Bankruptcy, Subsidized Loans, and Exit Decisions of Start-up Firms

Inauguraldissertation
zur Erlangung des akademischen Grades
eines Doktors der Wirtschaftswissenschaften
der Universität Mannheim

Susanne Luise Prantl

Vorgelegt im November 2001

Referent:	Prof. Konrad Stahl, Ph.D.
Korreferent:	Prof. Dietmar Harhoff, Ph.D.
Dekan:	Prof. Dr. Christoph Buchheim
Tag der mündlichen Prüfung:	14.02.2002

Acknowledgements

Firstly, I am very indebted to Konrad Stahl. During all the time I worked on this thesis he provided an excellent work environment allowing me to choose my own research projects. He supported all the projects I then embarked on in many respects. Dietmar Harhoff deserves special thanks for his motivating support and many beneficial discussions. Moreover, I would like to thank Michael Lechner for introducing me to the exiting field of program evaluation research. Many thanks go to Christoph Buchheim, Bernd Fitzenberger and Josef Brüderl for their helpful suggestions. I also benefited from many thoughtful comments by conference participants at the ESEM, EARIE and VfS conferences in Seattle, Lausanne, Dublin, Berlin and Magdeburg.

For this thesis I use several large, comprehensive data bases. This would have been impossible without the support and contributions of many institutions and people in these institutions. I am very grateful to Georg Licht for his cooperation. I would also like to thank Creditreform for their long-standing cooperation with the Centre for European Economic Research since I use Creditreform's firm data in every part of this thesis. The second and the third part of this thesis could only be realized due to the support of the Deutsche Ausgleichsbank (DtA), Bonn. Access to a unique data base on start-up assistance in East and West Germany during the 1990s was generously provided. I am especially grateful to Jochen Struck and Daniel Skambracks for many enlightening discussions on start-up assistance as well as on data issues and for their hospitality during many visits to the DtA in Bonn. Last but not least Jürgen Moka, Thorsten Doherr and several hard-working student researchers at the Centre for European Economic Research and at the University of Mannheim helped to set up the data bases in the way they were used in this thesis.

Financial support for the research presented in this thesis and for related research was provided by the Deutsche Forschungsgemeinschaft, the Deutsche Ausgleichsbank, the Deutsche Bundesbank and the European Association for Research in Industrial Economics. All this funding is gratefully acknowledged.

For numerous suggestions, detailed comments as well as for creating a friendly work environment I would like to thank my colleagues at the department of economics at the University

of Mannheim and at the Centre for European Economic Research. I am especially grateful to Matthias Almus for the hard work we shared as well as for our joint research.

Finally, I want to thank my family for their love and understanding during the time I worked on this thesis. Especially Markus deserves heartfelt thanks for his constant encouragement.

Contents

List of Tables

List of Figures

Chapter 1

General Introduction

Start-up firms attract the attention of policy makers and researchers for several reasons. On the one hand, new firms are argued to play an important role for job creation, for market restructuring, and for the development and diffusion of new technologies and products. This stimulated research on new firm entry, growth, and exit covered in surveys on industrial dynamics by Geroski (1995), Sutton (1997), and Caves (1998). On the other hand, new firms are argued to face higher costs of external capital and a higher risk of capital rationing than mature firms. Evans and Jovanovic (1989), Holtz-Eakin, Joulfaian, and Rosen (1994a), Blanchflower and Oswald (1998) and Taylor (2001) present empirical evidence suggesting that financial constraints bind when entrepreneurs decide upon firm formation and initial investment.

The role of new firms for employment, restructuring as well as technological progress and the relevance of financial constraints for entrepreneurial decisions provide the main rationales for governments to offer subsidized loans, loan guarantees or grants to entrepreneurs starting new firms. Such start-up assistance is provided by various government programs in the U.S. and the European Union. In Germany, federal programs offering start-up assistance were extended to an unprecedented level after the breakdown of the German Democratic Republic in 1989. In Eastern European transition economies and other low-income countries more and more micro-credit programs have popped up since the beginning of the 1990s.

In this thesis, I address so far unanswered questions in the context of evaluating assistance for start-up firms and explore in depth exit decisions of young firms. The thesis covers three self-contained empirical papers linked with respect to the following aspects.

1. In each chapter, I investigate topics of particular importance in the unique economic context after the German unification. In chapter two, the exit behavior of start-ups in the comparatively stable West German market economy is compared to the exit behavior of start-ups during the East German transition from a planned economy to a market

economy. Studying the role of young firms in the unique East German environment is of high interest. The planned economy system of the German Democratic Republic (GDR) had favored centralized production and had systematically discouraged entrepreneurial activities for several decades. After its breakdown in 1989, the privatization agency "Treuhandanstalt" restructured and privatized or liquidated more than 8,000 formerly state-owned firms with altogether more than four million employees. Industry production in East Germany went down dramatically and the rate of registered unemployment rose to a level being roughly twice as high as in West Germany. Since then new firms have been urgently needed to create new jobs, to build up viable industry structures and to introduce new technologies.

In order to reestablish production and to raise employment, the German government started to subsidize investment in East Germany substantially with investment allowances, investment grants and specific allowances for depreciation. Moreover, several federal programs offered loans with subsidized interest rates and redemption-free periods to entrepreneurs starting new firms. These start-up loans were mostly handled by the second largest public bank in Germany, the Deutsche Ausgleichsbank (DtA). Between 1990 and 1994, the DtA disbursed subsidized loans with an aggregate value of about 18 billion Euro to young East German firms. The aggregate value that went to West German firms during the same time period was about 4 billion Euro. Given the high volume of subsidized loans in East Germany after unification, the evaluation of this type of start-up assistance in the third and fourth chapter of this thesis is clearly interesting in the specific German context. Since the number of similar programs in other countries is large and still rising both the studies can also be helpful for policy makers who decide elsewhere upon the design, introduction, prolongation or abolition of such programs.

2. Semi- and non-parametric estimation methods are applied in each chapter. In the first chapter, I use semi-parametric Cox proportional hazard-rate models with competing risks. Stratified baseline hazard functions are estimated by applying a non-parametric Kaplan-Meier estimator. In chapter three and four I use non-parametric propensity score matching methods. These techniques are well established in the area of evaluating active labor market policies as surveyed by Angrist and Krueger (1999) and Heckman, LaLonde, and Smith (1999). In contrast, parametric or non-parametric approaches adequately controlling for selective program participation have so far not very often been used to evaluate programs that subsidize firm investment decisions like firm formation or research and development. The basic idea of non-parametric propensity score methods is to construct a comparison group that is similar to a treatment group of interest with respect to all factors simultaneously influencing the program assignment process and

the outcome variables. This comparison group is then used to identify counterfactual outcomes and to estimate causal program effects. Compared to parametric approaches, non-parametric propensity score methods have the advantage of imposing no restrictions on individual causal effects and of allowing for various functional forms of conditional expectations. In the third chapter of the thesis, I apply nearest neighbor matching on the balancing score as proposed by Rubin (1974) and Rosenbaum and Rubin (1983) for the case of a binary treatment. This binary evaluation framework was recently extended to the case of multiple treatments by Imbens (2000) and Lechner (2001a, 2002a). I build on these extensions in the fourth chapter to compare the effects of different treatments.

3. In each chapter, I use newly prepared data sets. For the second chapter a large firm sample well suited for analyzing and comparing exit decisions of start-ups in East and West Germany was build up. At first, a stratified random sample of 10,000 East and 12,000 West German firms was drawn from the East and West German firm panels at the Centre of European Economic Research (ZEW), Mannheim. These two complementary panels cover about 2.6 million firms. Data on these firms are provided by Creditreform, the leading German credit rating agency, either in encoded form or in free flow text format. Especially for the purpose of this thesis, I then extracted crucial and comprehensive information on firm formation and liquidation events from about 4,000 pages of the free flow text material. In addition, further information about the activity status of 5,299 firms in the sample was collected in a large telephone survey. The survey was conducted in 1999 for the purpose of a related research project funded by the German National Science Foundation (DFG).

   The evaluation studies presented in the third and fourth chapter are based on a so far unique data set. It combines the sample of 22,000 firm from the ZEW firm panels with a large internal data base of the Deutsche Ausgleichsbank (DtA). This data base contains information on nearly 800,000 subsidized loans disbursed between 1990 and 1999 in East and West Germany.[1] To merge the data bases for the purpose of research by Almus and Prantl (2002), Almus (2001) and this thesis, Matthias Almus and I applied a computer based search algorithm carrying out heuristic comparisons. In addition, extensive manual checking of the computer-generated links was conducted. For the empirical analysis in the third chapter, the link between both data bases is used to distinguish between firms with and without start-up assistance from the DtA. In the last chapter, I take advantage of information in the DtA data base on loan characteristics and on the firms' financing.

[1] The DtA generously provided access to this data base. Due to data protection rules it was connected to the firm sample within the DtA headquarter. Research results and conclusions in this thesis are mine and do not necessarily indicate concurrence by the Deutsche Ausgleichsbank.

In the following, I briefly survey the objectives and results of each chapter. Since each chapter is self-contained the reader may jump directly to the part of the thesis (s)he is most interested in.

The second chapter provides an investigation of young firm exit in East and West Germany during the 1990s. Different types of liquidations are not pooled together as in many related studies on firm exit. Instead, I distinguish between entrepreneurial self-selection via voluntary liquidation and external selection based on the German insolvency regulation. Separating between these two competing exit mechanisms turns out to be crucial for understanding the relation between entrepreneur-specific characteristics and new firm exit. According to theoretical considerations education and age of an entrepreneur should affect future venture-related returns as well as alternative employment opportunities. In line with this view, the effects of education and age on a young firm's bankruptcy and voluntary liquidation risk differ systematically in the empirical analysis. Such differences would be obscured in estimations pooling both types of liquidation. Effects of firm-specific characteristics like the initial firm size, the firm's legal form, the ownership and management structure are also risk-specific. These results are consistent with reputation considerations, liability arrangements, and the view that the feasibility and attractiveness of out-of-court liquidation arrangements compared to court-procedures depend on firm characteristics.

By comparing the empirical results for East and West Germany, it is shown whether and how exit decisions of start-ups in the East German transition economy and in the more stable West German market environment deviate. The comparative analysis contributes to the understanding of the role start-ups played during the first decade of the East German transition process. Effects of several entrepreneur- and firm-specific characteristics on the exit risks of young firms are similar in both economic environments. This is also the case for the time-pattern of the exit processes. Striking differences arise with respect to the effects of firm size and education of the entrepreneurs on the voluntary liquidation risk. In addition, the share of bankruptcy-related liquidations in East Germany turns out to be higher than in West Germany. These differences are argued to reflect different capital and labor market conditions as well as distinct industry structures in East and West Germany during the 1990s.

In the third chapter, short- and long-run effects of federal start-up assistance in Germany are evaluated. I consider start-up assistance in the form of subsidized loans provided within the three most important federal programs during the 1990s. These are the equity capital assistance program (EKH) within the European Recovery Program (ERP), the ERP business start-up program and the DtA business start-up program. The programs aim at preventing sub-optimal start-up capitalization and sub-optimal investment activity of ex ante efficient projects after market entry. New firms with start-up assistance are expected to have higher survival chances and to perform better than they would without such assistance. I focus

on the effects of start-up assistance on firm survival because the struggle to survive usually dominates the initial years of start-ups. In addition, the effects on firm size and investment per employee shortly after the assignment of subsidized loans are investigated.

In the context of program evaluation, understanding the selection of program participants is of key importance. Assignment to federal start-up assistance is expected to depend on the decisions of entrepreneurs, mediating banks and the DtA. Banks can influence program assignment because applications for subsidized loans have to be passed on to the DtA by a bank willing to handle the potentially approved loan. The empirical analysis of firm selection for start-up assistance shows that indeed entrepreneur- and firm-specific characteristics as well as the structure of the banking industry at firm location affect the assignment probability significantly.

The evaluation of program effects indicates that subsidized start-ups choose a higher capital intensity shortly after receipt of start-up assistance than they would choose without it. Start-up assistance seems to relax capital constraints and to allow for more efficient start-up capitalization. The main result of the evaluation analysis is that the average net effect of start-up assistance on the survival chances of subsidized firms during the first nine years after market entry is found to be positive. Analyzing the variation of the survival effect over time allows for important additional insights. Subsidized firms face a lower instantaneous liquidation risk during the first seven years after market entry due to start-up assistance. More importantly, the empirical evidence does not suggest that the initially positive effects of start-up assistance will be erased over time. Subsidized firms can not be judged simply to live on the provided assistance and to delay exit for some time. By contrast, their instantaneous liquidation risk turns out to decline during the last three years of the observation period. From the eighth year after market entry onwards it does so in a very similar way as it would in the case without start-up assistance. A rough measure of the program benefit through better survival chances indicates that a subsidized firm, receiving on average a loan of 120,000 Euro, employs on average one person for ten years it would not employ without start-up assistance.

In the last chapter of the thesis, I take heterogeneity of start-up assistance into account when analyzing determinants of subsidy assignment and subsidy effects. Firms can combine start-up assistance within the EKH program and the ERP or DtA business start-up program. Moreover, interest rates, redemption conditions and pay-out discounts differ across programs. Hence, start-up assistance varies considerably between firms with respect to subsidies on capital costs per Euro handed out by the DtA and with respect to the share of external capital covered by subsidized DtA loans.

At first, I try to find out whether the observable pattern of subsidy assignment reflects rather program objectives or distortions in the assignment process. Especially, the observed concen-

tration of high subsidies on East German firms and most observed equity share effects are in line with program objectives. However, for example the observed effects of size, age, and legal form suggest that mediating banks offer more favorable financing conditions, and thus also higher DtA subsidies to start-ups with a low ex ante observable default risk.

Then, I compare the effects of different subsidy modes on the short-, medium- and long-run survival chances of new firms. This comparison allows to identify additional effects on firm survival chances due to additional subsidies on capital costs. The main results can be summarized as follows. Three years after market entry, strong capital cost subsidies have a significantly higher effect on the firm survival rate of strongly subsidized West German start-ups than low capital cost subsidies would have had. In the medium- and long-run effects of similar magnitude are found but they remain insignificant. For East Germany no significant, positive short-, medium- or long-run effects are observed. Consequently, it seems feasible to reduce the level of capital cost subsidies offered within the programs in East Germany without reducing the survival chances of the subsidized firms significantly. However, it has to be noted that so far no other evaluation studies addresses this question in the context of federal start-up assistance in Germany or any other similar program. High capital cost subsidies may well have other positive direct or indirect effects that can not be analyzed with the data available for this thesis.

The last part of the empirical analysis in chapter four is very interesting from a conceptual point of view. A temporary interruption of the most favorable program in West Germany is exploited to see whether the main assumption needed to make causal inference in a matching context can be justified. This is the assumption of random assignment conditional on all exogenous factors simultaneously affecting assignment and outcomes, called CIA. If CIA does not hold, effect estimates would be biased. The analysis based on the program interruption does not suggest dependence of subsidy assignment on unobserved variables and thus assuming CIA seems justifiable in the context at hand.

Chapter 2

Bankruptcy and Voluntary Liquidations in East and West Germany

2.1 Introduction

The fall of the Berlin Wall in November 1989 marks the political and economic breakdown of the German Democratic Republic (GDR). Entrepreneurial activity was systematically discouraged in the GDR by expropriations of flourishing private businesses, by restrictions on input use including employment and by high profit taxation. The planned economy system of the GDR was built on centralized production in large state-owned firms. After unification of East and West Germany, the privatization agency "Treuhandanstalt" restructured and privatized or liquidated more than 8,000 formerly state-owned firms with a total of more than four million employees. At the beginning of the transition from a planned to a market economy, industry production largely broke down and dismissals led to a high level of unemployment. Facing this situation, start-ups in East Germany received extraordinary public attention and considerable financial support. New firms were urgently needed to create jobs, to revive entrepreneurship, and to build up viable industry structures with competitive small and middle-sized firms. Since November 1989, monthly start-up numbers rose sharply until July 1990, remained on a very high level until January 1991 and declined quite steadily thereafter.

In this chapter, I investigate the exit behavior of East German start-ups in the unique economic context after German unification. In addition, I show how their behavior deviates from the one of start-ups during the same period in the comparatively stable West German market economy. For the empirical analysis I use panel data until 1999 on about 14,000 firms

started between 1990 and 1993. The sample covers all East and West German regions and all industries in the manufacturing, construction and trade sectors as well as most service industries. The comparative analysis I provide extends the existing literature on industrial dynamics and new firm exit to transition economies. Since the end of the eighties, Dunne, Roberts, and Samuelson (1988, 1989), Audretsch (1991), Audretsch and Mahmood (1995), Mata and Portugal (1994), Mata, Portugal, and Guimarães (1995), and others have used large firm data bases to investigate the exit behavior of newly founded firms in Western industrial economies. Existing studies on new firm exit in West Germany by Brüderl, Preisendörfer, and Ziegler (1992) and Wagner (1994) are based on small samples with firms in specific regions. New firm exit in East Germany is rarely addressed. Brixy and Kohaut (1999) and Hinz and Wilsdorf (1999) are exceptions, but both studies are based on data covering a time period of less than five years. Most importantly, so far no study has used a firm sample with East and West German firms to compare in detail the exit behavior of start-ups in both parts of Germany.

In the following, firm exits are not treated as homogeneous events. I distinguish between voluntary liquidations and liquidations after a bankruptcy filing. The importance of separating between different types of exit is discussed for example by Hudson (1986, 1987), Phillips and Kirchhoff (1989), and Sutton (1997). However, so far only a few studies have used comprehensive firm data to analyze competing types of exit. Schary (1991) investigates firm exit through bankruptcy, voluntary liquidation and merger using a very small sample of firms in the declining cotton industry between 1924 and 1940 in New England. She finds that bankrupt firms differ significantly from those surviving or choosing another type of exit. Harhoff, Stahl, and Woywode (1998) examine the bankruptcy and voluntary liquidation risk for about 11,000 West German firms between 1990 and 1994. In 1990, these firms were on average 29 years old. The main focus of the study is the role of a firm's legal form for the bankruptcy and voluntary liquidation risk. The effects of firm size, diversification, and age of the majority shareholder turn out to be risk-specific. Most recently, Taylor (1999) analyzed the risk of exit via bankruptcy and moves to alternative employment between 1991 and 1995 for about 1,300 British self-employed starting business activities after 1979. He finds distinct effects of industry classification, personal wealth, education, and professional experience in hazard-rate models if both exit risks are considered separately.

The analysis of new firm exit in this chapter builds upon a framework with passive learning along the lines of Jovanovic (1982) and the two competing exit mechanisms: entrepreneurial self-selection via voluntary liquidation and external selection based on the German insolvency regulation. The estimation of competing risk models confirms the main theoretical expectations. First, the effects of entrepreneur-specific characteristics like education or age at market entry on the bankruptcy and the voluntary liquidation risk differ in accordance with the distinct underlying decision rules of bankruptcy and voluntary liquidation. The effects of initial

firm size, legal form or affiliations to parent firms are consistent with the expected pattern of bankruptcy avoidance. The comparison of competing risk estimates for East and West Germany reveals similar effects of the entrepreneur's age, the firm's legal form, its ownership and management structure, and the existence of franchise relations in both economic environments. Interestingly, non-parametric baseline hazard estimates also indicate a quite similar time-pattern of the exit process. The most striking differences between the exit process in East and West Germany after unification are distinct size and education effects as well as the fact that a substantially higher share of liquidations in East Germany is related to bankruptcy filings than in West Germany. These differences between the exit process among new firms in East and West Germany are argued to reflect the different industry structures, capital and labor market conditions in the two parts of Germany during the 1990s.

The remainder of the chapter is organized as follows. In the next section, I analyze the exit decision of newly founded firms and discuss how firm-specific and entrepreneur-specific characteristics are supposed to affect a firm's bankruptcy and voluntary liquidation risk. Section 2.3 contains a brief description of the data. In section 2.4, I discuss the econometric model, the applied estimation methods and the results. Section 2.5 concludes.

2.2 Exit decision of new firms: bankruptcy versus voluntary liquidation

2.2.1 Theoretical and institutional framework

Empirical studies on firm performance and exit by Dunne, Roberts, and Samuelson (1989), Baldwin and Rafiquzzaman (1995), Troske (1996) and many others reviewed in Sutton (1997) or Caves (1998) are motivated by the theoretical work of Jovanovic (1982), Ericson and Pakes (1995), and Pakes and Ericson (1998) on industry evolution with noisy selection among entrants.[1] In Jovanovic (1982) the exit process among firms entering an industry is based on passive Bayesian learning about time-invariant firm productivity. Ericson and Pakes (1995) and Pakes and Ericson (1998) model actively learning entrants with productivity varying over time due to stochastic market changes, their own investment decisions and those of other market participants.

In the following, I use a framework with passive learning to examine the exit decision of new firms when both, self-selection by entrepreneurs and external selection according to the German insolvency regulation are at work. Consider a population of market entrants characterized by unknown, firm-specific values of a productivity parameter θ and observable firm

[1] See also Frank (1988) and Cabral (1995).

heterogeneity. Firms believe their value of θ at the moment of entry to be a random draw from the same known a priori distribution conditional on observable firm heterogeneity. After market entry, each firm observes one realization of a profit-relevant random variable per period. This random variable is denoted by η and not observable to the econometrician. As the distribution of η depends on θ, the information history $n_t \equiv (\eta_1, \eta_2, ...\eta_t)$ in period t allows for updating the a priori expectation of θ and future values of η. Using their posteriors, the risk-neutral and profit-maximizing entrants then decide whether to continue the firm or to liquidate it by finally terminating all business activities.[2]

At first, I focus on the most frequent type of a new firm and then extend the analysis in section 2.2.2.3. The "typical" new firm is started by a single entrepreneur owning and managing the firm. One bank creditor usually allows for overdraft and sometimes disburses loans. Unsecured trade creditors may provide additional financing.[3]

The owner-manager holds all control rights of the firm as long as all current payments on the firm's debt obligations are covered. He will opt for a *voluntary liquidation* in period t if his individual liquidation threshold in t exceeds the expected future returns from optimal continuation of the firm, that is:

$$O_t^e(x_e) + L_t^e > V_t^e(n_t, x_f, x_e). \tag{2.1}$$

The individual liquidation threshold in t consists of two parts. One part is the expected present value O_t^e of the entrepreneur's (e) future returns when choosing the best alternative employment opportunity. These expected returns from wage work, an alternative firm project or retirement depend on his personal characteristics x_e. The second part is the share L_t^e of the firm's liquidation value L_t the entrepreneur receives as residual claimant when liquidating the firm's assets in t and satisfying all creditors' claims. V_t^e is his share of the maximal expected present value in t of venture-related future returns in case of optimal firm continuation. V_t^e depends on the history n_t of the profit-relevant variable η, personal characteristics x_e and firm-specific characteristics at market entry x_f.

As soon as the firm runs into financial distress the German insolvency regulation transfers control rights by entitling all creditors of the firm as well as the owner-manager to file for *bankruptcy*.[4] From that moment on, a firm liquidation or restructuring can be started and realized independently of the owner-manager's decision.

[2]In this chapter, I focus on exit by liquidation. Mergers, takeovers, and other changes in ownership are not treated as exit events here because some market activities of the concerned units continue even in the case of a fundamental restructuring.

[3]Harhoff and Körting (1998a) show that German firms being younger than 6 years have on average 1.28 bank creditors. Cressy (1996b) identifies overdraft borrowing as an important source of short-term finance for start-ups. According to Petersen and Rajan (1997) trade credits are used for short-term financing as well.

[4]According to the German insolvency regulation a firm is financially distressed if either the criteria of

The most likely candidates for financial distress are inefficient firms with low productivity and no market success. The liquidation value L_t of an inefficient firm exceeds the maximal expected present value of venture-related future returns $V_t(n_t, x_f, x_e)$:

$$L_t > V_t(n_t, x_f, x_e). \tag{2.2}$$

Nevertheless, efficient firms may also enter financial distress. In Germany, such firms will choose a private contractual debt restructuring rather than a court procedure. German bankruptcy procedures are strongly oriented towards liquidation. Court reorganization procedures have to be initiated by the debtor, are rarely used, and are usually unsuccessful and followed by a bankruptcy procedure (Hesselman and Stefan 1990, Häsemeyer 1998). Due to this situation, filing for bankruptcy would cause high indirect bankruptcy costs for firms that shall be continued. Suppliers, customers and employees with limited information about the firm's prospects would interpret the filing as a signal of forthcoming liquidation. They would stop delivery, seek for alternative suppliers and search for new jobs, respectively. The deterioration of business relations would not strongly affect the liquidation value of the filing firm's assets, but could considerably reduce the firm's going-concern value (Hax 1985). Such indirect costs provide a strong incentive for coalitions of owners and creditors interested in firm continuation to choose private debt restructuring and to avoid the detrimental filing.[5] Consequently, efficient, financially distressed start-ups in Germany can be assumed to enter a private restructuring and not to file for a court procedure. By contrast, German start-ups that file for bankruptcy can be assumed to be inefficient firms that will be liquidated. In the following, I will often use the shorter term "bankruptcy risk" instead of "risk of liquidation after bankruptcy filing" since inefficiency, bankruptcy and liquidation are that closely linked in the German context.

---

incessant inability to pay (insolvency) or overindebtedness applies (§102 Konkursordnung, Häsemeyer 1998). Insolvency is fulfilled in period t, if the firm is actually and probably also in s subsequent periods not able to meet its financial obligations: $C_t < T_t + B_t$ and $C_{t+i} < T_{t+i} + B_{t+i} \forall\ i = 1, \ldots, s$. C_t denotes cash, T_t the payments due to trade creditors and B_t the sum of repayment and interest payment due to the bank in period t. Overindebtedness applies only to corporate firms. A firm is overindebted if the firm's assets are worth less in t than the face value of its debt obligations D_t. The value of the firm's assets is measured by the maximum of the firm's continuation value V_t and liquidation value L_t. Overindebtedness is difficult to evaluate and therefore of much less empirical relevance in Germany than the insolvency criterion (Häsemeyer 1998). Note that any detail on German insolvency regulation given in this chapter refer to the legal situation before 1999 because the data I use mainly covers that period.

[5] A coalition interested in firm continuation may not be feasible for an efficient, financially distressed firm due to distortions modeled and discussed by Bulow and Shoven (1978), White (1989) and Gertner and Scharfstein (1991). Nevertheless, it can be assumed in the following that such coalitions are more likely in more efficient firms.

2.2.2 Determinants of a new firm's exit decision

According to the theoretical and institutional framework introduced above a new firm's exit can either result from entrepreneurial self-selection (see equation (2.1)) or from external selection based on the insolvency regulation (see equation (2.2)). Referring to both coexistent mechanisms, I derive hypotheses on the relations between entrepreneur- and firm-specific characteristics and the firm's bankruptcy and voluntary liquidation risk in sections 2.2.2.1 to 2.2.2.3. The corresponding effects in hazard-rate models are discussed in section 2.4.3.

2.2.2.1 Characteristics of the entrepreneur

Characteristics of the entrepreneur, x_e, are related to the bankruptcy risk due to their impact on venture returns and thus on the firm's continuation value in equation (2.2). The link between characteristics of the entrepreneur and the voluntary liquidation risk is more complex. According to equation (2.1) it depends on both, the impact of entrepreneur-specific characteristics on venture returns and the impact on returns of the entrepreneur's best alternative employment opportunity.

Entrepreneurs with high general human capital, measured by educational degree, are usually assumed to attain high venture returns (Cressy 1996a, Brüderl, Preisendörfer and Ziegler 1992). Hence, they can be assumed to face a lower bankruptcy risk than poorly educated entrepreneurs. High educational degrees should not only promote high venture returns but also high individual exit thresholds due to well-paid job offers and good ideas for alternative firm projects (Gimeno et al. 1997, Taylor 1999). Even assuming that the best alternative employment is wage work does not clarify whether a positive or a negative effect of education on the voluntary liquidation risk should be expected. Existing studies about the relative return of education in wage work versus self-employment by Evans and Leighton (1989) and Fujii and Hawley (1991) provide mixed evidence.

> H1: Well educated entrepreneurs have ceteris paribus (c.p.) a lower risk to exit via bankruptcy than poorly educated ones. The effect of education on the voluntary liquidation risk depends on the relative strength of the impact on venture returns and on individual exit thresholds.

Bates (1990) and Cressy (1996a) use the demographic variable "age of the entrepreneur at market entry" as a proxy of business and work experience. Since high experience should promote high venture-related returns, I expect age and the bankruptcy risk to be negatively correlated. This expectation follows as well if not only experience but also risk-aversion and wealth increase in age (Holtz-Eakin, Joulfaian, and Rosen 1994b, Cressy 1996b).

Age is presumably not only correlated with venture-related returns but also with the entrepreneur's exit threshold. First, the number and quality of alternative job offers is likely

to decrease in age and consequently the exit threshold should initially decrease as well (Gimeno et al. 1997). But at a certain age, retirement considerations come into play and tend to shift the exit threshold upwards. Retiring entrepreneurs often liquidate the firm's assets rather than transferring the firm as an operating unit. Harhoff, Stahl, and Woywode (1998) mention two reasons that inhibit transfers of small, young firms. First, they can often not be sold because the firm's viability and profitability depend crucially on the entrepreneur's human capital. Second, the German institutional setting can impede the transfer of ownership considerably.

H2: The age of the entrepreneur and the bankruptcy risk are c.p. negatively correlated. The effect of age on the voluntary liquidation risk is U-shaped.

2.2.2.2 Characteristics of the firm project

Firm-specific characteristics at market entry, x_f, are correlated with both liquidation risks due to their impact on venture returns. Moreover, a financially distressed firm's interest in bankruptcy avoidance as well as the attractiveness of an out-of-court liquidation agreement versus a court procedure may depend on firm-specific characteristics.

In the empirical literature, firm size is often discussed as an important determinant of new firm exit. Mata and Portugal (1994) and Audretsch and Mahmood (1995) argue that small start-ups are more likely than large ones to operate at sub-optimal production scale and to incur cost-disadvantages. Caves (1998) interprets sub-optimal scale as a consequence of binding input constraints. Most important are probably capital constraints caused by rationing on imperfect capital markets (Holtz-Eakin, Joulfaian and Rosen 1994b, Blanchflower and Oswald 1998). In addition, small scale can signal low or imprecise ex ante profit expectations and avoidance of large sunk commitment. According to Frank (1988) and Caves (1998) such small firms are more prone to leave the market after a few periods with low returns than large firms. Summing up, the understanding of small scale as disadvantage or negative signal suggests a negative correlation between initial firm size and the exit risk of start-ups.

However, certain economic environments can induce entry of small firms that are unlikely to have a higher exit risk than larger entrants. First, along the lines of Caves and Porter (1977) firms may choose to enter small in order to fit into strategic market niches. Agarwal and Audretsch (1999, 2001) provide evidence for the U. S. consistent with the hypothesis that entrants in industries at the mature stage of the product life cycle are more likely to occupy product niches than entrants in formative stages. In contrast to small start-ups in West Germany, I do not expect small-scale entrants during the early East German transition years to face significantly higher exit risk than their large-scale counterparts that enter into a different strategic group in the same industry. Many small start-ups may have filled local

market niches with a low exit risk. Middle-sized and large start-ups presumably had to compete with experienced West German and foreign firms. Moreover, they had to cope with privatized and often heavily subsidized firms emerging from the restructuring of formerly state-owned firms (May-Strobl and Paulini 1994). Second, flexible small-scale entry and subsequent step-by-step growth based on updated expectations should pay off especially in uncertain and changing markets.[6] Considering that market developments were more uncertain during the transition period in East Germany, the exit risk of small and large entrants may be more similar in East than in West Germany.

In addition to the foregoing arguments, it is crucial to see how firm size can affect an exiting firm's choice between an out-of-court liquidation agreement and a bankruptcy procedure. First, bankruptcy procedures get increasingly attractive with increasing employment due to the German insolvency regulation. Most important, unpaid wages of firms in bankruptcy will temporarily be covered by the federal labor office and simplified worker dismissals via collective settlement are allowed.[7] Second, the larger the firm, the lower the share of the liquidation value which is needed to cover direct bankruptcy costs. Third, according to Harhoff and Körting (1998a) firm size is positively correlated with the number of creditors. Hence, informational asymmetries and the risk of free-riding tend to increase in firm size and the chance of a successful out-of-court agreement decreases.

H3: The relation of firm size and the bankruptcy risk has c.p. an inverted U-shape. Firm size and the voluntary liquidation risk are negatively correlated in West Germany but probably not in East Germany.

Some start-ups opt for a diversified firm concept by entering several industries at once. According to simple portfolio theory, diversification can serve as a risk-reducing investment strategy by combining projects with imperfectly positively correlated returns. Rose (1992) shows in a theoretical model that owner-managers choose costly diversification if it reduces the firm's liquidation risk and thus increases the expected value of their firm-specific human capital. Following Jovanovic (1993), diversified firms may also realize cost advantages by exploiting economies of scope.

H4: Diversified start-ups have c.p. a lower risk of bankruptcy and voluntary liquidation than non-diversified start-ups.

[6] See Geroski (1991, 1995) for a discussion. See also the model of Mills and Schumann (1985). The authors assume that small firms have higher minimum average costs than their larger competitors but a more flexible production technology due to a high share of variable costs. These flexible small firms are shown to be more successful in industries with high rather than low demand fluctuations.

[7] As the labor office covers due wage payments including social security contributions, bankruptcy filings by social security agencies become increasingly likely the more employees are concerned. Häsemeyer (1998) discusses the relevant regulations.

Start-ups participating as franchisee in business format franchising pay a fee and royalties to receive a detailed business plan and a trade name (Lafontaine and Shaw 1999). Applying an already tested business plan is probably less risky than developing and using a new one. Well-known trade names can help to attract customers. Moreover, Rubin (1978) and Bates (1995) discuss that franchisers may pre-select and train their franchisees as well as facilitate access to financial resources.

H5: Franchisees have c.p. a lower risk of bankruptcy and voluntary liquidation than non-franchise entrants.

As discussed by Harhoff, Stahl, and Woywode (1998) the legal form of a start-up in Germany can be interpreted as a signal for project risk since it determines the liability status of the owners.[8] Entrepreneurs who want to start a highly risky project tend to choose a legal form with limited liability rather than full liability. Fully liable owners risk all their distrainable personal wealth and usually have continuing obligations after the completion of a bankruptcy procedure due to the German insolvency law in force until 1999.[9] Thus, a rational, risk-neutral owner-manager with full liability will liquidate voluntarily rather than continue a firm he considers to be inefficient. In contrast, owners with limited liability are only liable up to the amount of their equity share. Thus, the residual firm value for such an owner resembles a call option and is c.p. at least as high to him as to a fully liable owner. Consider a situation with asymmetric information between a rational, risk-neutral owner-manager with limited liability and the firm's creditors. If then the firm turns out to be inefficient, the owner-manager may not liquidate voluntarily but increase his expected residual firm value at the expense of the creditors by shifting to a riskier project with the same or a lower expected value than the initial project (Stiglitz and Weiss 1981). Such a behavior will increase the risk of financial distress and thus bankruptcy.

H6: Firms with fully liable owners will c.p. have a lower bankruptcy risk than firms with limited liability. The relation between liability status and voluntary liquidation risk is ex ante not clear.

2.2.2.3 Ownership and management

So far, I referred to the "typical" new firm started by a single owner-manager. But start-ups can have several owner-managers and the owner team can include other firms. Different

[8] Moreover, legal fees, disclosure and taxation rules as well as the mode of ownership change depend on the legal form. I omit these aspects here because they have no clear implications for the exit risk of German firms.

[9] After bankruptcy all creditors with unmet claims are entitled to pursue these claims against any distrainable future earnings and profits of the debtors (Häsemeyer 1998).

internal control and management situations are presumably a crucial factor affecting the bankruptcy and voluntary liquidation risk of new firms.

Firms started by a team of owner-managers should be endowed with a higher human capital stock than start-ups with only one owner-manager because deficiencies of one team member's education or experience can be compensated by others (Cressy 1996a). Eisenhardt and Schoonhoven (1990) mention specialization of team members for different tasks as an additional advantage. Altogether, team start-ups tend to attain higher venture returns than other start-ups and will consequently face a lower bankruptcy risk.

However, team members may disagree about central issues and preferences can turn out to be incompatible (Wagner, Pfeffer and O'Reilly 1984, Eisenhardt and Schoonhoven 1990). If a team fails to build up a viable organization and breaks apart, one or several owner-managers will probably leave the firm and may trigger a voluntary liquidation. They will hardly wait until the firm's decline forces it into bankruptcy.

H7: Team start-ups are c.p. less likely to exit via bankruptcy than firms not managed by a team. The existence of a team has ex ante no clear impact on the voluntary liquidation risk.

Some firms are partly or fully owned by parent firms when starting their business activities. Such affiliates often benefit from the parent firm's network, funding, and knowledge. Most important, I expect Western affiliations of East German start-ups to compensate for insufficient managerial skills as well as lacking marketing, accounting and institutional knowledge. Such deficiencies were substantial at the beginning of the economic transition in East Germany (Dyck 1997). All these resource-based advantages of affiliations should increase venture returns and thus lower the risk of liquidation.

