

Determinants of Success of German Venture Capital Investments

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Based on literature reviews, I formulated 10 hypotheses for a wide range of determinants of success for German venture capital firms (VCFs). I tested and largely confirmed these hypotheses using bivariate correlation analyses and confirmatory multivariate LISREL models on a data set of 103 transactions by 12 German VCFs. The analyses indicate that emphasizing portfolio companies' managers' qualifications, intensifying cooperation between VCFs and portfolio companies, and ensuring a strong (minority) shareholder position of the VCFs coincide with above average success.

In recent debates on ways to improve the supply of equity capital for young or small enterprises in Germany, research on venture capital (VC) financing has again attained increased attention [Kulicke and Wupperfeld, 1996; Pfirrmann, Wupperfeld, and Lerner 1997; Schween 1996; Zemke 1995]. VC financing can be defined as equity investments in closely held private companies with no publicly traded stock (termed portfolio companies (PC)) intended for a limited period of

time. Furthermore, financial intermediaries providing VC (venture capital firms (VCFs)) usually provide management support and exercise control and direction [Bygave and Timmons 1992; Fischer 1987].

I focused on investments of profit-oriented VCFs in the private sector. Because VCFs aiming to allocate public funds usually serve structural and regional development objectives, it would hardly be useful to investigate relationships between management variables and

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company-level economic success criteria in this segment.

At first glance, the development of the German VC market looks positive—despite all criticism of the legal and economic environment. Between 1989 and 1999, the total invested portfolio grew by 18.9 percent per year on average to €7.9 billion (US \$7 billion) [Bundesverband deutscher Kapitalbeteiligungsgesellschaften 2000]. A closer look, however, reveals problems: Available capital consistently grew faster than invested portfolio. This led to a war chest at VCFs that increased by 26.3 percent per year on average between 1989 and 1999 to €6.2 billion or 78 percent of invested portfolio. In addition, the German VC market is small compared to markets in other nations.

Possibly, a low level of success at VCFs could make them a bottleneck in matching supply and demand for private equity effectively. Therefore, I tried to shed light on three research questions:

- (1) How successful are private-sector VCFs in Germany at the level of individual investments?
- (2) Which managerial variables determine the success of individual investments?
- (3) What are the theoretical and practical implications for managing VCFs?

Conceptual Background

The results of published accounts of multivariate investigations of success correlates for VCFs form the basis of my study [Dubini 1989; Keeley and Roure 1990; Rah, Jung, and Lee 1994; Sapienza and Amason 1993; Sapienza and Timmons 1989]. A review of the literature revealed no similar studies for VCFs in German-speaking countries. In fact, the vast major-

ity of studies concern US financing. Exceptions include Fredriksen, Olofson, and Wahlbin [1991], who looked at Swedish VCFs, and Rah, Jung, and Lee [1994], who studied VCFs in Korea.

By analyzing determinants of success for German VC investments, I hope to establish the validity of international results in the German market. However, I have not limited my study to country-specific issues. Rather, I try to advance research relevant to other international markets as well. Based on previous studies, I developed basic blocks of variables to analyze for this purpose (Figure 1). I then developed hypotheses regarding the key relationships between these variables.

The first hypothesis concerns characteristics and policy of the VCF. I defined policy as those properties that VCF management can directly shape. In contrast, structural characteristics can rarely be controlled directly at least over the short term [Schröder 1992 and Zemke 1995]. In developing a hypothesis on economies of scale, I assumed that the size of a VCF had a positive impact on success. Scale advantages result from large VCFs being able to provide resources corresponding to fixed cost (for example, office infrastructure, information technology) more efficiently than small VCFs. In addition, large VCFs are better prepared to capitalize on the functional specializations of their experts, for example, by differentiating acquisition and investment management. In analyzing the consequences of such scale effects, Rosenstein et al. [1993] distinguish between leading VCFs and other VCFs. They find that leading or larger VCFs are better positioned to add substantial value in post-

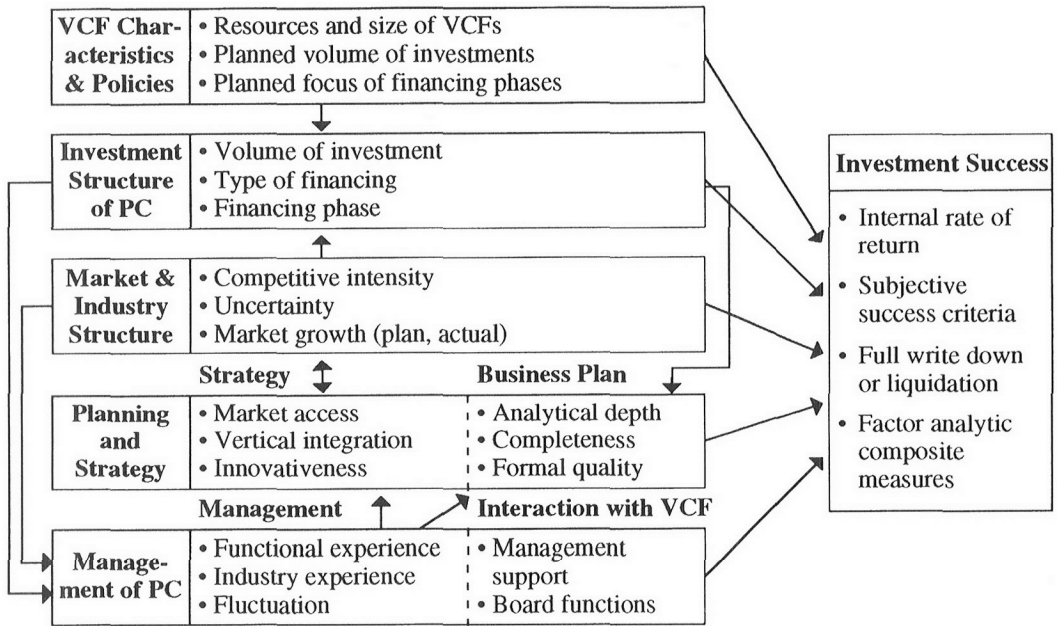


Figure 1: Five blocks of independent variables determine success of VC investments.

acquisition management support. Thus, I hypothesize:

H₁: Growth in size of a VCF measured by volume of investment or number of employees contributes positively towards VC investment performance.

