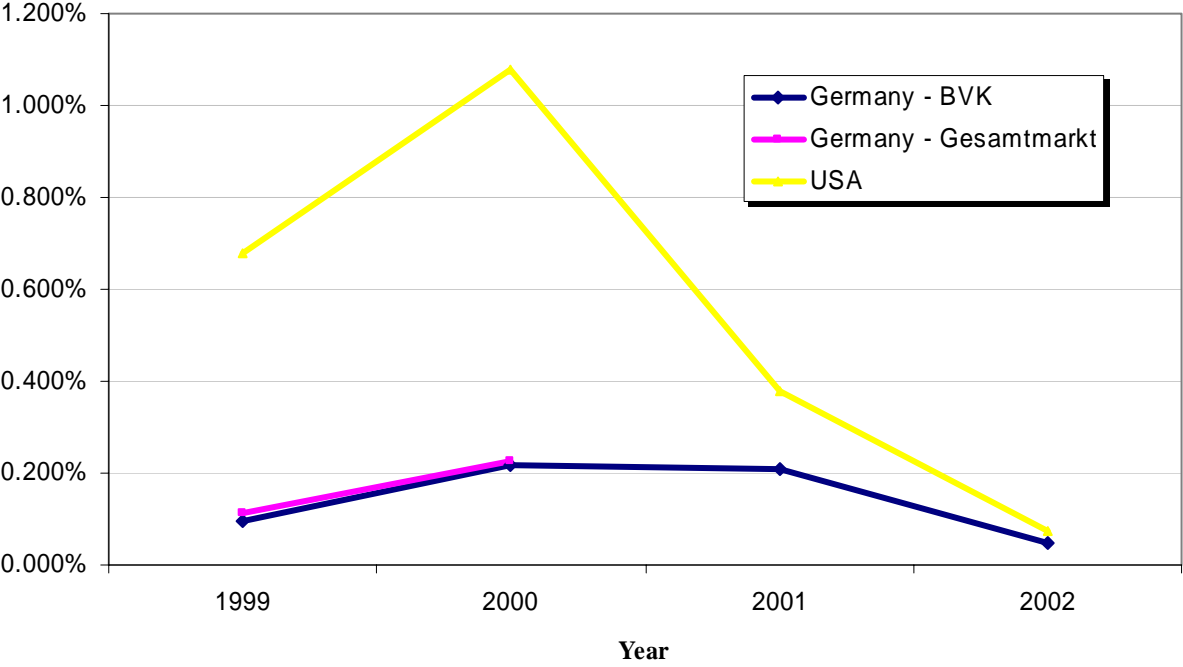
Source: Germany: *BVK Statistik*. United States: Figure 3.09 *National Venture Capital Association Yearbook*, 2003.

**Table 7. Venture Capital Commitments in Germany and the United States**

Year	Germany				United States	
	Commitments in million €(BVK)	As a % of GDP	Commitments in million €(Gesamtmarkt)	As a % of GDP	Commitments in million \$	As a % of GDP
1999	€1,929.76	0.098%	€2,220.21	0.112%	\$62,776.7	0.677%
2000	€4,425.12	0.218%	€4,566.20	0.225%	\$105,800.9	1.077%
2001	€4,304.31	0.208%	NA		\$37,937.3	0.376%
2002	€1,012.42	0.048%	NA		\$7,666.4	0.073%

Source: Germany: BVK Statistik, DAI Factbook 2003. United States: Figure 3.09, National Venture Capital Association Yearbook, 2003 ed.

**Figure 4. Venture Capital Commitments in Germany and the US as a Percentage of GDP**



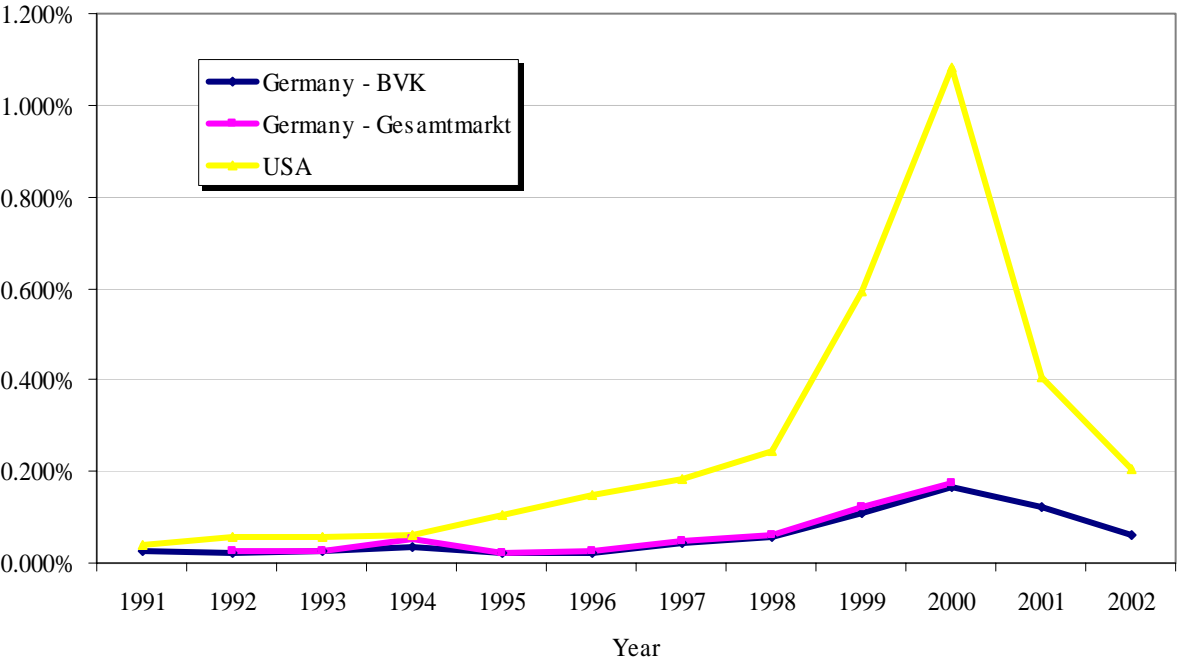
Source: Germany: BVK Statistik, DAI Factbook 2003. United States: Figure 3.09, National Venture Capital Association Yearbook, 2003.