However, affiliated firms may have higher liquidation values than non-affiliated ones. Among others, Baden-Fuller (1989), Liebermann (1990) and Deily (1991) argue that in case of liquidation an affiliate's assets and employees and along with it some of its specific capital and human capital may be successfully transferred to the parent firm.

Two other reasons imply a low bankruptcy risk for affiliated firms. First, a parent firm is often fully liable for its affiliate's obligations and the affiliate can not default as long as the parent firm is not bankrupt itself. Full liability is implied by several types of firm relations, for example by agreements to transfer profits.[10] Full liability of the parent firm can also result from declarations of patronage and explicit or implicit guarantees often asked for by the affiliate's creditors. Second, even in cases where bankruptcy of the affiliate is independently feasible, parent firms often cover the affiliate's obligations and liquidate it voluntarily (Li and

[10]See Häsemeyer (1998) for a discussion of the relevant regulation in the German corporate and insolvency law.

Guisinger 1990). They do so in order to preserve their own reputation on the credit market and to prevent customers and suppliers from interpreting the affiliate's default as a signal of financial problems of the parent firm itself.

H8: Affiliated start-ups have c.p. a lower bankruptcy risk than non-affiliated ones. The relation between affiliation and voluntary liquidation risk depends on the relative importance of the affiliation effect on venture returns, of the effect on liquidation values, and of bankruptcy avoidance. East German start-ups with an affiliation to Western parent firms have lower liquidation risks than other affiliated start-ups in East Germany.

2.3 Data

The empirical analysis is based on a large firm sample well suited for analyzing and comparing exit decisions of new firms in East and West Germany. To set it up a stratified random sample with 10,000 East and 12,000 West German firms was drawn from two complementary firm panels maintained at the Centre of European Economic Research (ZEW), Mannheim. In September 1999, the East and West German panel covered altogether about 2.6 million firms. The data are provided by the leading German credit rating agency, Creditreform, approximately every six months.[11] Creditreform collects information on legally independent, active firms either proactively or on demand. Information collection from public registers, newspapers, company reports, and in firm interviews is an ongoing process such that the frequency of information updating varies among firms. A typical firm record in the panels informs about firm formation, insolvency filings and liquidation. Moreover, it indicates the firm's location, industry classification, number of employees, legal status, ownership and management details.[12]

Now, I briefly comment on three issues crucial in the context of the following empirical analysis. First, I want to compare firm behavior in East and West Germany during the decade right after unification. The East and West German panel at the ZEW are well suited for that purpose since Creditreform uses standardized data collection and cleaning procedures. Such comparative studies are of high interest since obtaining reliable data for transition economies and comparing it to data for Western market economies is typically very difficult (Filer and Hanousek 2002).

[11] Phillips and Kirchhoff (1989), Audretsch (1995), and Harhoff, Stahl, and Woywode (1998) also use credit rating data to study firm exit.

[12] Further information on ZEW firm panels can be found in Almus, Engel, and Prantl (2000) and Harhoff, Stahl, and Woywode (1998).

Second, data on a well-defined population of start-ups should be used to analyze exit decisions of new firms. Creditreform collects information on firms of any size or legal form in all industries and regions. Comparisons with other data bases conducted by Harhoff and Steil (1997) show that firms having several employees or being registered in the trade register are very well covered in Creditreform's data base.[13] In contrast to many other data bases, micro firms with often only one owner-manager, no additional employee and no trade register entry are also covered.[14] However, such firms may be underrepresented and may enter the data base only some time after market entry.[15] Late recording is correlated with firm survival. Moreover, information on start-up characteristics is missing for late recorded firms. Therefore, all firms entering Creditreform's data base more than one year after the first recorded formation date were eliminated from the panel population before drawing the sample.

Being interested in start-ups during the first years after unification, only firm records with a primary or secondary firm formation date between 1990 and 1993 were considered.[16] After drawing the sample of 22,000 firms about 4,000 pages of Creditreform's free flow text material were analyzed in detail, because it contains important and comprehensive information on firm formation and liquidation events not provided in coded form. It turned out that 3,484 firms in the sample started their business activity before 1990. A legal form change, a relocation or an ownership change did cause the secondary formation date between 1990 and 1993. These firms were deleted in order to restrict the empirical analysis to firms starting market activity between January 1, 1990 and December 31, 1993.

Third, detailed liquidation data is needed for an analysis of different exit types. Firm liquidation is defined here as the termination of all business activities and the sell-off of the firm's assets. This is usually accompanied by a deregistration of the firm from the trade or business register. Whenever Creditreform detects the liquidation of a firm, it records information about it. Most of this information is stored in the free flow text already mentioned. Thus, the text information on liquidations between January 1, 1990 and December 31, 1999 was extracted for all 22,000 firms. A large telephone survey conducted in 1999/2000 pro-

[13] Registration in the trade register is compulsory for all commercial partnerships, limited liability firms, stock companies and large sole proprietorships (§1, §106 and §162 Handelsgesetzbuch (HGB), §7 GmbH-Gesetz, §36 Aktiengesetz). Sole proprietorships classified as small businesses according to §2 HGB, freelances, firms in the agricultural sector and civil law associations do not appear in the trade register.

[14] In the final sample a large share of all 13,767 firms, i.e. 23,5 percent, has only one employee and no trade register entry.

[15] The extent of undercoverage is unknown since none of the official firm statistics covers all existing entrepreneurial activity in Germany.

[16] Per firm and panel wave there exist three data fields called formation date 1 - 3. Creditreform stores primary formation dates in these fields. Moreover, secondary dates caused by legal form changes, relocations or ownership changes do also enter.

vides further data about the activity status of 5,299 firms in the sample.[17] Liquidations were classified as bankruptcy-related or voluntary based on Creditreform's comprehensive data on bankruptcy filings and proceedings. This insolvency information is highly reliable for several reasons. First, a credit rating agency needs complete and accurate information about a firm's solvency. Second, information about insolvency proceedings is publicly accessible due to compulsory publication in newspapers and official registers. Facing time and money restrictions, a sample well suited for analyzing firm exit was obtained by oversampling firms approximately twofold if one of several indicator variables coded by Creditreform suggested a liquidation. The disproportionally stratified choice-based sampling feature increased the sample variation crucial for the empirical analysis presented below. However, the dependence of the sampling rule on the endogenous variable has to be taken into account in all estimation and test procedures.[18]

Before conducting the empirical analysis three additional exclusion restrictions were applied. 927 records on holding companies, part-time projects, and legally dependent firm units were removed. 1,794 firm records had to be eliminated because of missing information on firm characteristics at market entry, inconsistencies or typing errors. Moreover, I did not use 2,028 firms in the main analysis because owner age information was not available. Table A.1 contains the definitions of all variables used and descriptive statistics for the main sample of 13,767 firms.

2.4 Competing risk analysis

In the following, I present a competing risk analysis of voluntary liquidations and of liquidations linked to bankruptcy filings in East and West Germany. In Section 2.4.1, I briefly describe the econometric model and estimation techniques. Non-parametric baseline hazard estimates are discussed in section 2.4.2. The baseline hazard estimates shed light on the time-pattern of the firms' learning after market entry and on the exit behavior of firms with different legal forms. In addition, the structure of the exit process in East and West Germany can be compared. Estimated covariate effects are explained in section 2.4.3 and linked to the hypotheses of section 2.2.

[17] A description of this telephone survey provide Almus et al. (2001).

[18] See Manski and McFadden (1981) and Angrist and Krueger (1999) for further discussion and section for details.

2.4.1 Econometric model and estimation techniques

For the competing risk analysis, a semi-parametric, continuous-time proportional hazard model with two mutually exclusive absorbing states is used. Distinguishing between liquidation after bankruptcy filing b and voluntary liquidation v I define two latent liquidation times T^b and T^v for each firm (Kalbfleisch and Prentice 1980, Cox and Oakes 1984). T denotes the observable liquidation time and is defined as the minimum of the two latent variables: $T = \min\left(T^b, T^v\right)$. L indicates the observed type of liquidation: $L = l$ if $T = T^l$ where $l \in \{b, v\}$. The following hazard function $h_l(t; X = x)$ depicts the instantaneous probability of liquidation type l:

$$h_l(t; X = x) = \lim_{\Delta t \to 0+} \frac{P\left(t \leq T^l < t + \Delta t \mid t \leq T^l, X = x\right)}{\Delta t} \tag{2.3}$$

where X denotes a vector of time-constant covariates, x a realization of X and t indicates time since firm formation.

This unobservable function $h_l(t; X = x)$ equals the observable hazard function

$$h^l(t; X = x) = \lim_{\Delta t \to 0+} \frac{P\left(t \leq T^l < t + \Delta t \mid t \leq T = \min\left(T^b, T^v\right), X = x\right)}{\Delta t} \tag{2.4}$$

for all t and l if the random variables T^b and T^v are mutually independent. Assuming independence, the likelihood function can be factorized into additive, separable terms for each liquidation type l. Each type-specific hazard can be estimated with a single-risk model where firms exiting by the competing type of liquidation are treated as censored at the moment of liquidation (Petersen 1995).

20.1 percent of the firms in the sample ran into liquidation after a bankruptcy filing, 19.5 percent liquidated voluntarily.[19] The remaining 60.4 percent have uncompleted duration spells and are censored in all estimations. 87.5 percent of these uncompleted spells are right-censored at the end of the observation period. 12.5 percent are censored earlier because Creditreform stopped updating the firm record after a relocation or an ownership change. Estimating a continuous-time model is considered appropriate here, since the process of interest is continuous in time. Moreover the duration of a firm's market activity can be measured in days such that tied duration spells occur only rarely.[20]

To estimate the type-specific hazard functions I used the following stratified version of the Cox proportional hazard model:

$$h^l(t; X = x) = h^l_{0,s}(t) * e^{x\beta^l} \quad \text{with} \quad l \in \{b, v\} \quad \text{and} \quad s = 1, 2. \tag{2.5}$$

[19] All shares mentioned in this paragraph are non-weighted shares.

[20] The data base provides exact dates for all firm formation and most liquidation events. Whenever only the month and year of a liquidation is registered, I imputed the date into the 15^{th} of the respective month.

The coefficient vector β^l can be estimated without specifying the stratified baseline hazard function $h^l_{0,s}(t)$ by maximizing a partial likelihood function (Cox 1972, 1975). Since the observations are choice-based sampled from the parent population, I used the weighted maximum likelihood estimator proposed by Manski and Lerman (1977) and the robust variance-covariance matrix estimator of Lin and Wei (1989).

One separate baseline hazard function $h^l_{0,s}(t)$ was estimated for each stratum group by applying a non-parametric Kaplan-Meier estimator. I used a legal form indicator as stratification variable since its linear modeling in the exponential factor of equation (2.5) would not have been appropriate. Graphical investigations and statistical tests along the line of Kalbfleisch and Prentice (1980) and Grambsch and Therneau (1994) indicated non-proportional hazard functions for different legal form groups.

2.4.2 Baseline hazard estimates

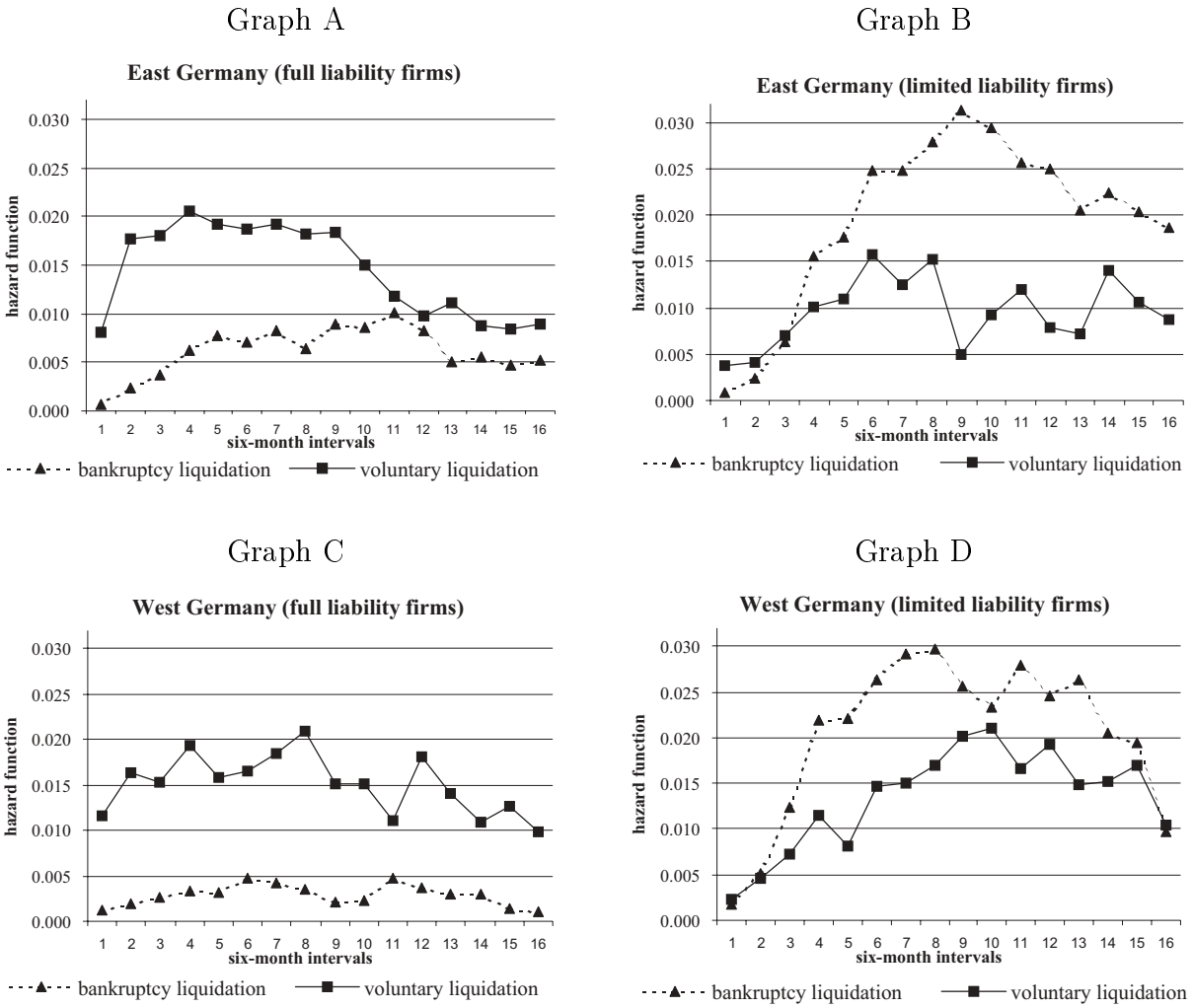
The baseline hazard estimates are calculated for the model in equation (2.5) and displayed in figure 2.1. The corresponding estimates of the coefficient vectors β^l with $l \in \{b, v\}$ are presented in table 2.2 and discussed in section 2.4.3. In figure 2.1, the graphs for East German firms refer to retail firms started in 1990 in Saxony-Anhalt. The graphs for West German firms refer to retail firms started in 1990 in North Rhine-Westphalia. In both the East and West German graphs the firms have mean employment (6 employees), mean owner-manager age (37 years), no diversified firm-concept, no franchise contract, no firm affiliation, and one owner-manager who completed an apprenticeship or some other type of low education.

All four graphs in figure 2.1 reveal a non-linear pattern of the baseline hazard functions for the bankruptcy and the voluntary liquidation risk. This pattern is valid not only for firms in the reference group, but also for all other firms in the sample because other covariate values induce proportional shifts of the estimated baseline hazards due to the underlying model structure in equation (2.5).[21] Following Pakes and Ericson (1998), non-linear baseline hazard functions are consistent with Jovanovic's passive learning model discussed in section 2.2.1.[22] Many functional forms of the model imply that it takes time to accumulate a history n_t with realizations of the profit-related variable η that is sufficiently informative to ensure optimality

[21] A non-linear pattern of the exit risk when all liquidation types are pooled was found by Brüderl, Preisendörfer, and Ziegler (1992) and Wagner (1994) for two specific regions in West Germany. Their results are, however, not directly comparable to mine because I control for observable firm heterogeneity. Brüderl, Preisendörfer, and Ziegler (1992) present a proportional log-logistic hazard estimation without covariates and Wagner (1994) discusses life table estimations.

[22] Pakes and Ericson (1998) stress that the passive learning model is in line with different shapes of the hazard function. It does not necessarily imply a monotonously decreasing hazard function which was associated with the model of Jovanovic (1982) by Dunne, Roberts, and Samuelson (1989) and in related work.

Figure 2.1: Baseline Hazard Estimates



Note: Non-parametric Kaplan-Meier baseline hazard estimates referring to retail firms started in 1990 in Saxony-Anhalt (North Rhine-Westphalia) with mean employment, mean owner-manager age, no diversified firm-concept, no franchise contract, no firm affiliation, and one owner-manager who completed an apprenticeship or some other type of low education.

of firm liquidation. Accordingly, the instantaneous liquidation risk of new firms increases in time during the initial periods after market entry. But at some point, it starts to decrease because from then on firms still active in period t have on average more precise knowledge about their initially unknown productivity parameter θ and are less prone to liquidate than active firms in period $t-1$.

The stratification variable distinguishes between two firm groups. One group covers non-public limited liability firms (GmbH) and the few stock companies (AG) in the sample. According to the German business law, owners of such corporate firms are only liable up to the amount of their equity share. The other group consists of all non-corporate legal forms in

the sample: sole proprietorships (Gewerbebetriebe, Einzelunternehmungen), civil law associations (GBR) and commercial partnerships (KG, OHG). These non-corporate firms have at least one owner who is fully liable with all his distrainable personal wealth.

In East and West Germany, limited liability firms have a substantially higher bankruptcy hazard than firms with fully liable owner-managers. By contrast, the levels of the voluntary liquidation hazards are not that different. According to graphs A and B the bankruptcy hazard of East German limited liability firms is at least two and a half times as high as the hazard of East German full liability firms surviving more than two and a half years. For West German firms surviving more than one and a half years, graphs C and D exhibit a bankruptcy hazard in case of limited liability which is at least five times higher than in case of full liability. Altogether, the evidence on the relation between a firm's liability status and its bankruptcy as well as voluntary liquidation hazard is in line with hypothesis H6 in section 2.2.2.

Comparing graphs B and D indicates a deviating structure of the exit process in East and West Germany. The bankruptcy hazard for East German limited liability firms relative to their voluntary liquidation hazard is higher than for West German firms in the group the figures refer to. A similar pattern can be observed in graphs A and C for full liability firms. Before interpreting this result, it has to be checked whether it holds for all other firms in the sample.[23] When looking at the whole sample population, 39.17 percent of all liquidations in East Germany are related to bankruptcy filings, but only 28.78 percent of those in West Germany. To show that the observed gap is not simply a consequence of the different composition of the East and the West German population with respect to industry, size or legal form table 2.1 describes the composition of the East and West German sample population and shows the structure of the exit process in several sub-samples.

The second and third column in table 2.1 indicate the shares of each industrial sector, size class and legal form class in the East and West German sample population. In the fourth column the results of two-tailed tests of the null hypothesis stating equality of the means in column 2 and 3 are shown. East German start-ups belong more often to the sectors construction and retail trade and less often to wholesale or intermediate trade and services than West German ones. In contrast to West German firms, East German firms appear more often in the two upper size classes and less often in the group of firms with only 1 employee including the owner-manager. East German start-ups are more often organized as sole proprietorships or commercial partnerships and less often as limited liability firms or stock companies. The fifth and sixth column in table 2.1 show for each sub-sample in East and West Germany which share of liquidations is linked to bankruptcy filings. Column 7 indicates a significantly higher

[23]Note that each curve in the graphs B and D or A and C results from the estimation of another model. Hence, stability of the described pattern is not guaranteed for other firm groups by proportionality of the hazards within a model.

Table 2.1: Exit Process in East (E) and West (W) German industries, size classes and legal form classes

Firm Group	Population Share in % E	W		Bankruptcy Share in % E	W	
Total						
	100.00	100.00		39.17	28.78	***
Industry						
manufacturing	11.58	11.97		55.97	37.46	***
construction	20.92	12.62	***	62.63	46.05	***
wholesale & int. trade	10.99	12.67	***	37.41	35.06	
retail trade	29.19	24.84	***	24.60	18.90	***
transport & comm.	6.90	6.29		35.99	24.76	**
services	20.41	31.61	***	29.07	25.30	
Size						
1 employee	25.39	39.56	***	16.47	17.43	
2 - 10 employees	59.25	55.84	***	38.25	33.61	***
> 10 employees	15.36	4.60	***	70.34	51.29	***
Legal form						
ltd. liab. & stock corp.	35.50	38.83	***	21.21	10.49	***
civil law association	9.33	9.56		18.99	9.18	***
sole prop. & com. part.	55.17	51.61	***	65.56	49.83	***

Note: The table shows weighted shares for the sample of 6,281 East German and 7,583 West German firms. Column 2 (3) shows the shares of each firm group in the East (West) German sample population. Column 5 (6) indicates for each firm group in East (West) Germany which share of liquidations is linked to bankruptcy filings. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) level. The tested null hypothesis is equality of the means in the groups of East and West German firms.

bankruptcy share in East than in West Germany for all legal form classes, both the higher size classes and the manufacturing, construction, retail trade and transport and communication sectors.

This result is very interesting since it is not simply caused by different insolvency regulation in East and West Germany.[24] At first, the result can be linked to differences in capital availability and capital use in East and West Germany. Private capital accumulation in East Germany before unification was low such that East German entrepreneurs after unification typically started their firms with a lower share of private equity and collateral than West

[24]The German insolvency law after unification was implemented in the same way in East and West Germany (Häsemeyer 1998).

German entrepreneurs. According to Harhoff and Körting (1998b) banks charge East German firms with less than 500 employees c.p. significantly higher interest rates for lines of credits than West Germany ones. However, the government supported East German investment by substantial investment allowances, investment grants and special depreciation provisions not available to firms in West Germany.[25] In addition, subsidized loans were more generously offered to start-ups in East than in West Germany.[26] Despite these government interventions, Harhoff and Körting (1998b) find that East German firms use c.p. significantly more often trade credits than West German firms. According to Petersen and Rajan (1994), using this type of credit with interest rates far above the rates charged by banks suggests binding external financing constraints. Stronger financial constraints imply a higher risk of financial distress and are thus consistent with a higher share of bankruptcy-related liquidations in East than in West Germany.

Different labor market situations in East and West Germany are also likely to contribute to the higher share of bankruptcy cases among all liquidations in East Germany. Labor market conditions affect the individual liquidation threshold of entrepreneurs. After unification, the restructuring of large, formerly state-owned firms triggered a huge number of dismissals in East Germany and the labor market situation remained precarious during the 1990s. The East German rate of registered unemployment varied between 10.3 and 19.5 percent during the 1990s whereas the West German rate remained at a lower level between 6.3 and 11.0 percent. Furthermore, the number of registered open positions per person was lower in East than in West Germany (Sachverständigenrat 2000/2001). Taking into account low regional mobility of German job seekers, the individual liquidation thresholds of entrepreneurs in East Germany should be lower than in West Germany. According to equation 2.1 this implies a lower propensity to liquidate voluntarily and can thus contribute to a higher share of bankruptcy-related liquidations in East than in West Germany. Further evidence in line with an impact of labor market conditions on the exit process among new firms is presented in the next section.

2.4.3 Covariate effects on the hazards

Based on the estimated covariate effects in table 2.2, I now discuss the hypotheses of section 2.2.2 not dealt with in the foregoing section. In the East German regressions all 6,236 East German firms in the sample of 13,767 firms with owner age information are used. In the West German regressions 7,531 firms are used. The covariate vector X covers the human capital variables and firm characteristics mentioned in section 2.2.2. In addition, several control

[25] See Sinn (1995) for details.

[26] See for example chapter 4 of this thesis.

variables are used to capture cohort-, industry- and location-specific effects.[27] All results in table 2.2 I comment on are quite robust with respect to substantial sample variation. As can be seen in table A.2, the regressions based on an extended sample including all 15,795 firms with or without human capital information confirm the discussed effects of firm characteristics. Moreover, the regressions in table A.3 for the reduced sample of 9,050 firms that are owned and managed by one entrepreneur and not affiliated to other firms indicate quite similar effects of human capital variables and firm characteristics.

The regressions in table 2.2 include several indicator variables capturing different internal control and management situations. These variables are used since the sample includes not only firms owned and managed by a single entrepreneur but also team start-ups and start-ups with affiliations to other firms.[28] The dummy variable TEAM is coded one if a start-up is managed by a team of persons. Table 2.2 displays a significant, negative coefficient of TEAM in the bankruptcy equations for East and West Germany. The bankruptcy hazards are found to be significantly lower for team start-ups in both parts of Germany than for firms started by a single owner-manager. Hence, I do not find evidence against the human capital stock argument in hypothesis H7. TEAM is significantly and positively correlated with the voluntary liquidation hazard in both parts of Germany. This result is in line with the view that start-ups are rarely continued if the initial team of owner-managers breaks apart.

In the regressions for West Germany, the variable FULL_AFFIL indicates whether a start-up is a subsidiary, i.e. whether it is fully affiliated to a parent firm, or not. PART_AFFIL is coded one if a start-up is no subsidiary but has at least one firm among its owners. Subsidiaries and partly affiliated start-ups exit significantly less often in connection with a bankruptcy filing than non-affiliated firms. But subsidiaries and partly affiliated firms are as prone as non-affiliated firms to liquidate voluntarily. In accordance with H8, the results suggest the empirical relevance of bankruptcy avoidance induced by declarations of patronage, guarantees or by reputation effects. The fact that the coefficient of FULL_AFFIL is lower than the coefficient of PART_AFFIL in both the bankruptcy and the voluntary liquidation equation points towards stronger resource-based advantages of fully than of partly affiliated start-ups. The null hypothesis of equal coefficients could, however, not be rejected.

[27] Three indicator variables for the firm formation years 1991, 1992, and 1993 are used to pick up differences across cohorts. These dummies are jointly significant in both regressions for East Germany and in the voluntary liquidation regression for West Germany. In addition to 5 (10) crude indicators for East (West) German states I control for location-specific effects by using a measure of the population density in the district of firm location. I find significant hazard-increasing agglomeration effects in both equations for East Germany. Finally, 18 (18) industry dummies at the two-digit level are meant to account for industry-specific effects. These are jointly significant in each equation.

[28] 29.4 percent of all firms in the sample are team start-ups. 7.4 percent are partly affiliated to other firms and 2.3 percent are subsidiaries.

Table 2.2: Competing Risk Model with Bankruptcy (B) and Voluntary Liquidation (V)

	East Germany		West Germany	
	B	V	B	V
Independent Variable	Coefficient (Robust Standard Error)			
TEAM	-0.251***	0.312***	-0.172**	0.311***
	(0.085)	(0.091)	(0.076)	(0.072)
FULL_AFFIL			-0.417*	0.127
			(0.217)	(0.236)
FULL_AFFIL_EAST	-0.279	0.667**		
	(0.288)	(0.281)		
FULL_AFFIL_WEST	-0.787***	-0.420		
	(0.240)	(0.374)		
PART_AFFIL			-0.256**	0.142
			(0.112)	(0.119)
PART_AFFIL_EAST	-0.155	0.039		
	(0.133)	(0.184)		
PART_AFFIL_WEST	-0.671***	-0.316		
	(0.168)	(0.231)		
EDUC_UNKNOWN	-0.232**	-0.000	-0.096	-0.079
	(0.105)	(0.081)	(0.093)	(0.068)
MASTER_CRAFT	-0.551***	-0.246*	-0.479***	-0.367***
	(0.129)	(0.142)	(0.140)	(0.138)
BUS_ADMIN	-0.371*	-0.064	-0.704***	-0.221
	(0.208)	(0.221)	(0.209)	(0.206)
ENGINEERING	-0.400***	-0.467***	-0.604***	-0.175
	(0.098)	(0.129)	(0.142)	(0.155)
OTHER_GRADUATE	0.017	0.254	-0.529**	0.229
	(0.211)	(0.191)	(0.211)	(0.175)
GRAD_MIX	-0.185	-0.091	-1.112***	0.137
	(0.219)	(0.291)	(0.355)	(0.283)
OTHER_MIX	-0.156	0.001	-0.380***	0.056
	(0.120)	(0.144)	(0.130)	(0.125)
MEAN_AGE	-0.009**	-0.093***	-0.011***	-0.033*
	(0.004)	(0.025)	(0.004)	(0.020)
$MEAN\_AGE^2$		0.001***		0.000*
		(0.000)		(0.000)
ln(SIZE)	0.809***	-0.026	0.459***	-0.115***
	(0.109)	(0.042)	(0.087)	(0.042)
$ln(SIZE)^2$	-0.126***		-0.080***	
	(0.024)		(0.023)	
DIVERSIFIED	0.059	0.179***	0.054	-0.000
	(0.071)	(0.068)	(0.070)	(0.063)

continued on next page

continued from previous page

	East Germany		West Germany	
	B	V	B	V
FRANCHISEE	-0.937***	-0.491**	-0.453*	-0.436**
	(0.245)	(0.202)	(0.263)	(0.195)
POPUL_DENSITY	0.119***	0.087**	0.045	0.008
	(0.039)	(0.038)	(0.033)	(0.028)
Wald-statistic (χ^2 (degrees of freedom))				
Size Variables	74.08 (2)***	0.36 (1)	36.46 (2)***	7.65 (1)***
Affiliation Indicators	25.53 (4)***	9.45 (4)*	8.08 (2)**	1.58 (2)
Age Variables	4.54 (1)**	13.99 (2)***	8.93 (1)***	5.03 (2)*
Education Indicators	29.40 (7)***	19.12 (7)***	48.57 (7)***	12.51 (7)*
Cohort Indicators	30.94 (3)***	8.73 (3)**	1.88 (3)	13.96 (3)***
Industry Indicators	47.65 (18)***	72.39 (18)***	62.56 (18)***	76.43 (18)***
Location Indicators	4.83 (5)	12.30 (5)**	22.72 (10)**	7.41 (10)
Model	276.62 (44)***	201.13 (44)***	231.53 (47)***	176.98 (47)***
log Likelihood	-5420.12	-8851.97	-4996.45	-12798.51
# observations	6236		7531	

Notes: The table shows the estimation results of Cox proportional hazard-rate models for East and West Germany using the sample of 13,767 firms. Reference firms in East (West) Germany have the following characteristics: one owner-manager with apprenticeship or some other type of low education, no firm affiliations, no diversified firm-concept, no franchise contract, cohort 1990, retail trade industry, Saxony-Anhalt (North Rhine-Westphalia). *** (**, *) indicates that the coefficient or the coefficients differ significantly from zero at the 1% (5%, 10%) significance level.

In the regressions for East Germany, I use four variables to distinguish between full and partial affiliations to East German or Western firms (FULL_AFFIL_EAST, FULL_AFFIL_WEST, PART_AFFIL_EAST, PART_AFFIL_WEST). FULL_AFFIL_EAST has a significant positive effect on the voluntary liquidation risk and all other indicators do not affect the voluntary liquidation hazard significantly. By contrast, the bankruptcy hazard of start-ups fully or partly affiliated to Western firms is significantly lower than the one of non-affiliated start-ups. The coefficients for subsidiaries of East German firms and of other East German affiliates remain insignificant. In both the bankruptcy and voluntary liquidation equation the sign and size pattern of the four coefficients suggests stronger hazard-reducing effects of affiliations to Western firms than to East German firms. Western parent firms promote a new East German firm's prospects probably by providing valuable management support and funding or by integration into a market-proven network. There is also statistical support for the superiority of Western affiliations since the coefficients of PART_AFFIL_EAST and PART_AFFIL_WEST in the bankruptcy equation as well as the coefficients of FULL_AFFIL_EAST and FULL_AFFIL_WEST in the voluntary liquidation regression differ significantly.

Given the sample composition, I use the following indicator variables to capture educational degrees of individual owner-managers or managers and the mixture of degrees in owner-

manager or manager teams. The variable MASTER_CRAFT is coded one if a firm is either owned and managed or managed by a person or a team of persons with high vocational training indicated by the master craftsman degree. The other dummies indicate graduate degrees in economics or business administration (BUS_ADMIN), engineering (ENGINEERING), other academic fields (OTHER_GRADUATE), apprenticeships or other forms of low education (LOW_EDUC), and missing degree information (EDUC_UNKNOWN). GRAD_MIX is coded one if a team consists of members with at least two different types of graduate degrees. OTHER_MIX indicates heterogeneous teams with at least two educational degrees out of the following groups: LOW_EDUC, MASTER_CRAFT and graduate degrees. Using this set of indicator variables provides a sufficiently flexible specification of the model according to the following test results. First, interaction terms between the team indicator and all education dummies referring to both, start-ups by individuals and teams, remain jointly insignificant in any of the equations in table 2.2. Second, interactions between the education dummies with an indicator coded one for fully or partly affiliated firms are jointly insignificant as well.[29] Note that the coefficient of EDUC_UNKNOWN remains insignificant in three equations and is significant only at the 10-percent significance level in the East German bankruptcy equation. Altogether, these results are in line with the view that missing human capital information raises no selectivity concern when estimating liquidation risk equations with the data at hand.[30]

West German firms managed by a person or a team of persons with a graduate degree in business administration or economics, engineering or any other field, face a significantly lower bankruptcy hazard than firms managed by persons with low education. In the voluntary liquidation equation, all variables that indicate a graduate degree remain insignificant. This pattern is consistent with hypothesis H1. It suggests that graduation promotes high venture returns as well as high returns in alternative employment. Thus, the individual liquidation thresholds of graduates are sufficiently high to render the indicators of graduate degrees insignificant in the voluntary liquidation equation. Taylor (1999) finds no significantly lower bankruptcy hazard and a significantly higher chance of moving to alternative employment for self-employed British men with high education than for those with low education. Interestingly, his results indicate a weaker effect of education on venture returns but the same structural difference between the two competing exit mechanisms as my analysis. In contrast to the pattern discussed so far, the coefficient for master craftsmen is significant and negative

[29]Interacting the education indicators and the indicator of subsidiaries was not feasible since many cells contained an insufficient number of observations. An interaction between an indicator of any type of high education and the indicator of subsidiaries is found to be insignificant in three of the four equations and significant at the 10-percent level in one equation.

[30]This result confirms the conclusion that can be drawn from the comparison of the estimation results in table 2.2 and in table A.2.

in both, the bankruptcy as well as the voluntary liquidation equation. This result suggests that master craftsmen receive less favorable wage offers than graduates because of high self-employment in the German crafts industries. Moreover, the master craftsman degree is an important institutional entry barrier in many areas of business activity in Germany. Thus, the master craftsman coefficient may partly reflect the survival-enhancing effect of this entry barrier not captured by the two-digit industry dummies.

In East Germany, firms managed by master craftsmen or engineers have a significantly lower bankruptcy hazard than firms managed by persons with low education. In addition, the coefficient for firms managed by persons with a graduate degree in business administration or economics is also negative and significant at the 10-percent significance level.[31] In contrast to West Germany, not only firms of master craftsmen but also firms of engineers have a significantly lower voluntary liquidation hazard than those of persons with low education. This result indicates that East German engineers who became self-employed after unification face less favorable alternative employment opportunities than engineers who started a firm in West Germany.

In West Germany, firms with heterogeneous teams (GRAD_MIX, OTHER_MIX) have a significantly lower bankruptcy hazard than firms managed by homogeneous teams of persons with low education. Teams with more than one type of graduate degree (GRAD_MIX) have also a significantly lower hazard than homogeneous teams of master craftsmen. A different pattern is found for East Germany. In contrast to homogeneous teams of master craftsmen, engineers or economists, heterogeneous teams have no significantly lower bankruptcy hazard than homogeneous teams with low education.[32] This difference between East and West German evidence can be related to the literature in organization science about the composition of teams. Following Eisenhardt, Kahwajy, and Bourgeois (1997) and Lawrence (1997) heterogeneity in teams is costly because the time needed for discussion and decision-making increases with heterogeneity. The benefit of heterogeneity is argued to be a higher propen-

[31]This result was unexpected. Persons that graduated in business administration or economics in East Germany before the breakdown of the planned economy should have accumulated a lot of system-specific knowledge being useless when managing a start-up after unification. One possible explanation for the estimation result is the following. The group of persons with a degree in business administration or economics may cover a higher share of migrants from West Germany than the other graduate groups in the East German subsample. Given that I can not control for the West or East German origin of persons with the data at hand, such migrants may cause the significant negative coefficient of BUS_ADMIN in the bankruptcy equation and the insignificant coefficient in the voluntary liquidation equation.