Indicators of size are also among the most frequently discussed characteristics of the investment structure of PCs. Common measures of transaction size include (1) PC revenues, (2) number of employees of the PC, and (3) investment in the PC, either overall investment or the VCF's share. Based on such measures, most empirical findings indicate a higher level of VC investment performance for large PCs than for small PCs due to lower transaction costs. For example, Brüderl, Preisendörfer, and Ziegler [1992] found logarithmic relationships between number of employees as well as amount of capital invested and probability of survival. These empirical re-

sults are generally in line with theory, as larger PC and — even more — large VC deals do imply lower transaction costs. As a consequence, a more thorough investigation of PCs can be justified. Thus, hypothesis H₂ concerns the size of a PC at the time of initial investment:

H₂: A large volume of investment per PC contributes positively towards VC investment performance.

Another important characteristic of the investment structure is the proportion of classical equity versus loans used in a transaction. Key advantages of including some loan financing are (1) a reduction of the risk the VCF carries, because the VCF's performance depends less heavily on the proceeds from finally disinvesting PCs, (2) increased prospects of learning about illiquidity early on, (3) a possibility of influencing management and participating in the board of directors, particularly during



crises, (4) the possibility of providing further capital while the (presumably still active) founders control most of the voting rights, and (5) a chance of recovering the ongoing expenditures of the VCF quickly. Norton and Tenenbaum [1992] and Ofek [1993] report similar reasoning, and Forst [1992] describes the implications of different investment structures of management-buy-out and management-buy-in transactions.

As long as the overall equity character of a VC financing is maintained (in terms of a suitable proportion of loans), I assumed that the advantages of including loans should outweigh the disadvantages. In general, a reverse u-shaped relationship should exist between the proportion of loans and performance, in line with hypothesis H₃:

H₃: A medium proportion of loans in VC financing and the VCF having a strong shareholders' position in the PC coincides with above average VC investment performance.

Regarding market-and-industry-structure variables, analysts traditionally argue that both high market acceptance of a PC's products and services as well as market and industry structure affect PC performance. For example, Bygrave and Timmons [1992], Cooper and Gimeno-Gascón [1992], the literature reviewed in these sources, and Wupperfeld [1994] see the following variables as indicators of market attractiveness: (1) the growth of market volume and customer base, (2) (low) uncertainty regarding future market development, (3) the heterogeneity of products in direct competition, (4) a (low) competitive intensity measured, for example, by the number of competitors and

customers, and (5) level of barriers to market entry. I formulated two hypotheses to represent aspects of market attractiveness, namely competitive intensity (H₄) and uncertainty (H₅):

H₄: Competitive intensity in a PC's market is inversely related to VC investment performance.

H₅: The level of uncertainty regarding the future development of the market and competition is inversely related to VC investment performance.

The literature on the relationships between planning and strategy and success does not provide a clear picture on this subject. Because strategies are hard to measure, tend to be context specific, and are thus difficult to generalize, it is problematic to uncover the impact of various PC strategies on success [Sandberg and Hofer 1987]. In particular, Gottschlich [1989] consistently finds that non-situation-specific strategy variables are less relevant for explaining success than situation-specific strategy variables. However, for the sake of market focus and independence, a young firm's having at least a channel to directly access its end-customer market contributes positively to its performance, H₆:

H₆: A channel a PC can use to directly access its end-customer market contributes positively towards VC investment performance.

The business plan a potential PC prepares for a VCF is a core factor in each VCF's investment decision [Pichotta 1990; Wupperfeld 1994]. Researchers on VC generally assume that this business plan prepared for an external audience represents the quality of planning for internal purposes. In line with this, I postulate positive

relationships between various perceptual measures of the quality of business planning and performance from the perspective of a VCF:

H₇: Analytical rigor, completeness, and formal quality of a business plan contribute positively towards VC investment performance.

The literature largely indicates consensus regarding the relevance of PC top managers (variables on "management of PC") for the economic success of VC investments [Arndt 1995; Bruno, Leidecker, and Harder 1987]. PC managers have to cope with a plethora of expectations [Bhide 1993; Laub 1989; Opitz 1990]. Typical indicators of founder and manager qualifications studied in entrepreneurship research include age, sex, nationality, education, occupational experience, management or directorship experience, industry experience, plus number of founders and managers [Brüderl and Jungbauer-Gans 1991; Cooper, Gimeno-Gascón, and Woo 1994]. However, it is not clear to what extent previous results of entrepreneurship research hold for German VC-financed firms. By thoroughly screening applicants, VCFs will likely reduce the variance of such factors to levels at which the remaining differences can no longer predict success or failure. Researchers and practitioners alike frequently comment that German PC managers' focus on technology and engineering issues is accompanied by a lack of business skills. For instance, in a survey-based study, Wupperfeld and Kulicke [1993] found that for 80 percent of failing companies sponsored by public pilot programs, characteristics of the founder-manager contributed to the failure. PC manager shortcomings were most fre-

quently identified in business functions or skills, such as marketing and sales and general management know-how. In light of prior results, I focused primarily on the (business) functional experience and industry experience of PC management. I formulated two hypotheses, H₈ and H₉:

H₈: The amount of business functional experience of PC managers contributes positively towards VC investment performance.