**Table 8. Venture Capital Disbursements in Germany and the United States**

Year	Germany				United States	
	Disbursements in million €(BVK)	As a % of GDP	Disbursements in million €(Gesamtmarkt)	As a % of GDP	Disbursements in million \$	As a % of GDP
1991	€369.43	0.025%	NA		\$2,284.8	0.038%
1992	€271.11	0.020%	€324.11	0.024%	\$3,593.1	0.057%
1993	€356.92	0.024%	€399.19	0.027%	\$3,876.2	0.058%
1994	€374.75	0.033%	€580.13	0.052%	\$4,200.0	0.060%
1995	€367.97	0.022%	€389.42	0.023%	\$7,683.0	0.104%
1996	€420.85	0.024%	€433.39	0.024%	\$11,592.7	0.148%
1997	€759.05	0.044%	€826.60	0.048%	\$15,139.3	0.182%
1998	€938.49	0.055%	€1,054.89	0.061%	\$21,466.5	0.244%
1999	€1,916.07	0.108%	€2,134.15	0.120%	\$54,924.3	0.592%
2000	€3,162.78	0.164%	€3,328.77	0.173%	\$106,294.7	1.082%
2001	€2,530.58	0.122%	NA		\$41,033.5	0.407%
2002	€1,265.33	0.060%	NA		\$21,224.2	0.203%

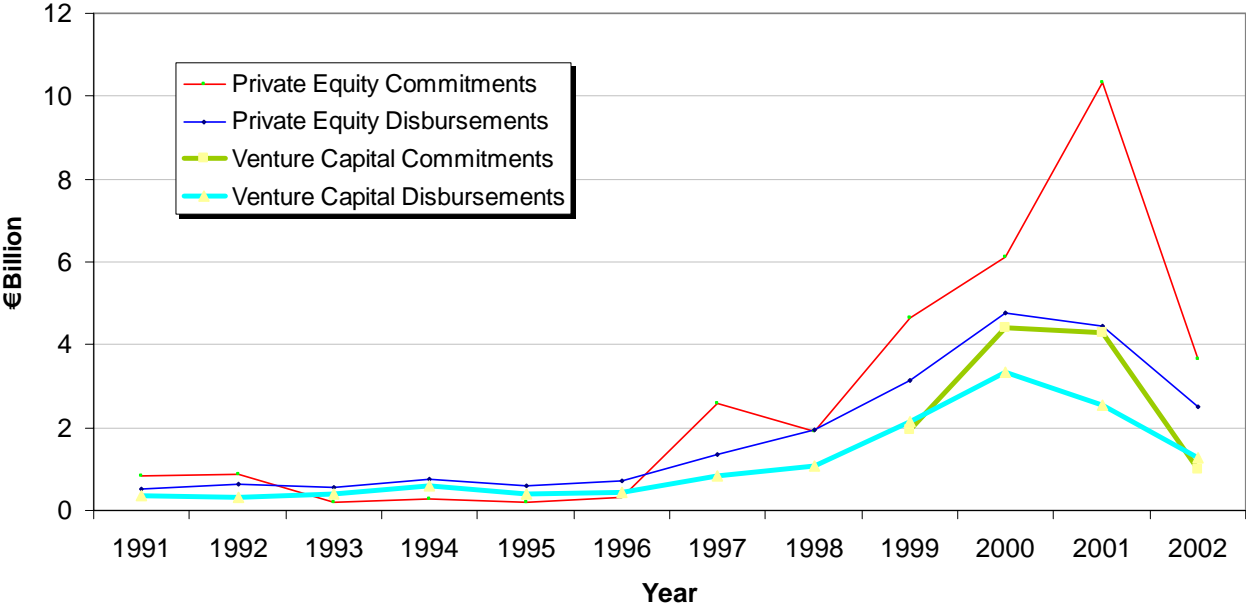
Source: Germany: BVK Statistik, DAI Factbook 2003. United States: Figure 3.09, National Venture Capital Association Yearbook, 2003 ed.

**Figure 5. Venture Capital Disbursements in Germany and the US as a Percentage of GDP**



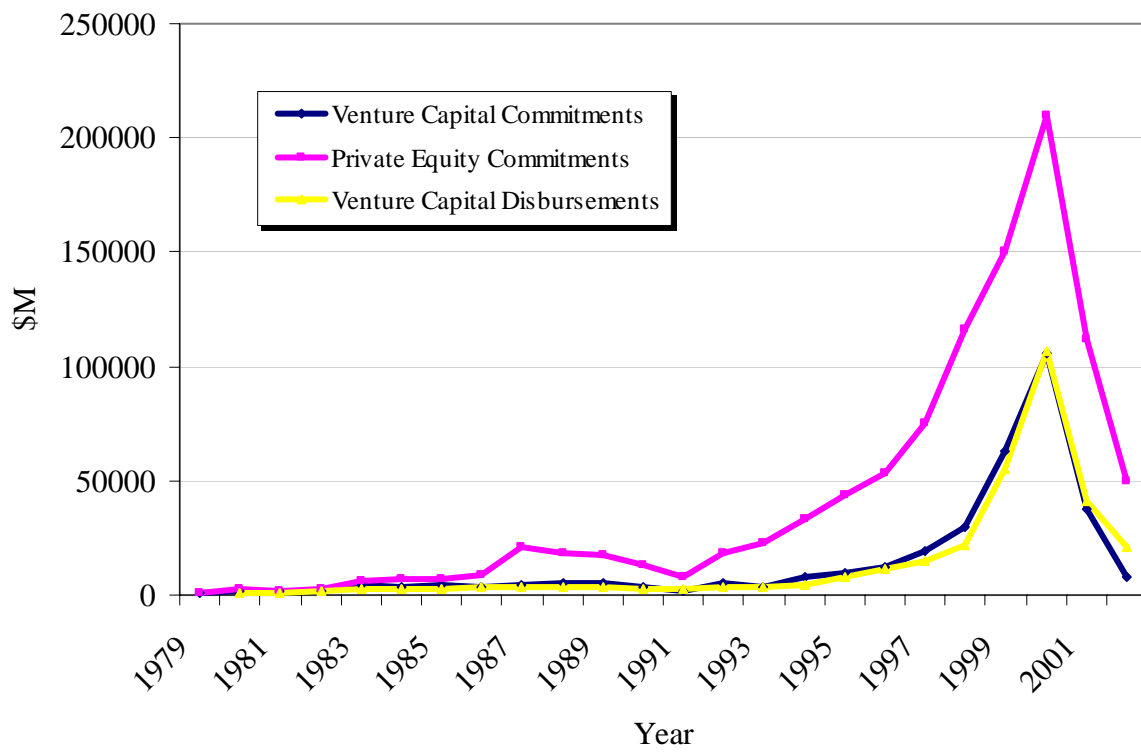
Source: Germany: BVK Statistik, DAI Factbook 2003. United States: Figure 3.09, National Venture Capital Association Yearbook, 2003 ed.