[32]Since the dummies GRAD_MIX and OTHER_GRADUATE are insignificant in the bankruptcy equation for East Germany an alternative specification with two dummies instead of GRAD_MIX was also tested. One dummy indicated teams consisting of persons with degrees in economics and engineering. The other one indicated all other graduate teams. The alternative specification lead to the same conclusions as the one used in table 2.2.

sity of innovative problem solutions, for example a new product idea or an unconventional marketing concept. Therefore, heterogeneous teams can be expected to be less successful in economic environments rewarding quick decision-making rather than unconventional ideas. As explained in the following, the evidence I find for East and West Germany is in line with this expectation. West German start-ups face stable industry structures and well established, incumbent competitors such that they have to come up with new ideas to win a lasting market position. By contrast, the East German transition economy seems to offer first-mover advantages to quickly deciding firms entering with a main-stream concept. In this environment, heterogeneous teams with a high potential for innovative ideas run as often into bankruptcy as teams with low education, probably because of their time-consuming decision process.

The age variable MEAN_AGE is the mean age of the start-up's owner-manager or manager team. As in the case of education indicators, including interaction terms between the age variable and the team indicator turned out to be insignificant in all four equations in table 2.2. Interaction terms with the indicator for subsidiaries or an indicator for full and partial affiliations were also statistically insignificant in all equations. Age is significantly negatively correlated with the bankruptcy hazards in East and West Germany. By contrast, it has a significant non-monotonous effect on both voluntary liquidation hazards. In East Germany, persons or teams with a (mean) age of about 41 years have a lower voluntary liquidation hazard than others. In West Germany, the minimum is reached at about 35 years. The evidence on age effects is consistent with hypothesis H2. Moreover, it suggests that human capital decay as discussed by Bates (1990), Cressy (1996a) and Storey and Wynarczyk (1997) does probably not cause the inverse U-shaped age effects on firm survival chances they report. Human capital decay should affect not only the voluntary liquidation hazard but also the bankruptcy hazard. Hence, the business and work experience of entrepreneurs starting a firm at high age could only be judged to suffer from depreciation if I observed a U-shaped age effect on both competing hazards. By contrast, I observe an upward shifted voluntary liquidation hazard but a downward shifted bankruptcy hazard in the upper part of the age distribution. Thus, the observed quadratic age effects are most likely to reflect retirement decisions.[33]

Firm size at market entry is measured by the logarithm of SIZE, i.e. the number of employees including owner-managers in full-time equivalents. In the bankruptcy equations, I use a quadratic polynomial to capture the impact of firm size. Harhoff, Stahl, and Woywode (1998) use a similar specification in a bankruptcy risk equation for a sample including mature firms. The marginal effect of firm size on the bankruptcy hazard is initially positive. For East (West) German firms with more than 25 (18) employees, it is negative. This suggests that

[33] At first sight, the insignificance of interaction terms between age and the indicator for subsidiaries mentioned above seems to contradict the retirement argument, because retiring managers are in contrast to retiring independent entrepreneurs obviously less likely to trigger a voluntary liquidation. But these interaction terms are likely to be insignificant simply because of too few relevant observations in the sample.

the feasibility and attractiveness of out-of-court liquidations for financially distressed firms decreases with firm size as explained when discussing hypothesis H3 in section 2.2.2. Brüderl, Preisendörfer, and Ziegler (1992), Audretsch and Mahmood (1995), and Mata and Portugal (1994) among others report negative correlation of entry size and the pooled exit risk. All these studies do not distinguish between competing liquidation types and address start-up survival in Western economies. I observe a significant, negative coefficient of entry size in the voluntary liquidation equation for West Germany. In the voluntary liquidation regression for East Germany, the coefficient turns out to be negative, but insignificant. This East-West difference is in line with hypothesis H3. In contrast to small West German start-ups, small start-ups in East Germany after the breakdown of the planned economy had no higher voluntary liquidation hazard than larger start-ups. Probably, they occupied market niches with good survival chances. Another explanation can be that small-scale flexibility is more advantageous for start-ups coping with uncertain market conditions and unsettled industry structures during the transition of East Germany than for new firms in West Germany. My result for a transition and a stable market economy adds to the evidence on the size-survival correlation provided by Agarwal and Audretsch (1999, 2001) for different stages of the industry life-cycle.

Hypothesis H4 about diversification as a hazard-reducing strategy has to be rejected for German start-ups. The coefficient of the indicator variable DIVERSIFIED is positive but insignificant in two of the four equations. The effect on the voluntary liquidation hazard in East Germany is positive and significant. These results partly contradict Harhoff, Stahl, and Woywode (1998), but can be related to negative diversification effects on firm profitability, productivity and sales reported by Berger and Ofek (1995), Schoar (2002) and Nguyen, Kaiser, and Laisney (2000). Along the lines of Schoar (2002) my result for the exit risks of German start-ups can be explained by distraction of the owner-managers from core competencies and overtaxing due to the number and complexity of arising management tasks.

The indicator variable FRANCHISEE is significant and negatively correlated with both type-specific hazards in East and West Germany. Thus, I find support for hypothesis H5 in two different economic environments. By contrast, Bates (1995) reports a significantly higher exit probability for franchisees than for non-franchise firms in a sample of sole proprietorships, partnerships and S-corporations founded in the United States between 1984 and 1987. When I restrict my sample to sole proprietorships and partnerships I still find reduced hazards for franchisees in all equations. However, in two of the four equations the negative coefficients fail to pass the 10-percent significance level.[34]

[34]The evidence provided by Brüderl, Preisendörfer, and Ziegler (1992) is not conclusive in this context, because they use an indicator variable that pools franchisees and firms of entrepreneurs pursuing also other business projects.

Summing up, the presented competing risk analysis reveals that the links of many firm characteristics to the bankruptcy risk differ systematically from those to the voluntary liquidation risk. These differences reflect the different underlying decision rules introduced in section 2.2.1. Moreover, the empirical results show how exit of new firms in the East German transition economy deviates from exit of start-ups in the West German market economy.

2.5 Conclusions

In this chapter, I analyze the exit behavior of newly founded firms in East and West Germany after unification. In contrast to most existing studies on firm exit I distinguish between entrepreneurial self-selection via voluntary liquidation and external selection via liquidation after a bankruptcy filing. Related research by Schary (1991), Harhoff, Stahl, and Woywode (1998) and Taylor (1999) for firm populations with mature firms or self-employed persons is extended in several respects. The pattern of human capital effects I report suggests that entrepreneur-specific characteristics are related to the bankruptcy hazard of start-ups according to their impact on venture returns and thus on the continuation value of the firm. By contrast, human capital effects on the voluntary liquidation hazard of start-ups reflect the human capital impact on venture returns but also on the entrepreneurs' alternative employment opportunities and thus on their liquidation thresholds. Age of the owner-managers at market entry has a non-linear effect on the voluntary liquidation hazard. Initially, the hazard decreases in age and at some point starts to increase. Such U-shaped age effects are often explained by human capital decay in the literature on the pooled exit risk. However, I observe a linear negative effect of age on the bankruptcy hazard not explainable by human capital decay. Hence, the U-shaped age effect on the voluntary liquidation hazard does rather reflect retirement decisions of old entrepreneurs than human capital decay. Firm size is found to have a non-linear effect on the bankruptcy hazard, but not on the voluntary liquidation hazard. This result is in line with the view that the feasibility of out-of-court liquidation agreements decreases in firm size due to increasing information asymmetry and free-riding among creditors. Moreover, employee-related insolvency regulations in Germany render court-procedures more attractive for larger firms. Indicators of the firm's legal form, of affiliations to parent firms and of team start-ups affect the bankruptcy and voluntary liquidation hazard differently as well. Summing up, distinguishing between different types of exit augments the understanding of the exit behavior of new firms.

The comparison of new firm exit in East and West Germany I provide is of particular interest because of the unique economic context. East German firms in the sample started between 1990 and 1993, i.e. at the beginning of the transition from a planned to a market economy. By contrast, the West German start-ups entered a comparatively stable market economy.

The comparison reveals several differences and similarities as well. In both economic environments, firm characteristics like a firm's legal form at market entry, the existence of affiliations to parent firms, franchise relations and start-up teams are related to the bankruptcy and voluntary liquidation hazards in a similar way. In addition, non-parametric baseline hazard estimates exhibit a similar time-pattern. Entrepreneurs and creditors in East Germany seem to take time for collecting market experiences before realizing liquidations in a comparable way as in West Germany.

The most interesting differences I found between new firm exit in East and West Germany during the 1990s can be related to the different industry structures, capital and labor market conditions. In contrast to small West German start-ups, small start-ups in East Germany after unification had no significantly higher voluntary liquidation hazard during the 1990s than larger ones. They seem to have occupied market niches with low exit risks whereas middle-sized and large start-ups competed with experienced Western firms and heavily subsidized, privatized East German firms. This result adds to the evidence on the size-survival correlation provided by Agarwal and Audretsch (1999, 2001) for different stages of the industry life-cycle. In addition, education effects on the voluntary liquidation risk of new firms in East and West Germany differ and the share of liquidations related to bankruptcy filings turns out to be higher among start-ups in the East German transition economy than in the comparatively stable West Germany market economy. The latter can be explained by stronger financial constraints in East than in West Germany. Both the deviating human capital effects and the weaker entrepreneurial self-selection in East Germany are in line with higher voluntary liquidation thresholds of East German entrepreneurs. Higher voluntary liquidation thresholds are a plausible consequence of higher local unemployment rates and correspondingly worse alternative employment opportunities in East than in West Germany.

Chapter 3

The Role of Start-up Assistance for New Firm Survival

3.1 Introduction

In this chapter, I evaluate effects of federal assistance for entrepreneurs starting new firms in Germany. After the political and economic breakdown of the German Democratic Republic in November 1989 start-up assistance was expanded to an unprecedented level. Subsidized loans with an aggregate value of more than 22 billion Euro were disbursed between 1990 and 1994 within several federal programs administered by the Deutsche Ausgleichsbank (DtA). Similar and often long-established programs in the U.S., in the U.K. and many other countries in the European Union subsidize investment activities like firm formation, self-employment, and research and development.[1] Moreover, micro credit programs promoting self-employment and small businesses in transition countries are growing in number and size (Economist 2001). Since the number of existing financing programs is high and will rise even higher in the future, evaluation studies on such programs are very valuable.

The main rationales usually given for subsidizing entrepreneurs who start new firms are the impact of financial constraints on entrepreneurial decisions and the role of new firms for economic development. Job creation by young and small firms has inspired policy makers at least since the widely known and often criticized study of Birch (1979).[2] Start-up activity is considered to balance concentration in established industries and to contribute to new industry formation (Beesley and Hamilton 1984). Furthermore, Scherer and Ross (1990) emphasize the importance of young and small innovative firms for the development and diffusion of new technologies and products.

[1] See Lerner (1999) for a list of U.S. programs, Storey (1994b) for a discussion of U.K. programs, and De, Kaufmann, Niederbach, and Wimmers (1995) for details about programs in several European countries.

[2] See Davis, Haltiwanger, and Schuh (1996) for a more recent investigation of job creation and destruction.

Young firms are often argued to face higher costs of external capital and a higher risk of capital rationing than older firms. In a seminal paper Stiglitz and Weiss (1981) show how informational asymmetries between borrowers and lenders on financial markets can lead to credit rationing. According to Hubbard (1998) and Gompers and Lerner (1999) informational asymmetries are particularly severe in the case of young firms because these firms face idiosyncratic risks that are difficult to evaluate externally. In addition, monitoring young firms is relatively expensive because the involved loans are usually small. Entrepreneurs often emphasize the lack of personal equity and insufficient collateral to obtain debt financing as the major impediment to start and enlarge their investment and innovation activity. Moreover, new firms are usually too young and too small to issue public debt or equity. Evidence presented by Evans and Jovanovic (1989), Holtz-Eakin, Joulfaian, and Rosen (1994a), Blanchflower and Oswald (1998), and Taylor (2001) is consistent with entrepreneurs facing binding financial constraints when deciding upon firm formation and capital use. Empirical results of Holtz-Eakin, Joulfaian, and Rosen (1994b) and Honjo (2000) suggest that financial constraints reduce the survival chances of young firms. However, Cressy (1996a) and Taylor (2001) provide no support for this view.[3]

In accordance with the rationales discussed, the main objective of federal start-up assistance in Germany is to prevent sub-optimal start-up capitalization of ex ante efficient projects and sub-optimal investment activity after market entry. New firms with start-up assistance are expected to perform better and to have higher survival chances than they would in case of a more financially constrained entry. In this study, I focus on firm survival effects because the struggle to survive usually dominates the initial years of start-ups. Precisely, I analyze short- and long-run effects of federal start-up assistance on the survival chances of new firms started between 1990 and 1993 in all major sectors of the East and West German economy. In addition, the effects on firm size and investment per employee shortly after the assignment of subsidized loans are investigated.

To evaluate whether start-up assistance has the intended positive effect on the survival chances of subsidized firms, program effects and effects of non-random selection of program participants have to be disentangled. This crucial identification challenge in the context of program evaluation is not taken into account in many existing studies about the performance of subsidized start-ups in Germany.[4] Among the studies evaluating financing programs elsewhere in

[3] In addition to the few studies on financial constraints of newly started or very small firms a large literature addresses the impact of financial constraints on firms' investment activities in general. Most of the authors conclude that financial constraints have a considerable impact on investment decisions. See Hubbard (1998) and Schiantarelli (1996) for surveys.

[4] See Breitenacher et al. (1994) for a survey of studies that provide simple, unadjusted comparisons between subsidized and non-subsidized firms. Brüderl, Preisendörfer, and Ziegler (1993) and Hinz and Ziegler (2001) compare firms that receive different types of financing.

Europe, U.S. or other countries only some use an adequate parametric or non-parametric approach.[5] In this chapter, I apply non-parametric matching on the balancing score as proposed by Rubin (1974) and Rosenbaum and Rubin (1983). Program effects are estimated as the difference between the survival chances in the group of subsidized firms and a matched comparison group without subsidies. Building on random assignment conditional on covariates the matched comparison group is constructed in order to inform about the survival chances of the subsidized firms in the counterfactual situation without subsidy. Similar non-parametric techniques have recently been applied by Dehejia and Wahba (1998, 1999), Heckman, Ichimura, and Todd (1997, 1998), and Lechner (1999, 2000) to evaluate labor market programs. So far, no such evaluation study of the effects of federal start-up assistance in Germany on firm survival, firm size and investment exists.

For this study, I can use a large, unique data set containing firms with start-up assistance from the DtA and firms without such assistance. To construct this data set, an internal data base of the DtA with information on nearly 780,000 loans disbursed during the 1990s was for the first time connected with an external firm sample. The sample of 22,000 firms was randomly drawn from two complementary panel data bases build up with data from the leading German credit rating agency, Creditreform. These panels are kept at the Centre of European Economic Research (ZEW) and covered about 2.6 million firms in 1999.

In the first part of the empirical analysis, determinants of firm selection for federal start-up assistance in Germany are examined. This is interesting in its own right, because the assignment process for start-up assistance in Germany has rarely been investigated so far. The effects of entrepreneur- and project-specific variables show that, all else equal, better qualified entrepreneurs with less risky projects have higher chances to receive start-up assistance than others. However, firms in several East German states, in districts with a high local unemployment rate and in high-technology industries have, all else equal, as well increased assignment probabilities. The evaluation of average start-up assistance effects reveals first positive investment effects on subsidized firms shortly after receipt of start-up assistance and strong short-run survival effects. In addition, the analysis of effect changes over a long time period indicates that positive firm survival effects are unlikely to be a pure result of inefficient "cash-and-carry"-behavior. Subsidized firms do not seem to simply live on the provided loan for some years and exit some time later than matched comparison firms. By contrast, the group of subsidized firms faces a declining instantaneous liquidation risk during the last three years of the observation period. Moreover, the risk exposure of subsidized firms and of matched comparison firms is very similar from the eighth year after market entry onwards. Hence, the significant and substantial, positive survival effect of subsidized loans handed out to firms at the moment of start-up or shortly afterwards is found to persist over a long time

[5] I discuss such studies in section 3.2.3.

period.

The remainder of the chapter is set out as follows. Next, I briefly discuss the programs I evaluate, the selection of program participants and related empirical literature. In section 3.3, I explain the crucial identification problem arising in the context of program evaluation and the chosen econometric approach. Section 3.4 contains a brief description of the data base and descriptive statistics characterizing the groups of subsidized and non-subsidized firms in the sample. Empirical results are presented in section 3.5 and section 3.6 concludes.

3.2 Start-up assistance in Germany

3.2.1 Federal financing programs for young and small firms

In this section, I briefly describe the federal programs subject to evaluation here and sketch the economic situation in Germany for the period of evaluation, i.e. for the 1990s. All major West German financing programs for young and small firms were extended to East Germany shortly after the political and economic breakdown of the German Democratic Republic in November 1989. During the transition from a planned to a market economy new firms were urgently needed to introduce new technologies, to build up viable industry structures, and to create new jobs. This was the case because the formerly state-owned and mostly large East German firms underwent fundamental restructuring and privatization or liquidation. The restructuring of these firms with a total of more than four million employees forced into unemployment a large fraction of the work force. Industry production largely broke down. Private venture capitalists played only a minor role during the economic transition in East Germany.[6] By contrast, the DtA disbursed subsidized loans with an aggregate value of about 22 billion Euro to young firms within the first five years after the breakdown. The DtA is the second largest public bank in Germany. It handled about 90 percent of all federal subsidized start-up loans during the 1990s.[7]

According to table 3.1, the DtA provides start-up assistance almost exclusively in one of the following three programs: the business start-up program financed by the European Recovery Program (ERP), the DtA business start-up program, and the ERP equity capital assistance

[6] Lessat et al. (1999) show that start-up financing by private venture capitalists in Germany never reached the level of 10 million Euro per year before 1994 and only started to increase significantly from 1995 onwards.

[7] To finance the programs during the 1990s the DtA relied on the European Recovery Program (ERP) Fund, funds from the federal budget, and raised additional funds on international capital markets. The ERP Fund was created with Marshall Plan aid Germany received after the Second World War. The federal government extended it substantially after the German unification at the beginning of the 1990s (Deutsche Bundesbank 1991).

Table 3.1: Federal Financing Programs for Young and Small Firms in Germany

Year	Volume (Million Euro)		# Loans		Refusal Rate in %	
	East	West	East	West	East	West
All programs for young and small firms managed by DtA						
1990	1,565.35	762.49	38,403	27,172	2.4	9.2
1991	4,376.74	832.52	104,031	27,756	4.1	8.8
1992	4,521.63	704.65	70,658	19,763	6.5	6.1
1993	4,305.13	591.52	48,768	12,960	2.5	1.4
1994	3,415.43	1193.20	33,601	24,655	2.8	2.9
Equity capital assistance program (EKH)						
1990	262.91	219.20	9,492	8,604	4.4	12.6
1991	1,619.14	257.83	48,185	9,859	5.0	11.4
1992	1,814.26	152.34	34,707	4,515	8.4	8.1
1993	1,510.80	NA	22,511	NA	4.3	NA
1994	1,411.98	163.63	16,048	4,929	5.2	7.8
ERP/DtA Business start-up programs						
1990	1,302.44	525.98	28,909	17,136	1.7	9.0
1991	2,757.60	550.35	55,824	16,388	3.7	8.3
1992	2,681.38	532.17	35,789	13,681	5.2	5.4
1993	2,578.06	547.51	25,941	11,294	1.1	1.4
1994	1,858.92	976.82	17,317	17,944	0.6	1.4

Notes: The upper third of the table exhibits information on all programs for young and small firms managed by the DtA, i.e. on the three programs in the lower part of the table and some other, very small programs. NA denotes that information for the EKH Program in 1993 is not available due to an interruption of the program. The columns under the heading "Refusal Rate in %" indicate the shares of applications refused by the DtA in each year and program class. Refusal rates displayed in the section "ERP/DtA Business Start-up Programs" relate only to the ERP business start-up program because rates for the small accompanying DtA business start-up program were not provided by the DtA.

Source: Deutsche Ausgleichsbank (2000) and unpublished DtA tables with refusal rates.

program (EKH).[8] The EKH program offers equity capital assistance by providing loans for up to 20 years without redemption during the first 10 years. For East German firms, the interest rate is fixed at zero during the first three years but later on the annual interest rate increases stepwise. For West German firms, the interest rate is fixed at zero only during the first two years. Collateral is not needed but the applicant is personally liable. For private lending institutions these loans count as equity substitute. They may therefore induce further lending. Both, the ERP and the DtA business start-up program provide loans for about 10 to 15 years

[8] Within these programs the DtA subsidizes mainly start-ups but also some expanding young or small firms making growth investments or restructuring after ownership changes. However, the latter type of subsidies will not be evaluated in the following.

with subsidized interest rates.[9] In the ERP business start-up program no redemption is due for a maximum of 3 years in West Germany and 5 years in East Germany. In the DtA business start-up program the redemption-free period is restricted to at most 2 years. Collateral or a guarantee provided by a private lender or within a loan guarantee program are necessary.[10]

The variation of the annual volume and number of DtA loans is shown in table 3.1. In East Germany it closely follows the variation of the monthly start-up number over time. As East German firm formation per month rose steadily until July 1990 and remained on a very high level until 1991 (Steil 1997), the number and volume of DtA loans peaked in 1991 and 1992, respectively. After 1991, firm formation and correspondingly the number of DtA loans decreased in East Germany. The aggregate value of loans declined after 1992. In West Germany the level of start-up assistance was much lower than in East Germany. This indicates that German subsidization policies after unification focussed mainly on East Germany.

3.2.2 Selection of program participants

In the context of program evaluation understanding the selection of program participants is of key importance. Assignment to federal programs promoting start-up activity in Germany depends on the decisions of entrepreneurs, mediating banks and the subsidizing institution DtA. Figure 3.1 describes the assignment process.

Entrepreneurs may not apply for start-up assistance because of lacking information. Especially East-German entrepreneurs may not have known about the existence of the programs shortly after unification. Moreover, entrepreneurs may not apply because they either need no external financing or anticipate a rejection. Entrepreneurs who dislike interference by outsiders in general, even when it does not involve any loss of control rights, should not be expected to use start-up assistance.[11]

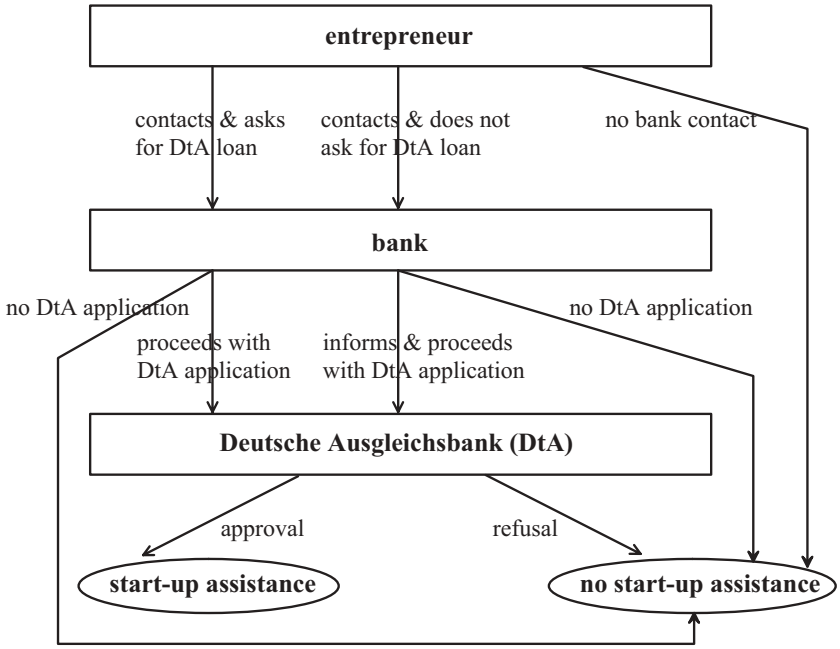
Banks have a strong influence on program assignment due to the so-called “house bank principle”. It requires an application for start-up assistance to be passed on to the DtA by a bank willing to handle the potentially approved loan. This mediator role of banks is important for the intended evaluation for two reasons. First, it decentralizes the process of assigning DtA

[9] According to the Deutsche Bundesbank interest rates of ERP and DtA business start-up loans are on average about 2.5 percentage points lower than the market rates (Deutsche Bundesbank 1991). Interest rate subsidies in these programs are, however, likely to be larger than 2.5 percentage points since private lenders typically charge a mark-up on the market rate when handing out loans to newly started firms.

[10] During the 1990s, several federal loan guarantee programs offered guarantees, especially to East German firms.

[11] See for example Hutchinson (1995) and Cressy and Olofsson (1997) on such demand-sided financial constraints.

Figure 3.1: Assignment to Start-up Assistance



start-up assistance. This increases the chance to find suitable comparison firms for evaluating program effects since a local bank may reject a customer after having accepted many similar customers in order to diversify the customer portfolio. Second, bank mediation is likely to imply selective program assignment. When a bank is contacted by an entrepreneur, it may refuse to provide venture financing and to pass on a program application to the DtA. This situation arises if the bank classifies as insufficient either the entrepreneur's abilities or the project's quality. Concerning accepted customers, a bank has to decide whether it provides all needed external financing or proposes the customer for DtA loans and provides only complementary financing.

Finally, DtA officials decide upon the approval of start-up assistance. First, they have to check whether an application fulfils the program requirements for start-up assistance. These can be summarized as follows:

1. The applying entrepreneur is sufficiently qualified to pursue the project and preferably less than 56 years old.[12] Entrepreneurs who start their first firm project are preferred.

2. The firm project is found promising, insufficiently financed and not already ongoing when the entrepreneur applies for assistance.

[12]Program requirements vary slightly over time and between programs with respect to the indicated age limit. This variation could be ignored in the following since it had only minor effects on assignment probabilities between 1990 and 1994.

3. The firm is not fully affiliated to one or several parent firms. Especially subsidiaries are not eligible.

Second, DtA officials may deviate from selection according to these program requirements because of distorted incentives.[13] The DtA needs political support for continuing its programs. The political debate about start-up assistance in Germany is controversial and causal effects of start-up assistance on success perspectives of otherwise financially constrained firms are difficult to measure and to communicate. Thus, DtA officials may be tempted to select projects with high success chances even if these could be financed privately. Such a "picking-the-winner"-strategy would guarantee a high number of survivors among the subsidized firms that could be used to proclaim program success.

Despite these arguments, distorted incentives of DtA officials are presumably the least important source of selective program assignment. As can be seen in table 3.1, the DtA refused only a small percentage of all loan applications between 1990 and 1994 in East and West Germany. Only in 1990 and 1991 the refusal rates for West German firms are about 9 percent. These high West German rates simply reflect the fact that most of the program funds available right after the unforeseen breakdown of the German Democratic Republic in 1989 were needed for subsidizing start-ups in East Germany.

3.2.3 Related empirical literature

A large number of microeconometric evaluation studies are about labor market programs offering job training, wage subsidies, and job search assistance.[14] By contrast, evaluation studies on firm programs subsidizing firm formation, self-employment, and research and development (R&D) are still rare.

In their surveys on R&D subsidies, Klette, Møen, and Griliches (2000) and David, Hall, and Toole (2000) cannot include but a few firm-level studies that take selective program participation into account when analyzing R&D program effects on firm performance. Lerner (1999) and Wallsten (2000) evaluate the largest U.S. initiative subsidizing R&D activity in small high-technology firms, the Small Business Innovation Research (SBIR) program.[15] Their studies differ with respect to the econometric approach and the time horizon of evaluation.[16]

[13] Distortions related to the provision of subsidies are addressed in a large public finance and public choice literature. See Lerner (1999) and Wallsten (2000) for references.

[14] See Heckman, LaLonde, and Smith (1999) for a survey of this literature.

[15] To finance the program, federal agencies have set aside a certain percentage of their annual external R&D budget since 1982 - so far more than US$ 10 billion.

[16] Busom (2000), Lach (2002) and Toivanen and Niininen (2000) present related studies on R&D programs addressing small as well as large firms.

Lerner (1999) analyses long-run effects of SBIR research awards on firm performance about ten years after program participation. He discusses three ex ante plausible reasons for observing positive program effects: information provision to potential investors by certifying firm quality, encouragement of innovation activities with positive externalities, and award allocation driven by distorted incentives of program managers and politicians. Despite considering potentially selective award allocation, Lerner (1999) does not set up a program selection equation when evaluating program effects. Instead, he explores and draws conclusions from the variation of program effects across regions, across industries and with the number of awards. The data base contains 541 firms with small, initial evaluation awards as well as substantial, subsequent research awards and 294 comparison firms only with initial evaluation awards. In addition, 600 non-subsidized comparison firms were matched to the research awardees with respect to size and industry or location. OLS regressions based on the whole sample show no significant correlation of employment or sales growth between 1985 and 1995 with the indicator for research awards in 1984 or 1985. But employment and sales are significantly positively correlated with the interaction between the award dummy and the regional volume of early-stage financing provided by venture capitalists. In industry-specific regressions this result is found for high-technology industries but not for low-technology industries. Adding an indicator for multiple awards before 1986 to the regressions for the whole sample shows no significant positive correlation between this indicator and employment or sales growth. Altogether, the results are consistent with a certification role of SBIR awards for investors but also with distortions in the process of award allocation.

Wallsten (2000) studies how SBIR awards granted between 1990 and 1992 affect firm employment in 1993. His simultaneous, fully parametric models consist of three equations explaining the received number of evaluation awards, the number of research awards, and the outcome. The total SBIR budget from which a certain firm can win awards serves as instrumental variable to identify the endogenous award variable in the outcome equation. Wallsten (2000) uses data on 367 awardees, 90 rejected firms and 22 eligible, publicly traded firms that did not apply for an award. Wallsten (2000) notes that he can only investigate short-run effects, and that the rejected firms in the sample as well as the eligible, non-applying firms may not be representative for the respective populations. According to the three stage least-squares estimates, large and patent-intensive firms, i.e. firms with presumably good growth and innovation perspectives receive more SBIR grants than others. But SBIR research awards between 1990 and 1992 do not significantly increase firm employment in 1993. Therefore, selective award allocation causes a significant positive correlation between SBIR grants and employment if an inappropriate single equation model is estimated. Estimates for the small sub-sample of 81 publicly traded firms show that the awarded dollar amount crowds out firm-financed R&D expenditures in 1992, i.e. shortly after the awards have been granted.

The following microeconometric studies evaluate firm programs that do not address R&D

activity but self-employment and entrepreneurship. Pitt and Khandker (1998) evaluate the effects of three major micro-credit programs in Bangladesh on household expenditure, asset holding, schooling and labor supply. Within these group-based programs, non-agricultural self-employment of persons from poor rural households is financed by loans and supported by accompanying non-financial services.[17] The data base is a stratified random sample with about 300 households non-eligible for program participation and 1,500 eligible ones. 900 households participated in one of the programs. Pitt and Khandker (1998) use simultaneous, fully parametric models with two gender-specific participation equations and an outcome equation. They take unobservable village- and household-specific heterogeneity into account by fixed-effect estimation and by exploiting discontinuity of program eligibility rules with respect to land ownership.[18] Estimation results show that controlling for unobservable heterogeneity matters. The main evaluation results are significant and positive effects of credit amounts borrowed by program participants since 1986 on household expenditure, on women's asset holding as well as on school enrolment of boys and a significant negative effect on men's labor supply measured in 1991 or 1992. Moreover, the effects of lending to women tend to be stronger than those of lending to men.

McKernan (2002) aims at disentangling the effects of these three Bangladeshi programs caused by credit disbursement and by non-credit services and incentives. Non-credit elements like information sharing and monitoring among credit-group members, vocational training or health education are a constituent part of most group-based micro-credit programs. McKernan (2002) uses the same data base and similar identification strategies as Pitt and Khandker (1998) to first estimate a simultaneous, fully parametric model with a program participation and a self-employment profit equation. Then, the author conditions the profit function not only on program participation but also on the level of productive capital to derive an estimate of the non-credit program effects on self-employment profits. The results indicate not only an economically and statistically significant positive total program effect but after conditioning on productive capital also a significant and large positive non-credit program effect on self-employment profits.

Pfeiffer and Reize (2000) analyze the effects of a German active labor-market program providing small subsidies, called bridging allowances, to unemployed people who try to build up self-employment.[19] The authors use simultaneous, fully parametric models with one outcome equation, either firm survival or employment growth, and one or two selection equations, respectively. Pfeiffer and Reize (2000) observe a firm survival indicator for 322 firms started by at least one unemployed person with bridging allowance and employment growth for 241

[17] Morduch (1999) surveys recent work on these and other micro-finance programs.

[18] See Morduch (1998) for some methodological concerns and Pitt (1998) for a response.

[19] See Meager (1996) on this type of active labor market programs in Denmark, France, Germany, UK, and the US.

such firms. For more than 12 times as many start-ups not involving a person with bridging allowance survival and growth information is available. However, the available data does not indicate whether a non-subsidized firm is started from unemployment or not. Moreover, only short-run effects can be evaluated, and the firm survival indicator the authors use is noisy.[20] According to the estimation results for East Germany, receipt of bridging allowances is negatively related to firm survival in the first year after start-up and the result is significant at the 6-percent level. The regression for West Germany shows a negative, but insignificant impact. Furthermore, no significant effect of receiving bridging allowances on employment growth during the first two years after start-up can be identified.

Battistin, Gavosto, and Rettore (2001) evaluate an Italian program promoting youth entrepreneurship in southern Italy. A participating young entrepreneur can receive substantial grants of up to 3 million Euro and additional subsidized loans. The sample contains about 250 subsidized and a large pool of non-subsidized firms. Following Dehejia and Wahba (1999), the authors choose a non-parametric matching approach closely related to the procedure I apply to construct a comparison group for evaluating program effects. The comparison group they use is similar to their group of subsidized firms with respect to three crude variables: industry classification, location and firm formation cohort. The empirical results show that subsidized firms survive much longer than firms in the comparison group. From the fifth year of firm life duration onwards the hazard rates of both groups are equally high until the end of the observation period. Most important, the hazard rate of subsidized firms does not decrease at the end of the observation period.

3.3 Evaluation and econometric methodology

3.3.1 Definition of causal effects and identification

The model of potential outcomes and causal effects formalized by Roy (1951) and Rubin (1974) and widely used in recent evaluation studies is a suitable framework for evaluating federal start-up assistance in Germany.[21] Given the main objectives of start-up assistance, I address the following question: What are the expected effects of start-up assistance on employment, investment, and survival of subsidized firms compared to the counterfactual situation where these firms received no such assistance? Thus, I focus on treatment effects on treated firms, denoted by the vector θ:

$$\theta := E(Y^t - Y^c \mid S = 1) = E(Y^t \mid S = 1) - E(Y^c \mid S = 1). \tag{3.1}$$

[20] See Almus, Engel, and Prantl (2000).

[21] See Holland (1986) and Sobel (1995) for further details and a discussion of related earlier work.

The binary assignment variable S indicates whether a firm was treated with start-up assistance ($S = 1$) or not ($S = 0$). Y^t and Y^c are potential outcome variables. Y^t denotes the vector of the outcomes, i.e. employment, investment, and survival, in state t with treatment. Y^c denotes the outcome vector in the comparison state c without treatment. The observed outcome vector depends on the treatment assignment mechanism: $Y = Y^c + S * (Y^t - Y^c)$. $E(Y^t \mid S = 1)$ and $E(Y^c \mid S = 1)$ denote the expected values of Y^t and Y^c, respectively, for the group of treated firms ($S = 1$). To allow for causal analysis in this framework the stable unit treatment value assumption (SUTVA) is supposed to hold: the potential outcome values for firm i, with index i running over all firms in the population, are stable for all different treatment allocations that assign the same sort of treatment to firm i.[22] Thus, indirect and general equilibrium effects of start-up assistance are ignored in section 3.5.3.[23]

θ cannot be identified directly because the sample analogue of $E(Y^c \mid S = 1)$, i.e. the mean of Y^c for treated firms is not observable. Identification has to be achieved by data collection design or plausible assumptions as surveyed in Angrist and Krueger (1999) and Heckman, LaLonde, and Smith (1999). If start-up assistance were randomly assigned, potential outcomes would be independent of the assignment mechanism. The mean of Y^c among untreated firms could be used to estimate $E(Y^c \mid S = 1)$ and thus θ.

The non-experimental data used for this study does not fulfil the requirement of random assignment. Following Rubin (1977) I base identification of θ on the assumption of random assignment conditional on covariates. This requires all important factors influencing assignment and outcomes simultaneously to be observed. In the context at hand I consider this to be fulfilled for two reasons: First, the transition process after the sudden breakdown of the German Democratic Republic created a particular economic situation. Second, the comprehensive data set provides a rich set of entrepreneur-, firm- and environment-specific variables.[24] Precisely, the imposed conditional independence assumption (CIA) states that the potential outcomes in the state without treatment are independent of assignment conditional on X taking a value x in the covariate space χ:

$$Y^c \amalg S \mid X = x \quad \forall \quad x \in \chi. \tag{3.2}$$

$\amalg$ denotes independence. X is the vector of covariates unaffected by the treatment and influencing assignment and outcomes simultaneously. If CIA holds, then $E(Y^c \mid S = 1, X = x) = E(Y^c \mid S = 0, X = x)$. Rewriting the not directly identifiable part of equation (3.1)

[22] See Rubin (1980, 1986, 1990) and Angrist, Imbens, and Rubin (1996).