H₉: The amount of industry experience of PC managers contributes positively towards VC investment performance.

The information and control rights specified in investment agreements [Grisebach 1989; Zemke 1995] and the management support the PC requires [Kulicke 1993; Wupperfeld 1994] are also core fields of VC research. Researchers have generally found that content-oriented consulting support usually takes place outside the board of directors, which focuses largely on exercising formal information and control rights. In addition, Rosenstein et al. [1993] found that the value of participating in the board is quite limited. At best, the contributions of highly experienced representatives of leading VCFs can systematically exceed the contributions of average board members. The case of Deutsche Wagnisfinanzierungs-Gesellschaft, formerly a public-sector VCF, further demonstrates the importance of consulting-type management support compared to merely exercising information and control rights [Mayer and Müller 1991]. This VCF initially focused on formal control mechanisms but soon shifted to more creative forms of management support. One might argue that consulting can systematically enhance the performance of PCs, while ex-

exercising information and control rights can at best contribute to avoiding failures, H_{10} :

H_{10} : *Management support provided by the VCF—unlike merely exercising information and control rights—contributes positively to VC investment performance.*

Methodology

I collected PC data for this study from members of "Bundesverband deutscher Kapitalbeteiligungsgesellschaften (BVK)-German Venture Capital Association" in 1995. I gathered data by means of a largely standardized questionnaire, which the BVK mailed in October 1995. At that time, the overall population consisted of approximately 94 VCFs in Germany, of which 79 were members of BVK. Among the BVK members, 48 VCFs were classified as private-sector firms striving for economic returns. As some firms manage multiple funds, these 48 VCFs can be consolidated into 37 groups of private-sector VCFs. The BVK mailed my questionnaire to directors at each of these 37 groups. Ten experts returned usable questionnaires, a

27.0 percent response rate. The 10 experts provided information on 103 PCs of 12 VCFs. These experts provided all the objective and subjective information I used in this study. At the end of 1995, these 12 VCFs collectively held a portfolio of approximately €0.7 billion (US \$0.6 billion) equivalent to 33.0 percent of the total portfolio of all profit oriented VCFs in Germany of €2.1 billion. The frequency distribution of VCF size and ownership type of our sample indicates that it is fairly representative of the industry, although it lacks VCFs focusing on seed and start-up financing.

The measurement PC performance criteria and main potential correlates of success are defined in the Appendix.

Empirical Analysis

Table 1 shows the descriptive statistics for PC performance. For 88 cases, the internal rate of return (IRR) reported ranged from -23 percent to +111 percent per year. For nine cases, no IRR could be calculated, because these firms were liqui-

PC Performance Measures ^a	M^b	S	Median	N	Kendall's Tau \ Pearson's r^c			
					1	2	3	4
1. IRR	18.3%	21.1%	15.0%	88	—	+0.47***	+0.42***	—
2. RPLAN ^d	1.7	0.9	2.0	100	+0.54***	—	+0.76***	-0.59***
3. RINDU ^d	2.1	1.0	2.0	98	+0.47***	+0.66***	—	-0.69***
4. LOSS ^e	0.09	0.28	0.0	103		-0.45***	-0.49***	—

a) Abbreviations: IRR = internal rate of return; RPLAN = return as compared to business plan; RINDU = return as compared to industry average; LOSS = write off/liquidation.

b) Abbreviations: M = (arithmetic) mean; S = standard deviation; N = number of cases.

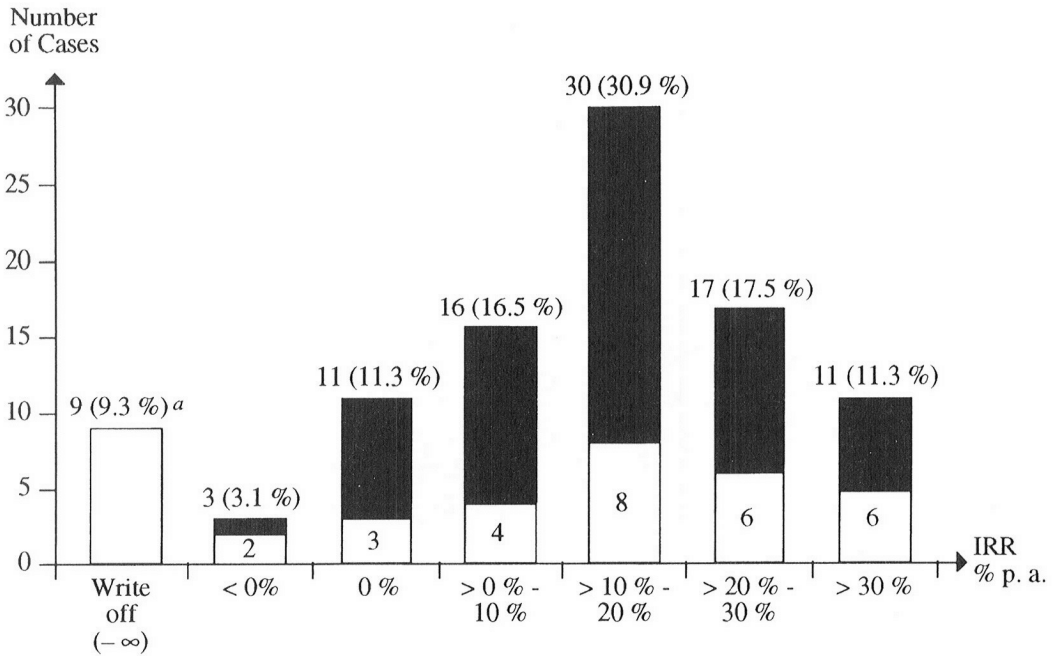
c) Values above the main diagonal: Pearson's r ; below the main diagonal: Kendall's Tau.

d) Scale: 0 = write off; 1 = worse than expected; 2 = as expected; 3 = better than expected.

e) Scale: 1 = write off; 0 = other.

+ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, and *** $p < 0.001$ (two-tailed tests).

Table 1: From a venture capitalist's perspective, portfolio companies yield an average internal rate of return of 18.3 percent per year.



a) In parentheses: Percentage of all cases (N = 88 + 9 = 97).

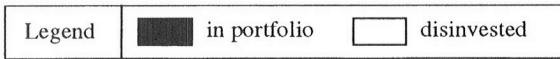


Figure 2: Most portfolio companies yield an internal rate of return of 10 to 20 percent per year.

dated. For six further PCs still held, the VCFs reported no IRR. In total, IRR averaged 18.3 percent with a median of 15.0 percent. As the average is skewed by extreme cases (for three investments, the VCFs reported returns above 100 percent per year), the median appears to be more suitable to characterize the usual VC-financed firm's returns in Germany.

Figure 2 shows distribution of returns. The majority of investments, 30 cases (30.9 percent), fall between over 10 percent to 20 percent per year. Seventeen PCs (17.5 percent) range from over 20 percent to 30 percent and 16 PCs (16.5 percent) fall between more than zero percent and 10 percent. For PCs already disinvested, the distribution is shifted slightly to the right indicating higher average returns. Two

characteristics of the IRR measured are important. First, investments that had to be fully written off cannot be included. Second, returns measured do not yet include costs incurred by the VCF. In light of these considerations, returns between 15.0 percent (median for the entire sample) and 22.6 percent (arithmetic mean for PCs already disinvested) do not exceed expectations based on conceptual thought: One can assume [Schefczyk 2000] that operating expenditures of a VCF equal two percent of portfolio volume. Furthermore, 85 percent of the return is likely to be represented by capital gains realized when disinvesting a PC. Of such capital gains, a VCF can typically collect a management fee of 20 percent for a net return to the investor of approximately 16.3 percent

(= 22% - 2% - 22% × 0.85 × 0.2) if one disregards investments ending in liquidation. Even if operating expenditures—for example, at large and captive VCFs—and the management fee upon disinvestment can be kept lower, this return at best appears to be marginally sufficient to fund (1) liquidations of failing investments and (2) the expected return to the funder given such write-offs. For the overall German VC market, liquidations have been approximately two percent per year [Schefczyk 2000]. This makes the returns observed in my sample incompatible with the frequently stated requirement of a net return of approximately 15 percent per year [Bygrave 1992; Reyes 1995].

In analyzing the differences in performance depending on the financing stage of the individual PC, I found that write offs in the sample were concentrated on start-up firms. Over 25 percent of these early stage financings had to be liquidated. In line with expectations, the risk of insolvency is thus significantly higher for early-stage financing than for later stage financing.

I developed descriptive statistics for the potential determinants of success (Table 2), including measures of VCF size. The portfolio sizes of the VCFs in my sample ranged between 8 and 204 million € (equal to US \$7 and 180 million). The arithmetic mean was €76 million (US \$67 million),

Performance Correlates	M ^a	S	Median	Min	Max	N
1. VCF's volume of investment ^b	76	71	49	8	204	12
2. VCF's number of employees	13.7	12.1	7.0	4	35	12
3. Volume of investment per PC ^b	3.45	3.57	2.07	0.26	18	103
4. Proportion of loans	15%	25%	0%	0%	95%	103
5. Equity stake per PC	31%	18%	25%	3%	80%	90
6. Intensity of competition ^c	0.37	0.91	1.00	-2.00	2.00	100
7. Uncertainty ^c	0.09	0.90	0.00	-2.00	2.00	100
8. Access to end-customer market ^d	93%					100
9. Quality of business plan ^c	0.16	1.05	0.00	-2.00	2.00	100
10. Functional experience ^c						
10a. Technical	0.87	1.05	1.00	-2.00	2.00	97
10b. Marketing and sales	0.73	1.12	1.00	-2.00	2.00	99
10c. Planning and strategy	0.24	1.27	0.00	-2.00	2.00	99
10d. Finance and mgt. accounting	0.20	1.27	0.00	-2.00	2.00	98
11. Industry experience ^e	84%	31.6%	100%	0%	100%	98
12. Management support ^d	42%					102
13. Functional integration ^c	-1.04	0.77	-1.25	-2.00	1.25	88

a) Abbreviations: M = (arithmetic) mean; S = standard deviation; N = number of cases.

b) In million €.

c) Five-point scale, range -2 to +2; -2 = very low level; 0 = average level; +2 = very high level.

d) 0/1-Variable: 1 = criterion met.

e) Proportion of mergers of the management team.

Table 2: Venture capitalists rate qualifications of portfolio companies' managers in planning, strategy, finance, and management accounting relatively low.

and the median was €49 million (US \$43 million). VCFs on average employ 13.7 staff. This is equivalent to a portfolio of €5.5 million (US \$5 million) per employee.

All further variables describe aspects of the PC. Individual transactions range between €0.26 and 18 million (US \$0.2 and 16 million) for an arithmetic mean (median) of €3.45 (2.07) million (US \$3.05 (1.83) million). Of this investment, on average 15 percent is provided as loans. On this basis, the percentage of a PC's equity controlled by a VCF equals a mean (median) of 31 percent (25 percent). Consistently for these variables the median is smaller than the arithmetic mean, indicating skewed distributions. This is plausible, as most deals are fairly small.