**Figure 6. German Private Equity and Venture Capital Commitments and Disbursements**



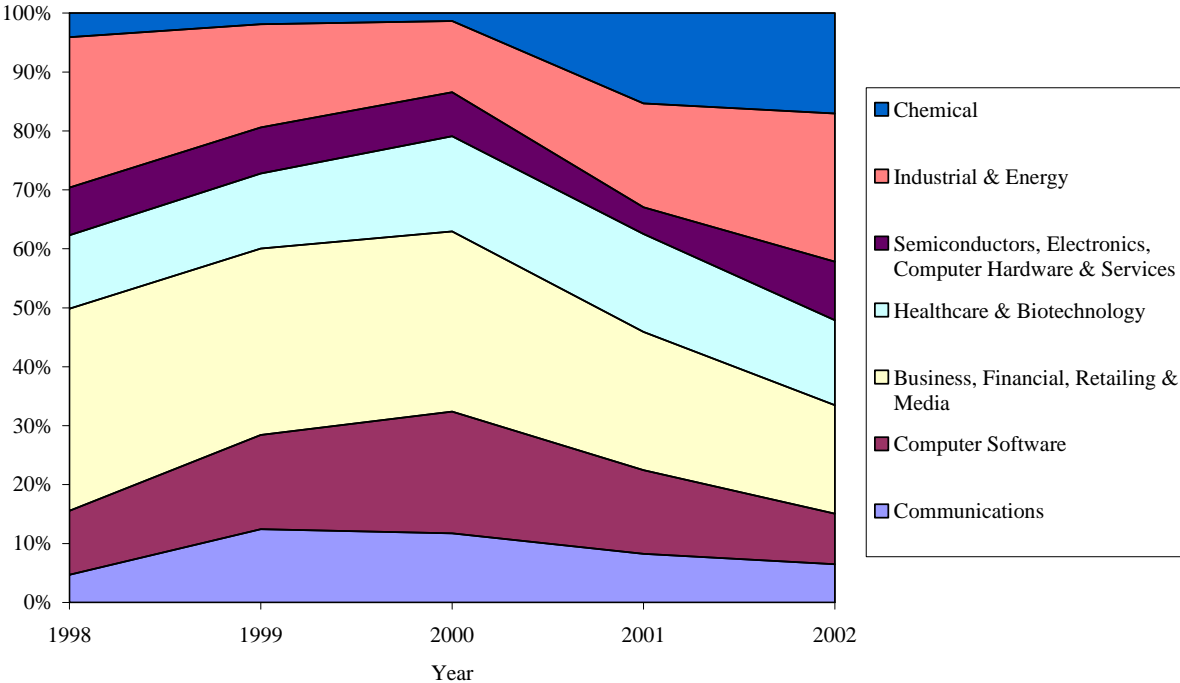
Source: BVK Statistik

**Figure 7. US Private Equity and Venture Capital Commitments and Disbursements**



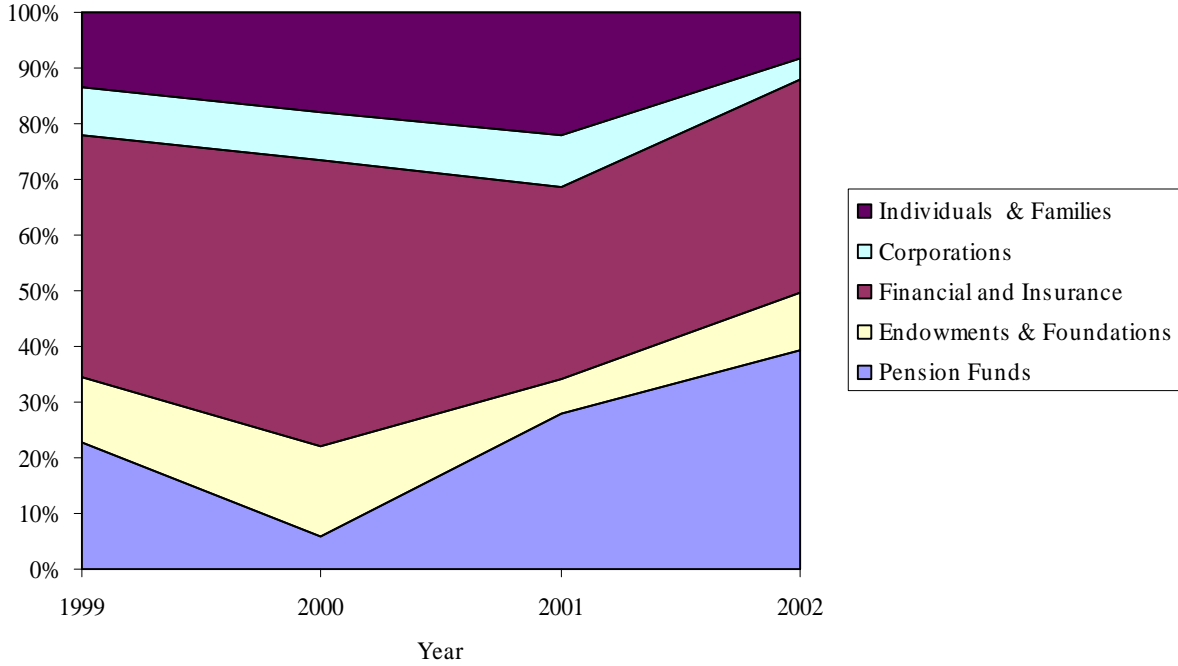
Source: Figure 2.03 & 3.10, *National Venture Capital Association Yearbook*, 2003 ed.