[23] Most programs addressing economic agents interacting on markets are unlikely to fulfil SUTVA literally. See section 3.6 for a discussion of indirect and general equilibrium effects in the case of programs providing start-up assistance.

[24] See section 3.5.1 for further discussion.

gives: $E[Y^c \mid S=1] = E_X[E(Y^c \mid S=1, X=x) \mid S=1]$. Thus, the sample analogue of $E_X[E(Y^c \mid S=0, X=x) \mid S=1]$ can be used to estimate $E[Y^c \mid S=1]$.

Being interested in treatment effects on the treated, I have to assume, besides CIA, that the assignment probability conditional on $X=x$, $P(x) = P(S=1 \mid X=x)$, is strictly smaller than 1. This assumption is necessary since CIA does not provide identification of the effects of interest in regions of χ where comparison firms for estimating $E(Y^c \mid S=1)$ are missing. Thus, effects will be estimated for the region of common support $\tilde{\chi}$, i.e. the part of χ where potential comparison firms exist.[25]

3.3.2 Estimation method

Conditioning on $X=x$ can be implemented by applying a matching procedure as recently done by Angrist (1998), Dehejia and Wahba (1998, 1999), Heckman, Ichimura, and Todd (1997), Heckman, Ichimura, Smith, and Todd (1998), Lechner (1999, 2000), and other authors. Matching estimators are intuitive, allow for various functional forms of the conditional expectations and permit individual causal effects to be heterogeneous within the population of interest.[26]

If each treated firm is matched to an untreated one exactly equal with respect to X, $E[Y^c \mid S=1]$ can obviously be estimated by the sample analogue of $E_X[E(Y^c \mid S=0, X=x) \mid S=1]$ in the matched comparison group of untreated firms. Since exact matching can hardly be applied if X is a high-dimensional vector, Rosenbaum and Rubin (1983) suggest using the propensity or balancing score property to reduce dimension. Call the conditional assignment probability $P(X)$ that was introduced above propensity score. Define the balancing score $b(X)$ as a function of X with the following property: $E[P(S=1 \mid X=x) \mid b(X)=b(x)] = P(x)$. If CIA holds, i.e. if the potential outcomes are independent of assignment conditional on $X=x$ then they are also independent of assignment conditional on $b(X) = b(x)$. It follows that: $E[Y^c \mid S=1, b(X)=b(x)] = E[Y^c \mid S=0, b(X)=b(x)]$. To condition on $b(X) = b(x)$ rather than directly on $X=x$ each treated firm has to be matched to an untreated firm similar in terms of $b(X)$ such that the distribution of $b(X)$ in the treatment group equals the one in the matched comparison group. Due to the balancing score property the corresponding distributions of X will then also be balanced. $E[Y^c \mid S=1]$ can be estimated by the sample analogue of $E_X[E(Y^c \mid S=0, b(X)=b(x)) \mid S=1]$ in the matched comparison group. $P(X)$ and thus any dimension reducing $b(X)$ is usually unknown and must be estimated. In this study, esti-

[25] See Heckman, Ichimura, and Todd (1997), Heckman, LaLonde, and Smith (1999), Imbens (2000) and Lechner (2001b) for discussions.

[26] See Heckman, Ichimura, Smith, and Todd (1998), Gerfin and Lechner (2002) and Rubin (1990).

mating the assignment model is interesting in itself because assignment to start-up assistance in Germany has rarely been investigated.

In this study, I apply nearest neighbor matching on the balancing score with replacement.[27] Matching with replacement means that each comparison firm can be drawn repeatedly. This helps to avoid strongly biased matches for firm types frequent in the group of treated firms but not among potential comparison firms. Appendix B.1 provides details on the matching procedure.

Using the matched comparison group, θ is estimated as follows:

$$\hat{\theta} = \frac{\sum_j w_j \cdot y_j^t - \sum_l w_l \cdot y_l^c}{\sum_j w_j} \quad \text{with} \quad j = 1, ..., N^t \quad \text{and} \quad l = 1, ..., N^m. \tag{3.3}$$

The variable y_j^t denotes the outcome vector observed for the treated firm j with index j running over all firms in the treatment group. y_l^c is the outcome vector observed for the comparison firm l which is matched to at least one treated firm. Index l runs over all firms selected for the matched comparison group. The variable w_j indicates the sampling weight of firm j taking account for the outcome-based sampling described in section 3.4.1. The variable w_l, denotes the sampling weight of a matched comparison firm l. It equals the sum of the weights of all treated firms (j) to which comparison firm l is matched: $w_l = \sum_{(j)} w_{(j)} \; \forall \; (j) = 1, ..., N^l$ with $N^l \leq N^t$ and $\sum_l N^l = N^t$. The construction of w_l implies $\sum_j w_j = \sum_l w_l$.

The estimator $\hat{\theta}$ is the difference between the weighted average of the observed outcomes in the treatment group and the weighted average in the matched comparison group. When calculating the variance of the matching estimator repeated drawing is taken into account as proposed by Lechner (2001a) and applied, for example, by Gerfin and Lechner (2002).[28]

3.4 Data

3.4.1 Main data bases and merge

The empirical analysis is based on a large, unique data set containing firms with start-up assistance from the DtA and firms without such assistance. To construct the data set, the internal DtA data base was for the first time connected to an external data base. The former

[27] See Dehejia and Wahba (1998) and Lechner (2001a) for similar matching procedures.

[28] Lechner (2001a) assumes that the estimation of the propensity score and the estimation of the weights w_l within the matching procedure can be ignored in the context of variance calculation. I use the approximate variance estimator he proposes despite these simplifying assumptions since the computational burden of bootstrapping would be high in the context at hand. See Lechner (2002b) for an application where variance approximation and bootstrapping lead to similar results.

provides information on 775,781 DtA loan approvals between 1990 and 1999. The latter is a stratified random sample with 10,000 East and 12,000 West German firms drawn from two large, complementary firm panels kept at the Centre for European Economic Research (ZEW), Mannheim. In September 1999, the East and West German panel included altogether about 2.6 million firms. The data for the panels are provided by the leading German credit rating agency, Creditreform, approximately every six months (Almus, Engel, and Prantl 2000). The sample covers all East and West German regions and all industries in the manufacturing, construction and trade sectors as well as most service industries. All firms in the sample were started before January 1, 1994 and panel data is available for the period until December 31, 1999. Hence, short- and long-run effects of start-up assistance can be evaluated.

A typical firm record in the ZEW firm panels contains detailed information on the firm, its owners, and its managers. Creditreform delivers data on firm formation and liquidation partly in encoded variables and partly in free flow text. Since I extracted this text information for all 22,000 firms in the sample from about 4,000 pages comprehensive formation and liquidation data can be used for the following analysis. A large telephone survey conducted in 1999 provides further data on the activity status of 5,299 firms in the sample (Almus et al. 2001). When drawing the sample, firm groups having a high liquidation risk according to Creditreform's encoded information were over-sampled approximately twofold. This disproportionally stratified outcome-based sampling rule is taken into account here in all estimation and test procedures (Manski and McFadden 1981, Angrist and Krueger 1999). According to the detailed, partly text-extracted start-up information 4,411 firms in the sample were started before January 1, 1990, turned out to be holding companies, part-time projects, or legally dependent firm units. These were not considered for the following analysis because of the restrictions imposed on firms with DtA start-up assistance (see section 3.2.2) and because of the time period covered by the internal DtA data base.

To merge the DtA data base and the firm sample we proceeded in two steps. First, a computer-based search algorithm was used to link data entries in both data bases by means of a heuristic comparison procedure. A link was established if coincidence of firm or owner names, owners' birth dates, and address information was high. Then, extensive manual checking of the computer-generated links was conducted. Several checks of data consistency indicate a highly reliable merge between both data bases and that subsidized firms in the sample represent the population of firms with DtA assistance well.[29]

[29]See appendix B.2 for further details.

3.4.2 Final sample and descriptive statistics

Before conducting the empirical analysis 4,965 of all 17,589 start-ups between January 1, 1990 and December 31, 1993 were discarded from the sample due to exclusion restrictions precisely described in table B.1. Conceptually most important, I eliminated firms not eligible for the considered DtA programs due to the restrictions on owner age or firm affiliations (see section 3.2.2). Some firms participating in small DtA programs not evaluated here were also dropped. For most of the other discarded firms either basic firm or owner age information was missing.[30]

Table B.2 contains descriptive statistics for the final sample. It covers 2,261 firms treated with start-up assistance and 10,363 untreated firms. The average treated firms received ERP or DTA start-up loans with a face value of 77,715 Euro and 41,803 Euro as ERP equity capital assistance loan.[31] The untreated firms constitute the group of potential comparison firms. Table 3.2 shows descriptive statistics for treated firms and potential comparison firms. According to the displayed test results, the group of treated firms does not constitute a random sample from the sample population.

For each selected variable I conducted a two-tailed test of the null hypothesis stating equality of weighted means in the treatment group and the group of potential comparison firms. The results indicate many statistically significant and substantial differences between both groups with respect to firm- and entrepreneur-specific characteristics. In comparison with untreated firms, treated firms are more likely to start with a larger team of entrepreneurs and as franchisees. In addition, treated firms are more often sole proprietorships, commercial partnerships, and independent firms without affiliations to incumbent firms. Entrepreneurs in the treatment group belong more often to the medium age class (30-44 years) and hold more often a high educational degree, i.e. a master craftsman degree or a university diploma in engineering, than those in the group of untreated firms.[32] Moreover, both groups differ significantly with respect to the distribution of start-up years, industry classification, and location-specific characteristics. Interestingly, the selection process seems to depend on characteristics of the bank office density at the firm location.

[30] Note that 1,633 firms without investment information are kept in the sample to avoid unnecessary sample size reduction. Thus, the empirical results for the outcome variable investment are based on a reduced sample.

[31] 64.6 percent of the treated firms received equity capital assistance as well as at least one loan in the ERP or DtA business start-up program. 7.3 percent received nothing but equity capital assistance and 28.1 percent received only loans in the business start-up programs.

[32] 28.3 percent of all start-ups in the sample have several entrepreneurs, i.e. several owner persons with management function. In such cases, I selected the entrepreneur-specific information of the managing owner with the highest equity share. Sometimes share data was missing and I chose the entrepreneur-specific information of the oldest managing owner. Alternative ways of encoding were tested but did not lead to qualitatively different results.

Table 3.2: Potential Comparison Group versus Treatment Group

Variable	Mean/Share in %	
	Potential Comparison Firms	Treated Firms
education unknown	31.50	24.75***
apprenticeship	44.59	35.61***
master craftsman	8.77	17.43***
business administration	2.89	3.00
engineering	9.58	16.81***
other academic degrees	2.67	2.43
age, 17-29	23.18	20.06***
age, 30-44	53.45	57.56***
age, 45-72	23.37	22.38
female	11.08	15.90***
team size	1.3214	1.3583**
diversified	27.35	27.19
franchisee	3.06	4.92***
ltd. liability & stock company	34.86	31.51***
civil law association	10.04	9.00
commercial partnership	1.08	2.48***
sole proprietorship	54.01	57.01**
firm affiliation	6.53	3.85***
cohort 1990	26.87	24.85*
cohort 1991	24.18	32.32***
cohort 1992	20.66	26.05***
cohort 1993	28.29	16.78***
manufacturing	9.84	17.08***
construction	15.00	21.53***
wholesale & intermediate trade	12.36	8.35***
retail trade	26.37	33.15***
transport & communication	6.98	4.88***
services	29.45	15.01***
high technology	7.74	7.07
unemployment rate	10.09	13.29***
population density	1.067	0.6168***
bank office density	0.6809	0.8589***
West Germany	0.6204	0.2733***

Note: The table shows weighted means and shares for the groups of 2,261 treated firms and of 10,363 potential comparison firms. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in the potential comparison group and the treatment group.

These significant and substantial differences suggest that selection into DtA programs depends on variables simultaneously influencing assignment and outcome variables. Therefore, the selection process must be controlled for when estimating program effects. I will apply the

non-parametric evaluation approach discussed in section 3.3.

3.5 Empirical results

In the following, I present the results of analyzing assignment to start-up assistance and of evaluating its effects on subsidized firms. Section 3.5.1 contains the estimation results of the program assignment model. These inform about determinants of assignment to federal start-up assistance in Germany and are essential prerequisites for the evaluation of causal effects by applying a matching estimator. The subsequent application of the matching procedure and the achieved balancing quality are described in section 3.5.2. In section 3.5.3, I discuss estimated long-run effects on the firm survival rate and the effects on firm size and on investment per employee shortly after assignment. Moreover, effects on survival as well as hazard functions for the first nine years after firm formation are considered.

3.5.1 Determinants of program assignment

A fully parametric binary probit model is used to estimate the program assignment equation. Since sampling from the parent population is outcome-based I apply the weighted maximum likelihood estimator introduced by Manski and Lerman (1977). The dependent variable S is coded as 1 if firm i received start-up assistance in the firm formation year or the subsequent year and 0 otherwise for all $i = 1, ..., N$. X is the vector of independent variables.[33] The expected value of S conditional on $X = x_i$ is modeled as follows:

$$E[S \mid X = x_i] = P[S = 1 \mid X = x_i] = \Phi(x_i'\beta/\sigma) \qquad \forall \quad i = 1, ..., N. \tag{3.4}$$

$\Phi()$ is the cumulative distribution function of a standard normal distribution evaluated at $x_i'\beta/\sigma$. It is assumed that the error term in the latent model conditional on $X = x_i$ follows a normal distribution with mean $\mu = 0$ and variance $\sigma^2 = 1$. β is the parameter vector to be estimated.

The program participation equation has to be specified adequately since a consistent estimate of the propensity score is needed for estimating causal effects. Most importantly, all variables that simultaneously influence program assignment as described in section 3.2.2 and the interesting outcome variables have to be included in X and thus in the propensity score estimate. At first, I estimated a very flexible model specification with 182 explanatory variables includ-

[33] All independent variables are measured in the firm formation year or the subsequent year except otherwise indicated in table B.2.

ing various interaction terms.[34] Lagrange multiplier tests against omitted variables indicated that 122 of these variables were not missing at the 10-percent significance level. Thus, the preferred model specification excludes these variables. Omitted are, for example, gender of the entrepreneur which is often argued to affect bank lending decisions and a dummy for start-ups with a diversified entry strategy. Such a diversification dummy is sometimes used to proxy firm project risk. For the finally chosen model specification I conducted several statistical tests since violating the main stochastic assumptions of the probit model can lead to inconsistent parameter estimates. A Lagrange multiplier test of normality indicated no rejection of the null hypothesis of a normally distributed error term at any usual significance level. Using Lagrange multiplier tests, the null hypothesis of homoscedasticity was neither rejected for human capital variables, legal form indicators, other firm-specific variables, location variables, cohort and industry dummies nor interaction terms.[35] Thus, the conducted tests indicate no need to reject the chosen specification of the program assignment equation.

The results of the finally estimated model are shown in table 3.3. In the following, I will first explain for each independent variable I use how it is expected to affect the decisions of entrepreneurs, banks and DtA officials in the process of program assignment. Then, I will discuss the related estimation results.

Entrepreneurial success is usually argued to increase in human capital (Bates 1990, Cressy 1996a). Therefore, banks are assumed ceteris paribus (c.p.) to prefer well educated entrepreneurs as borrowers. DtA officials are also likely to prefer such entrepreneurs because of the program requirements and the potentially existing incentives to inflate program success records by picking winners. Moreover, well educated people may be better informed about the existence of DtA programs and thus more likely to apply for start-up assistance. The estimation results in table 3.3 are consistent with these expectations. The following groups of entrepreneurs receive significantly more often start-up assistance than entrepreneurs who have only completed an apprenticeship or any other type of low education: young or medium-aged entrepreneurs with a master craftsman degree, entrepreneurs in East German start-ups with a university degree in business and administration, entrepreneurs with a degree in engineering and entrepreneurs with other academic degrees that choose a legal form with full liability.

The age of the entrepreneur can be interpreted as a proxy for experience, risk attitude or wealth (Bates 1990, Holtz-Eakin, Joulfaian, and Rosen 1994b, Cressy 1996b). Entrepreneurs who build up a firm relatively late in life are more likely than young entrepreneurs to start with a high level of business and work experience that promotes commercial success. They

[34] I used interactions between age and education indicators, between the limited liability dummy and human capital as well as firm-specific variables, between cohort and industry dummies, and interaction terms of all variables with the dummy for West Germany.

[35] See Greene (2000) and Verbeek (2000) for a description of the applied Lagrange multiplier tests of normality and of homoscedasticity. I adapted the proposed test statistics to include probability weights.

are usually assumed to choose less risky projects and to have accumulated more wealth that can be used as collateral. In addition, the curriculum vitae of older persons may provide more information and thus allow for a more precise prediction of the expected entrepreneurial success. Consequently, risk averse banks and DtA officials with distorted incentives should c.p. prefer older entrepreneurs as borrowers. In contrast, especially entrepreneurs starting their first firm project shall be preferred according to program requirements.

Table 3.3: Estimation Results of the Probit Assignment Model

Independent Variable	Coefficient	Robust Standard Error
education unknown	-0.0697*	0.0395
master craftsman	0.9388***	0.2026
business administration	0.3983***	0.1155
engineering	0.2931***	0.0517
other academic degrees	0.4104***	0.1331
age	0.0876***	0.0136
age^2	-0.0011***	0.0002
age*master craftsman	-0.0158***	0.0052
team size	0.1300***	0.0314
franchisee	0.2120**	0.0831
firm affiliation	-0.1449	0.1807
ltd. liability & stock company	-0.0680	0.0444
civil law association	-0.1497**	0.0638
commercial partnership	0.3746***	0.1195
ltd. liability*firm affiliation	-0.3511*	0.1977
ltd. liability*other acad. degrees	-0.4652**	0.2035
East Berlin	-0.2152***	0.0674
Brandenburg	0.2466***	0.0742
Mecklenburg West-Pommerania	0.0796	0.0596
Saxony-Anhalt	0.2684***	0.0646
Thuringia	-0.1014	0.1169
West Germany	-0.2541	0.1676
West*bus. admin.	-0.3654*	0.1914
West*age	-0.0115***	0.0039
unemployment rate	0.0477***	0.0168
unemployment rate^2	-0.0013**	0.0006
population density	-0.1224***	0.0211
bank office density	0.0906**	0.0370
West*bank office density	0.3153***	0.1010
cohort 1991	0.0778*	0.0442
cohort 1992	0.1131**	0.0466
cohort 1993	-0.3679***	0.0477

continued on next page

continued from previous page

Independent Variable	Coefficient	Robust Standard Error
high technology	0.1819**	0.0845
West*structural & civil engineering	-0.4270***	0.1196
West*intermediate trade	-0.3988**	0.2001
West*transport & comm., no carriage	-0.2900*	0.1730
West*accommodation & food services	-0.5635***	0.1285
intercept	-2.6260***	0.3006
Wald-statistic (χ^2 (degrees of freedom))		
Industry Indicators	106.46 (17)***	
Cohort*Industry Indicators	25.37 (6)***	
Model	1451.98 (60)***	
log Likelihood (# obs.)	-5065.06	(12624)

Notes: The dependent variable in the probit regression is the assistance indicator (1: start-up assistance within the firm formation year or the subsequent year; 0: else). Reference firms have the following characteristics: one entrepreneur with apprenticeship or inferior education, no franchise contract, sole proprietorship, no firm affiliation, cohort 1990, retail trade industry in Saxony. *** (**, *) indicates that the coefficient or the coefficients differ significantly from zero at the 1% (5%, 10%) significance level.

Table 3.3 shows that age has a statistically significant quadratic effect on program participation. The basic age effect attains its maximum at an age of about 38 years. After reaching this peak the effect decreases quite slowly such that it remains positive until the maximal age in the sample. Due to the significant interaction variables the age effect peaks at 33 and 31 years and remains positive until the age of 66 and 64 for West German entrepreneurs and master craftsmen, respectively. Altogether, these results would be in accordance with a preferred selection of medium-aged and older entrepreneurs by DtA officials. Nevertheless, as argued earlier distorted incentives of DtA officials should be only of minor empirical relevance. The results rather indicate strong selection at the bank level.

Firms started by a team of entrepreneurs are c.p. probably endowed with a better human capital stock than start-ups of individual entrepreneurs because deficiencies in one person's education or experience can be compensated by other team members (Cressy 1996a). If a higher human capital stock implies an informational advantage, then team start-ups are more likely to apply for start-up assistance than firms of individual entrepreneurs. Consistent with this arguing, a significant positive coefficient of the team size variable is shown in table 3.3.

Some firms enter the market as franchisees. Franchisees copying already tested firm concepts are probably less risky than newly designed projects. Using well-known trademarks can facilitate access to customers. In addition, the founders of franchisees may have been carefully selected and trained by the franchiser (Rubin 1978). Consequently, franchisees should c.p. be preferred as borrowers in case of risk averse bank lending behavior. Consistent with this expected behavior, table 3.3 exhibits a significant positive coefficient of the indicator for franchisees.

The legal form of start-ups can be argued to indicate project risk.[36] Entrepreneurs who want to start a high risk project tend to choose a legal form with limited liability. According to Stiglitz and Weiss (1981), an entrepreneur with limited liability might even increase his residual firm value after start-up by shifting to a riskier project with the same or a lower expected value than the initial project. If banks tend to be risk-averse when selecting credit customers and thus program participants, then limited liability firms have c.p. less chances to receive start-up assistance. Moreover, entrepreneurs who choose a legal form with limited liability may be reluctant to accept the personal liability condition within the equity capital assistance program or to provide collateral for a loan in a business start-up program. In accordance with these expectations, the coefficients of the limited liability indicator, its interaction with the dummy for start-ups with partial affiliations to other firms and its interaction with the dummy for entrepreneurs with other academic degrees are negative. The coefficient of the limited liability indicator just fails to pass the 10-percent significance level. However, both the limited liability effects for partly affiliated start-ups and for entrepreneurs with other academic degrees are significant.[37]

Program requirements preclude the assignment of start-up assistance to temporary firm projects. Since entrepreneurs with temporary firm projects in Germany usually start a civil law association the significant negative coefficient of the indicator variable for civil law associations in table 3.3 is in line with the program requirements.

As mentioned in section 3.4.2, firms with full affiliations to a parent firm were excluded from the sample because they are not eligible for the DtA programs evaluated here. Due to this program requirement partly affiliated firms may c.p. have lower chances to receive start-up assistance than independent start-ups. In accordance with this expectation, the estimation indicates a lower assignment probability for partly affiliated firms than for independent start-ups. The effect is significant for partly affiliated firms started as limited liability firm or stock company, i.e. for nearly 90 percent of all affiliated firms in the sample.

The estimation results discussed so far show that firm- and entrepreneur-specific characteristics have a strong impact on program assignment. Next, I examine location-specific factors. Control variables for East German states indicate significant deviation of the program assignment probability in East Berlin, Brandenburg and Saxony-Anhalt from the probability in the

[36] Harhoff, Stahl, and Woywode (1998) discuss this in detail.

[37] Storey (1994a) finds weak empirical support for the view that limited companies in the U.K. are more likely to use bank loans or overdraft than firms without limited liability. He explains his result with higher credibility and seriousness of incorporated firms. At first sight, Storey's and my results seem to be at odds, but this is probably not the case because of two reasons. First, I analyze assignment to subsidized medium- or long-term loans whereas Storey (1994a) uses an endogenous variable that pools all types of loans including overdrafts typically used for short-term financing. Second, in contrast to my German data set, his data is based on a retrospective survey covering only surviving U.K. firms.

reference state Saxony. Despite the focus of start-up assistance activity on East Germany at the beginning of the 1990s (see table 3.1), the negative coefficient for West German start-ups remains insignificant in the program assignment equation.[38] However, all interactions between the dummy for West German start-ups and entrepreneur-specific variables as well as industry indicators are negative and significant. Moreover, the effect of the local unemployment rate in the start-up year on the assignment probability captures an important difference between East and West Germany since unemployment rates in East Germany were on average much higher in East than in West Germany during the 1990s. The unemployment rate effect on assignment is captured by a quadratic polynomial. The effect increases until the 90-percent percentile of the local unemployment rate distribution and remains positive over the whole distribution. Accordingly, start-up assistance is directed towards districts with poor local labor market conditions and a weak local business cycle. General agglomeration effects are suggested by the negative and significant coefficient of the local population density.[39]

Selection of firms for start-up assistance at the bank level may c.p. depend on competition in the banking sector contacted by the entrepreneur because lending relationships are known to depend on credit market competition.[40] In competitive markets banks may c.p. be more reluctant to sink screening costs for the evaluation of entrepreneurs than in less competitive markets because the potential credit customer can easily switch to another bank. Instead, it may be optimal to offer an application for start-up assistance to many unscreened or only slightly screened customers and to sell small accompanying bank loans to all these customers in order to exploit portfolio diversification effects. To check for the relation between assignment of start-up assistance and credit market competition I use a continuous proxy variable for competition: the density of bank offices measured as the number of bank offices times 1000 per inhabitants in the district the firm is located. This variable is assumed to be positively correlated with competition intensity in the local credit market.[41] In accordance with the described dependence of bank behavior on credit market competition, the coefficient of the local density of bank offices and its interaction with the indicator for West German firms in table 3.3 are positive and significant.

Finally, program assignment varies between firm formation cohorts and industries. Start-

[38] As alternative specification I used several controls for individual West German federal states but this did not improve the fit of the model significantly.

[39] The population density is measured by the number of inhabitants in the district the firm is located per 1000 square kilometer.

[40] Petersen and Rajan (1995) analyze the effect of credit market competition on lending relationships in the United States. Harhoff and Körting (1998b) investigate lending relationships in Germany.

[41] Focussing on local market conditions is reasonable here since founders of new firms contact mainly bank offices within a very restricted radius around their firm's location. Petersen and Rajan (1995) use a crude categorical indicator based on the Herfindahl index of commercial bank deposit concentration in the area of the firm headquarter to proxy concentration of the local credit market.

ups in 1991 and 1992 have a significantly higher and those in 1993 a significantly lower participation probability than start-ups in 1990. The 17 industry dummies used to capture basic industry-specific effects are jointly significant at the 1-percent level according to the Wald-statistic shown in the lower part of table 3.3. Six interaction terms between cohort and industry indicators are jointly significant as well. Interestingly, the dummy for high technology industries has a positive and significant coefficient. Firms in high technology industries have significantly higher assignment chances than firms in 3- or 4-digit low technology industries within the same 2-digit industry group. This significantly increased assignment chance of innovative and thus potentially risky firms is an exception since the coefficients of firm- and entrepreneur-specific variables discussed so far suggest rather risk-averse selection of program participants.

The presented program assignment equation allows for a more extensive selection control than in related studies evaluating firm programs. Nevertheless, important variables might have been ignored or captured insufficiently. It can be argued that the available data about entrepreneurial education and the firm concept allow only a crude control for entrepreneur motivation and business plan quality.[42] Such doubts cannot be dispelled completely. However, the particular situation in East Germany after unification eases the justification of assuming independence between the potential outcomes in the comparison state and assignment conditional on the vector X of covariates observable here. The situation in East Germany is important in the context at hand since 73 percent of all subsidized firms in the sample are located in East Germany. These start-ups at the beginning of the 1990s faced a very unstable environment. For example, non-anticipated re-privatization of the firm location forced many entrepreneurs either to risk a relocation or to close their firm. Market development was highly uncertain and industry structures changed rapidly due to the transition from a planned to a market economy. The East German banking industry was just emerging and bank clerks started to collect experiences in screening East German entrepreneurs. Given all these characteristics of the transition period, it is assumed here that bank clerks and DtA officials were hardly able to classify the success chances of start-ups during the years after unification systematically better than it can be done on the basis of the observable covariates used here.

Summing up, the results for entrepreneur- and project-specific variables in the program assignment equation are consistent with the view that better qualified entrepreneurs with less risky projects are more likely to receive start-up assistance than others. However, start-ups in several East German states, in districts with a high local unemployment rate that are most likely to be found in East Germany and in high technology industries have significantly higher

[42] Variables that capture the financial background of the entrepreneurs, their pursuit of independence, and the implied dislike for external finance might also be needed.

assignment probabilities than others. The latter results are in line with the focus of German subsidization policies on East Germany after unification and with the program requirements mentioned in section 3.2.2. All else equal, East German firms and start-ups in high-technology industries are likely to face stronger financial constraints than other start-ups due to uncertain market conditions and high project risk. Altogether program assignment is shown to be highly selective and mediating banks seem to have a strong influence. The results confirm that a suitable econometric approach for the evaluation of federal firm financing programs in the context at hand has to control adequately for the selection of program participants in order to allow for the estimation of causal program effects.

3.5.2 Matching and balancing quality

Figure 3.2 shows the distributions of the unbounded propensity score for the group of 2,261 treated firms and the group of 10,363 potential comparison firms.[43] As already discussed in section 3.3.1 a matching estimator can only lead to an adequately matched comparison group in those regions of the covariate space χ where comparison firms are available. Here, the distribution of the propensity score in the potential comparison group nearly covers the whole interval of the distribution in the treated firm group. Only 3 treated firms fail to meet the common support restriction mentioned in appendix B.1.

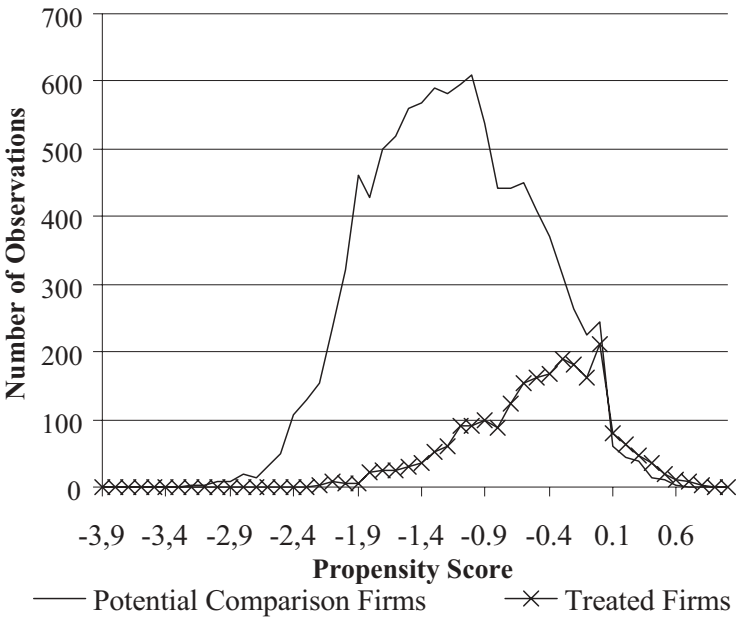
The mass of the treated firm distribution lies to the right of the untreated firm distribution. This simply indicates the already discussed differences between both groups. It can also be seen that the frequency of treated firms is slightly higher in the rightmost region than the frequency of potential comparison firms. Therefore, matching without replacement could imply strongly biased matches in this area (Dehejia and Wahba 1998). To avoid this, the matching algorithm described in appendix B.1 allows for drawing the same comparison firm more than once.

The chosen balancing score includes the estimated propensity score and seven indicators for West German firms, for limited liability firms and for firms in the manufacturing, construction, wholesale and intermediate trade, transport and communication as well as the service sectors. The most important matching variables in the balancing score, the propensity score and the indicator for West German firms were given a weight of ten instead of one in the Mahalanobis distance measure.

After applying the matching procedure, I tested the achieved balancing between the distribution of X in the matched comparison group and the group of 2,258 treated firms in the common support area. High balancing quality is crucial because otherwise causal effect estimation would provide biased results. To illustrate the balancing quality, table 3.4 shows the

[43] The estimated program assignment model in table 3.3 is used to predict the unbounded propensity score.

Figure 3.2: Propensity Score Distributions for Potential Comparison Firms and Treated Firms



sample means of the unbounded propensity score and of selected variables in the treatment group and the matched comparison group.[44] For each variable, the difference between the group-specific sample means is small and statistically insignificant in a two-sided t-test. Most importantly, the sample means of the propensity score itself do not differ significantly. The distributions of the propensity score in both groups coincide very closely as well according to the kernel density estimates in figure 3.3. In addition, both groups show similar standard deviations for all other continuous variables in table 3.4. These results indicate that the treatment and the matched comparison group are well balanced. Due to the chosen balancing score vector the balancing quality in the location- and industry-specific sub-samples used in section 3.5.3 is also very high.[45]

The advantage of bias-reduction when using a matching procedure with replacement comes at the cost of drawing some comparison firms repeatedly despite availability of almost identical, only slightly less close comparison firms. This could substantially reduce the precision of the estimated causal program effects. To investigate excessive use of single comparison firms, I

[44] All selected variables were found to affect program assignment significantly in section 3.5.1.

[45] In all sub-samples, the difference between the mean of the propensity score in the treated firm group and in the group of matched comparison firms is insignificant at any usual significance level. In addition, the mean differences of all variables in table 3.4 are insignificant at the 5-percent significance level in the majority of sub-samples. Only in two sub-samples the means of three variables differ significantly. Test results are available upon request.

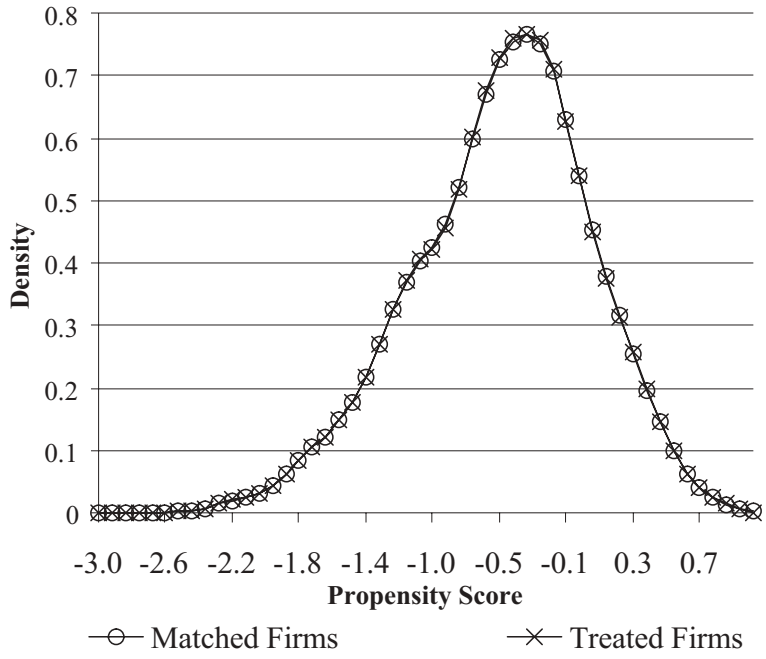
Table 3.4: Matched Comparison Group versus Treatment Group

Variable	Mean/Share in %	
	Matched Comparison Firms	Treated Firms
propensity score	-0.5293	-0.5288
education unknown	25.43	24.77
apprenticeship	37.03	35.65
master craftsman	17.11	17.44
business administration	2.56	2.98
engineering	15.22	16.72
other academic degrees	2.64	2.43
age, 17-29	21.82	20.08
age, 30-44	57.54	57.51
age, 45-55	20.64	22.40
team size	1.3436	1.3569
franchisee	4.41	4.85
ltd. liability & stock company	31.25	31.44
civil law association	8.88	9.01
commercial partnership	2.84	2.49
sole proprietorship	57.02	57.06
firm affiliation	4.15	3.85
cohort 1990	25.67	24.85
cohort 1991	31.88	32.27
cohort 1992	26.74	26.08
cohort 1993	15.72	16.80
manufacturing	17.00	17.00
construction	21.50	21.55
wholesale & intermediate trade	8.35	8.35
retail trade	33.23	33.18
transport & communication	4.89	4.89
services	15.03	15.03
high technology	6.34	6.97
unemployment rate	13.07	13.28
population density	0.6653	0.6173
bank office density	0.8439	0.8581
West Germany	27.36	27.36

Note: The table shows weighted means and shares for the groups of 2,258 treated firms and of 1,646 matched comparison firms. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in the matched comparison group and the treatment group.

used a measure proposed by Lechner (2002a). The measure is a concentration ratio, computed as the sum of weights w_l in the highest decile of the weight distribution in the sample of matched comparison firms divided by the sum of weights $\sum_l w_l \quad \forall \quad l = 1, ..., N^m$. The resulting value of 21.3 percent is at the lower end of the values reported by Lechner (2002a).

Figure 3.3: Kernel Density Estimates of the Propensity Score Distributions for Matched Firms and Treated Firms



In addition, 75.2 percent of all matched comparison firms were only drawn once. Therefore, the repeated use of single comparison firms was not excessive.

3.5.3 Effects of start-up assistance

In this section, I analyze long-run effects of DtA start-up assistance on the survival chances of subsidized firms in the sample. In addition, I investigate how these firms adapt their labor and capital inputs shortly after assignment to start-up assistance. Finally, I discuss the changes of the effects on survival and hazard functions over time.