I estimated competitive intensity and uncertainty for each PC on a five-point scale ranging from -2 to $+2$. As the mean of 0.37 indicates, throughout the PCs faced intense competition. Ninety-three percent of the PCs analyzed can directly access their end-customer markets. Companies that focus on more basic levels of the value chain (for example, contract developers or manufacturers of intermediary products for a small customer base) are not the norm. I represented quality of the business plan using an average of scores on three individual scales. Large differences of quality exist among PCs in the sample, as the standard deviation of 1.05 indicates. Further conclusions, however, should not be drawn from descriptive statistics alone.

I evaluated PC managers' functional experience at the time of the initial VC investment; means ranging from $+0.20$ to $+0.87$ indicate an above-average level of

perceived qualification. As I expected, I saw their average level of experience in technical fields as quite high (mean score: $+0.87$). Rather surprisingly, I thought their experience in marketing and sales, with a score of $+0.73$, was similar to that for technical functions. Substantially lower—and again in line with my expectations—are the VCFs' experts' evaluations of their experience in the business functions of planning and strategy (with a score of $+0.24$) and finance and controlling (with a score of $+0.20$). Approximately 84 percent of the PC managers had been active in the same industry immediately prior to joining a VC-financed firm.

I also measured cooperation between VCF and PC. At 42 percent of PCs, in addition to financial investment, the VCFs provided management support beyond participation in the board of directors and could be classified as management consulting. However, informants usually perceived VCFs' participation in the PCs' functional decisions as low, as an average score of -1.04 (scale -2 to $+2$) indicates.

Relationships Between Success Factors and Performance

Table 3 shows the bivariate relationships between the potential success factors described before and the PC performance measures. The VCFs' portfolio size (variable 1) is correlated with internal rate of return (IRR) with $r = +0.18$ ($p < 0.1$). I detected no significant relationships between VCFs' number of employees (variable 2) and any of the performance measures. In line with hypothesis H_1 , these findings indicate that some scale efficiencies exist for VCFs holding large portfolios. The scope of hypothesis H_1 , however,

Performance Correlates	Pearson's <i>r</i>	Kendall's Tau		Pearson's <i>r</i>
	IRR ^a	RPLAN	RINDU	LOSS
1. VCF's volume of investment	+0.18 ⁺	—	—	—
2. VCF's number of employees	—	—	—	—
3. Volume of investment per PC	—	+0.20 *	+0.19*	-0.18 ⁺
4. Proportion of loans	+0.23*	—	+0.15 ⁺	—
5. Equity stake per PC	—	—	+0.24**	—
6. Intensity of competition	-0.16	-0.19*	-0.16 ⁺	+0.21*
7. Uncertainty	—	-0.28***	-0.26**	+0.22*
8. Access to end-customer market	+0.25*	+0.18 ⁺	+0.17 ⁺	—
9. Quality of business plan	—	+0.29***	+0.18*	-0.27**
10. Functional experience				
10a. Technical	+0.19	+0.25**	+0.29***	-0.29**
10b. Marketing and sales	+0.34***	+0.33***	+0.24**	-0.23*
10c. Planning and strategy	+0.23*	+0.37***	+0.28***	-0.26**
10d. Finance and mgt. accounting	—	+0.35***	+0.22*	-0.26*
11. Industry experience	—	+0.32***	+0.27**	-0.38***
12. Management support	—	+0.21 *	+0.26**	-0.25*
13. Functional integration	—	—	+0.13	—

a) Abbreviations: IRR = internal rate of return; RPLAN = return as compared to business plan; RINDU = return as compared to industry average; LOSS = write off/liquidation.

Number of cases: 76 ≤ N ≤ 103.

+*p* < 0.10, **p* < 0.05, ***p* < 0.01, and ****p* < 0.001 (two-tailed tests).

Relationships for which *p* > 0.15 are not shown.

Table 3: Business functional and industry experience of portfolio company managers contribute towards performance.

should be limited to portfolio volume as the only measure of size relevant to performance.

In hypothesis H₂, I postulate a higher level of VC investment performance for larger transactions. In support of H₂, my findings indicated that volume of investment per PC (variable 3) correlates—to a modest degree—with both perceptual measures of performance and with the risk of failure. Hypothesis H₃ states that—within limits—a loan component built into a VC financing can lead to an advantageous allocation of property rights for the VCF and thus improved PC performance. Correlations between the propor-

tion of loans (variable 4) and IRR as well as return as compared to industry (RINDU) confirm H₃.

Hypothesis H₄ is that PC performance, in particular the probability of survival, is adversely affected by competitive intensity, which is supported by my findings (line 6 of Table 2). In line with H₅, high uncertainty is associated with low performance, with the exception of IRR (line 7 of Table 2). The strong association of high uncertainty with RINDU is somewhat counterintuitive: Uncertainty should be similar for all firms in an industry. This phenomenon might be a consequence of (1) the perceptual measurement of success

and (2) the classification of PC by industry. The bivariate findings, however, are sufficient to support both hypotheses.

In agreement with H_6 , access to the end-customer market contributes positively to performance (variable 8). However, direct access to the market apparently can not reduce the risk of failure.

Regarding the quality of the business plan (variable 9), the negative association of high quality with risk of failure and the positive association with RINDU are easily interpreted. However, ex-post judgments of business plan quality are likely to be biased negatively for PCs that had to be liquidated. Furthermore, (1) the seemingly tautological correlation of business plan quality with the RPLAN performance measure, and (2) its lack of a significant correlation with IRR, are problematic. Thus, business plan quality might have to be excluded from multivariate analyses to avoid similar problems. Taken together, bivariate findings still largely support that high-quality business plans can increase VC investment performance and decrease the risk of failure.