**Figure 8. Venture Capital Investments in Germany from 1998 to 2002 by Industry**



Source: BVK Statistik

**Figure 9. Venture Capital Commitments in Germany by Limited Partner Type 1999-2002**



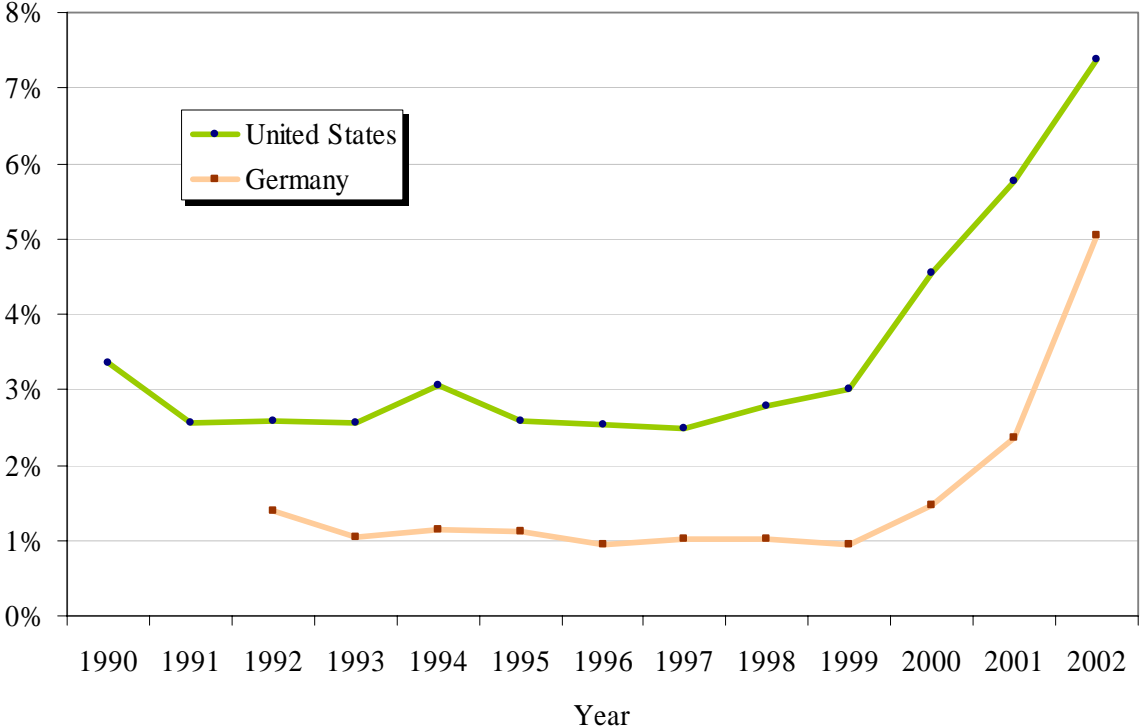
Source: BVK Statistik

**Table 9. Germany & United States Public and Private Equity Market Capitalization**

Year	Germany			United States	
	Private Equity Capital Under Management €M (BVK)	Private Equity Capital Under Management €M (Gesamtmarkt)	Public Equity Market Cap €M (all indices)	Private Equity Capital Under Management \$M	Public Equity Market Cap (NYSE /AMEX/ NASDAQ) \$M
1990	€2,020	NA	€286,938	\$99,969	\$2,979,570
1991	€2,838	NA	€304,973	\$102,062	\$3,997,610
1992	€3,440	€4,016	€287,292	\$113,653	\$4,396,349
1993	€3,618	€4,222	€409,084	\$128,813	\$5,056,265
1994	€3,918	€4,514	€395,679	\$153,404	\$4,999,761
1995	€4,465	€4,715	€422,523	\$175,629	\$6,785,126
1996	€4,783	€5,047	€528,713	\$210,023	\$8,297,149
1997	€6,969	€7,634	€758,681	\$267,639	\$10,779,882
1998	€8,563	€9,522	€931,626	\$370,833	\$13,287,997
1999	€12,808	€13,641	€1,428,873	\$512,782	\$17,031,643
2000	€18,605	€20,127	€1,371,270	\$703,950	\$15,499,118
2001	€28,492	NA	€1,203,681	\$793,087	\$13,761,213
2002	€33,252	NA	€658,573	\$809,659	\$10,965,961