Table 3.5 displays the estimated average effects on the survival rate of start-ups between 1990 and 1993 measured at the end of the observation period, i.e. December 31, 1999.[46] For the group of all treated firms the estimated average survival rate is 78 percent. For the group of all matched comparison firms it is 60 percent. This difference implies a positive and significant program effect of 18 percentage points. In other words, due to start-up assistance the share of subsidized firms operating until 1999 is 30 percent higher than it would have been without

[46]These estimation results are based on a simplifying assumption. I assume that all firms that do not exit the market during the observation period have duration spells that are right-censored on December 31, 1999. This is the case for about 90 percent of all non-exiting firms in the sample.

Table 3.5: Estimated Average Long-run Effects on Firm Survival

All Firms
(East German Firms; West German Firms)

Firm Group	# Matches	Mean for Matched Firms $\hat{E}(Y^c \mid S=1)$	Mean for Treated Firms $\hat{E}(Y^t \mid S=1)$	Causal Effect $\hat{\theta}$
Industries				
manufacturing	382	0.65	0.83	0.18***
	(240;142)	(0.69;0.58)	(0.83;0.82)	(0.14**;0.25***)
construction	515	0.66	0.79	0.13***
	(410;105)	(0.64;0.71)	(0.78;0.82)	(0.14***;0.10)
whol. & int. trade	199	0.54	0.72	0.18***
	(145;54)	(0.55;0.51)	(0.70;0.75)	(0.15**;0.25**)
retail trade	704	0.60	0.79	0.20***
	(519;185)	(0.58;0.62)	(0.80;0.78)	(0.22***;0.15***)
trans. & comm.	120	0.63	0.75	0.12
	(101;19)	(0.63;0.62)	(0.74;0.79)	(0.11;0.16)
services	338	0.53	0.75	0.22***
	(235;103)	(0.55;0.50)	(0.74;0.78)	(0.19***;0.27***)
Total				
	2258	0.60	0.78	0.18***
	(1650;608)	(0.61;0.60)	(0.78;0.79)	(0.17***;0.19***)

Notes: The table shows weighted results for the share of start-ups surviving until December 31, 1999. All firms were started between January 1990 and December 1993. The sample of 2,258 treated firms and 1,646 matched comparison firms is used. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in the matched comparison group and the treatment group.

start-up assistance.

Estimates for various sub-samples in table 3.5 show how the overall effect on firm survival is composed. The estimate of the effect for East German firms turns out to be quite similar to the one for West German firms. Industry-specific estimates indicate that the absolute as well as the relative effect estimates for manufacturing and trade firms are at about the level of the overall effect. Higher absolute and relative effect estimates are found for the service sector. Smaller effects occur in the construction and the transport and communication sectors and the latter effect remains insignificant. Splitting the industry samples along the indicator for East and West German firms and estimating program effects for all resulting sub-samples reveals insignificant effects for West German firms in the construction sector and for East and

West German firms in the transport and communication sector.

Summing up, a significant positive average effect of federal start-up assistance in Germany on the long-term survival rate of subsidized firms can be observed when using the sample of all treated firms and matched comparison firms. Industry-specific effects are all positive as well. Only for three of the smaller firm groups the effect estimates remain insignificant.

Table 3.6: Estimated Average Short-run Effects on Employment

All Firms
(East German Firms; West German Firms)

Firm Group	# Matches	Mean for Matched Firms $\hat{E}(Y^c \mid S=1)$	Mean for Treated Firms $\hat{E}(Y^t \mid S=1)$	Causal Effect $\hat{\theta}$
Industries				
manufacturing	382	8.29	7.82	-0.47
	(240;142)	(9.93;5.63)	(10.03;4.30)	(0.11;-1.33)
construction	515	9.91	11.25	1.35
	(410;105)	(11.44;3.80)	(12.96;4.35)	(1.53;0.55)
whol. & int. trade	199	6.45	6.73	0.28
	(145;54)	(7.22;4.31)	(7.52;4.55)	(0.30;0.24)
retail trade	704	3.68	3.96	0.28
	(519;185)	(4.11;2.55)	(4.29;3.10)	(0.18;0.55)
trans. & comm.	120	5.24	5.22	-0.02
	(101;19)	(5.84;2.23)	(5.58;3.42)	(-0.26;1.19)
services	338	4.34	5.73	1.39*
	(235;103)	(4.97;2.83)	(6.35;4.25)	(1.38;1.43*)
Total				
	2258	6.21	6.75	0.54
	(1650;608)	(7.17;3.65)	(7.82;3.90)	(0.65;0.24)

Notes: The table shows weighted results for the number of employees measured shortly after the firm received start-up assistance. The sample of 2,258 treated firms and 1,646 matched comparison firms is used. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in the matched comparison group and the treatment group.

After discussing program effects on the survival rate of subsidized firms at the end of 1999 I now investigate whether these long-run effects are accompanied by changes of labor and capital input shortly after assignment to start-up assistance.[47] This sheds light on the question whether subsidized firms choose a more efficient production plan than they would have chosen

[47] For effect calculation I used the first available employment and capital information recorded after assign-

in case of no start-up assistance. Table 3.6 contains the average program effects on firm employment shortly after assignment. The effect estimate for the whole sample shows that subsidized firms do not respond to start-up assistance by significantly increasing the average number of workers in the short-run. For the sub-samples of all service firms as well as only West German service firms the effects turn out to be positive and significant at the 10-percent significance level. For all other sub-samples the effect estimates are small and insignificant. The results suggest that it doesn't pay for entrepreneurs in most industries to increase their work force directly after assignment to start-up assistance. If new firms start with a sub-optimal number of employees due to financial constraints then they apparently need more time after receipt of start-up assistance to switch to a more efficient scale by hiring new employees. Lerner (1999) gives a similar argument in his discussion of Wallsten (2000) who finds no significant employment effects one year after receipt of a SBIR research grant. Lerner (1999) explains the result with difficulties arising when the number of key researchers in a small high-technology firm shall be enlarged.

In contrast to these mostly small and insignificant short-run effects on firm employment, significant and positive investment effects can already be observed in the short-run. Table 3.7 shows that subsidized firms choose to invest on average 4769 Euro or 32 percent more per employee than matched comparison firms. The capital variable used for the calculations is available for 3,510 firms in the sample of all 3,904 treated and matched comparison firms and captures a specific type of investment. It mainly indicates the amount invested in office equipment, machinery or stocks.[48] The industry-specific results suggest that the positive overall effect is strongly driven by the effects for manufacturing, retail trade and service firms.

Altogether, the behavior of subsidized firms shortly after receipt of start-up assistance is consistent with the view that they would otherwise have been more capital constrained. Right from the beginning they opt, on average, for a higher level of capital intensity than matched comparison firms. However, they do not immediately scale up their projects by employing significantly more workers.

When evaluating the survival effects of start-up assistance for new firms it is crucial to find out whether the positive average effect of start-up assistance on the survival rate in 1999 is merely a result of "cash-and-carry"-behavior or not. Analyzing effect changes over time is helpful in this context. If subsidized firms simply live on the provided loan, the survival chances should be very high during the first years after receipt of the loan. Afterwards the

ment to start-up assistance. Recording took place no later than two years after assignment. For most firms I used the first information recorded at all.

[48]The available data base provides no other variables indicating investment or capital structure for a sufficiently large sub-sample of firms.

Table 3.7: Estimated Average Short-run Effects on Capital Intensity

All Firms
(East German Firms; West German Firms)

Firm Group	# Matches	Mean for Matched Firms $\hat{E}(Y^c \mid S=1)$	Mean for Treated Firms $\hat{E}(Y^t \mid S=1)$	Causal Effect $\hat{\theta}$
Industries				
manufacturing	352	18115	26043	7928**
	(220;132)	(16939;20171)	(24426;28636)	(7486*;8465**)
construction	479	9178	10278	1100
	(381;98)	(9162;9237)	(9569;13102)	(408;3866*)
whol. & int. trade	185	19992	24720	4728
	(135;50)	(22130;14714)	(24836;24397)	(2706;9683*)
retail trade	661	14581	18798	4217***
	(483;178)	(13594;17017)	(19472;17045)	(5878***;28)
trans. & comm.	106	23551	34818	11267
	(87;19)	(22866;26282)	(34421;36592)	(11555;10310)
services	308	15953	21037	5083**
	(209;99)	(16942;13827)	(20991;21136)	(4049;7310*)
Total				
	2091	15002	19771	4769***
	(1515;576)	(14601;16007)	(19293;21010)	(4693***;5002***)

Notes: The table shows weighted results for the capital intensity, i.e. the Euro amount invested per employee measured shortly after the firm received start-up assistance. The sample of 2,091 treated firms and 1,419 matched comparison firms with capital information is used. *** (**, *) indicates significance of a t-test statistic in a two-tailed test at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in the matched comparison group and the treatment group.

instantaneous liquidation risk should rise considerably and even reach a higher level than the risk of matched comparison firms.

Figure 3.4 shows the estimated survival functions for the group of all treated firms and for the group of all matched comparison firms.[49] The survival function for the treatment group remains at a higher level than the survival function for the matched comparison group during the entire observation period. This simply reflects the already discussed positive effect on the survival rate in 1999. Comparing the curvature, both survival functions provide first evidence pointing to changes of the effect size over time. After starting slightly concave, the curve for matched comparison firms drops considerably from the middle of the second year to the end of the fifth year after firm formation and only slightly afterwards. Thus, it displays a clearly

[49] See Cox and Oakes (1984) for details on the product-limit estimator of the survival function I applied.

convex pattern from the second year onwards which indicates negative duration dependence of the related hazard function. The curve for treated firms is only lightly curved and remains concave for much longer than the counterpart for matched comparison firms.

Figure 3.4: Estimates of the Survival Functions for Matched Firms and Treated Firms

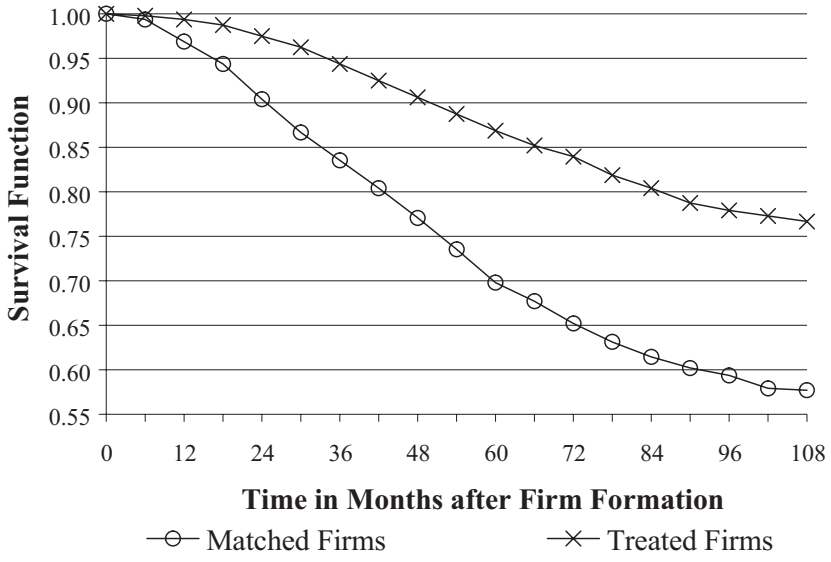


Figure 3.5 displays the hazard function estimates.[50] The hazard function for matched comparison firms shows the pattern typically observed for newly founded firms.[51] It increases initially and declines from the fifth year after firm formation onwards, i.e. negative duration dependence is revealed. In contrast, the hazard rate for the treated firms increases until the beginning of the fourth year. Afterwards it fluctuates around a rather constant level until the seventh year. Most importantly, the hazard rate for treated firms decreases during the last three years of the observation period.

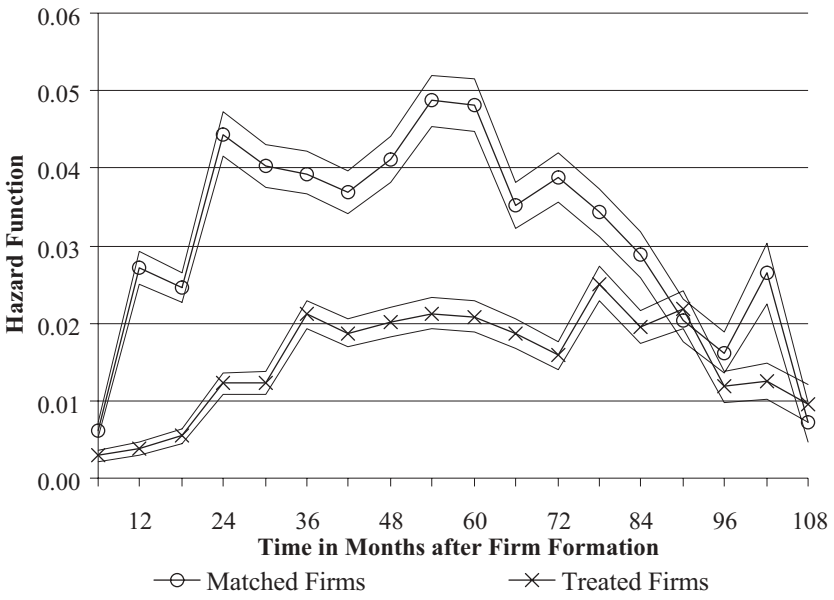
In addition, the hazard rates for both groups are at about the same level from the eight year onwards. This is also illustrated in figure 3.6. The graph shows very similar survival function estimates for those treated and matched comparison firms that survive the initial seven years after firm formation. Using a log-rank test, the null hypothesis of equal survival functions cannot be rejected at any usual significance level.[52] Thus, the survival and hazard

[50]To estimate hazard functions I used a life-table estimator. The hazard function in period t equals the weighted number of firms liquidated in the six-month period t divided by the weighted number of firms at risk of liquidation at the beginning of period t. The number of firms at risk is adjusted for right-censored spells. See Cox and Oakes (1984) for further details.

[51]See for example Brüderl, Preisendörfer, and Ziegler (1992) and Wagner (1994).

[52]See Kalbfleisch and Prentice (1980) for the standard version of the test. Since I used probability weights,

Figure 3.5: Estimates of the Hazard Functions for Matched Firms and Treated Firms (with 95% Confidence Intervals)



rate evidence indicate the following: During the first seven years, 20 percent of the subsidized and 39 percent of the matched non-subsidized firms are liquidated. From the eighth year onwards the remaining 80 percent of the subsidized firms face a decreasing instantaneous liquidation risk that is similar to the risk of the best 61 percent of the matched firms.

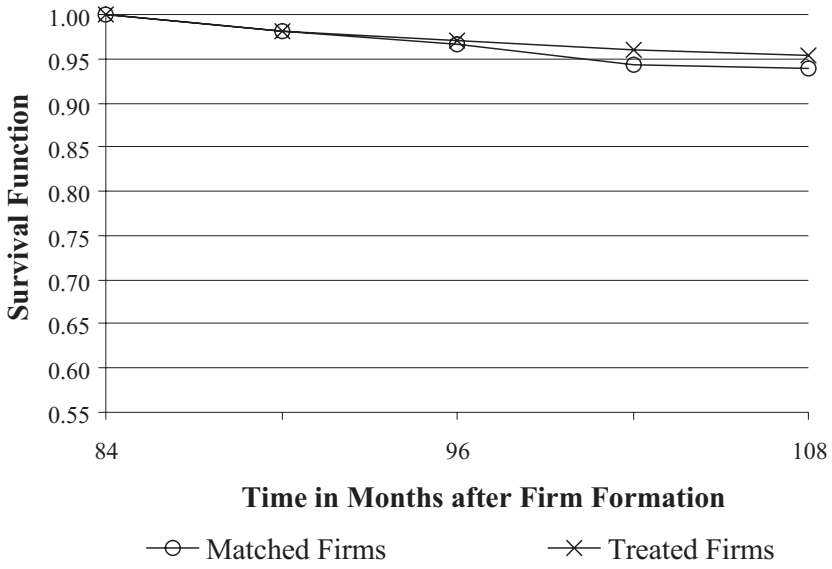
Before interpreting this result, it has to be investigated whether the hazard rate comparison is affected by selection effects. Ham and LaLonde (1996) discuss that selection effects resulting from different exit processes in the treatment and the matched comparison group can gradually destroy the initial balancing between both groups and thus invalidate hazard rate comparisons. Here, I found no significant propensity score differences between the groups of survivors from the pool of all treated firms and the pool of matched comparison firms in any considered period.[53] Therefore, the hazard rate comparison seems not to be affected by unbalanced comparison groups.

The time pattern of the hazard rate for subsidized firms is clearly consistent with strong short-run effects of start-up assistance and with dependence on the provided DtA financing and the subsidized capital costs. The diminishing of the financial buffer over time and the increase of capital costs due to program rules may cause some of the observed late liquidation

a modified version of the standard test was applied.

[53]For each period, I conducted two-tailed tests of the null hypothesis stating equality of weighted means in the sub-group of treated and the sub-group of matched comparison firms that are still alive. Results are available upon request.

Figure 3.6: Estimates of the Survival Functions for Matched Firms and Treated Firms Surviving at least 84 Month



decisions of subsidized firms. However, the available evidence does not suggest that the initial positive effects will be erased over time. The results show that treated firms face a decreasing instantaneous liquidation risk during the last three years of the observation period. In addition, the instantaneous liquidation risks of the treated and the matched comparison group are at a similar level from the eighth year onwards.

For the given observation period, a rough measure of the additional employment caused by the positive survival effects of start-up assistance can be calculated. On average, a firm with a subsidized loan of about 120,000 Euro employs one person for ten years it would not employ without start-up assistance. This rough measure is based on the firms' survival time measured in 1999 and on the employee numbers reported shortly after assignment of start-up assistance. Using the latter ignores the fact that subsequent average employment growth may differ between subsidized and matched comparison firms. Thus, as already mentioned, the measure indicates only the employment gain caused by the survival effects of start-up assistance. It should be treated as a lower bound of the whole employment effect of start-up assistance due to the results of Almus and Prantl (2002). Their analysis, based on a smaller sample than used here, shows that start-up assistance significantly increases employment growth of surviving subsidized firms.[54]

[54] Almus and Prantl (2002) use firm-specific average annual growth rates that are calculated for a period of maximally 10 years.

3.6 Conclusions

This chapter offers an evaluation of start-up assistance handed out to new German firms by the Deutsche Ausgleichsbank (DtA). To separate the effects of start-up assistance from effects of non-random assignment to assistance a non-parametric matching on the balancing score is applied. For the empirical analysis I use a large, unique firm data set including 12,624 firms started between 1990 and 1993 in the manufacturing, construction, and trade sectors as well as most service industries. 2,261 of the firms received start-up assistance within the firm formation year or the subsequent year.

I address the question whether start-up assistance has the intended effect of causing on average higher survival chances of subsidized firms than in the counterfactual situation where the same firms are not subsidized. Thus, the empirical analysis presented here is focussed on evaluating the net effect on the survival chances of subsidized firms. It must be taken into account that the high level of start-up assistance reached in East Germany after unification makes indirect effects plausible. First, start-up assistance might lead to displacement effects that are ex ante ambiguous from a welfare perspective.[55] Second, the programs could have general equilibrium effects on the firm formation decision of potential entrepreneurs and thereby on the number of start-ups.[56] Other indirect effects might concern consumers, financial institutions, and other economic agents. Indirect and general equilibrium effects are difficult to identify in general, and especially for an economy in transition like East Germany after unification. Moreover, they cannot be evaluated using the data available for this study.

The presented evaluation of program effects on program participants constitutes an important initial evaluative step because federal start-up assistance in Germany is shown to satisfy a crucial condition for program success: start-up assistance has a significant and substantial positive net effect on the survival chances of subsidized firms that persists until the end of the observation period. Already a short time after receipt of start-up assistance the subsidized firms adapt their production plan by choosing higher capital intensity than matched comparison firms. This short-term reaction is in line with the view that start-up assistance relaxes capital constraints and allows for shifts to more efficient production plans. The variation of the effects on liquidation risk and survival chances over time is consistent with strong short-run effects of start-up assistance. More importantly, the positive firm survival effect can not be judged to be only a result of inefficient "cash-and-carry" behavior. The evidence does not suggest that subsidized firms simply live on the provided loan for some years and

[55] Revolving door effects, i.e. repetitive replacement of similar entrants without technological progress, without improvement of customer service or the like probably imply a waste of resources and reduce welfare. In contrast, displacement of old, inflexible firms using technologies that are no longer up-to-date with new, innovative and flexible organizations are likely to increase welfare.

[56] Storey (1994b) mentions this aspect as one objective of small business policies.

exit some time later than matched comparison firms. Instead, the group of subsidized firms faces a declining instantaneous liquidation risk during the last three years of the observation period. Moreover, the instantaneous liquidation risk of treated firms and of matched comparison firms is very similar between the eighth year after market entry and the end of the observation period in 1999.

In further research it seems worthwhile to investigate whether heterogeneity of treatments matters for the effects on firm survival and other outcome variables. This is of high interest in the context of start-up assistance offered by the DtA since some firms receive high and others only low subsidies. As evaluation studies on firm financing programs using non-parametric evaluation methods are still rare and as such programs are usually much more expensive than the relatively often evaluated active labor market programs, similar studies of other firm financing programs are another interesting issue. For example, applying non-parametric matching or other adequate evaluation techniques can provide new insights about the effects of R&D programs in Europe and the U.S. as well as about the impact of micro credit programs in low-income and transition countries.

Chapter 4

Determinants and Effects of Heterogeneity in Start-up Assistance

As in many other countries, the federal government in Germany offers financial assistance to entrepreneurs starting new firms.[1] After the political and economic breakdown of the German Democratic Republic in November 1989 federal start-up financing reached an unprecedented level: the Deutsche Ausgleichsbank (DtA) disbursed subsidized loans with an aggregate value of about 22 billion Euro to young East and West German firms within five years. Subsidized DtA loans became an important source of external financing, especially for young East German firms.[2]

Assigned start-up assistance in Germany varies considerably between firms with respect to subsidies on capital costs per Euro handed out and with respect to the share of external capital covered by subsidized loans. To finance their start-up investment, some firms are offered large sums of long-term financing at very low interest rates and with long redemption-free periods. Others receive only small amounts of medium-term financing at moderately subsidized interest rates and with early redemption payments. Empirical studies comparing the effects of different modes of start-up assistance are of interest to policy makers who decide upon the design and introduction of new programs and upon the modification or abolition of existing ones. So far little empirical work is available to guide policy makers with respect to these questions (Lerner 2002).

[1] See Lerner (1999), Storey (1994b) and De et al. (1995) for the programs in the U.S., U.K. and other European countries.

[2] According to the data base used for this study about one third of all East German and one tenth of all West German start-ups between 1990 and 1993 received subsidized DtA loans. The high share in East Germany during its transition from a planned to a market economy reflects the general focus of German subsidization policies after unification. In 1991, for example, about 17 percent of all long-term loans handed out by banks to firms and individuals in Germany and about 50 percent of those in East Germany were subsidized (Deutsche Bundesbank 1992).

In this chapter, I evaluate the effects of different subsidy modes on the survival chances of newly founded firms while controlling for selective subsidy assignment. Separating between the effects of non-random subsidy assignment and subsidy effects is crucial in such a context. Analyzing subsidy assignment is, however, not only a necessary prerequisite for estimating subsidy effects but also interesting in itself. The pattern of assigned subsidies may reflect either program objectives or distortions in the assignment process.

When evaluating multiple modes of start-up assistance, standard microeconometric evaluation methods referring to situations with a binary treatment cannot be applied. Imbens (2000) and Lechner (2001a) extended the non-parametric evaluation approach introduced by Rubin (1977) and Rosenbaum and Rubin (1983) to the case of multiple treatments. In this study, I build on these extensions and use a propensity score matching estimator to compare the effects of different modes of start-up assistance. A unique natural experiment generated by a temporary program interruption in West Germany can be used to assess the plausibility of the conditional independence assumption imposed to identify subsidy effects for a larger, non-experimental sample with East and West German firms. This data set with comprehensive credit file information covers 2,098 East and West German start-ups between 1990 and 1993 that received subsidized start-up loans from the DtA. To construct it, the large internal data base of the DtA on about 800,000 loans handed out between 1990 and 1999 was for the first time connected with an external sample of East and West German firms. This stratified random sample of firms was drawn from two complementary panel data bases build up with data from the leading German credit rating agency, Creditreform. Both, the panels are kept at the Centre of European Economic Research (ZEW) and covered about 2.6 million firms in 1999.

The first part of the empirical analysis is devoted to analyzing the process of subsidy assignment. Assignment to different subsidy modes is found to depend strongly on characteristics of the planned firm project, the entrepreneur and environmental conditions. The results are in line with the view that mediating banks have a strong influence on the process of subsidy assignment. In the second part of the empirical analysis I ask whether handing out loans at highly subsidized capital costs causes stronger firm survival effects than handing out weakly subsidized loans. This evaluation leads to the following main results. Three years after market entry, strong capital cost subsidies have a significantly higher effect on the firm survival rate of strongly subsidized West German start-ups than low capital cost subsidies would have had. In the medium- and long-run effects of similar magnitude are found but they remain insignificant. For East German firms started between 1990 and 1993, no significant, positive short-, medium- or long-run effects are observed. The last part of the empirical analysis is very interesting from a conceptual point of view. A temporary interruption of the most favorable program in West Germany is exploited to see whether the main assumption needed to make causal inference in a matching context can be justified. This analysis indicates no need

to reject the assumption of random assignment conditional on observable covariates since no support is found for dependence of subsidy assignment on variables unobserved in the context of this study.

The remainder of the chapter is organized as follows. In the next section, I introduce the programs subject to evaluation. Moreover, hypotheses about the determinants and effects of different modes of start-up assistance are discussed. In section 4.2, I explain the econometric approach chosen for evaluation. A short description of the data base, the definition of the firm groups receiving different modes of start-up assistance, and a discussion of the main differences between these groups are given in section 4.3. Empirical results are presented and interpreted in section 4.4. Section 4.5 provides a summary and conclusions.

4.1 Theoretical considerations

4.1.1 Heterogeneity of start-up assistance in Germany

The three most important programs offering start-up assistance in Germany are: the business start-up program financed by the European Recovery Program (ERP), the DtA business start-up program and the ERP equity capital assistance program (EKH). All these federal programs are handled by the second largest public bank in Germany, the Deutsche Ausgleichsbank (DtA). The DtA provided about 90 percent of all subsidized start-up loans during the 1990s.[3] The EKH program offers equity capital assistance in form of long-term loans for up to 20 years without redemption during the first 10 years. For East German firms, the interest rate is fixed at zero percent during the first three years and at 2, 3, and 5 percent in the fourth, fifth, and sixth year, respectively. For West German firms, the interest rate is fixed at zero percent during the first two years and at 2, 3, and 5 percent in the third, fourth, and fifth year, respectively. Afterwards all firms pay approximately the long-term market rate fixed at the moment of loan approval and readjusted only once in the tenth year. Only 98 percent of the nominal EKH loan amount are paid out. Collateral is not needed, but the applicant is personally liable. These loans count as equity substitute for private lending institutions. Both, the ERP and the DtA business start-up program provide medium-term loans with fixed subsidized interest rates. The data at hand shows for the period between 1990 and 1994 that East (West) German firms received business start-up loans running on average 12.7 (10.2)

[3]To finance the programs during the 1990s the DtA relied on the European Recovery Program (ERP) Fund, funds from the federal budget, and raised additional funds on international capital markets. The ERP Fund was created with Marshall Plan aid Germany received after the Second World War. The federal government extended it substantially after the German unification at the beginning of the 1990s (Deutsche Bundesbank 1991).

years at an average interest rate of 7.2 (8.0) percent.[4] Pay-out discounts for DtA business start-up loans vary between 5 and 2 percentage points at the beginning of the 1990s. In the ERP business start-up program no pay-out discounts are taken and no redemption is due for up to 3 years in West Germany and up to 5 years in East Germany. In the DtA business start-up program the redemption-free period is at most 2 years long. Collateral or a guarantee provided by a bank or within a loan guarantee program are necessary.[5]

The extent of subsidization varies considerably between firms with DtA start-up assistance. Capital cost subsidies are firm-specific for two reasons. First, redemption conditions for loans in the business start-up programs can differ between firms. Second, interest rate conditions and pay-out discounts differ between programs as well as over time and firms can combine all three programs. In addition to heterogeneity in capital cost subsidies, there does exist substantial variation of the share of external capital covered by subsidized DtA loans.

4.1.2 Determinants of subsidy assignment

When analyzing the process of subsidy assignment in the context of program evaluation it is crucial to consider all variables that influence simultaneously assignment and the outcome variable of interest, here firm survival. Otherwise subsidy effects and effects of non-random subsidy assignment could not be disentangled properly.

Two opposing sets of hypotheses about the impact of firm characteristics on the degree of subsidization assigned to subsidized firms can be derived. The *first set of hypotheses* builds upon the view that the degree of subsidization should be assigned according to the stated program objectives. The second set of hypotheses, discussed in the latter part of this section relies on the assumption that private lenders mediating in the process of subsidy assignment and DtA officials focus on limiting the volume of defaulting loans. The corresponding empirical analysis is presented in section 4.4.1.

Following the rules of the programs considered here, start-up assistance should be offered to ex ante efficient firm projects not yet started and otherwise insufficiently financed. The

[4] To get an impression of the size of interest rate subsidies in these programs, the interest rates should be compared to those of lines of credit handed out to young and small German firms during the same period. Harhoff and Körting (1998b) found lines of credit to be an important source of external capital for small German firms and they are presumably even more important for new firms. According to the statistics of the Deutsche Bundesbank (1990-2000) for the time period 1990 to 1994 lines of credit with a volume below 500,000 Euro were handed out to German firms at an average interest rate of 12.4 percent. Mortgages with a maturity of 10 years were handed out at on average 8.6 percent. Average rates referring only to the group of young and small German firms are not available but can be assumed to be higher.

[5] During the 1990s, several federal loan guarantee programs offered guarantees, especially to East German firms.

programs aim at preventing sub-optimal start-up capitalization of such projects and sub-optimal investment after market entry by relaxing financial constraints.[6] Given the program objectives, the degree of subsidization should be positively correlated with the strength of financial constraints a program participant faces ceteris paribus (c.p.) at the moment of firm formation.

East German start-ups at the beginning of the 1990s are shown by Harhoff and Körting (1998b) to face c.p. higher capital costs and stronger capital rationing than West German start-ups. Their success chances were presumably more difficult to predict by investors because of uncertain market development and rapidly changing industry structures during the transition from a planned to a market economy. Gompers and Lerner (1999) argue that start-ups in high technology industries tend c.p. to suffer more from the consequences of informational asymmetries between borrowers and lenders than other start-ups. Their idiosyncratic risks are higher and thus predicting firm success is more difficult. Capital costs and the risk of capital rationing should c.p. decrease in entrepreneurs' age because of several reasons. Idiosyncratic firm risk may decrease in entrepreneurs' age because increasingly informative curricula vitae improve the predictability of entrepreneurial success. In addition, Holtz-Eakin, Joulfaian, and Rosen (1994b) and Cressy (1996b) argue that the accumulation of personal wealth and thus risk-aversion as well as the availability of collateral can be assumed to increase in age. Project size should c.p. be negatively correlated with capital costs because of fixed costs for loan administration and monitoring.[7]

These arguments lead to the two following hypotheses, if higher subsidies are indeed assigned to program participants facing c.p. higher financial constraints at the moment of firm formation:

H1.1: Start-ups in East Germany or in high technology industries are c.p. offered higher subsidies than others.

H1.2: The probability to receive high subsidies decreases c.p. in entrepreneurs' age and in project size.

Finally, capital costs and the risk of obtaining no debt finance at all is usually expected to decrease c.p. in the share of personal equity the entrepreneurs contribute to the venture's financing (Cressy 1996b). However, the probability to receive high subsidies cannot be expected

[6] Schiantarelli (1996) and Hubbard (1998) survey a large strand of literature on financial constraints and investment activity. Most empirical research in this area supports the view that financial constraints influence investment decisions. Evans and Jovanovic (1989), Holtz-Eakin, Joulfaian, and Rosen (1994a), Lindh and Ohlsson (1996), Blanchflower and Oswald (1998) and Taylor (2001) present empirical evidence consistent with binding financial constraints for entrepreneurs starting new firms.

[7] The EKH program had a minimum size requirement at the beginning of the 1990s. The few, small firms below this level were excluded from the sample for the empirical analysis because they had no access to all subsidy modes addressed in this study. See section 4.3.1.

to be negatively correlated with equity share because of the following program requirement. EKH loans shall only be assigned to projects with a private equity share of at least 15 and can be used to increase the share of private equity plus EKH loans counted as equity substitute up to 40 percent. Analyzing the data at hand showed that EKH loans were indeed hardly assigned to firms with a very high private equity share. Accordingly, the firms in the final sample with a private equity share above 40 percent were excluded from the empirical analysis.[8] The minimum requirement of 15 percent, however, was not strictly enforced, especially not in East Germany. Thus, firms with equity shares below 15 percent were not excluded from the sample and a non-monotonous relation between the equity share and the degree of subsidization is expected:

H1.3: The effect of the equity share on the probability to receive high subsidies has c.p. an inverted U-shape.

The *contradicting, second set of hypotheses* builds upon the influence of private lenders on the process of subsidy assignment and on private lender-like assignment of loan conditions and loan amounts by the DtA itself. The DtA may try to limit the impact of defaulting borrowers on program success by assigning high subsidies preferably to projects with high success chances even if these could also be financed privately.[9] The resulting low volume of defaulting loans could be used as an easily measurable and understandable criteria of program success in order to get the needed political support for continuing the programs. In addition to the DtA, private lenders influence subsidy assignment. Due to the so-called "house bank principle", applications for DtA-loans have to be passed on to the DtA by a bank willing to handle the potentially approved loan.[10] Usually, the loan amount approved by the DtA does not deviate from the one demanded in the application form and outright loan refusals are rare.[11] Hence, rather the mediating banks than DtA officials have a strong influence on the share of external capital covered by DtA loans, on the chosen combination of available programs and thus the firm-specific average capital costs for DtA loans.

Loan costs determined by private lenders should be related to the ex ante observable borrower risk. It is a well-known theoretical result for most situations with symmetric information about borrower risk that riskier borrowers face c.p. higher costs for unsecured loans than oth-

[8] See section 4.3.1.

[9] See Wallsten (2000) for a similar argument.

[10] When deciding upon the handling of a DtA loan and the related start-up financing, a bank will take into account that usually either some of the start-up's collateral or a guarantee must be used for loans in the ERP or DtA business start-up program. Moreover, Breitenacher et al. (1994) mention that the involvement of the DtA as another creditor can complicate and prolong debt renegotiations.

[11] In the sample used here, approved and demanded loan amounts are equal in 86,7 percent of all cases. According to unpublished DtA information, the average refusal rate between 1990 and 1994 is 4.0 percent in East and 6.3 percent in West Germany.

ers (Freixas and Rochet 1998).[12] Empirical evidence is consistent with a positive correlation between ex ante observable borrower risk and capital costs. Machauer and Weber (1998) and Lehmann and Neuberger (2001) find a significant positive correlation between borrower risk and loan costs using data bases with information about bank-internal borrower ratings as a proxy of borrower risk.[13] Additional support for a positive risk-cost-relation is given by the firm age and size effects found by Petersen and Rajan (1994), Harhoff and Körting (1998b), and others.[14] Summing up, private lenders can be assumed to offer favorable financing conditions to start-up customers with low ex ante observable risk. Such favorable financing conditions should include high DtA subsidies.

Given the expected assignment strategy of private lenders, firm characteristics indicating low default risk and high firm success chances should be positively correlated with the degree of DtA subsidization. Such firm characteristics are discussed in detail in the literature on survival chances and the bankruptcy risk of new firms.[15] The hypotheses can be summarized as follows:

H2.1: Firm success increases in human capital. Hence, firms started by teams of entrepreneurs, well educated entrepreneurs or experienced, i.e. older entrepreneurs receive c.p. higher subsidies than others.

H2.2: Start-ups receive c.p. higher subsidies if the project risk is reduced due to diversification, high risk-aversion of older entrepreneurs or choice of a low technology industry.

H2.3: Larger start-ups are less likely to operate at a sub-optimal production scale and receive c.p. higher subsidies than smaller ones.

The expected effects of the entrepreneur's age, firm size and the indicator for high technology industries are not only based on their correlation with default risk and firm success chances. They are also in line with the arguments on the predictability of firm risk and fixed costs for loan administration and monitoring, discussed above in connection with the first set of hypotheses.

[12] A monotonous relationship does not necessarily arise in the incomplete contracting situation with symmetric information analyzed by Gorton and Kahn (2000).

[13] These studies and all others discussed in the following use interest rates to measure loan costs. The authors choose different strategies to control for the effect of prime rate fluctuations on the level of interest rates.

[14] Firm size is sometimes considered to reflect the borrower's bargaining power. However, in the case of young and small firms it should rather be interpreted as a proxy of borrower risk given the minimal efficient scale argument discussed by Audretsch and Mahmood (1995). Firm age is another important proxy for borrower risk because ongoing selection after market entry increases the average quality of surviving firms with increasing age of an entry cohort (Jovanovic 1982).