Regarding PC manager qualifications, experience in all functions studied and industry experience (variables 10 and 11) are positively associated with perceived performance and negatively associated with the risk of PC liquidation. However, IRR correlates with only three out of five indicators. The reasons for this weak IRR-correlation pattern include the following: (1) The individual success criteria represent different facets of success. (2) Subsequent to VC investments, manager qualifications primarily affect deviations of success from an expected value

(based on business plan or industry), while the expected value itself depends on business aspects of the PC.

(3) IRR as a measure of PC performance is not determined by any single manager qualification variable but by a whole set of such variables.

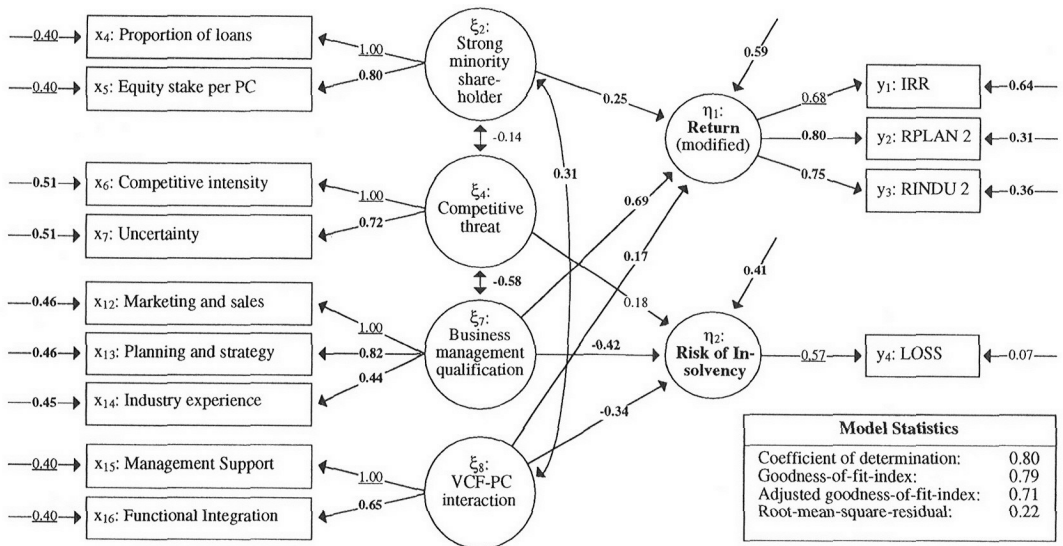
(4) Correlations between the perceived manager qualifications and subjective PC performance assessments are overestimated due to common method variance.

To conclude, the data provide some support for hypotheses H_8 and H_9 .

In line with H_{10} , multiple performance criteria are significantly associated with the management support (variable 12) the VCF provided. Measured by RPLAN and RINDU, approximately four to seven percent of performance variance can be explained by differences in the management support they gave to PCs. Rather surprisingly, no significant association exists for IRR. One could suspect that the correlations with perceived performance were due to the experts' bias arising from their involvement in these firms. This interpretation, however, should be rejected as management support is negatively associated with the risk of failure—a rather objective criterion. The variables on integration of a VCF in functional PC decisions (variable 13) are also associated with performance criteria but to a lesser degree.

Multivariate Analyses Seeking to Confirm Relationships

I attempted to confirm the bivariate findings through additional multivariate analyses. I used a causal analytic approach (1) to rigorously test the hypotheses defined while avoiding a focus on explorative analyses and (2) to go beyond associa-



(Path-)coefficients in bold letters are significant on a 5 % level (one-tailed tests). Significant of coefficients in underlined letters cannot be tested since values had to be restricted to define scales.

Figure 3: Business management qualification has a significant impact on return as well as risk of insolvency.

tions in terms of variance shared across variables to validate causal relationships.

The core of my causal analytic approach was LISREL-models [Jöreskog and Sörbom 1989]. In the first LISREL-model (Figure 3), I measured four exogenous latent variables: strong minority shareholder, competitive threat, business management qualification, and VCF-PC interaction using two or three indicator variables. The indicator variables are equivalent to the measures used for bivariate analyses. Structural relationships between the exogenous latent variables and the two endogenous latent variables, return (modified) and risk of insolvency, drawn on the right, are in the center of this analysis. The endogenous variables are represented by the performance measures (Table 1). To conceptually separate the two endogenous constructs, I assigned the perceptual performance scores a missing value when a PC was liq-

uidated. Key technical assumptions in this LISREL analysis were pairwise exclusion of missing values and an analysis of a covariance matrix via the maximum-likelihood method.

Because the sample size limits the number of parameters that can be estimated simultaneously, I had to prioritize variables in specifying the model. This model reflects hypotheses H_{3-5} and H_{8-10} . I omitted VCF size (H_1) because it seems to represent a control variable that is not specific to individual PCs. I disregarded transaction size (H_2) because it also seems to be a control variable. I excluded direct access to the end-customer market (H_6) for technical reasons. I wanted to avoid problems with latent constructs being represented by single, dichotomous indicator variables. I omitted the variable on business plan quality (H_7) because it seemed a secondary determinant of performance.



In examining the structural relationships between the latent variables, I found an overall coefficient of determination of 0.80, which implies that the structural model explains most of the observed variance. Three latent variables significantly determine return: PC management qualification, primarily in business functions, has the strongest influence (0.69). Strength of the VCF's position as a minority shareholder (0.25) and the interaction between VCF and PC (0.17) come second and third. Risk of insolvency is reduced most effectively by high manager qualifications (-0.42) and second by close interaction between VCF and PC (-0.34). However, risk is increased by competitive threat (0.18), albeit with moderate significance ($p < 0.10$). Thus, all the path coefficients are in line with my expectations and support my hypotheses.