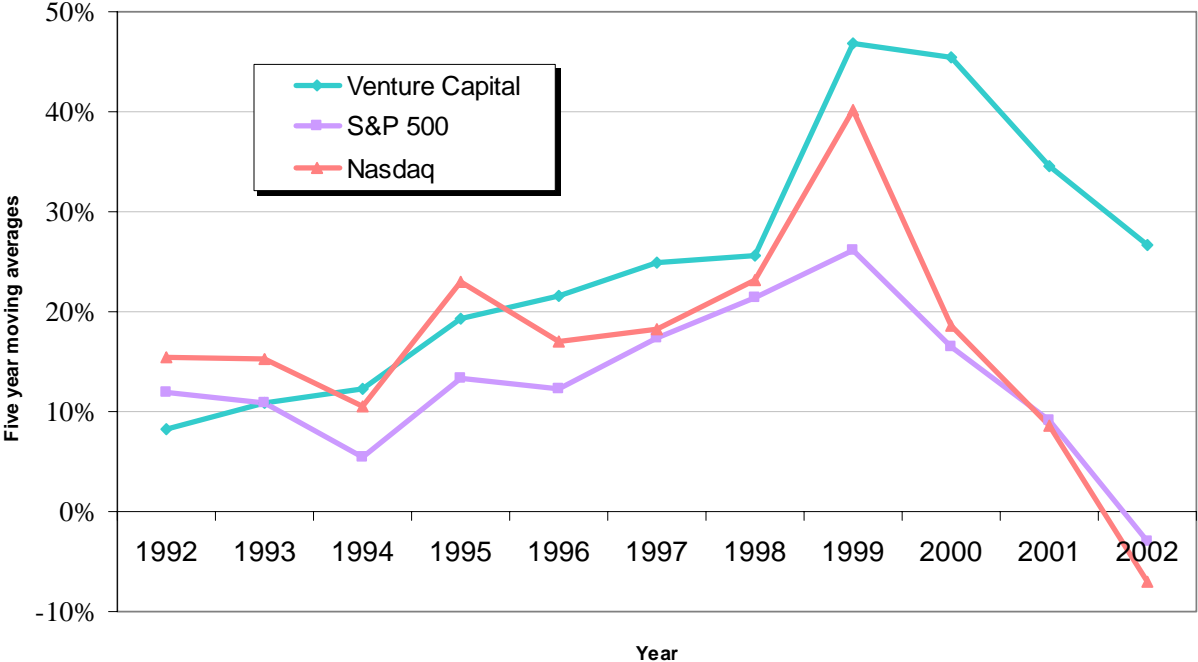
Source: Germany: DAI Factbook 2003. United States: Figure 1.01, National Venture Capital Association Yearbook, 2003 ed. CRSP Database.

**Figure 10. Private Equity under Management as a share of Public Equity Market Capitalization for Germany and the US**



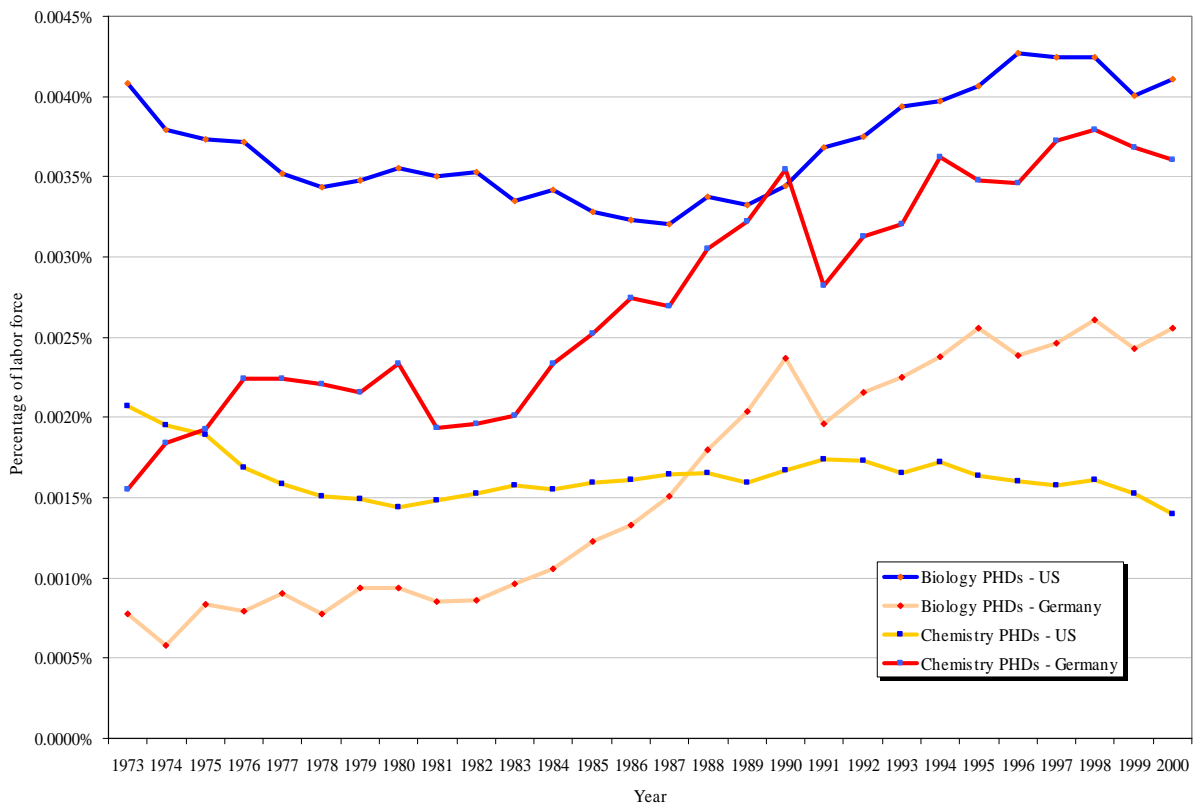
Source: Germany: BVK Statistik, Market cap data from DAI Factbook 2003. United States: Figure 1.01, National Venture Capital Association Yearbook, 2003. Market cap data from CRSP Database.