[15] See for example Bates (1990), Cressy (1996a) and chapter 2 of this thesis.

Collateral may also play an important role in the context of determining capital costs and thus subsidies. Practitioners usually consider collateral as a compensation device for observable risk. Theoretical models of Bester (1985, 1987) and Besanko and Thakor (1987) show that collateral can serve as a sorting device in ex ante lending situations with asymmetric information about borrower risk and adverse selection. In Bester (1987), collateral can also serve as an incentive device in ex-post lending situations with moral hazard. Bester (1994) and Welch (1997) investigate the strategic role of collateral in contractual situations with debt renegotiations.[16] Given these different functions of collateral, opposing hypotheses about the relations between borrower risk, collateral provision and capital costs can be formulated. Harhoff and Körting (1998b), Elsas and Krahnen (2000) and Lehmann and Neuberger (2001) provide mixed evidence on the correlation of borrower risk and collateral provision.[17] Machauer and Weber (1998), Lehmann and Neuberger (2001) and Harhoff and Körting (1998b) investigate the relation between collateral provision and capital costs assuming sequential determination of collateral and costs instead of simultaneous decisions. Respectively, they report a significant positive, significant negative and insignificant effect of collateral on costs. Thus, the existing theoretical and empirical literature provide opposing hypotheses and mixed evidence on the relations between borrower risk, collateral provision and capital costs determined by private lenders. Detailed information on collateral is not available in the context of this study.[18]

However, the collateral and liability requirements of the programs can be expected to have the following implication for subsidy assignment. Entrepreneurs choosing a legal form with limited liability should c.p. be more reluctant to accept the personal liability requirement of the favorable EKH program than others because an entrepreneur's decision for limited liability may signal high project risk just like the decision not to provide collateral in Bester (1985). In addition, entrepreneurs using more personal equity to finance their venture are, as already mentioned above, often argued to face c.p. a lower risk of credit rationing and to be offered better financing conditions. Thus, I can add the following hypothesis to the second set:

H2.4: The probability to receive high subsidies increases c.p. in the equity share and is higher for firms with fully liable owners than for limited liability firms.

Petersen and Rajan (1994), Berger and Udell (1995), Elsas and Krahnen (1998), and Harhoff and Körting (1998b) among others show that characteristics of bank-borrower relationships

[16] Welch (1997) analyzes the role of internal collateral in form of seniority rights on firm assets. All other theoretical models mentioned in this paragraph look at outside collateral consisting of assets not belonging to the firm but the entrepreneur.

[17] All empirical studies mentioned in this paragraph use data about German firms. In some of them, the measure of borrower risk may be endogenous. Most empirical studies for other countries suggest a positive correlation between the provision of collateral and borrower risk (Berger and Udell 1998).

[18] Section 4.4.4 elaborates further on this point.

can influence lending behavior. Nguyen, Kaiser, and Laisney (2000) find that such characteristics affect firm performance significantly. The data base I use informs about the type of bank handling the firm's DtA loans. Thus, I can investigate whether customers of savings, cooperative or commercial banks face distinct subsidy assignment chances. Variables like the number or the duration of a firm's relationships with banks are not available but this should be of minor relevance here since the empirical analysis is devoted exclusively to start-ups. Start-ups rarely borrow from more than one bank (Harhoff and Körting 1998b). Typically, they build up new bank borrower relationships.[19]

4.1.3 Subsidy effects

As already mentioned, the programs subject to evaluation here aim at preventing sub-optimal start-up capitalization and sub-optimal investment after market entry. Strongly assisted firms are expected to perform better and to have higher survival chances than they would have had with less start-up assistance and thus stronger financial constraints. Since the struggle to survive usually dominates the initial years of start-ups, I use the survival rate as outcome variable in the evaluation analysis in section 4.4.3. The main question addressed is the following:

> How do the average effects of start-up assistance on firm survival differ by subsidy mode?

In order to guideline future program choice and design, it has to be clarified whether assigning high subsidies instead of low subsidies can be justified from a welfare perspective. An important evaluative step in this context is to find out whether high subsidies increase firm survival significantly more than low subsidies and whether this difference persists over a long time period. Since panel data is available for at least six years after firm formation I can compare the short-, medium- and long-run effects of different subsidy modes on firm survival chances after 3, 4.5 and 6 years of firm activity. Investigating the implications of the current pattern of subsidy assignment on program effects can also indicate interesting directions for policy modifications. Finally, evidence on German start-up assistance is of particular interest more than a decade after the German unification because of an ongoing discussion about continuation, modification or reduction of transfers directed to East Germany. In this discussion,

[19] In East Germany, the banking industry was fundamentally restructured after the breakdown of the planned economy system in 1989. Hence, all East German start-ups at the beginning of the 1990s had to establish new bank relationships. West German entrepreneurs starting a new firm may have chosen the same bank as in previous business or private customer relations. Only then previously collected internal customer information might have been used to determine the conditions of the new loan.

Ragnitz (2000) and Sinn (1995, 2002) call for a reduction of capital cost subsidies in East Germany.

4.2 Econometric approach

4.2.1 Causal effects and identification in a multiple state context

Evaluation studies using non-experimental data often use the framework of potential outcomes and causal effects introduced by Roy (1951) and Rubin (1974).[20] Within this framework Rubin (1977) and Rosenbaum and Rubin (1983) show how average causal effects can be identified and estimated in the case of only two states, usually named treatment and non-treatment. However, treatment is often heterogeneous. For example, active labor market policies usually include several programs differing with respect to content and duration. Programs offering start-up assistance, micro credit lending or R&D subsidies typically assign firm-specific subsidies. Imbens (2000) and Lechner (2001a) extended the approach of Rubin (1977) and Rosenbaum and Rubin (1983) to the case of multiple treatments. These extensions will be used here to compare average effects of different subsidy modes on the outcome firm survival.

In the following, causal analysis builds upon the stable unit treatment value assumption (SUTVA). SUTVA states that the value of a potential outcome variable for firm i, with index i running over all firms in the population, is the same for all variations of the treatment allocation in the population giving firm i the same sort of treatment. Most important, SUTVA implies that indirect and general equilibrium effects of start-up assistance are ignored in section 4.4.3.[21] Suppose that firms can be assigned to M mutually exclusive subsidy modes, named treatments. Call the vector of observable covariates, i.e. variables unaffected by treatments and influencing assignment and outcomes simultaneously, X. Denote by Y^j the potential outcome variable in case of treatment j with $j = 1, \ldots, M$. Each firm is assigned to exactly one treatment j which is indicated by the assignment indicator S with $S \in \{1, \ldots, M\}$. Only the potential outcome Y^j can be observed for a firm receiving treatment j. All other $M - 1$ potential outcomes are unobservable counterfactuals.

In this study, I focus on the following causal effects based on pair-wise treatment comparisons:

$$\begin{aligned} \theta^{ml}: &= E(Y^m - Y^l \mid S = m) \\ &= E(Y^m \mid S = m) - E(Y^l \mid S = m) \quad \forall\ l, m \in \{1, \ldots, M\} \text{ with } l \neq m \end{aligned} \tag{4.1}$$

In addition, I investigate the following type of effects:

$$\gamma^{ml}: = E(Y^m - Y^l) = E(Y^m) - E(Y^l) \tag{4.2}$$

[20] See Holland (1986), Sobel (1995) and Prantl (1997) for a more detailed discussion.

[21] See Rubin (1980, 1986, 1990) and Angrist, Imbens, and Rubin (1996).

$$= \sum_{j=1}^{M} \left(E\left(Y^m \mid S=j\right) - \left(E\left(Y^l \mid S=j\right)\right) \cdot P\left(S=j\right) \right.$$
$$\forall \;\; l,m \in \{1,\ldots,M\} \text{ with } l \neq m$$

θ^{ml} is the expected effect of treatment m relative to treatment l on the outcome of a firm randomly drawn from the *sub-population* receiving treatment m. The treatment effect γ^{ml} is the expected effect of treatment m relative to treatment l on the outcome of a firm randomly drawn from the *whole population*. $E(Y^m \mid S=m)$ denotes the expected value of Y^m in the group of firms with treatment m. $E(Y^m - Y^l \mid S=m)$ and $E(Y^l \mid S=m)$ have to be read in a similar way. $P\left(S=j\right)$ is the probability of $S=j$. Equation 4.2 shows that γ^{ml} can be written as a weighted sum of treatment effects in sub-populations. Note that population effects are symmetric, hence $\gamma^{ml} = -\gamma^{lm}$ holds. Effects in sub-populations are asymmetric, i.e. $\theta^{ml} \neq -\theta^{lm}$, whenever the sub-population receiving m differs non-randomly from the one receiving l with respect to variables affecting individual treatment effects (Lechner 2001a).

The crucial problem of treatment effect evaluation results from counterfactual terms, $E\left(Y^l \mid S=m\right)$ with $l \neq m$, not being observable. Experimental data collection guaranteeing random assignment of firms to different subsidy modes would imply independence between potential outcomes and assignment such that $E\left(Y^l \mid S=m\right) = E\left(Y^l \mid S=l\right)$. Thus, the mean of Y^l in the group of firms receiving treatment l could be used as a consistent estimate of the unobservable $E\left(Y^l \mid S=m\right)$.

Since several variables discussed in section 4.1.2 simultaneously affect subsidy assignment and the outcome survival chances the non-experimental data used for this study does not fulfill random assignment. Therefore, identification of θ^{ml} and γ^{ml} is based on the assumption of random assignment conditional on covariates as proposed by Rubin (1977) and extended to the multiple state case by Imbens (2000) and Lechner (2001a). It requires all important factors simultaneously influencing assignment and outcome to be observed. In the context at hand a lot of information on entrepreneur-, firm-, industry-, location- and time-specific characteristics is available. Moreover, the data set provides a unique natural experiment in West Germany which is well suited for analyzing the plausibility of the conditional independence assumption (CIA) imposed when estimating effects for the full sample of East and West German firms. This analysis does not indicate dependence of the subsidy assignment on unobservable variables and thus CIA is assumed to hold in the following.[22]

CIA states independence between potential outcomes and assignment conditional on X taking a value x in the covariate space χ:

$$\left\{Y^1,\ldots,Y^M\right\} \;\amalg\; S \mid X=x \;\; \forall \;\; x \in \chi. \tag{4.3}$$

[22] See section 4.4.4 for details.

$\amalg$ denotes independence. If CIA is valid, then $E\left(Y^l \mid S=m, X=x\right) = E\left(Y^l \mid S=l, X=x\right)$. To understand how causal effects can be estimated based on CIA, rewrite the not directly identifiable counterfactual terms in equations 4.1 and 4.2 as follows: $E\left[Y^l \mid S=m\right] = E_X\left[E\left(Y^l \mid S=m, X=x\right) \mid S=m\right]$. This shows that the sample analogue of $E_X\left[E\left(Y^l \mid S=l, X=x\right) \mid S=m\right]$ can be used to estimate $E\left[Y^l \mid S=m\right] \ \forall \ l,m \in \{1,\ldots,M\}$ with $l \neq m$.

When using CIA for identification of θ^{ml} and γ^{ml} in a certain region of χ firms in that region of χ need to have a positive probability to be assigned to treatment m as well as to l. Otherwise comparison firms for estimating $E(Y^l \mid S=m)$ would be missing. Thus, I assume $0 < P^m(x) < 1 \ \forall \ m=1,\ldots,M$ where $P^m(x) = P^m(S=m \mid X=x)$ denotes the probability of being assigned to treatment m conditional on $X=x$. All treatment effects will be estimated for the region of joint common support $\tilde{\chi}$, i.e. the part of χ where all treatments have a positive assignment probability.[23]

4.2.2 Effect estimation

Conditioning on $X=x$ can be implemented by selecting for each firm with treatment m a comparison firm with treatment l that is equal with respect to X. Obviously, such a method can hardly be applied if X is a high-dimensional vector. High dimensionality can be avoided by exploiting the balancing score property as proposed by Rosenbaum and Rubin (1983) and as generalized by Imbens (2000) and Lechner (2001a) to the multiple state case. Call the vector of conditional assignment probabilities $P^m(x)$ the propensity score vector: $P(X) = \{P^1(X),\ldots,P^m(X)\}$. Moreover, define a balancing score $b(X)$ as a function of X with the following property: $E\left[P(S=m \mid X=x) \mid b(X)=b(x)\right] = P^m(x) \ \forall \ m=1,\ldots,M$. If CIA holds, i.e. if the potential outcomes are independent of the assignment conditional on X, they are also independent of the assignment conditional on $b(X)$. It follows that: $E\left[Y^l \mid S=m, b(X)=b(x)\right] = E\left[Y^l \mid S=l, b(X)=b(x)\right] \ \forall \ l,m \in \{1,\ldots,M\}$.

Conditioning on $b(X)=b(x)$ rather than on $X=x$ can be implemented by constructing a comparison group of firms with treatment l whose distribution of $b(X)$ coincides with the corresponding distribution in the group with treatment m. Due to the balancing score property, the distributions of X will then also be balanced. $E\left[Y^l \mid S=m\right]$ can be estimated by the sample analogue of $E_X\left[E\left(Y^l \mid S=l, b(X)=b(x)\right) \mid S=m\right]$, i.e. the corresponding mean in the comparison group of firms with treatment l. Conditioning on the balancing score

[23] See Heckman, Ichimura, and Todd (1997), Heckman, LaLonde, and Smith (1999), Imbens (2000) and Lechner (2001b) for recent discussions. Treatment effects outside of the common support region may be identified and consistently estimated by extrapolating from regions where the treatments of interest are assigned with a positive probability.

simplifies the estimation problem whenever $b(X)$ is defined as having a lower dimension than X. Directly extending Rosenbaum and Rubin (1983) to the multiple treatment case suggests $b(X) = P(X) = \{P^1(X), \ldots, P^m(X)\}$ as balancing score. Imbens (2000) and Lechner (2001a) show that conditioning on a balancing score of lower dimension consisting of the two marginal probabilities $P^m(X)$ and $P^l(X)$ is also sufficient for the estimation of θ^{ml} and γ^{ml}.

Several alternative methods exploiting this generalized balancing score property can be used to estimate θ^{ml} and γ^{ml}. Brodaty, Crépon, and Fougère (2001) apply a kernel matching estimator. Frölich, Heshmati, and Lechner (2000), Lechner (2002a) and Larsson (2002) construct comparison groups by nearest neighbor matching with replacement.[24] As Dehejia and Wahba (1998) point out, nearest neighbor matching with replacement uses less firms to construct a comparison group than other matching methods. Lechner (2001a) and Frölich, Heshmati, and Lechner (2000) stress the drawback of potentially drawing the same comparison firm repeatedly when other, very similar firms could be used instead. This can inflate the variance of effect estimates unnecessarily.

In the following, I apply weighting estimators proposed by Imbens (2000) and Brodaty, Crépon, and Fougère (2001) and investigated further by Frölich (2000). Comparison groups for estimation of θ^{ml} are matched by weighting each firm with treatment l such that the distribution of $b(X)$ in the weighted comparison group equals the corresponding distribution in the group with treatment m. For estimating γ^{ml}, firms with treatment m and firms with treatment l are weighted such that the distribution of $b(X)$ in both groups equals the corresponding distribution in the whole sample population. Then, the balancing score property implies balanced distributions of X in each pair of treatment and comparison group and average treatment effects can be estimated. Weighting procedures use all potential comparison firms to construct comparison groups. Therefore, they may be preferred in applications where nearest neighbor matching with replacement indeed leads to unnecessarily inflated variances.

The applied estimation algorithm proceeds as follows:

1. Estimate the unconditional assignment probabilities $\hat{P}(S = 1), \ldots, \hat{P}(S = M)$ for the sample of all firms receiving different treatments. Since outcome-based sampling of the data has to be taken into account in this study estimate the probabilities by the respective weighted sample frequencies (see section 4.3.1). Denote the sampling weight of firm i with w_i. Index i runs over all firms in the sample from 1 to N.

2. Specify and estimate a multinomial choice model to obtain the predicted conditional probabilities $\hat{P}^1(x_i), \ldots, \hat{P}^M(x_i)$ for each firm i. Given outcome-based sampling of the

[24] Replacement has to be allowed for when applying a matching procedure in a multiple treatment application since some ml-combinations will involve a group of potential comparison firms not being larger or being smaller than the group of treated firms.

data apply a weighted maximum likelihood estimator as proposed by Manski and Lerman (1977). Use the predicted probabilities to construct the propensity score vector $\hat{P}(x_i)$ (see section 4.4.1 and section 4.4.2).

3. Determine the joint common support $\hat{\hat{\chi}} = \{x \mid \hat{P}^m(x) > 0 \ \forall \ m \in \{1, \ldots, M\}\}$. To do so, calculate the maximum and minimum of $\hat{P}^m(x)$ in each treatment group $\forall \ m \in \{1, \ldots, M\}$. Then, delete all firms i for which at least one $\hat{P}^m(x_i)$ lies above the minimum of the group-specific maxima or below the maximum of the group-specific minima of $\hat{P}^m(x)$.[25]

4. For estimating an average treatment effect $\hat{\theta}^{ml}$ let firm n in the group with treatment l and $n = 1, \ldots, N^l$ enter the comparison group with the following weight:

$$w'_n = \frac{\hat{P}^m(x_n) \cdot \hat{P}(S = l)}{\hat{P}^l(x_n) \cdot \hat{P}(S = m)} \cdot w_n \quad \forall \ n = 1, \ldots, N^l \tag{4.4}$$

   For each firm o in the group with treatment m and $o = 1, \ldots, N^m$ use the sampling weight w_o mentioned in step 1.

5. For estimating an average treatment effect $\hat{\gamma}^{ml}$ let firm o in the group with treatment m and $o = 1, \ldots, N^o$ enter the treatment group with the following weight:

$$w''_o = \frac{\hat{P}(S = m)}{\hat{P}^m(x_o)} \cdot w_o \quad \forall \ o = 1, \ldots, N^m \tag{4.5}$$

   Let firm n in the group with treatment l and $n = 1, \ldots, N^l$ enter the comparison group with the following weight:

$$w''_n = \frac{\hat{P}(S = l)}{\hat{P}^l(x_n)} \cdot w_n \quad \forall \ n = 1, \ldots, N^l \tag{4.6}$$

6. Check whether each pair of treatment and corresponding comparison group is sufficiently balanced with respect to X. If this is not the case, refine the specification of the multinomial choice model and repeat steps 2 - 6 (see section 4.4.2).

7. Estimate $\hat{\theta}^{ml} \ \forall \ l, m \in \{1, \ldots, M\}$ and $l \neq m$ by using the weights determined in step 4 (see section 4.4.3):[26]

$$\hat{\theta}^{ml} = \frac{\sum_{o=1}^{N^m} w_o \cdot y_o^m}{\sum_{o=1}^{N^m} w_o} - \frac{\sum_{n=1}^{N^l} w'_n \cdot y_n^l}{\sum_{n=1}^{N^l} w'_n} \text{ with } o = 1, ..., N^m \text{ and } n = 1, ..., N^l. \tag{4.7}$$

   The variable y_o^m (y_n^l) denotes the outcome observed for firm o (n) in the group receiving treatment m (l).

[25] It is assumed that the support regions for each conditional assignment probability in each treatment group are compact.

[26] See the proof of proposition 2 in Brodaty, Crépon, and Fougère (2001).

8. Estimate $\hat{\gamma}^{ml}\ \forall\ l, m \in \{1, \ldots, M\}$ and $l \neq m$ by using the weights determined in step 5 (see section 4.4.4):[27]

$$\hat{\gamma}^{ml} = \frac{\sum_{o=1}^{N^m} w''_o \cdot y_o^m}{\sum_{o=1}^{N^m} w''_o} - \frac{\sum_{n=1}^{N^l} w''_n \cdot y_n^l}{\sum_{n=1}^{N^l} w''_n} \text{ with } o = 1, ..., N^m \text{ and } n = 1, ..., N^l. \qquad (4.8)$$

The estimators $\hat{\theta}^{ml}$ and $\hat{\gamma}^{ml}$ are differences of weighted averages of the observed outcome for the group of firms with treatment m and for the comparison group with treatment l. The variance of the effect estimator is computed by using straightforward extensions of Lechner (2001a).[28]

4.3 Data and descriptive statistics

4.3.1 Data

This study is based on a large, unique firm data set with detailed credit file information about subsidized loans provided by the DtA. To construct the data set, the internal data base of the DtA was for the first time connected to an external firm data base.[29] The former provides information on 775,781 DtA loan approvals between 1990 and 1999. The latter is a stratified random sample of 22,000 firms from two complementary firm panels maintained at the Centre of European Economic Research (ZEW). 10,000 firms were drawn from the East German firm panel covering about one million firms in September 1999. Another 12,000 firms were drawn from the West German firm panel with about 1,600,000 firms in September 1999. The data for the panels are provided by the leading German credit rating agency, Creditreform, approximately every six months.[30] The sample covers all East and West German regions and all industries in the manufacturing, construction and trade sectors as well as most service industries. All firms in the sample were started before January 1, 1994 and panel data

[27] The result can be proved by modifying the proof of proposition 2 in Brodaty, Crépon, and Fougère (2001). See also Imbens (2000).

[28] The applied formulas impose the assumptions of fixed propensity score values as well as fixed weights. These are simplifying assumptions because the propensity score values are derived from a multinomial choice model estimation and the weights w'_n, w''_o and w''_n are determined within the estimation procedure. Moreover, the estimated conditional assignment probabilities determine the elimination of observations not within the joint common support $\hat{\hat{\chi}}$. See Lechner (2002b) for an application where the results based on variance approximation and on bootstrapping lead to similar conclusions.

[29] Due to data protection rules the data bases were merged at the DtA headquarter.

[30] More details about panels based on Creditreform data can be found in Almus, Engel, and Prantl (2000) and Harhoff, Stahl, and Woywode (1998).

is available for the period until December 31, 1999. Hence, short- and long-run effects of heterogeneous subsidy modes can be evaluated.

A typical firm record in the ZEW firm panels contains address data, information on many firm characteristics, and details about firm owners as well as managers. Creditreform delivers data on firm formation and liquidation partly in encoded variables and partly in free flow text. Since I extracted this text information for all 22,000 firms in the sample from about 4,000 pages comprehensive formation and liquidation data can be used here. A large telephone survey conducted in 1999 provides further data on the activity status of 5,299 firms in the sample (Almus et al. 2001). When drawing the sample, firm groups having a high liquidation risk according to Creditreform's encoded information were over-sampled approximately twofold. This disproportionally stratified outcome-based sampling rule is taken into account here in all estimation and test procedures (Manski and McFadden 1981, Angrist and Krueger 1999).

12,624 of all 22,000 firms in the random sample meet the following conditions: they were started between January 1, 1990 and December 31, 1993, were eligible for start-up subsidization by the DtA and their data records provide all the needed firm and owner information.[31] According to the results of a diligently conducted merge of the firm sample with the internal DtA data base, the DtA provided start-up assistance for 2,261 of these firms.[32] Each subsidized start-up got at least one DtA loan at latest in the year subsequent to its firm formation year. Some supported firms were precluded from participating in the EKH program because of the enforced size and equity share restrictions mentioned in section 4.1. Thus, they did not have access to all different subsidy modes analyzed in the following and were removed from the sample. The final sample covers 2,098 firms. Most of the firms in the final sample received equity capital assistance as well as one or two loans in the DtA or ERP business start-up programs in the firm formation year or the subsequent year. All in all, this amounts to 4,940 start-up loans.

Table C.1 in Appendix C contains descriptive statistics for the final sample. Definitions of all

[31] According to the detailed, partly text-extracted start-up information about one half of all firms not considered any further in the following entered the market before 1990 or could be classified either as holding company, part-time project or as legally dependent firm unit. These firms were not considered because of the time period covered by the internal DtA data base and because of eligibility restrictions that exclude such firms from DtA start-up assistance. For nearly one quarter of all excluded firms information on owner age was missing. Subsidiaries and firms without at least one entrepreneur younger than 56 years were also excluded due to eligibility restrictions.

[32] To merge the internal DtA data base and the firm sample a sophisticated computer based search algorithm was used. The algorithm linked all data entries in both data bases by means of a heuristic comparison procedure if coincidence of firm and owner-specific names, address information and birth dates of firm owners was high. Then, extensive manual checking of the computer-generated links was conducted. Several tests of data consistency indicated a highly reliable merge between both data bases. For further details see the appendix of chapter 3 in this thesis.

variables used for the empirical analysis can also be found there. From the DtA data base I use information on loan characteristics and firm-specific data on bank relations, investment and financing structure as indicated in the application forms for DtA-loans. Entrepreneur- and further firm-specific variables are based on Creditreform data. Moreover, monthly averages of the day-to-day interbank money rates and several location-specific variables were taken from the statistics of the Bundesbank, the Bundesamt für Bauwesen und Raumordnung and the Bundesanstalt für Arbeit.

4.3.2 Descriptive statistics for start-up financing and DtA assistance

In the following, I characterize the sample population of subsidized start-ups and show how heterogeneous subsidies are. According to table 4.1 about 25 percent of all start-ups in East and West Germany planned to invest less than 51,000 Euro. But in contrast to the investment distribution in West Germany, the East German one exhibits a fatter right tail. The median West German firm invests about 80,000 Euro and the one at the 75-percent quartile about 153,000 Euro. The corresponding values in East Germany are about 25 percent and about 50 percent higher, respectively. In addition, comparing the means shows that new firms in East Germany after the breakdown of the old industry structures and the planned economy system are on average much larger than in the relatively stable West German market economy.

The financing structure of start-ups in East and West Germany turns out to be very different. 50 percent of all West German start-ups in the sample financed between 13.4 and 17.1 percent of their start-up investment with equity.[33] The mean as well as the median are at about 15 percent. For East German start-ups the mean as well as the median of the equity share distribution are at about only 8.5 percent. Moreover, 27.9 percent of all East German projects were started without equity. This is likely to reflect the low level of private capital accumulation in East Germany before unification. On average, East and West German start-ups finance 10.4 percent of their planned start-up investment with equity.[34] Harhoff and Körting (1998b) report the mean for small German firms of all age classes to be about 11 percentage points higher. This difference can be explained by selective exit of new firms after market entry.

To describe the variation of subsidies in the sample population I use two variables: the subsidized loan share and the firm-specific average annual debt service rate for DtA loans.

[33]Equity capital assistance by the DtA may serve as equity substitute. Since it is, however, approved in form of a long-term loan in the EKH program I do not count it as equity here.

[34]Note that firms with an equity share above 40 percent were excluded from the final sample used here (see section 4.3.1). If this restriction were not applied the equity share distribution would, however, be very similar and would have a mean of 11.5.

Table 4.1: Descriptive Statistics for Start-up Investment, Financing and Subsidies

All Firms
(East German Firms; West German Firms)

Variables	Quartiles 25%	50%	75%	Mean
start-up investment	51.13	92.03	206.56	202.35
	(51.13;51,13)	(100.21;80.27)	(230.08;153.39)	(227.55;137.66)
equity share	2.16	10.80	15.28	10.44
	(0.00;13.41)	(8.31;15.07)	(15.00;17.13)	(8.65;15.02)
subsidized loan share	51.58	81.40	88.22	70.36
	(66.67;40.00)	(87.65;53.04)	(88.74;67.32)	(76.66;54.20)
debt service rate	4.69	6.55	9.06	7.34
	(4.51;5.88)	(5.82;8.40)	(8.15;11.67)	(6.83;8.64)
EKH share	0.00	33.99	43.94	33.47
	(29.24;0.00)	(35.47;29.12)	(43.49;48.22)	(36.05;26.83)

Notes: The table shows weighted results for the sample of 2,098 subsidized firms. Start-up investment is measured in 1000 Euro and all other variables in percent. For further details on the definition of the variables see table C.1.

The subsidized loan share is defined as the sum of a firm's subsidized DtA start-up loan amounts divided by the amount of planned start-up investment not financed with equity.[35] The average annual rate of debt service for a firm's DtA loans is defined as the average of all the firm's interest and redemption payments on DtA start-up loans during the first three years after loan approval.[36] Several other definitions of the debt service rate were tested but did not change the results of the subsequent empirical analysis in any major way. This can be explained by the fact that the variation of the debt service rate is mainly driven by the variation of the firm-specific EKH share, i.e. the share of the sum of a firm's subsidized loan amounts that is assigned within the EKH program.[37] As already described in section 4.1.1 EKH loans are considerably more subsidized with respect to interest rates and redemption conditions than loans in the ERP or DtA business start-up programs.

The subsidized loan share varies considerably between firms as the 75-percent quartile of the sample distribution is 88.2 percent and the 25-percent quartile is 51.6 percent. This implies a difference of about 37 percentage points. The variation of the firm-specific average annual

[35]Recall that program-specific pay-out discounts exist. To take them into account, I used the effectively usable and not the nominal loan amounts in the calculations.

[36]In addition to interest rate and redemption conditions, I considered program-specific pay-out discounts by calculating the debt service rate for the effectively usable loan amounts.

[37]The correlation coefficient between the EKH share and the average annual debt service rate is -0.7.

debt service rate for DtA loans indicates further heterogeneity. One quarter of the firms in the sample has an average annual dept service rate of less than 4.7 percent and one quarter faces a rate of about 9.1 percent or more. Comparing subsidies in East and West Germany indicates that the average level of subsidized loan shares in East Germany is 76.7 percent which is about 40 percent higher than in West Germany. In addition, the East German distribution of subsidized loan shares is skewed to the right in contrast to the West German one.[38] Moreover, the mean of the firm-specific average annual debt service rate on DtA loans in East Germany is 6.8 percent and thus about 20 percent lower than in West Germany.

Summing up, subsidized East German start-ups between 1990 and 1993 are on average larger than subsidized West German ones during the same time period. They use less equity and more subsidized external capital to finance their start-up investment. Moreover, their debt service rate on DtA loans is on average lower than in West Germany. Most importantly, subsidies vary substantially in both parts of Germany.

For the empirical analysis, I formed four treatment groups by splitting the sample at about the mean of the subsidized loan share and at about the mean of the firm-specific average annual debt service rate on DtA loans. Treatment group one receives subsidy mode one, the second group receives mode two, etc. The four subsidy modes generated by the splitting rule can be characterized as follows:[39]

1. subsidy mode 1: low subsidized loan share, high debt service rate
2. subsidy mode 2: low subsidized loan share, low debt service rate
3. subsidy mode 3: high subsidized loan share, high debt service rate
4. subsidy mode 4: high subsidized loan share, low debt service rate

Low average annual debt service rates on DtA loans corresponds to strong loan cost subsidies in the central part of the empirical analysis in sections 4.4.1 to 4.4.4. This correspondence arises since I control for prime rate fluctuations when estimating the assignment model by using the average day-to-day interbank money rate. As a consequence, all treatment and comparison groups used for effect estimation are balanced with respect to the average day-to-day interbank money rate. Table 4.2 shows the mean of the subsidized loan share, the mean of the firm-specific average annual debt service rate on DtA loans and the number of observations in each treatment group.

[38] My results for East Germany are consistent with results of Roland Berger Forschungs-Institut (1995).

[39] I also tested different splitting rules, but the alternative approaches led to qualitatively similar results in the subsequent empirical analysis. Splitting the sample into more than four groups was not feasible due to sample size restrictions.

Table 4.2: Description of the Treatment Groups

	Mode 1	Mode 2	Mode 3	Mode 4
mean(subsidized loan share)	47.91	45.87	86.58	86.64
mean(debt service rate)	12.77	4.05	11.17	5.40
number of observations	354	499	371	874

Notes: The table shows weighted results for the sample of 2,098 subsidized firms. The subsidized loan share and the firm-specific average annual debt service rate on DtA loans are measured in percent.

4.3.3 Differences between treatment groups

Table 4.3 displays descriptive statistics for selected firm characteristics in the four treatment groups. These indicate that each group constitutes a selective sub-sample of the sample population. For each variable the table shows an overall F-test of the null hypothesis stating equality of the weighted means in all groups.[40] In addition, I analyzed mean differences for all possible pairs of groups. As dependence of tests arises in the multiple comparison context, I adjusted the significance level of the standard t-test for the comparison of two means as proposed by Bonferroni.[41] For the sake of brevity the test results of the various pair-wise comparisons are not presented in table 4.3 but considered in the following discussion.[42]

The F-test results and various pair-wise comparisons indicate that mean investment and equity shares vary substantially and statistically significant between treatment groups. In addition, the distribution of bank relationships varies as well. Savings bank customers belong significantly more often to groups with low subsidized loan shares (1 & 2) than to other groups. Firms that applied for DtA-loans via commercial banks belong significantly more often to group 3 with high subsidized loan shares and less often to group 1 with low subsidized loan shares than to other groups. A reverse pattern can be observed for customers of cooperative banks. The share of limited liability firms is significantly higher in group 2 with low subsidized loan shares than in groups with high subsidized loan shares (3 & 4). The reverse pattern is found for sole proprietorships. In addition, treatment groups differ significantly with respect to mean team size, the share of firms with female entrepreneurs and the shares of start-ups in 1990, 1991 and 1992.

With respect to educational degrees and the age of the entrepreneur, most pair-wise compar-

[40] Test results for the East and West German subsample are not displayed because the majority of results is similar in both subsamples.

[41] See Winer, Brown, and Michels (1991). Using the alternatively applicable adjustment proposed by Šidák or the Scheffé test led to quite similar results.

[42] These test results and all other test results not presented but discussed in the text are available upon request.

Table 4.3: Comparison of Different Treatment Groups

Variables	Mean/Share in %				
	Mode 1	Mode 2	Mode 3	Mode 4	F-statistic
start-up investment	161.00	283.12	122.98	206.37	19.21***
equity share	11.47	11.24	12.07	8.89	19.27***
commercial bank	23.24	33.44	50.77	37.85	21.21***
cooperative bank	35.21	24.05	16.87	26.98	11.17***
savings bank	41.55	42.51	32.35	35.17	4.69***
team size	1.27	1.45	1.30	1.37	6.08***
diversified	28.46	28.97	23.00	26.90	1.45
franchisee	7.25	4.53	3.52	5.37	1.89
ltd. liability & stock company	33.79	39.56	25.91	29.36	7.62***
civil law association	8.36	9.12	9.55	9.53	0.16
commercial partnership	1.79	2.86	3.10	2.66	0.46
sole proprietorship	56.05	48.47	61.43	58.45	6.03***
firm affiliation	2.12	4.83	4.22	4.28	1.46
cohort 1990	23.78	26.33	29.63	18.10	8.14***
cohort 1991	29.35	35.79	29.34	35.25	2.66**
cohort 1992	27.48	22.55	25.57	29.84	3.01**
cohort 1993	19.38	15.33	15.47	16.81	0.98
female	8.40	12.70	16.32	21.05	12.13***
apprenticeship	67.45	59.13	59.82	59.40	2.69**
master craftsman	19.76	17.91	18.75	14.73	2.07
business administration	2.28	3.33	4.13	2.99	0.72
engineering	7.95	16.90	14.74	21.31	11.43***
other academic degrees	2.56	2.74	2.56	1.57	0.91
age, 17-29	20.91	19.99	20.67	17.41	1.07
age, 30-44	60.06	58.29	55.36	58.00	0.56
age, 45-72	19.03	21.71	23.96	24.59	1.70
manufacturing	18.67	22.36	13.47	15.72	4.88***
construction	17.27	15.48	23.72	24.96	7.36***
wholesale & intermediate trade	8.74	8.45	9.97	7.78	0.54
retail trade	36.57	23.17	32.79	37.72	10.99***
transport & communication	4.59	4.06	8.46	3.35	5.29***
services	14.17	26.47	11.59	10.46	23.65***
high technology	8.40	10.70	4.56	5.56	5.85***
West Germany	66.71	43.84	22.42	5.67	247.57***
unemployment rate	9.37	11.37	13.41	15.65	162.69***
population density	678.15	653.08	749.27	512.33	7.07***
bank office density	75.39	84.80	81.48	93.69	11.24***

Note: The table shows weighted results for the sample of 2,098 firms. *** (**, *) indicates significance of the F-test statistic at the 1% (5%, 10%) significance level. The tested null hypothesis is equality of the means in all four groups.

isons and F-tests indicate insignificant mean differences between the groups.[43] But group 1 contains significantly more entrepreneurs with apprenticeships, low or no recorded education than groups with low debt service rates (2 & 4) and less entrepreneurs with a diploma in engineering than all other groups. Group 4 has a higher share of entrepreneurs with a diploma in engineering than groups with high debt service rates (1 & 3).

The four treatment groups also differ significantly with respect to all considered industry indicators, except one. In contrast to firms in construction and retail trade, firms in manufacturing and services as well as high technology firms in these sectors belong more often to group 2 with low subsidized loan shares than to groups with high ones (3 & 4). Firms in the transport and communication sector belong more often to group 3 than to any other group. In accordance with the subsidization pattern in East and West Germany discussed in section 4.3.2, the share of West German firms decreases substantially and statistically significantly from group 1 to group 4. The reverse pattern can be observed for the group-specific means of the unemployment rate. This result merely reflects the high level of unemployment in East Germany. Finally, the groups differ significantly with respect to population and bank office density in the district of firm location.