Most of the relationships between the exogenous latent variables also confirmed my expectations. First, a strong minority shareholder's position enables a VCF to best structure its cooperation with the PC (0.31). Second, a slight negative link exists between competitive threat and shareholder's position (-0.14 , $p < 0.10$). This is compatible with my expectations, because I used the proportion of loans as an indicator variable of the construct "strong minority shareholder." It can be demonstrated that the proportion of loan financing decreases when the competitive threat is high (that is, when the risk of insolvency is high). Third, a high competitive threat goes along with low manager qualifications (-0.58). Considering my method of data collection, this could imply that the evaluation of manager qualifications is

not fully objective but rather also depends on environmental factors. While a satisfactory interpretation can be found for the nature of this relationship, its strength remains to be explained. As the goodness-of-fit-index of 0.79 (adjusted, 0.71) indicates, model quality is quite acceptable beyond the structural equations as well.

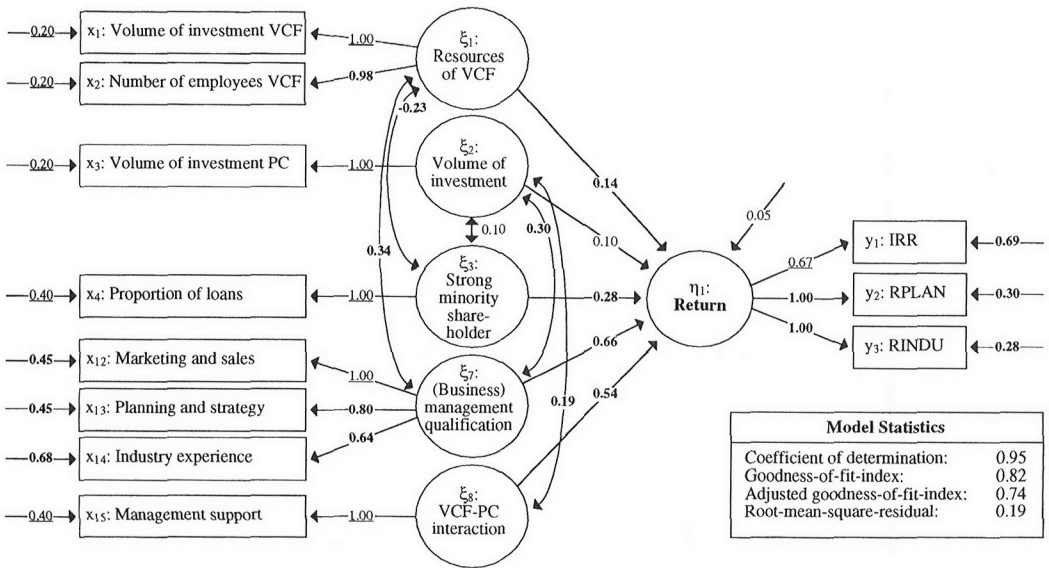
The second LISREL-model (Figure 4) considers return as the only endogenous latent variable. In this case, I defined the indicator variables for return to be RPLAN and RINDU which are defined exactly as discussed in the previous section. As an overlap between multiple endogenous variables is no longer relevant, no modification is necessary to treat the case of failure as a missing value in this model. The technical assumptions in this LISREL analysis were listwise exclusion of missing values and an analysis of a polychoric and polyserial correlation matrix via the maximum-likelihood method.

This model reflects hypotheses H_{1-3} and H_{8-10} . I made three restrictions because a limited number of parameters could be estimated simultaneously:

- (1) I omitted the equity stake per PC as the second indicator variable for the construct "strong minority shareholder."
- (2) I omitted functional integration as the second indicator variable for the construct "VCF-PC interaction."
- (3) I could not include the indicator variable regarding direct access to the end-customer market.

In addition, I dropped the construct "competitive threat" from the model, because it is primarily related to the variable "risk of insolvency," which I also dropped.

For the structural relationships between



(Path-)coefficients in bold letters are significant on a 5 % level (one-tailed tests). Significant of coefficients in underlined letters cannot be tested since values had to be restricted to define scales.

Figure 4: An alternative model confirms the impact of business management qualification on return.

the latent variables, I found an overall coefficient of determination of 0.95. The same variables as in the first model again determine return. PC management qualification still has the strongest influence (0.66). Compared to the first model, this model showed more importance for the interaction between VCF and PC (0.54). It is hard to explain this increase in the path coefficient. On the one hand, the influence of this construct might have become more focused, because the risk of insolvency is considered directly in RPLAN and RINDU instead of being represented by a separate latent variable as it was in the first model. On the other hand, only one dichotomous indicator variable remains for the construct "VCF-PC interaction," which increases the likelihood of analytical problems. The third variable determining return is the strength of the VCF's position as a share-

holder (0.28). Next in order are those variables not considered in the first model: the size and resources of the VCF (0.14) and the volume of investment per transaction (0.10, $p < 0.10$).

The relationships between the exogenous latent variables were again mostly in line with my expectations. High management qualification was significantly associated with high volume of investment (0.30). This indicates that large PCs are usually more attractive employers. A similar association exists between volume of investment and intensity of cooperation between VCF and PC (0.19). This implies that for large transactions, VCFs can justify providing substantial management consulting. As the size and resources of the VCFs increase, the strength of their positions as shareholders tended to decrease (-0.23). Many large VCFs are subsidiaries

of German banks, and the banks often provide VC and loans via different companies (for example, VCF versus bank at large or mortgage-banking subsidiary). The complexities of coordinating multiple intermediaries providing capital to a single PC will often reduce the shareholders' position. In contrast, VCFs' positions as shareholders tend to increase with the volume of investment (0.10). More difficult to explain is the strong relationship between VCF size and manager qualification (0.34). This could mean that large and well-known VCFs find it easy to acquire PCs with highly qualified managers. Or it could indicate analytical problems in evaluating manager qualifications, that is, that large VCFs tend to view PC managers more positively than small VCFs. For the overall model, I found a goodness-of-fit index of 0.82 (adjusted, 0.74). When compared to the results of the first model, these indices and slightly more plausible coefficients represent an improvement in model quality.