**Figure 11. Returns to Equity Investing**



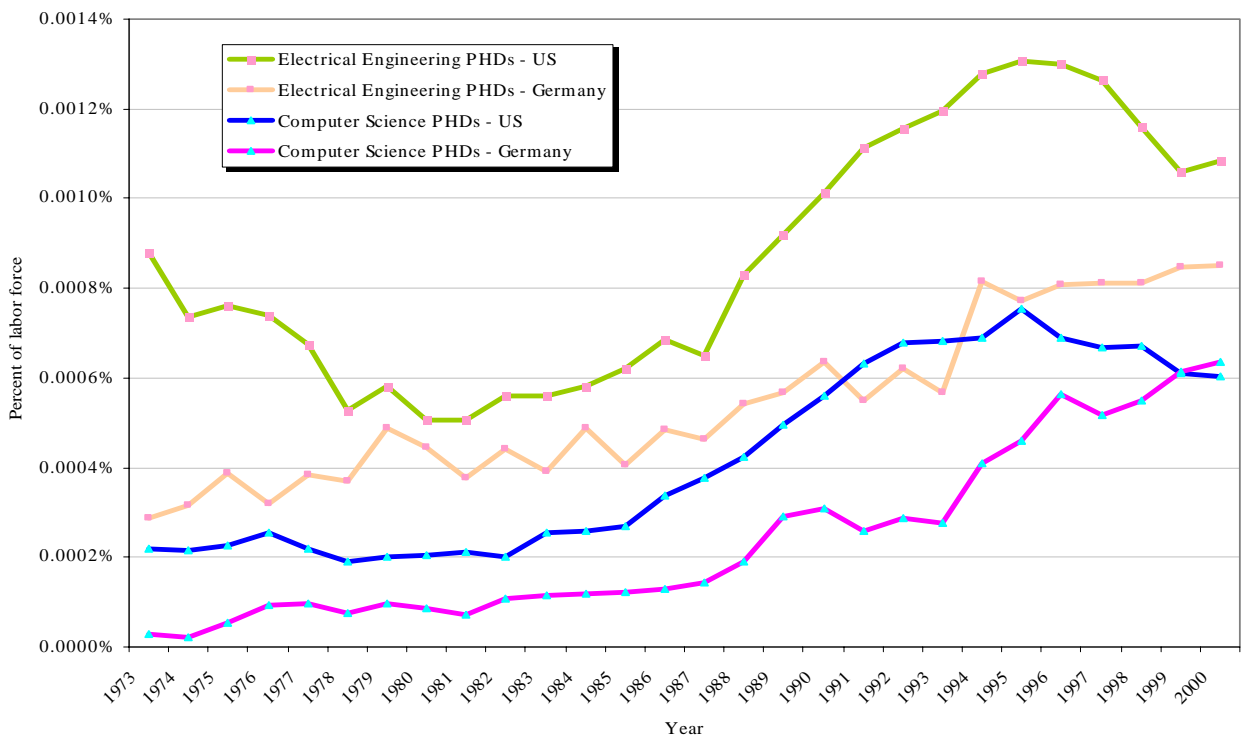
Source: Figure 7.03 NVCA Yearbook (2003).

**Figure 12. Biology and Chemistry PhDs in the US and Germany**



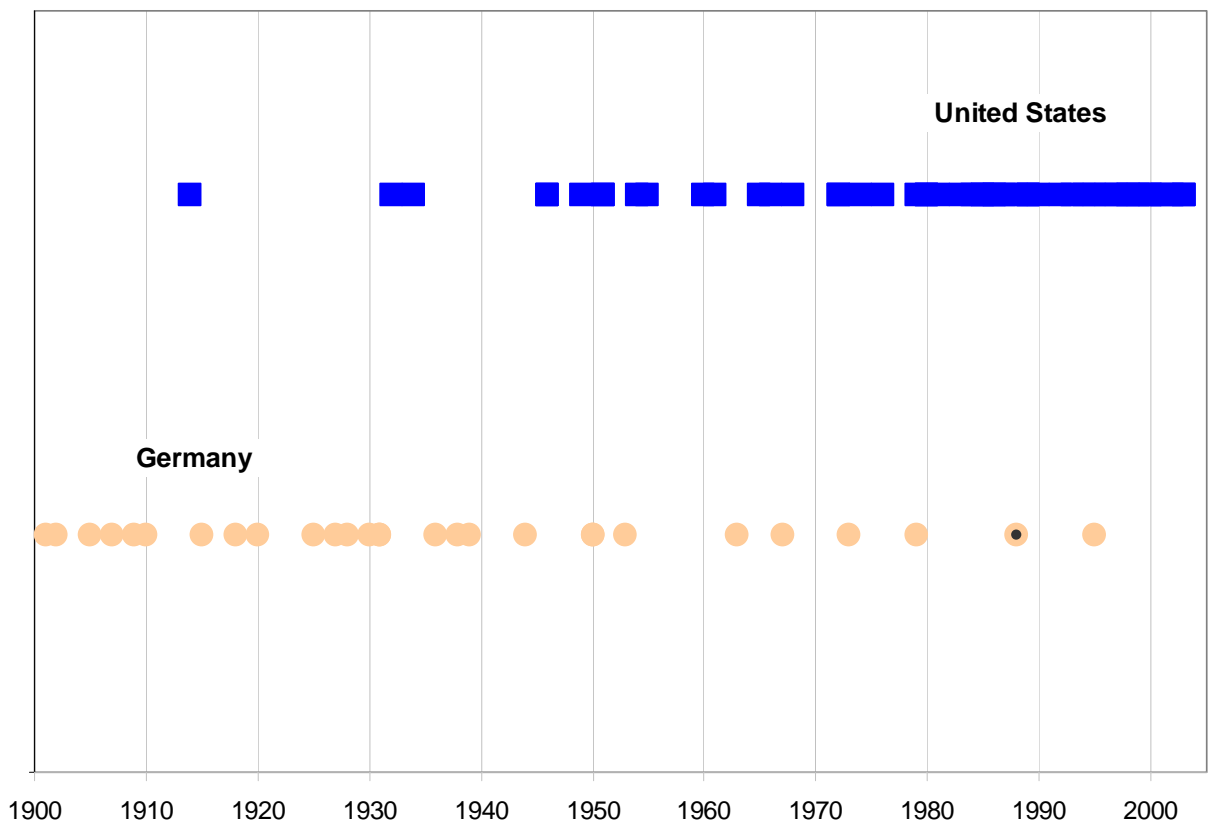
Source: Germany: Statistisches Bundesamt. VDI e.V. USA: National Science Foundation and Department of Education Center for Education Statistics