Summing up, the considerable variation of important firm characteristics between the four treatment groups suggests dependence of the treatment assignment on variables influencing firm survival as well. To control appropriately for the selective assignment when estimating treatment effects in the next section, I will apply the evaluation approach discussed in section 4.2.

4.4 Empirical results

In the following, I examine the assignment to different modes of federal start-up assistance in Germany and their effects on firm survival. In section 4.4.1 the results of estimating the assignment model are presented. These show how firm-, entrepreneur-, industry-, location- and time-specific factors affect assignment. The predicted assignment probabilities used for the construction of comparison groups, the common support regions for effect estimation and the achieved balancing of treatment and comparison groups are described in section 4.4.2. In section 4.4.3, I discuss the estimated short-, medium- and long-run effects of alternative start-up assistance modes on the firm survival rate. To assess the plausibility of the CIA and

[43] 30.12 percent of all firms in the sample are started by teams. They have several entrepreneurs, i.e. several owner persons with management function. In such cases, I selected the entrepreneur-specific information of the managing owner with the highest equity share. If share data was missing the information about the oldest managing owner was chosen. Alternative ways of encoding were tested but did not lead to different results.

thus the validity of the effect estimates in section 4.4.3, I exploit a temporary interruption of the EKH program for West German firms in section 4.4.4.

4.4.1 Determinants of different subsidy modes

Given the distinction between four subsidy modes, I used a multinomial logit (MNL) model to estimate the assignment model.[44] Since the observations are outcome-based sampled from the parent population I applied the weighted maximum likelihood estimator introduced by Manski and Lerman (1977). The dependent variable S is coded as m if firm i received subsidy mode m, called treatment m, in the firm formation year or the subsequent year and 0 otherwise $\forall\ i = 1, \ldots, N$ and $m = 1, .., M$. X denotes the vector of independent variables.[45] The MNL model provides a set of probabilities P_{mi} for the M possible assignments of firm $i\ \forall\ i = 1, \ldots, N$. Normalizing the coefficient vector for receiving treatment 1 to 0 ($\beta_1 = 0$) in order to remove the indeterminacy of the model the following probabilities can be estimated (Maddala 1983):

$$P_{mi} = P(S = m \mid X = x_i) = \frac{exp^{x_i'\beta_m}}{\sum_{g=1}^{M} exp^{x_i'\beta_g}} \ \forall\ m = 1, .., M \ \text{ and } \ i = 1, \ldots, N \ \text{ with } \ \beta_1 = 0. \tag{4.9}$$

The MNL model is more restrictive than the alternatively applicable multinominal probit model because the later does not assume independence of irrelevant alternatives (IIA). The IIA assumption is a restriction on the structure of assignment probabilities. It requires the probability ratio of any two categories to be independent from the probability of other categories in the choice set. If IIA holds, omission of a category and model estimation conditional on the restricted choice set implies consistent, albeit inefficient conditional parameter estimates. In the context here, IIA would be violated if some treatments were closer substitutes than others. I tested the validity of the IIA assumption by applying the standard Hausman specification test proposed by Hausman and McFadden (1984) using all four specifications of the model arising by deletion of one category. The test results indicated no violation of the IIA assumption but the computation of the test statistic failed in two cases. This is a common problem in applications of Hausman-type tests because the involved difference between two matrices often turns out to be non-positive definite or nearly singular. As alternative test, I chose the likelihood ratio test developed by Small and Hsiao (1985) which is asymptotically unbiased due to the use of random sub-samples. Since the calculated test statistics indicated

[44] I did not use an ordered probit model based on a single latent variable with four ordered categories because the chosen treatment classification implies no clear ordering of category 2 and 3. Moreover, estimating a coefficient vector for each category is less restrictive than estimating a single one.

[45] All independent variables are measured at firm formation or loan application except otherwise indicated in table C.1.

no need to reject IIA I did not estimate the computationally more burdensome multinomial probit model.

As the coefficients of many exogenous variables in table 4.4 vary considerably between the equations distinguishing between four treatment groups appears to be informative. To test this, I applied the likelihood ratio test proposed by Cramer and Ridder (1991) using the six possible specifications with pooling of two categories. The tested null hypothesis states that separating between category j and k $\forall$ $j,k = 1,..,M$ with $j \neq k$ is not informative, i.e. pooling these categories is a valid restriction of the MNL model. This hypothesis can be rejected for all tested cases at any usual significance level.

Table 4.4: Estimation Results of the Multinomial Logit Assignment Model

	Mode 2	Mode 3	Mode 4
Independent Variable	Coefficient (Robust Standard Error)		
ln(start-up investment)	0.642	2.245***	2.954***
	(0.673)	(0.824)	(0.679)
ln(start-up investment)^2	-0.032	-0.245***	-0.268***
	(0.067)	(0.085)	(0.068)
equity share	-0.015	0.034	0.099***
	(0.036)	(0.034)	(0.034)
(equity share)^2	0.001	-0.000	-0.004***
	(0.001)	(0.001)	(0.001)
West*equity share	0.262***	0.186***	0.047
	(0.063)	(0.065)	(0.075)
(West*equity share)^2	-0.007***	-0.004**	0.001
	(0.002)	(0.002)	(0.003)
team	0.438**	0.237	0.339
	(0.216)	(0.248)	(0.235)
diversified	-0.247	-0.089	-0.020
	(0.271)	(0.267)	(0.239)
West*diversified	0.802**	-0.161	1.066**
	(0.386)	(0.526)	(0.461)
ltd. liability & stock company	-0.227	-0.628**	-0.545**
	(0.243)	(0.285)	(0.247)
civil law association	-0.414	-0.349	-0.368
	(0.329)	(0.390)	(0.339)
master craftsman	0.273	0.014	-0.306
	(0.232)	(0.253)	(0.232)
business administration	-0.073	0.106	-0.485
	(0.524)	(0.530)	(0.512)

continued on next page

continued from previous page

	Mode 2	Mode 3	Mode 4
engineering	0.531*	0.213	0.384
	(0.289)	(0.320)	(0.281)
other academic degrees	-0.184	-0.354	-1.137**
	(0.485)	(0.609)	(0.542)
ln(age-16)	2.656*	2.390	3.370**
	(1.536)	(2.031)	(1.684)
$\ln(\text{age-16})^2$	-0.499*	-0.432	-0.631**
	(0.276)	(0.360)	(0.300)
high technology	-0.443	-1.004**	-0.729*
	(0.360)	(0.483)	(0.410)
Berlin	-0.380	-0.573	-1.298***
	(0.379)	(0.373)	(0.341)
West Germany, North	-4.991***	-2.878***	-3.030***
	(0.946)	(0.887)	(0.988)
West Germany, Middle	-4.728***	-3.255***	-4.504***
	(0.987)	(0.971)	(1.293)
West Germany, NRW	-2.907***	-4.905***	-3.749***
	(0.783)	(0.971)	(0.871)
West Germany, South	-3.298***	-5.404***	-5.499***
	0.858)	(1.023)	(0.976)
commercial bank	0.163	0.514**	0.174
	(0.214)	(0.230)	(0.209)
cooperative bank	0.103	-0.361	0.300
	(0.310)	(0.330)	(0.276)
West*cooperative bank	-0.828**	-0.225	-0.607
	(0.399)	(0.474)	(0.498)
interbank money rate	-0.479***	-0.288	-0.257
	0.170)	(0.213)	(0.0203)
ln(population density)	0.117	0.079	0.024
	(0.099)	(0.106)	(0.098)
unemployment rate	0.009	-0.007	0.041
	(0.029)	(0.030)	(0.028)
bank office density	0.540**	0.347	0.522**
	(0.275)	(0.282)	(0.265)
West*bank office density	1.633***	0.462	0.972
	(0.636)	(0.672)	(0.877)
intercept	-3.651	-5.957	-9.858***
	(3.251)	(3.816)	(3.381)
Wald-statistic (χ^2 (degrees of freedom))			
investment variables	12.20 (2)***	9.46 (2)***	25.97 (2)***
equity share variables (basic)	0.23 (2)	5.96 (2)*	9.53 (2)***
equity share variables (all)	21.91 (4)***	25.28 (4)***	17.91 (4)***
diversification indicators	4.89 (2)*	0.41 (2)	7.04 (2)**
age variables	3.55 (2)	1.46 (2)	4.95 (2)*

continued on next page

continued from previous page

	Mode 2	Mode 3	Mode 4
cooperative bank indicators	7.36 (2)**	3.51 (2)	1.78 (2)
cont. regional variables	14.61 (4)***	2.65 (4)	10.94 (4)**
cohort indicators	23.23 (5)***	12.18 (5)**	31.10 (5)***
industry indicators	35.69 (13)***	31.67 (13)***	26.19 (13)**
East German state indicators	0.10 (3)	4.18 (3)	5.06 (3)
model		877.87 (156)***	
log likelihood (# obs.)		-2050.48 (2098)	

Notes: The dependent variable in the multinomial logit regression is the subsidy mode indicator S. Reference firms have the following characteristics: one entrepreneur with apprenticeship, low or no recorded education, no diversification, sole proprietorship or commercial partnership, savings house bank, cohort 1990, start-up in the retail trade industry in Saxony-Anhalt or Thuringia. *** (**, *) indicates that the coefficient or the coefficients differ significantly from zero at the 1% (5%, 10%) significance level.

The specification of the MNL model finally used builds on the preferred specification of three intermediary binary logit models each for the chosen base-category, treatment 1, and one of the remaining categories. When determining the specification of these binary models, I checked whether the fit of the models could be improved by using less or more aggregated industry and location indicators. Moreover, I tested for the significance of omitted variables including interaction terms between all included variables and the indicator for location in West Germany. Following the test results, the final specification of the MNL does neither include the indicators for firm affiliations, franchisees, female entrepreneurs nor interaction terms that are not needed in the binary models. The results of the finally estimated MNL model are shown in table 4.4. When interpreting these results, recall that each estimated coefficient represents a marginal effect on a log-odds ratio $\ln\left(\frac{P_{ji}}{P_{1i}}\right) \ \forall \ j = 2,3,4$. In the following, I briefly describe the results. Then, I discuss which of the hypotheses introduced in section 4.1.2 can be rejected on the basis of these results.

According to Wald tests of joint significance displayed at the end of table 4.4, a quadratic polynomial of the logarithm of the planned start-up investment affects the log-odds ratios $\ln\left(\frac{P_{2i}}{P_{1i}}\right)$, $\ln\left(\frac{P_{3i}}{P_{1i}}\right)$ and $\ln\left(\frac{P_{4i}}{P_{1i}}\right)$ significantly. The relative chances to receive one of the favorable subsidy modes 3 and 4 rather than mode 1 increase in start-up investment until the median and mean investment level, respectively. Then, the relative chances decrease slowly. At the maximal investment in the sample, the chances to receive subsidy mode 3 and 4 with high subsidized loan shares are still much higher than the chances for mode 1. The relative chance for mode 2 increases in start-up investment over the whole investment distribution. The impact of the equity share indicates structural differences between subsidy assignment in East and West Germany. For West German firms, Wald tests show that the equity share has a significant quadratic effect on the relative chances to receive mode 2, 3 and 4 rather than mode 1. The effects increase until beyond the 75-percent quartile of the West German equity share distribution. Then, they start to decrease and reach zero at equity share levels between

38 percent and 53 percent. For East German firms, Wald tests indicate joint significance of the quadratic effects on the log-odds ratios for mode 3 and 4. In contrast to what is observed for West Germany, the turning point of the effect on the log-odds ratio for mode 4 lies below the 75-percent quartile of the East German equity share distribution. The effect on the log-odds ratio for mode 3 is rising until the maximal equity share in the sample.

The number of entrepreneurs has a significant, positive effect on the log-odds ratio for mode 2. Wald tests of joint significance of the diversification indicators show that West German firms started in more than one 5-digit-sectors have a significantly higher chance for mode 2 and 4 than for mode 1. Hence, diversified firms as well as team start-ups tend to receive lower debt service rates than other firms. Compared to reference firms started as sole proprietorships or commercial partnerships, limited liability firms have significantly lower chances to receive modes 3 and 4 with high shares of subsidized loans relative to their chance for mode 1. The indicator for civil law associations remains always insignificant. Thus, the process of subsidy assignment differs not significantly between firms with different types of legal forms as long as these require at least one fully liable owner.

The indicator for entrepreneurs with a university degree in engineering has a significant, positive effect on the log-odds ratio for mode 2. By contrast, the indicator for entrepreneurs with other academic degrees has a significant, negative effect on the log-odds ratio for mode 4. The logarithm of the entrepreneur's age has a significant, quadratic effect on the log-odds ratio for mode 4. In case of mode 2, the age variables are individually significant, but fail to pass the 10-percent significance level in the Wald test of joint significance. The relative chances to receive mode 2 and 4 with low debt service rates rather than mode 1 increase initially in age and then decrease slightly. At the maximal age in the sample the chances to receive mode 2 and 4 are still higher than the chances for mode 1.

The indicator for start-ups in high technology industries has a negative effect on the log-odds ratios $\ln\left(\frac{P_{2i}}{P_{1i}}\right)$, $\ln\left(\frac{P_{3i}}{P_{1i}}\right)$ and $\ln\left(\frac{P_{4i}}{P_{1i}}\right)$ and is significant in case of mode 3 and 4. Accordingly, firms in high-technology industries have significant lower relative chances to receive mode 3 or 4 than firms in 3- or 4-digit low technology industries within the same 2-digit industry group. The significant coefficients of indicators for West German states indicate substantially lower log-odds ratios of West German firms for mode 2, 3, and 4 compared to East German firms in Saxony-Anhalt or Thuringia. The coefficients of the indicators for the East German states Brandenburg, Mecklenburg West-Pommerania and Saxony are always jointly insignificant.

Compared to firms having applied for DtA-loans via savings banks, customers of commercial banks have significantly higher chances to receive the favorable subsidy mode 3 relative to their chance for mode 1. West German customers of cooperative banks face a significantly lower log-odds ratio for mode 2. These results suggests bank-type specific assignment strategies.

The average day-to day interbank money rate in the month of firm formation is used to control

for the effect of prime rate fluctuations on subsidy assignment. The effect is always negative but only significant in case of mode 2. Thus, the relative chance for low rather than high debt service rates and low shares of subsidized loans decreases significantly if refinancing costs increase. But the relative chance to be chosen for mode 4 with high shares of subsidized loans and low debt service rates are not significantly affected by interest rate fluctuations and thus central bank policies.[46].

Finally, the vector of independent variables includes cohort- and industry-indicators to control for further time- and industry-specific effects. Several continuously measured regional variables are used to capture effects of agglomeration, unemployment and bank competition at the district level. The continuous, regional variables affect the log-odds ratios for mode 2 and 4 jointly at least at the 5-percent significance level. The cohort dummies as well as the industry dummies are always jointly significant.

Summing up, the discussed results indicate that assignment of different modes of federal start-up assistance in Germany depends on the planned project size, on other characteristics of the firm project, the entrepreneur, the bank relationship and the economic environment. The preferred assignment of high subsidies to East German firms is consistent with hypothesis H1.1 in section 4.1.2. H1.1 states that program assignment favors East German firms with a high risk of being financially constrained according to the main program objective. Moreover, most observed equity share effects reflect roughly the requirement for the EKH program. Thus, they are in line with hypothesis H1.3. However, this is not true in the case of mode 3 for East German firms. Moreover, the significant, negative coefficients of the indicator for high technology industries, the negative coefficients of the indicator for legal forms with limited liability, and the positive coefficients for diversified West German firms suggest that start-ups with reduced risks are more likely to receive favorable subsidy modes. Most importantly, the significant effects of project size and entrepreneur's age are positive over the whole sample population which cannot be reconciled with the first set of hypotheses, H1.1 and H1.2. Thus, several aspects of the assignment process are in line with the second set of hypotheses, H2.1 to H2.4. Since banks have a strong influence on the assigned subsidies, as already mentioned in section 4.1.2, the discussed evidence most likely suggests that banks offer more favorable financing conditions, and thus also higher DtA subsidies to start-ups with a low ex ante observable default risk.

4.4.2 Assignment probabilities, common support and balancing

To estimate treatment effects by applying the matching estimator described in section 4.2.2, I use the predicted assignment probabilities based on the estimated multinomial logit model in

[46]See (Deutsche Bundesbank 1992) for a related discussion.

table 4.4 as propensity score vector. Table 4.5 displays the correlation matrix of the predicted assignment probabilities. The correlation between the probabilities reflects the correlation of the covariates influencing the assignment decision. A strong negative correlation between the probability of assignment to subsidy mode 4 and the probability of assignment to mode 1 and to mode 2 can be observed. The correlation coefficient between the probabilities of receiving mode 3 and of receiving mode 2 is also large and negative. These results suggest substantial and systematic differences between firms with low subsidized loan shares (1 & 2) and those with high shares (3 & 4).

Table 4.5: Correlation Matrix of the Estimated Assignment Probabilities

	Assignment Probability			
Assignment Probability	$\hat{P}^1(X)$	$\hat{P}^2(X)$	$\hat{P}^3(X)$	$\hat{P}^4(X)$
$\hat{P}^1(X)$	1.00			
$\hat{P}^2(X)$	0.04	1.00		
$\hat{P}^3(X)$	-0.16	-0.44	1.00	
$\hat{P}^4(X)$	-0.68	-0.55	-0.11	1.00

Note: The predicted assignment probabilities are based on the estimated multinomial logit model summarized in table 4.4.

Applying a matching approach for evaluation requires, however, treatment groups that do not differ too much with respect to the covariates. Otherwise, an a-priori overlap of the group-specific probability distributions and a joint common support sufficiently large for estimation of treatment effects would not exist.[47] Table 4.6 indicates whether a sufficiently large common support can be expected here. The row for treatment group 1 shows at first the 5-percent, 50-percent and 95-percent quantiles of the predicted assignment probability $\hat{P}^1(X)$, then the respective quantiles of $\hat{P}^2(X)$, $\hat{P}^3(X)$ and $\hat{P}^4(X)$. The following rows refer to the treatment groups 2, 3 and 4. All four probabilities vary considerably within each group. Hence, firms within each treatment group are quite heterogeneous with respect to predicted probabilities and thus covariates. High heterogeneity within treatment groups is a necessary prerequisite for a sufficiently large common support. Here, 1,843 of 2,098 firms, i.e. 87.9 percent of all firms in the final sample belong to the joint common support calculated as described in step 3 of the estimation algorithm in section 4.2.2.

After having applied the matching procedure described in section 4.2.2, I tested for each pair of treatment group m and comparison group l whether both the groups are sufficiently similar with respect to the covariate vector X. High balancing of the covariate distributions is needed because insufficient balancing biases effect estimates. To investigate the achieved balancing

[47] See section 4.2 for details on the common support restriction.

Table 4.6: Descriptive Statistics for the Estimated Assignment Probabilities

	Quantiles of Assignment Probabilities in %											
	Assignment Probability											
	$\hat{P}^1(X)$			$\hat{P}^2(X)$			$\hat{P}^3(X)$			$\hat{P}^4(X)$		
Group	5%	50%	95%	5%	50%	95%	5%	50%	95%	5%	50%	95%
1	4	35	91	2	19	66	0.4	10	43	0.5	10	68
2	2	11	53	9	42	80	1	7	39	2	28	73
3	2	9	46	4	12	46	6	26	65	3	39	75
4	2	6	21	5	12	51	3	13	39	19	62	83

Note: The predicted assignment probabilities are based on the estimated multinomial logit model summarized in table 4.4.

of the groups paired for the estimation of θ^{ml} with $l, m \in \{1, \ldots, 4\}$ and $l \neq m$, I calculated the absolute bias of the propensity scores $\hat{P}^m(X)$ and $\hat{P}^l(X)$. The absolute bias is measured as the difference between the means of the propensity score in the treatment and the matched comparison group. For all 12 pairs the two bias measures are insignificant in two-sided t-tests and the balancing of the covariates is high.[48]

4.4.3 Effects of different subsidy modes

In this section, I compare the average effects of different start-up assistance modes on the short-, medium- and long-run survival chances of new firms founded between 1990 and 1993.

Tables 4.7, 4.8 and 4.9 exhibit the estimated average effects $\hat{\theta}^{ml}$ on the firm survival rate after 3, 4.5 and 6 years of market activity, respectively.[49] A positive estimate in row m and column l indicates a positive effect of subsidy mode m compared to mode l on the survival rate of firms randomly drawn from the sub-population of firms receiving mode m. The estimates are reported in absolute terms, i.e. an estimate of 1.00 indicates an increase of the survival rate by one percentage point. For example, the first entry in the row of table 4.7 with $m = 2$ should be read as follows: The survival rate in the firm population receiving subsidy mode 2 is 2.86 percentage points higher due to mode 2 than it would be if these firms had received mode 1. Recall that $\hat{\theta}^{ml}$ may differ from $\hat{\theta}^{lm}$ as $\hat{\theta}^{ml}$ is defined for the sub-population receiving subsidy mode m and $\hat{\theta}^{lm}$ for the sub-population receiving l. If all effect estimates in row m

[48] Note that in case of several pairs some weights calculated for comparison firms as described in step 4 in section 4.2.2 were trimmed to improve the balancing between the treatment and the comparison group.

[49] All estimation results are based on a simplifying assumption. I assume that all firms that do not exit the market during the observation period have duration spells that are right-censored on December 31, 1999 since this is the case for about 90 percent of all non-exiting firms in the sample.

Table 4.7: Estimated Average Short-run Effects on the Firm Survival Rate (3 Years after Start-up)

($\theta^{ml} := E(Y^m - Y^l \mid S = m)$, in %-points)
All Firms
(East German Firms; West German Firms)

m \ l	1	2	3	4
1		-1.56	5.21	-0.48
		(-0.06;-2.41)	(-1.99;8.95)	(0.00;-1.96)
2	2.86		1.18	4.02
	(-0.17;8.43*)		(-1.07;3.31)	(0.61;6.84)
3	-1.63	-1.70		1.10
	(0.48;-5.81)	(1.04;-9.94**)		(1.39;-9.75*)
4	2.45	-0.22	-0.51	
	(2.66;5.27)	(-0.31;-2.75)	(-2.19;3.30)	

Notes: The table shows weighted effects of different subsidy modes on the firm survival rate three years after start-up. All 1,843 (1,262 East German, 406 West German) firms in the general (East German, West German) common support are used. *** (**, *) indicates significance at the 1% (5%, 10%) significance level of a t-test statistic in a two-tailed test. The tested null hypothesis is equality of the means in the treatment group m and the weighted comparison group l.

are positive, firms in the sub-population receiving mode m have higher survival chances in the situation with treatment m than they would have in all possible counterfactual situations with treatment l where $l \neq m$. See, for example, the estimates referring to the whole sample in the row of table 4.7 with $m = 2$.

The $\hat{\theta}^{ml}$-estimates in tables 4.7, 4.8 and 4.9 for all sub-samples of East German firms indicate insignificant differences of the impacts of different subsidy modes on firm survival chances.[50] In most of these comparisons the survival rates of the treatment group and the matched comparison group differ by less than two percentage points. Since East German firms dominate the whole sample, nearly all estimates based on the whole sample of firms are also insignificant.

For West Germany, however, several results suggest higher positive short-run effects of strong capital cost subsidies than of weak capital cost subsidies.[51] Three years after market entry,

[50]To estimate effects in East Germany, I use the joint common support for the East German sub-sample based on the assignment probabilities derived from the multinomial logit estimation in table 4.4. 1,262 of all 1,521 East German firms (83.0 percent) are included. After having conducted the matching, I tested the achieved balancing quality. The absolute bias of $\hat{P}^m(X)$ and $\hat{P}^l(X)$ is neither significant nor sizable and the match quality with respect to variables in the covariate vector X is very high for all pairs.

[51]Estimates for West Germany are derived for the West German joint common support with 406 of all 577 West German firms (70.4 percent). Testing the balancing quality achieved by matching showed that the

Table 4.8: Estimated Average Medium-run Effects on the Firm Survival Rate (4.5 Years after Start-up)

($\theta^{ml} := E(Y^m - Y^l \mid S = m)$, in %-points)
All Firms
(East German Firms; West German Firms)

m \ l	1	2	3	4
1		-4.37**	-0.78	-3.53
		(-2.12;-5.73**)	(-4.44;1.73)	(-1.42;-2.66)
2	2.47		-1.65	4.09
	(1.86;8.63)		(-1.06;-0.92)	(1.39;9.51)
3	-0.51	-1.68		1.04
	(0.03;3.98)	(-0.70;-3.91)		(0.88;-5.88)
4	0.99	0.08	0.19	
	(1.41;5.40)	(-0.82;0.87)	(-1.28;-1.25)	

Notes: The table shows weighted effects of different subsidy modes on the firm survival rate 4.5 years after start-up. All 1,843 (1,262 East German, 406 West German) firms in the general (East German, West German) common support are used. *** (**, *) indicates significance at the 1% (5%, 10%) significance level of a t-test statistic in a two-tailed test. The tested null hypothesis is equality of the means in the treatment group m and the weighted comparison group l.

West German firms in the sub-population receiving low shares of subsidized loans and strongly subsidized capital costs (mode 2) have a significantly higher survival rate than they would have had with low shares of subsidized loans and weakly subsidized capital costs (mode 1). The tables 4.8 and 4.9 show medium- and long-run estimates $\hat{\theta}^{21}$ of a similar magnitude, but these estimates fail to pass the 10-percent significance level. The short-run estimates $\hat{\theta}^{32}$ and $\hat{\theta}^{34}$ are significantly negative. This indicates that firms in the sub-population receiving high shares of subsidized loans and weakly subsidized capital costs (mode 3) would have had significantly higher survival chances with strongly subsidized capital costs (mode 2 or 4).

In the medium and long run, the effect $\hat{\theta}^{12}$ becomes significant for the whole sample. Its negative sign indicates that firms receiving mode 1 with weakly subsidized capital costs and low shares of subsidized loans would have gained by receiving the counterfactual mode 2 with strongly subsidized capital costs and low shares of subsidized loans. Comparing the medium- and long-run effects above and below the diagonal for the whole sample suggests the following: the survival rate in the sample population could have been increased by assigning subsidy modes differently. In the long run, the survival chances of firms receiving mode 1 could have

absolute bias of $\hat{P}^m(X)$ and $\hat{P}^l(X)$ is never significant. However, in case of the treatment and comparison groups for the estimation of $\hat{\theta}^{14}$, $\hat{\theta}^{23}$, and $\hat{\theta}^{34}$ some important determinants of assignment and survival differ significantly.

Table 4.9: Estimated Average Long-run Effects on the Firm Survival Rate (6 Years after Start-up)

($\theta^{ml} := E(Y^m - Y^l \mid S = m)$, in %-points)
All Firms
(East German Firms; West German Firms)

m \ l	1	2	3	4
1		-4.25*	-2.60	-0.54
		(-0.56;-6.66**)	(-4.36;-0.28)	(-1.29;3.30)
2	0.35		-2.61	4.34
	(1.53;7.26)		(0.97;3.31)	(0.78;10.27)
3	0.67	0.08		7.56
	(1.86;2.07)	(2.91;-5.41)		(2.18;16.07)
4	3.37	0.51	-0.63	
	(5.56;-1.72)	(0.20;-4.22)	(-1.85;-7.94)	

Notes: The table shows weighted effects of different subsidy modes on the firm survival rate six years after start-up. All 1,843 (1,262 East German, 406 West German) firms in the general (East German, West German) common support are used. *** (**, *) indicates significance at the 1% (5%, 10%) significance level of a t-test statistic in a two-tailed test. The tested null hypothesis is equality of the means in the treatment group m and the weighted comparison group l.

been increased significantly by more than 4 percentage points if mode 2 had been assigned. This shift from mode 1 to mode 2 could have been financed by reducing the subsidies of some of those firms in the sample that would then still face similar survival chances according to the effect estimates below the diagonal.

4.4.4 A natural experiment

The causal interpretation of the effect estimates presented in section 4.4.3 depends crucially on the validity of the underlying identifying assumption, i.e. on random assignment conditional on covariates. Imposing this conditional independence assumption (CIA) is justified if all covariates simultaneously influencing subsidy assignment and firm survival are considered in the propensity score estimation. This can be questioned here since firms assigned to different subsidy modes may, for example, differ systematically with respect to business plan details or their access to collateral. If these characteristics which are unobserved here do also affect firm survival chances, then random assignment conditional on the observable covariates does not hold and effect estimates are biased.

The data used for this study cover a unique natural experiment in West Germany that can be used to check whether selection on unobservables matters, and thus whether imposing

CIA can be justified in the context at hand. The EKH program for West German firms was stopped in December 1991 and reintroduced in June 1994. Start-ups between 1990 and 1993 without EKH loans chose their financing and applied for DtA loans either while the EKH program was available or during the period of EKH interruption. Hence, two different groups of firms without EKH loans exist. The two groups will differ systematically if selection into different subsidy modes depends on unobservable variables that do affect firm survival chances as well. For example, if firms with lower unobservable risk were preferably selected for EKH loans, the pool of firms without EKH loans started when the program was available has a higher average risk than the pool of firms started during the period of program interruption.

To test whether selection on unobservables indeed causes systematic differences between the two firm groups just described I proceed as follows: First, I construct a matched comparison group using subsidized firms without EKH loans from the period during which the program existed in order to estimate the population effect $\hat{\gamma}^{ml}$ of EKH loans. Second, I construct a matched comparison group using subsidized firms from the period of program interruption in order to estimate the same effect. If the estimates turn out to be stable with respect to this change of comparison group or otherwise said if both the comparison groups have similar survival chances, selection on unobservables can not be shown to be important here. Hence, doubts related to the plausibility of CIA should be dispelled. This interpretation of the results is only valid if either interfering time-varying effects of business-cycle conditions at market entry on firm survival chances do not exist or can be controlled for since both comparison groups have to be drawn from two different time-periods. To control for such potentially existing business cycle effects I included the interbank money rate and the regional unemployment rate at market entry into the propensity score model estimated for the analysis in this section.[52]

For the experimental analysis, I split the sample of subsidized West German firms in May 1992. 70.3 percent of all those started until May 1992 receive EKH loans. In contrast, only 15.4 percent of those started in May 1992 or later obtain EKH. May 1992 and not December 1991 is chosen as splitting point since most start-ups apply for DtA loans before they actually start business due to program requirements. In both the period before and after May 1992 more than 70 percent of all firms without EKH belong to the group with subsidy mode 1. More than 90 percent of those with EKH belong to the groups with mode 2, 3 or 4. Thus, receiving no EKH loan roughly coincides with low subsidies and receiving an EKH loan corresponds to medium or high subsidies.

[52]The interbank money rate and the regional unemployment rate at market entry are considered to allow for a sufficient control. Cohort dummies are jointly insignificant in a probit model of the firm exit risk of non-subsidized West-German firms in the firm sample described in section 4.3.1 if the interbank money rate and the regional unemployment rate at market entry are included in the X-vector of the probit model in addition to other available entrepreneur- and firm-specific variables.

To derive the propensity score estimates needed for effect estimation I estimated a logit model using the sample with all subsidized West German start-ups, the indicator for EKH loans as endogenous variable and all exogenous variables discussed in section 4.4.1.[53] Then, the propensity score estimates derived from this logit model were used to construct a common support region. Moreover, they served for the construction of the two alternative comparison groups by propensity score matching as described in section 4.2.2. According to two-tailed t-tests, both comparison groups are well balanced to the treatment group with respect to the distribution of the covariate vector X. The effect estimates indicate no sizable differences between the estimates of the population effect $\hat{\gamma}^{ml}$ using different comparison groups. This is the case because the survival function of both comparison groups for the first six years after market entry are very similar. Using a log-rank test, the null hypothesis of equal survival functions cannot be rejected at any usual significance level (p-value=0.8177).[54] Summing up, I do not find support for the relevance of selection on unobservables. Hence, imposing the assumption of random assignment conditional on covariates for the identification of effect estimates seems justifiable in the context of this study.

4.5 Conclusions

Evaluation studies provided in chapter 3 of this thesis and in Almus and Prantl (2002) focus on the question whether federal start-up assistance in Germany has the intended effects of reducing capital constraints and increasing both, the survival chances and the growth performance of subsidized firms. Significant positive average effects of start-up assistance on firm survival and growth are found in Almus and Prantl (2002) by comparing survival and growth of subsidized and matched comparison firms. In chapter 3 of this thesis I show that subsidized firms invest significantly more shortly after the receipt of start-up loans than matched comparison firms without such loans. Moreover, the significant, positive effect on firm survival chances is found to be sizable and to persistent over time. Thus, start-up assistance provided by the DtA can be argued to fulfill an important condition for being a successful policy fostering start-up activity in Germany by relaxing capital constraints.

This chapter extends the existing evaluative evidence on federal start-up assistance in Germany by considering for the first time the heterogeneous capital cost subsidies accompanying the start-up loans. The main question raised is whether handing out start-up loans at highly subsidized capital costs implies on average higher firm survival chances than handing out

[53] Results of the logit estimation are not presented here because they do not add further insights to the discussion in section 4.4.1.

[54] See Kalbfleisch and Prentice (1980) for the standard version of the test. Since I used probability weights, a modified version of the standard test was applied.

weakly subsidized loans. To provide empirical evidence on that question, I applied a new microeconometric approach for handling treatment heterogeneity. It was introduced by Imbens (2000) and Lechner (2001a) and has so far only been used in evaluation studies addressing active labor market programs. A unique firm data set with credit file information on 2,098 firms started between 1990 and 1993 in all East and West German regions in the manufacturing, construction, and trade sectors as well as most service industries was available for this study. In this sample, start-up assistance assigned by the Deutsche Ausgleichsbank (DtA) is very heterogeneous. It differs substantially with respect to the share of external capital covered by subsidized loans and the level of subsidies on capital costs per Euro handed out.

The effect evaluation I provide consists of comparing the effects of different subsidy modes on the short-, medium- and long-run survival rate of newly founded firms while controlling for selective assignment. This comparison allows to identify additional effects on firm survival chances due to additional subsidies on capital costs. Answering this question is of interest for policy makers who decide upon the introduction and design of new programs and upon the adaptation or abolition of existing programs. Strong capital cost subsidies for West German start-ups are shown to have a significantly higher short-run effect on the firm survival rate three years after market entry than low capital cost subsidies would have had. In the medium and long run the effect estimates are of similar size but insignificant. For East German firms no sizable or significant short-, medium- or long-run differences between subsidy modes are observed. Consequently, it seems feasible to reduce the level of capital cost subsidies offered within the programs in East Germany without reducing the survival chances of the subsidized firms significantly. This result could be used as support for the views of Ragnitz (2000) or Sinn (1995, 2002) who call for a reduction of capital cost subsidies in East Germany. However, given that so far no other evaluation studies addresses this question in the context of German start-up assistance or any other similar program this policy conclusion might be too early. It might well be possible that high capital cost subsidies have other positive direct or indirect effects, for example on employment growth or innovative activity and successful implementation of innovations. Thus, further evaluation studies investigating the effects of capital cost subsidies on other important outcome variables are needed.

Using the microeconometric evaluation framework with heterogeneous treatments developed by Imbens (2000) and Lechner (2001a) for other applications is another important direction for further research. In most countries start-up financing for entrepreneurs or R&D subsidies are offered in multiple programs that differ with respect to the target population, the type of subsidy assigned and presumably also their effects on outcome variables. Moreover, many micro credit programs in transition and other low income countries use various incentive schemes like group-based lending, repayment-related loan extension, and collateral substitutes. Thus, empirical studies that evaluate and compare these different schemes are an interesting area of research.