The results of both multivariate models—despite some shortcomings in methodology—support all hypotheses except H_6 and H_7 . Hypotheses H_6 and H_7 have not been rejected. Rather, analytical constraints did not allow these hypotheses to be tested multivariately. Thus, the results of the multivariate analyses do not cast doubt on the support bivariate analyses provided for these hypotheses.

Discussion

In my study, I tried to provide an empirical foundation regarding the performance of VC investments and its determinants. In Germany, these subjects have been discussed mainly on a qualitative ba-

sis. This is the first time findings based on a large sample of transactions by German private sector VCFs have been published. To characterize performance, I used internal rate of return, perceptual measures, and the proportion of failures. While the IRR-criterion is well accepted internationally, it has not yet fully penetrated VC practice in Germany. In addition, hypotheses-driven multivariate analyses permitted me to draw conclusions regarding what management characteristics are generally associated with high VC investment performance.

In so doing, I answered two research questions. First, I formulated and partially verified a new variable block model regarding determinants of success of VC investments in Germany. I found least limited support for all 10 hypotheses tested. Multivariate analyses reinforced the findings for eight of these hypotheses. Based on my findings, the performance of VC investments seems to depend most strongly on PC characteristics, primarily the qualifications of its managers. Ranked second are aspects of the managerial and financial relationships between VCF and PC. VCFs can influence these aspects by choosing appropriate PCs and can shape them by structuring and managing investments appropriately. Second, this study allows me to make some normative recommendations for VCFs:

- Emphasize the qualifications of PC managers, mainly with respect to business functions and industry experience.
- Pursue cooperation with PCs by providing consulting-type management support beyond mere participation on the board.
- Focus on strong (minority) shareholders'

positions; if necessary to maintain minority status, provide additional capital via loan financing.

In addition, the study's limitations indicate needed future VC research.

- (1) Larger samples are needed to ensure representativity and to permit the inclusion of more potential success factors in multivariate analyses.
- (2) Longitudinal studies in which data were collected in multiple phases that parallel actual developments would help researchers to avoid problems of common method variance and enable them to better interpret correlations in terms of cause-effect-relationships.
- (3) Future researchers should avoid relying in single-source expert perceptions and instead use multiple data sources.
- (4) Researchers need improved methods for evaluating PCs prior to disinvestment; current approaches almost exclusively consider deviations between plan and the pattern of past performance.
- (5) Researchers should develop risk-scoring models to project specific investment risk in a pragmatic manner during potential investment evaluation.

APPENDIX: Measurement of PC Performance and Performance Correlates **PC Performance Criterion**

—Internal rate of return (IRR): Based on the definition "gross return for realized and current investments" by the European Venture Capital Association (EVCA) (cf. European Venture Capital Association 1994; Schober 1995). IRR was requested for each investment. This variable measures the internal interest rate of cash outflows by the VCF to the PC (primarily cash outflows for equity acquisitions) and cash inflows from divestitures as well as dividends plus interest and repayments of

loans. For investments currently held, the cash flow from divestitures is replaced by an estimated terminal value of a PC.

—Actual return compared to business plan (RPLAN): Measured by asking respondents to compare actual return to predictions based on the business plan submitted prior to the investment. Experts used a four-point scale.

—Actual return compared to industry return (RINDU): Obtained by requesting respondents to compare a PC's return to other companies in the same industry using the same four-point scale format described for RPLAN.

—Full write down/liquidation (LOSS): LOSS criterion was measured as a 0/1-variable with 1 indicating a complete loss of the investment.

Performance Correlate

—Volume of investment VCF: Requested in million DM per end of the last fiscal year.

—Number of employees VCF: Requested as full-time equivalents per end of the last fiscal year.

—Volume of investment PC: Indicator of transaction size. For the sake of simplicity, this variable was measured as a cumulative figure. From a research perspective, time series data would have been advantageous. However, this would have significantly increased the scope of our survey instrument.

—Proportion of loans: Investment structure characteristic. Measured as a cumulative figure.

—Equity stake per PC: Investment structure characteristic. Measured as a cumulative figure.

—Competitive intensity: Estimated per PC by the experts surveyed on a five-point scale. The scales' center of zero has been marked to represent an average level.

—Uncertainty: Estimated per PC by the experts surveyed on a five-point scale. The scales' center of zero has been marked to represent an average level.

—Access to end customer market: Measured as a 0/1-variable with 1 indicating either direct sales or sales via dealers, while 0 was assigned to research and development subcontractors and comparable manufacturers without access to the relevant end customers.

—Quality of the business plan: Estimated on three five-point scales for analytical rigor, completeness, and formal quality. The average of these business plan quality scores was used for further analyses.

—Functional experience of PC managers: Measured in four fields: (1) development, (2) manufacturing/logistics, (3) marketing/sales, (4) planning/strategy, and (5) finance/controlling, each on a five-point scale ranging from low (= -2) to extensive (= +2) (cf. MacMillan, Zemann, and Narasimha 1987). An average for development and manufacturing/logistics forms an indicator of technical experience.

—Industry experience of PC managers: Measured via the percentage of managers who gathered industry specific professional experience immediately prior to joining the PC.

—Management support: Provisioning of management support by the VCF (in contrast to merely exercising information and control rights) was measured as a 0/1-variable.

—Integration of the VCF in functional decisions of the PC: Measured on four five-point scales for development, manufacturing, sales, and finance decisions. Averaging these variables yielded an overall measure of functional integration.

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