**Figure 13. Electrical Engineering and Computer Science PhDs in the US and Germany**



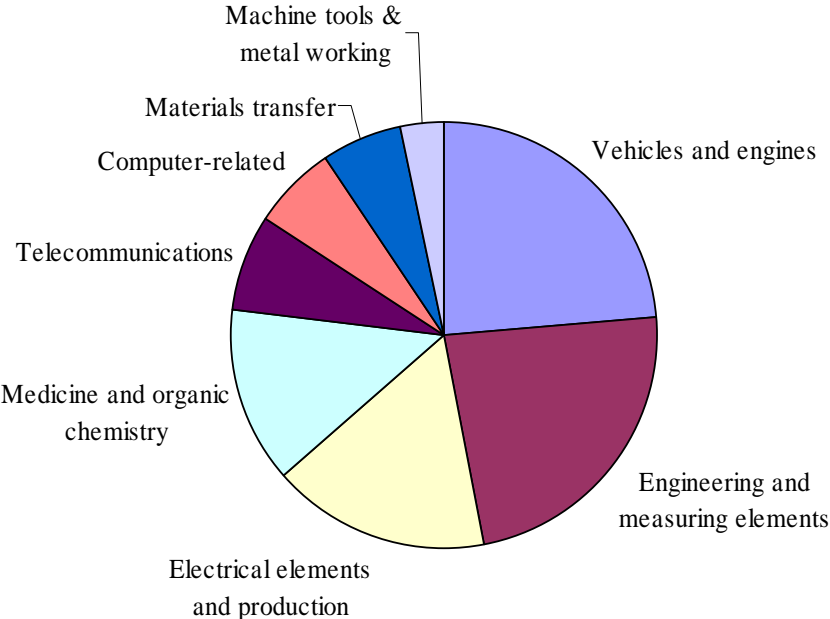
Source: Germany: Statistisches Bundesamt. VDI e.V. USA: National Science Foundation and Department of Education Center for Education Statistics

**Figure 14. Nobel Prizes for Chemistry**



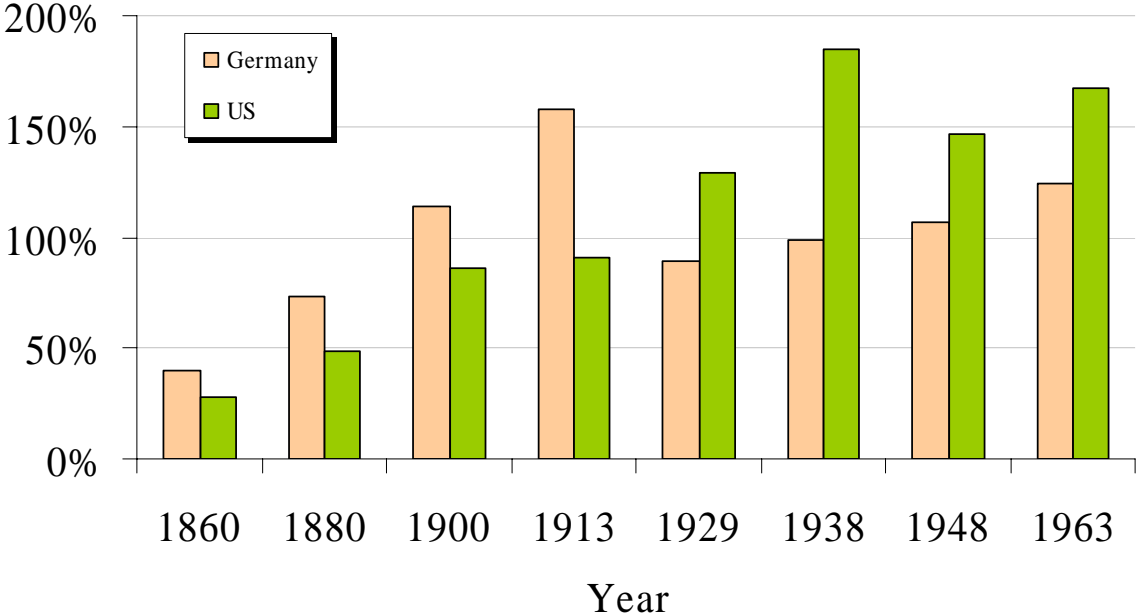
Source: Nobel Foundation.

**Figure 15. Patent Applications by Class in Germany in 2002**



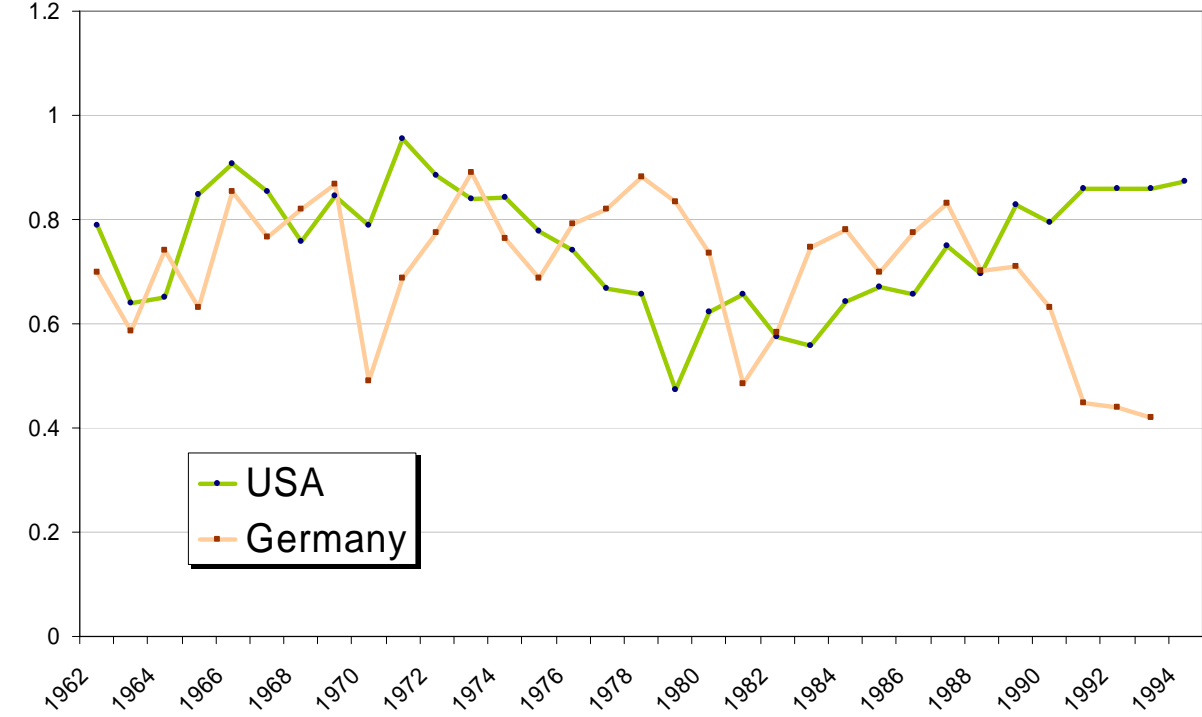
Source: German Patent Office, 2002 Annual Report, (classes with over 975 applications in 2002).

**Figure 16. Financial Institutions Assets as a Percentage of GNP**



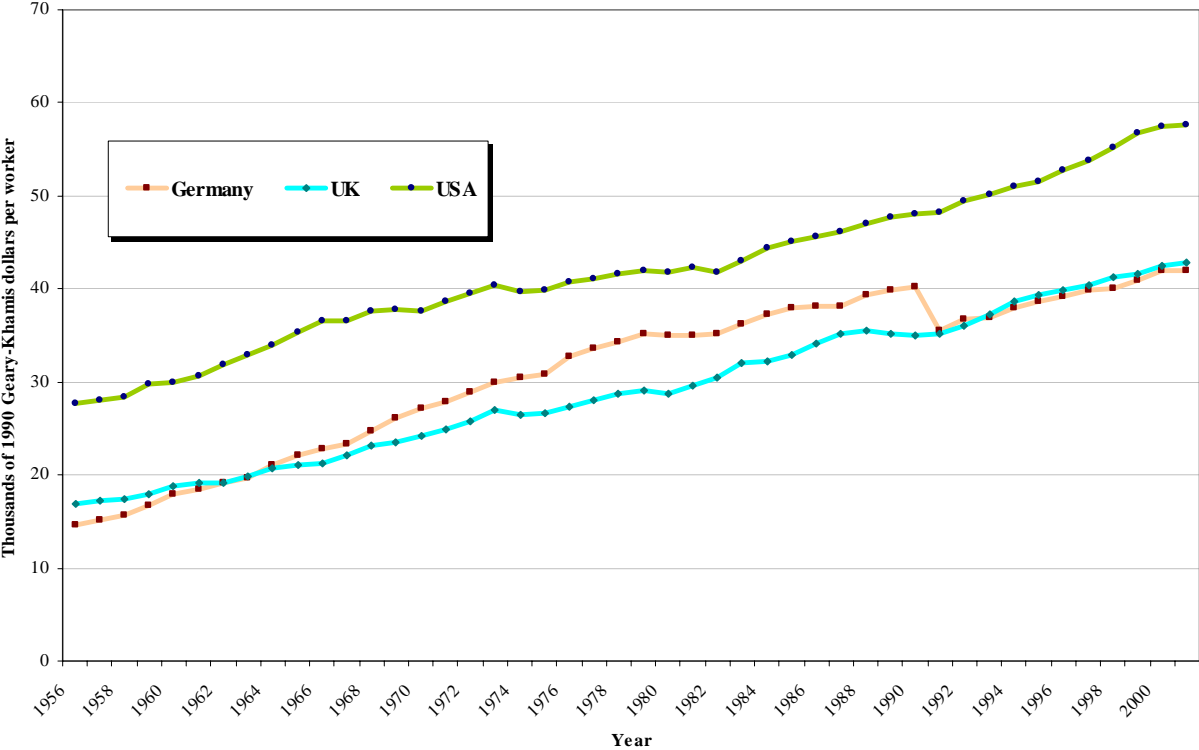
Source: Goldsmith, 1969

**Figure 17. Patents per Labor Force.**



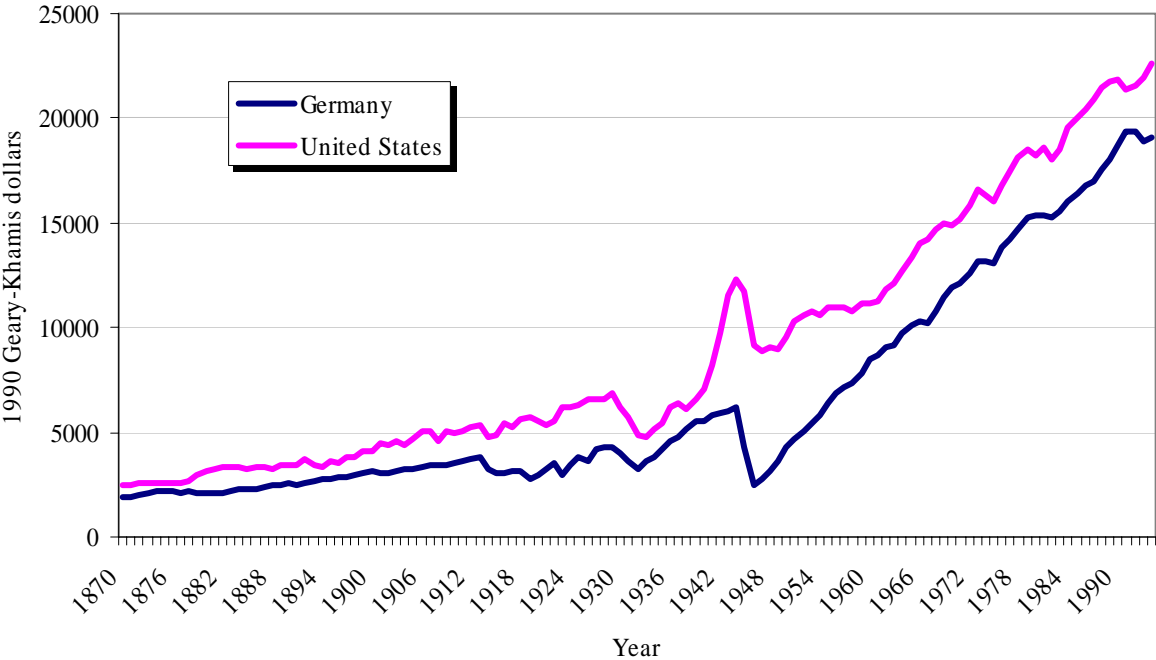
Source:

Figure 18. GDP per worker in the US, United Kingdom and Germany



Source: Maddison, Angus (2003).

**Figure 19. GDP per capita in the US and Germany**



Source: Maddison, Angus (2003)