Appendix A

Chapter 2

Tables

Table A.1: Definition of Variables and Descriptive Statistics

Variable	Definition	Mean/ Share	Standard Deviation
Continuous Firm and Human Capital Variables			
survival time	duration of market activity in days until liquidation or censoring date (at latest 31/12/1999)	2188.59	992.52
SIZE	number of employees incl. working owner persons	6.309	22.146
MEAN_AGE	mean age of the (owner-) managers (see notes)	37.300	9.023
Discrete Firm and Human Capital Variables			
bankruptcy liquidation	liquidation after bankruptcy filing during observation period until 12/31/1999	0.201	
voluntary liquidation	voluntary liquidation during observation period until 12/31/1999	0.195	
DIVERSIFIED	industry classifications in more than one 5-digit sector	0.286	
FRANCHISEE	franchisee	0.028	
ltd. liability & stock corp.	limited liability firm, stock company (GmbH, AG)	0.426	
civil law association	civil law association (GBR)	0.088	
commercial partnership	commercial partnership (KG, OHG)	0.013	
sole proprietorship	sole proprietorship (Einzelunternehmen, Gewerbebetrieb)	0.473	

continued on next page

continued from previous page

Variable	Definition	Mean/ Share	Standard Deviation
FULL_AFFIL	fully affiliated, i.e. completely owned by one firm	0.023	
PART_AFFIL	partly affiliated, i.e. one or more owner firms but not fully affiliated	0.074	
TEAM	more than one (owner-) manager	0.294	
EDUC_UNKNOWN	(team with) no recorded educational information	0.254	
LOW_EDUC	(team with) apprenticeships or low education	0.423	
MASTER_CRAFT	(team with) master craftsman degree(s)	0.086	
BUS_ADMIN	(team with) graduate degree(s) in business administration	0.024	
ENGINEERING	(team with) graduate degree(s) in engineering	0.099	
OTHER_GRADUATE	(team with) other graduate degree(s)	0.023	
GRAD_MIX	team with at least 2 different graduate degrees	0.012	
OTHER_MIX	team with 2 educational levels out of LOW_EDUC, MASTER_CRAFT or graduate degrees	0.079	
Industry Indicators			
manufacturing	manufacturing	0.117	
construction	construction	0.176	
wholesale & int. trade	wholesale and intermediate trade	0.126	
retail trade	retail trade	0.254	
transport & comm.	transport and communication	0.065	
services	services	0.263	
Cohort Indicators			
cohort 1990	firm formation in 1990	0.274	
cohort 1991	firm formation in 1991	0.261	
cohort 1992	firm formation in 1992	0.220	
cohort 1993	firm formation in 1993	0.246	
Continuous and Discrete Regional Variables			
POPUL_DENSITY	(# inhabitants/(square kilometer*1000)) in 1992 at district level	0.998	1.190
West Germany	firm location in West Germany	0.547	

Notes: The table displays non-weighted descriptive statistics for the sample of 13,767 firms. 65.7% of the firms in the sample have only one owner-manager and no firm affiliation such that the human capital variables refer to this person. Otherwise, the human capital variables refer to the team of owner-managers or managers. The population density information comes from the Bundesamt für Bauwesen und Raumordnung.

Table A.2: Competing Risk Model with Bankruptcy (B) and Voluntary Liquidation (V), Extended Sample

	East Germany		West Germany	
	B	V	B	V
Independent Variable	Coefficient (Robust Standard Error)			
TEAM	-0.161**	0.284***	-0.135**	0.321***
	(0.069)	(0.079)	(0.066)	(0.062)
FULL_AFFIL			-0.641***	0.073
			(0.196)	(0.208)
FULL_AFFIL_EAST	-0.109	0.597**		
	(0.242)	(0.250)		
FULL_AFFIL_WEST	-0.814***	-0.527		
	(0.236)	(0.367)		
PART_AFFIL			-0.348***	0.182*
			(0.101)	(0.107)
PART_AFFIL_EAST	-0.107	-0.140		
	(0.121)	(0.179)		
PART_AFFIL_WEST	-0.660***	-0.029		
	(0.155)	(0.180)		
ln(SIZE)	0.766***	-0.057	0.409***	-0.093**
	(0.102)	(0.039)	(0.079)	(0.039)
$\ln(SIZE)^2$	-0.121***		-0.083***	
	(0.022)		(0.020)	
DIVERSIFIED	0.063	0.150**	0.091	-0.028
	(0.067)	(0.064)	(0.065)	(0.059)
FRANCHISEE	-0.868***	-0.445**	-0.520**	-0.548***
	(0.229)	(0.181)	(0.254)	(0.193)
POPUL_DENSITY	0.124***	0.094***	0.033	0.037
	(0.037)	(0.035)	(0.030)	(0.027)
Wald-statistic (χ^2 (degrees of freedom))				
Size Variables	75.81 (2)***	2.15 (1)	28.40 (2)***	5.71 (1)**
Affiliation Indicators	28.26 (4)***	8.86 (4)*	20.67 (2)***	2.93 (2)
Cohort Indicators	39.81 (3)***	8.14 (3)**	2.08 (3)	18.56 (3)***
Industry Indicators	59.45 (18)***	97.50 (18)***	81.83 (18)***	102.20 (18)***
Location Indicators	5.80 (5)	12.38 (5)**	17.20 (10)*	8.01 (10)
Model	262.35 (36)***	173.13 (35)***	179.85 (39)***	164.80 (38)***
log Likelihood	-6072.69	-10394.38	-5775.93	-14575.12
# observations	7119		8676	

Notes: The table shows the estimation results of Cox proportional hazard-rate models for East and West Germany using the sample with 15,795 firms. As the data records of 2,028 firms in this sample contain no human capital information, all human capital variables (incl. age variables) used for the regressions in table 2.2 are excluded here. Reference firms in East (West) Germany have the following characteristics: one owner-manager, no firm affiliations, no diversified firm-concept, no franchise contract, cohort 1990, retail trade industry, Saxony-Anhalt (North Rhine-Westphalia). *** (**, *) indicates that the coefficient or the coefficients differ significantly from zero at the 1% (5%, 10%) significance level.

Table A.3: Competing Risk Model with Bankruptcy (B) and Voluntary Liquidation (V), Reduced Sample

	East Germany		West Germany	
	B	V	B	V
Independent Variable	Coefficient (Robust Standard Error)			
EDUC_UNKNOWN	-0.182	-0.004	-0.066	-0.072
	(0.122)	(0.092)	(0.109)	(0.077)
MASTER_CRAFT	-0.671***	-0.248	-0.415**	-0.596***
	(0.159)	(0.163)	(0.167)	(0.173)
BUS_ADMIN	-0.376	0.043	-0.562**	-0.091
	(0.279)	(0.268)	(0.269)	(0.249)
ENGINEERING	-0.516***	-0.432***	-0.521***	-0.013
	(0.134)	(0.159)	(0.187)	(0.196)
OTHER_GRADUATE	-0.339	0.183	-0.880***	0.219
	(0.287)	(0.231)	(0.286)	(0.219)
MEAN_AGE	-0.006	-0.087***	-0.011**	-0.042*
	(0.005)	(0.030)	(0.005)	(0.023)
$MEAN\_AGE^2$		0.001***		0.001*
		(0.000)		(0.000)
ln(SIZE)	1.061***	-0.004	0.443***	-0.100**
	(0.134)	(0.051)	(0.113)	(0.056)
$\ln(SIZE)^2$	-0.174***		-0.062*	
	(0.032)		(0.034)	
DIVERSIFIED	0.022	0.149*	0.031	0.026
	(0.100)	(0.085)	(0.091)	(0.077)
FRANCHISEE	-0.644**	-0.376*	-0.530	-0.572**
	(0.300)	(0.228)	(0.342)	(0.240)
POPUL_DENSITY	0.093*	0.047	0.046	-0.035
	(0.053)	(0.049)	(0.045)	(0.036)
Wald-statistic (χ^2 (degrees of freedom))				
Size Variables	78.94 (2)***	0.01 (1)	27.72 (2)***	3.86 (1)**
Age Variables	1.31 (1)	9.78 (2)***	5.25 (1)**	3.48 (2)
Education Indicators	25.33 (5)***	10.09 (5)*	23.09 (5)***	13.65 (5)**
Cohort Indicators	8.75 (3)**	7.26 (3)*	1.41 (3)	7.96 (4)**
Industry Indicators	20.75 (18)	45.88 (18)***	55.69 (18)***	59.39 (18)***
Location Indicators	1.32 (5)	13.59 (5)**	12.48 (5)	7.86 (10)
Model	153.69 (37)***	116.06 (37)***	137.88 (42)***	135.63 (42)***
log Likelihood	-2607.61	-5755.58	-2607.56	-8042.04
# observations	4040		5010	

Notes: The table shows the estimation results of Cox proportional hazard-rate models for East and West Germany using the sample with 9,050 firms owned and managed by one entrepreneur and not affiliated to other firms. Thus, the indicators for teams, firm affiliations or heterogeneous teams contained in the regressions in table 2.2 are not used here. Reference firms in East (West) Germany have the following characteristics: owner-manager with apprenticeship or some other type of low education, no diversified firm-concept, no franchise contract, cohort 1990, retail trade industry, Saxony-Anhalt (North Rhine-Westphalia). *** (**, *) indicates that the coefficient or the coefficients differ significantly from zero at the 1% (5%, 10%) significance level.

Appendix B

Chapter 3

B.1 Matching procedure

Nearest neighbor matching on the balancing score with replacement was conducted as follows:

1. Specify and estimate a binary choice model to obtain an estimate of the propensity score. Use the sample of all treated and potential comparison firms for estimation. Apply a weighted maximum likelihood estimator as proposed by Manski and Lerman (1977) to account for outcome-based sampling of the data (see section 3.4.1).

2. Construct the balancing score vector $\left[x'\hat{\beta}, v\right]$ by using the predicted unbounded propensity score $x'\hat{\beta}$ and the vector v of all particularly important components of X.[1]

3. Determine the common support $\hat{\hat{\chi}}$ by deleting all treated firms from the sample for which $x'\hat{\beta}$ is larger than the maximum of $x'\hat{\beta}$ in the group of potential comparison firms.[2]

4. Choose firm j in the treatment group with $j = 1, ..., N^t$ and remove it from that group.

5. Find the firm in the group of potential comparison firms that is closest to firm j in terms of the balancing score vector. To do this, compute for each firm k in the comparison group with $k = 1, ..., N^p$ the following distance to firm j:

   $d_{jk} = \left(x_j'\hat{\beta}, v_j\right)' - \left(x_k'\hat{\beta}, v_k\right)' \qquad \forall \quad k = 1, ..., N^p$

   Then compute for each firm combination the Mahalanobis distance measure

   $MD_{jk} = d_{jk}' Cov^{-1} d_{jk} \qquad \forall \quad k = 1, ..., N^p$

[1] The linear index $x'\hat{\beta}$ is used instead of the bounded propensity score $\Phi\left(x'\hat{\beta}\right)$. Otherwise, using the symmetric metric introduced in step 4 would have implied undesired asymmetry (Lechner 1999).

[2] The support region for the group of potential comparison firms can be assumed to be compact since figure 3.2 indicates no holes within the support region.

where Cov is the estimated variance-covariance matrix of $\left[x'\hat{\beta}, v\right]$ in the group of potential comparison firms. Choose firm k with the smallest Mahalanobis distance, i.e. the nearest neighbor to firm j as its matched comparison firm. Do not remove k from the group of potential comparison firms such that it can be used again.

6. Repeat steps 4 and 5 until no firm in the treatment group is left.

7. Check the balancing quality achieved by the conducted matching. If necessary, refine the specification of the program assignment model and repeat steps 2-6.

B.2 Merge of data bases

The data set used for the empirical analysis combines information from two large data bases. Firm data for a stratified random sample of 22,000 firms is taken from the ZEW East and West German firm panels. Information on start-up assistance comes from the internal DtA data base on loan approvals.[3] The information about each loan approval is collected at the moment of loan application and includes the name, address, and birth date of the applying person or firm. This information was used to connect the DtA database and the firm sample.[4]

At first, two temporary data bases were generated. The first one consisted of all 490,211 unique combinations of loan applicant name, birth date and address information in the DtA data base. The other one contained all 410,655 unique combinations of firm or firm owner name, birth date of the owner and address information in the firm sample. Here, all birth date corrections as well as name and address changes recorded by Creditreform between 1990 and 1999 were taken into account.

Then, all entries in the temporary data bases were compared one by one using a computer based search algorithm. It determined the degree of coincidence between firm or owner names, birth dates, street names, location names, and ZIP codes by means of a heuristic comparison procedure. A measure indicating the degree of coincidence between 0 and 100 percent was assigned to each pair of compared entries. Coincidence of words occurring frequently in the DtA data base increased the measure less than coincidence of rarely occurring ones. Coincidence of names (birth dates, streets, locations, ZIP codes) increased the measure at most by a value of 40 (25, 10, 13, 12). A value of 100 was assigned if two compared entries coincided perfectly.

Finally, all pairs with a coincidence value of at least 50 were linked together. Of all these links, 10,297 links could be used without further inspection because the assigned coincidence

[3] In section 3.2.2, I mentioned that the DtA refuses a small number of applications per year. However, information on these cases is not available in encoded form and thus can not be used here.

[4] Due to data protection rules the data bases were merged within the DtA headquarter.

measure indicated perfect coincidence of firm or owner name, birth date, and location name or more than one address criteria. 30,944 links were checked by hand in order to separate wrong links from those with a low coincidence value due to typing errors, spelling differences, or identifiable street name and ZIP code changes occurring mainly in East Germany after unification.

According to the remaining checked links, 2,721 of all 17,589 start-ups between January 1, 1990 and December 31, 1993 received start-up assistance in the firm formation year or the subsequent year. They received altogether 6,229 start-up loans. The number of start-up loans is that high because the majority of subsidized firms received equity capital assistance and at least one loan in the EPR or DtA business start-up program. The distribution of loans over time and federal states in the sample reflects the distribution in the parent population of the DtA data base closely. Moreover, the mean loan amount in the East and West German sample and population change in a similar way over time. Inconsistent links resulting from connecting one loan to more than one firm concerned only 96 of all 17,589 start-ups. Altogether, the computerized, heuristic comparison procedure and extensive manual checking led to a very reliable merge between both data bases.

Table B.1: Construction of the Final Sample

	# Exclusions	# Firms
Size of the stratified random sample:		22,000
Exclusion of firms...		
... started before January 1, 1990, holding companies, part-time projects, and legally dependent firm units:	4,411	
... with missings or inconsistencies in basic firm variables:	2,001	
... not eligible for start-up assistance, i.e. firms with full firm affiliations or owners all being older than 55 years:	788	
... with initially more than 50 employees since such firms are likely to be undetected dependent start-ups not eligible for start-up assistance:	167	
... participating in small DtA programs not evaluated here:	105	
... with inconsistent links to the DtA data base (see appendix B.2):	79	
... without owner age information:	1,825	
Size of the final sample:		12,624

Notes: In the table all exclusion restrictions are listed in the order they were applied.

Table B.2: Definition of Variables and Descriptive Statistics

Variable	Definition	Mean/ Share	Standard Deviation
Continuous Firm and Entrepreneur Characteristics			
size	number of employees incl. working owner persons after receipt of start-up assistance	5.5325	8.8016
capital intensity	Euro amount invested in tangible assets per employee after receipt of start-up assistance	16244.75	27380.36
survival time	duration of market activity in days until liquidation or censoring date	2197.53	992.23
team size	number of managing owners	1.3461	0.6191
age	age of the managing owner (see notes)	37.5050	9.1324
Discrete Firm and Entrepreneur Characteristics			
subsidized	start-up assistance within the firm formation year or the subsequent year	0.1791	
survival status	survival until end of observation period (12/31/1999)	0.6035	
diversified	industry classifications in more than one 5-digit sector	0.2814	
franchisee	franchisee	0.0292	
ltd. liability & stock corp.	limited liability firm, stock company (GmbH, AG)	0.3961	
civil law association	civil law association (GBR)	0.0917	
commercial partnership	commercial partnership (KG, OHG)	0.0137	
sole proprietorship	sole proprietorship (Einzelunternehmen, Gewerbebetrieb)	0.4986	
firm affiliation	partly affiliated, i.e. at least one owner is a firm but not all owners	0.0647	
female	female managing owner (see notes)	0.1217	
education unknown	no educational information recorded (see notes)	0.2875	
apprenticeship	apprenticeship or low education (see notes)	0.4443	
master craftsman	master craftsman (see notes)	0.1003	
business administration	graduate degree in business administration (see notes)	0.0295	
engineering	graduate degree in engineering (see notes)	0.1107	
other academic degrees	other graduate degrees (see notes)	0.0276	

continued on next page

continued from previous page

Variable	Definition	Mean/ Share	Standard Deviation
Cohort Indicators			
cohort 1990	firm formation in 1990	0.2737	
cohort 1991	firm formation in 1991	0.2642	
cohort 1992	firm formation in 1992	0.2167	
cohort 1993	firm formation in 1993	0.2455	
Industry Indicators			
manufacturing	manufacturing	0.1110	
construction	construction	0.1740	
wholesale & int. trade	wholesale and intermediate trade	0.1229	
retail trade	retail trade	0.2611	
transport & comm.	transport and communication	0.0654	
services	services	0.2658	
high technology	industries with average R&D intensity (real R&D expenditures/real sales)$>$ 3.5%	0.0760	
Continuous and Discrete Regional Variables			
unemployment rate	unemployment rate at district level in firm formation year (see notes)	10.6228	5.3059
population density	(# inhabitants/(square kilometer*1000)) in 1992 at district level	0.9976	1.1887
bank office density	((# bank offices*1000) / # inhabitants in 1992) at district level (see notes)	0.7060	0.4469
West Germany	firm location in West Germany	0.5611	

Notes: The table contains the definitions of the main variables used and non-weighted descriptive statistics for the sample of 12,624 firms. The capital intensity variable is only available for 10,991 firms. All variables are measured at firm formation except otherwise stated in the table or these notes. Entrepreneur-specific variables refer to the managing owner with the highest equity share if the firm has more than one managing owner. In cases with multiple managing owners, but missing share data the entrepreneur-specific information of the oldest managing owner was chosen instead. Unemployment rates are taken from the statistics of the Bundesanstalt für Arbeit. Since East German unemployment rates for 1990 and 1991 are not available, the earliest available monthly unemployment rate, measured in May 1992, is used for East German start-ups in 1990 and 1991. In all other cases I use the unemployment rate in September of the firm formation year. The population density information for 1992 comes from the Bundesamt für Bauwesen und Raumordnung. The Deutsche Bundesbank provided bank office information. The numbers of bank offices in West German districts were recorded in December 1990, the East German numbers in December 1991.

Appendix C

Chapter 4

Table C.1: Definition of Variables and Descriptive Statistics

Variable	Definition	Mean/ Share	Standard Deviation
Continuous Firm and Entrepreneur Characteristics			
survival time	duration of market activity in days until liquidation or censoring date	2465.76	839.68
start-up investment	planned start-up investment in 1000 Euro	219.76	357.34
equity share	percentage(equity financing/start-up investment)	10.264	8.084
subsidized loan share	percentage(subsidized loan amount/non-equity financing)	70.454	21.811
debt service rate	average annual rate of debt service, i.e. average of interest payments and repayments on subsidized loans during the first three years in percent	7.360	4.426
EKH share	percentage(EKH loan amount/subsidized loan amount)	33.572	26.225
interbank money rate	average day-to-day interbank money rate in the firm formation month in percent	8.585	0.793
team size	number of managing owners	1.379	0.660
age	age of the managing owner (see notes)	37.81	8.386
Discrete Firm and Entrepreneur Characteristics			
subsidy mode 1	subsidized loan share $\leq 69\%$ and debt service rate $> 7.9\%$	0.169	
subsidy mode 2	subsidized loan share $\leq 69\%$ and debt service rate $\leq 7.9\%$	0.238	
subsidy mode 3	subsidized loan share $> 69\%$ and debt service rate $> 7.9\%$	0.177	

continued on next page

continued from previous page

Variable	Definition	Mean/ Share	Standard Deviation
subsidy mode 4	subsidized loan share $> 69\%$ and debt service rate $\leq 7.9\%$	0.417	
survival status	survival until end of observation period (12/31/1999)	0.697	
commercial bank	house bank is a commercial bank	0.377	
cooperative bank	house bank is a cooperative bank	0.259	
savings bank	house bank is a savings bank	0.364	
diversified	industry classifications in more than one 5-digit sector	0.279	
franchisee	franchisee	0.044	
ltd. liability & stock corp.	limited liability firm, stock company (GmbH, AG)	0.357	
civil law association	civil law association (GBR)	0.088	
commercial partnership	commercial partnership (KG, OHG)	0.025	
sole proprietorship	sole proprietorship (Einzelunternehmen, Gewerbebetrieb)	0.530	
firm affiliation	partly affiliated, i.e. at least one owner is a firm but not all owners	0.045	
female	female managing owner (see notes)	0.151	
apprenticeship	apprenticeship, low or no recorded education (see notes)	0.600	
master craftsman	master craftsman (see notes)	0.171	
business administration	graduate degree in business administration (see notes)	0.033	
engineering	graduate degree in engineering (see notes)	0.175	
other academic degrees	other graduate degrees (see notes)	0.021	
Cohort Indicators			
cohort 1990	firm formation in 1990	0.236	
cohort 1991	firm formation in 1991	0.340	
cohort 1992	firm formation in 1992	0.266	
cohort 1993	firm formation in 1993	0.158	
Industry Indicators			
manufacturing	manufacturing	0.173	
construction	construction	0.226	
wholesale & int. trade	wholesale and intermediate trade	0.089	
retail trade	retail trade	0.310	
transport & comm.	transport and communication	0.051	
services	services	0.150	
high technology	industries with average R&D intensity (real R&D expenditures/real sales)$> 3.5\%$	0.069	

continued on next page

continued from previous page

Variable	Definition	Mean/ Share	Standard Deviation
Continuous and Discrete Regional Variables			
unemployment rate	unemployment rate at district level in firm formation year (see notes)	13.191	5.542
population density	(# inhabitants/square kilometer) in 1992 at district level	621.43	933.86
bank office density	((# bank offices * 1000) / # inhabitants in 1992) at district level (see notes)	0.858	0.546
West Germany	firm location in West Germany	0.275	

Notes: The table contains the definitions of the main variables used and non-weighted descriptive statistics for the sample of 2,098 firms. Variables are measured at firm formation or loan application except otherwise stated in the table or these notes. Entrepreneur-specific variables refer to the managing owner with the highest equity share if the firm has more than one managing owner. In cases with multiple managing owners, but missing share data the entrepreneur-specific information of the oldest managing owner was chosen instead. Unemployment rates are taken from the statistics of the Bundesanstalt für Arbeit. Since East German unemployment rates for 1990 and 1991 are not available, the earliest available monthly unemployment rate, measured in May 1992, is used for East German start-ups in 1990 and 1991. In all other cases I use the unemployment rate in September of the firm formation year. The population density information for 1992 comes from the Bundesamt für Bauwesen und Raumordnung. The Deutsche Bundesbank provided bank office information. The numbers of bank offices in West German districts were recorded in December 1990, the East German numbers in December 1991.

Bibliography

Agarwal, R., and D. B. Audretsch, 1999, "The Two Views of Small Firms in Industry Dynamics: A Reconciliation," *Economic Letters*, 62, 245–251.

Agarwal, R., and D. B. Audretsch, 2001, "Does Entry Size Matter? The Impact of the Life Cycle and Technology on Firm Survival," *Journal of Industrial Economics*, 49, 21–43.

Almus, M., 2001, "Evaluating the Impact of Public Start-up Assistance - Results from an Econometric Approach," ZEW-Discussion Paper 01-23, Mannheim.

Almus, M., D. Engel, and S. Prantl, 2000, "The "Mannheim Foundation Panels" of the Centre for European Economic Research (ZEW)," ZEW-Dokumentation 00-02, Mannheim.

Almus, M., and S. Prantl, 2002, "Die Auswirkungen öffentlicher Gründungsförderung auf das Überleben und Wachstum junger Unternehmen," *Jahrbücher für Nationalökonomie und Statistik*, 222, 161–185.

Almus, M., S. Prantl, J. Brüderl, K. Stahl, and M. Woywode, 2001, "Die Mannheimer Gründerstudie - Konzeption und Erhebung," ZEW-Dokumentation 01-01, Mannheim.

Angrist, J. D., 1998, "Estimating Labor Market Impact of Voluntary Military Service Using Social Security Data," *Econometrica*, 66, 249–288.

Angrist, J. D., G. W. Imbens, and D. B. Rubin, 1996, "Identification of Causal Effects Using Instrumental Variables," *Journal of the American Statistical Association*, 91, 444–472.

Angrist, J. D., and A. B. Krueger, 1999, "Empirical Strategies in Labor Economics," in: Ashenfelter, O., and D. Card (eds.), *Handbook of Labor Economics*, III A, chap. 23, 1277–1366, North-Holland, Amsterdam.

Audretsch, D. B., 1991, "New-Firm Survival and the Technological Regime," *Review of Economics and Statistics*, 73, 441–450.

Audretsch, D. B., 1995, *Innovation and Industry Evolution*, MIT Press, Cambridge, MA.

Audretsch, D. B., and T. Mahmood, 1995, "New Firm Survival: New Results Using a Hazard Function," *Review of Economics and Statistics*, 77, 97–103.

Baden-Fuller, C. W. F., 1989, "Exit from Declining Industries and the Case of Steel Castings," *Economic Journal*, 99, 949–961.

Baldwin, J. R., and M. Rafiquzzaman, 1995, "Selection versus Evolutionary Adaptation: Learning and Post-Entry Performance," *International Journal of Industrial Organization*, 13, 501–522.

Bates, T., 1990, "Entrepreneur Human Capital Inputs and Small Business Longevity," *Review of Economics and Statistics*, 72, 551–559.

Bates, T., 1995, "A Comparison of Franchise and Independent Small Business Survival Rates," *Small Business Economics*, 7, 377–388.

Battistin, E., A. Gavosto, and E. Rettore, 2001, "Why Do Subsidized Firms Survive Longer? An Evaluation of a Program Promoting Youth Entrepreneurship in Italy," in: Lechner, M., and F. Pfeiffer (eds.), *Econometric Evaluations of Active Labour Market Policies in Europe*, ZEW Economic Studies 13, 153–181, Physica, Heidelberg.

Beesley, M. E., and R. T. Hamilton, 1984, "Small Firms' Seedbed Role and the Concept of Turbulence," *Journal of Industrial Economics*, 33, 217–229.

Berger, A. N., and G. F. Udell, 1995, "Relationship Lending and Lines of Credit in Small Firm Finance," *Journal of Business*, 68, 351–381.

Berger, A. N., and G. F. Udell, 1998, "The Economics of Small Business Finance: The Roles of Private Equity and Debt Markets in the Financial Growth Cycle," *Journal of Banking and Finance*, 22, 613–673.

Berger, P. G., and E. Ofek, 1995, "Diversification's Effect on Firm Value," *Journal of Financial Economics*, 37, 39–65.

Besanko, D., and A. V. Thakor, 1987, "Collateral and Rationing: Sorting Equilibria in Monopolistic and Competitive Credit Markets," *International Economic Review*, 28, 671–689.

Bester, H., 1985, "Screening vs. Rationing in Credit Markets with Imperfect Information," *American Economic Review*, 75, 850–855.

Bester, H., 1987, "The Role of Collateral in Credit Markets with Imperfect Information," *European Economic Review*, 31, 887–899.

Bester, H., 1994, "The Role of Collateral in a Model of Debt Renegotiation," *Journal of Money, Credit, and Banking*, 26, 72–86.

Birch, D. L., 1979, *The Job Generation Process*, M.I.T. Studies on Neighbourhood and Regional Change, Cambridge, MA.

Blanchflower, D. G., and A. J. Oswald, 1998, "What Makes an Entrepreneur?," *Journal of Labor Economics*, 16, 26–60.

Breitenacher, M., G. Illing, E. Langmantel, A. Städler, L. Uhlmann, H. Klandt, S. Kirchhoff, J. Struck, and B. Manstedten, 1994, "Gesamtwirtschaftliche Wirkungen der Existenzgründungspolitik sowie Entwicklung der mit öffentlichen Mitteln - insb. Eigenkapitalhilfe - geförderten Unternehmnsgründungen," ifo Institut für Wirtschaftsforschung, München, and Betriebswirtschaftliches Institut für empirische Gründungs- und Organisationsforschung, Universität Dortmund: ifo studien zur finanzpolitik, 56.

Brixy, U., and S. Kohaut, 1999, "Employment Growth Determinants in New Firms in Eastern Germany," *Small Business Economics*, 13, 155–170.

Brodaty, T., B. Crépon, and D. Fougère, 2001, "Using Matching Estimators to Evaluate Alternative Youth Employment Programs: Evidence from France, 1986-1988," in: Lechner, M., and F. Pfeiffer (eds.), *Econometric Evaluations of Active Labour Market Policies in Europe*, ZEW Economic Studies 13, 85–123, Physica, Heidelberg.

Brüderl, J., P. Preisendörfer, and R. Ziegler, 1992, "Survival Chances of Newly Founded Business Organizations," *American Sociological Review*, 57, 227–242.

Brüderl, J., P. Preisendörfer, and R. Ziegler, 1993, "Staatliche Gründungsfinanzierung und der Erfolg neugegründeter Betriebe," *Jahrbücher für Nationalökonomie und Statistik*, 212, 13–32.

Bulow, J. I., and J. B. Shoven, 1978, "The Bankruptcy Decision," *Bell Journal of Economics*, 9, 437–456.

Busom, I., 2000, "An Empirical Evaluation of the Effects of R&D Subsidies," *Economics of Innovation and New Technology*, 9, 111–148.

Cabral, L., 1995, "Sunk Costs, Firm Size and Firm Growth," *Journal of Industrial Economics*, 43, 161–172.

Caves, R. E., 1998, "Industrial Organization and New Findings on the Turnover and Mobility of Firms," *Journal of Economic Literature*, 36, 1947–1982.

Caves, R. E., and M. E. Porter, 1977, "From Entry Barriers to Mobility Barriers: Conjectural Decisions and Contrived Deterrence to New Competition," *Quarterly Journal of Economics*, 91, 241–262.

Cox, D., and D. Oakes, 1984, *Analysis of Survival Data*, Chapman and Hall, London.

Cox, D. R., 1972, "Regression Models and Life Tables (with discussion)," *Journal of the Royal Statistical Society*, B 34, 187–220.

Cox, D. R., 1975, "Partial Likelihood," *Biometrika*, 62, 269–276.

Cramer, J., and G. Ridder, 1991, "Pooling States in the Multinominal Logit Model," *Journal of Econometrics*, 47, 267–272.

Cressy, R., 1996a, "Are Business Startups Debt-Rationed?," *Economic Journal*, 106, 1253–1270.

Cressy, R., 1996b, "Commitment Lending Under Assymmetric Information: Theory and Test on U.K. Startup Data," *Small Business Economics*, 8, 397–408.

Cressy, R., and C. Olofsson, 1997, "The Financial Conditions for Swedish SMEs: Survey and Research Agenda," *Small Business Economics*, 9, 179–194.

David, P. A., B. H. Hall, and A. A. Toole, 2000, "Is Public R&D a Complement or Substitute for Private R&D? A Review of the Econometric Evidence," *Research Policy*, 29, 497–529.

Davis, S. J., J. C. Haltiwanger, and S. Schuh, 1996, *Job Creation and Destruction*, MIT Press, Cambridge, MA.

De, D., F. Kaufmann, P. Niederbach, and S. Wimmers, 1995, "Gründungsförderung in Europa," Insitut für Mittelstandsforschung, Nr. 108, Bonn.

Dehejia, R. H., and S. Wahba, 1998, "Propensity Score Matching Methods for Nonexperimental Causal Studies," NBER Working Paper 6829.

Dehejia, R. H., and S. Wahba, 1999, "Causal Effects in Nonexperimental Studies: Reevaluating the Evaluation of Training Programmes," *Journal of the American Statistical Association*, 94, 1053–1062.

Deily, M. E., 1991, "Exit Strategies and Plant-Closing Decisions: The Case of Steel," *RAND Journal of Economics*, 22, 250–263.

Deutsche Ausgleichsbank, 2000, *DtA-Förderreport - 10 Jahre DtA-Förderung 1990-1999*, Bonn.

Deutsche Bundesbank, 1990-2000, "Monatsberichte, Zinssätze," August 1990-2000, Volumes 42-52.

Deutsche Bundesbank, 1991, "Wirtschaftsförderung in den neuen Bundesländern," *Monatsberichte der Deutschen Bundesbank*, 43, 15–26.

Deutsche Bundesbank, 1992, "Zinssubventionen und sonstige Finanzierungshilfen im geeinten Deutschland," *Monatsberichte der Deutschen Bundesbank*, 44, 22–29.

Dunne, T., M. J. Roberts, and L. Samuelson, 1988, "Patterns of Firm Entry and Exit in US Manufacturing Industries," *RAND Journal of Economics*, 19, 495–515.

Dunne, T., M. J. Roberts, and L. Samuelson, 1989, "The Growth and Failure of U.S. Manufacturing," *Quarterly Journal of Economics*, 104, 671–698.

Dyck, I. J. A., 1997, "Privatization in Eastern Germany: Management Selection and Economic Transition," *American Economic Review*, 87, 565–597.

Economist, 2001, "The EBRD's Second Decade," April 28th, 2001.

Eisenhardt, K. M., J. L. Kahwajy, and L. J. Bourgeois, 1997, "Conflict and Choices: How Top Management Teams Disagree," *California Management Review*, 39, 42–62.

Eisenhardt, K. M., and C. B. Schoonhoven, 1990, "Organizational Growth: Linking Founding Team, Strategy, Environment, and Growth among U.S. Semiconductor Ventures, 1978-1988," *Administrative Science Quarterly*, 35, 504–528.

Elsas, R., and J. P. Krahnen, 1998, "Is Relationship Lending Special? Evidence from Credit-File Data in Germany," *Journal of Banking and Finance*, 22, 1283–1316.

Elsas, R., and J. P. Krahnen, 2000, "Collateral, Default Risk, and Relationship Lending: An Empirical Study on Financial Contracting," Goethe-University Frankfurt, mimeo.

Ericson, R., and A. Pakes, 1995, "Markov-Perfect Industry Dynamics: A Framework for Empirical Work," *Review of Economic Studies*, 62, 53–82.

Evans, D. S., and B. Jovanovic, 1989, "An Estimated Model of Entrepreneurial Choice under Liquidity Constraints," *Journal of Political Economy*, 97, 808–827.

Evans, D. S., and L. S. Leighton, 1989, "Some Empirical Aspects of Entrepreneurship," *American Economic Review*, 79, 519–535.

Filer, R. K., and J. Hanousek, 2002, "Research Data from Transition Economies," *Journal of Economic Perspectives*, 16, 225–240.

Frank, M. Z., 1988, "An Intertemporal Model of Industrial Exit," *Quarterly Journal of Economics*, 103, 333–344.

Freixas, X., and J.-C. Rochet, 1998, *Microeconomics of Banking*, MIT Press, Cambridge, MA, 1 edn.

Frölich, M., 2000, "Nonparametric Covariate Adjustment: Pair-matching versus Local Polynomial Matching," Discussion Paper 2000-17, Department of Economics, St. Gallen.

Frölich, M., A. Heshmati, and M. Lechner, 2000, "A Microeconometric Evaluation of Rehabilitation of Long-Term Sickness in Sweden," Discussion Paper 2000-04, Department of Economics, St. Gallen.

Fujii, E. T., and C. B. Hawley, 1991, "Empirical Aspects of Self-Employment," *Economic Letters*, 36, 323–329.

Gerfin, M., and M. Lechner, 2002, "Microeconometric Evaluation of the Active Labour Market Policy in Switzerland," *Economic Journal*, 112, 854–893.

Geroski, P. A., 1991, "Some Data-Driven Reflections on the Entry Process," in: Geroski, P. A., and J. Schwalbach (eds.), *Entry and Market Contestability: An International Comparison*, Basil Blackwell, Cambridge, MA.

Geroski, P. A., 1995, "What Do We Know About Entry?," *International Journal of Industrial Organization*, 13, 421–440.

Gertner, R., and D. Scharfstein, 1991, "A Theory of Workouts and the Effect of Reorganization Law," *Journal of Finance*, 46, 1189–1222.

Gimeno, J., T. B. Folta, A. C. Cooper, and C. Y. Woo, 1997, "Survival of the Fittest? Entrepreneurial Human Capital and the Persistence of Underperforming Firms," *Administrative Science Quarterly*, 42, 750–783.

Gompers, P. A., and J. Lerner, 1999, *The Venture Capital Cycle*, MIT Press, Cambridge, MA.

Gorton, G., and J. Kahn, 2000, "The Design of Bank Loan Contracts," *Review of Financial Studies*, 13, 331–364.

Grambsch, P. M., and T. M. Therneau, 1994, "Proportional Hazards Tests and Diagnostics Based on Weighted Residuals," *Biometrika*, 81, 515–526.

Greene, W. H., 2000, *Econometric Analysis*, Prentice Hall, New York, 4 edn.

Ham, J. C., and R. J. LaLonde, 1996, "The effect of Sample Selection and Initial Conditions in Duration Models: Evidence from Experimental Data on Training," *Econometrica*, 64, 175–205.

Harhoff, D., and T. Körting, 1998a, "How Many Creditors Does It Take to Tango?," mimeo, Centre for European Economic Research, Mannheim.

Harhoff, D., and T. Körting, 1998b, "Lending Relationships in Germany - Empirical Evidence from Survey Data," *Journal of Banking and Finance*, 22, 1317–1353.

Harhoff, D., K. Stahl, and M. Woywode, 1998, "Legal Form, Growth and Exit of West German Firms - Empirical Results for Manufacturing, Construction, Trade and Service Industries," *Journal of Industrial Economics*, 46, 453–488.

Harhoff, D., and F. Steil, 1997, "Die ZEW-Gründungspanels: Konzeptionelle Überlegungen und Analysepotential," in: Harhoff, D. (ed.), *Unternehmensgründungen - Empirische Analysen für die alten und neuen Bundesländer* , 11–28, Nomos, Baden-Baden.

Häsemeyer, L., 1998, *Insolvenzrecht*, Carl Heymanns Verlag, Köln.

Hausman, J., and D. McFadden, 1984, "Specification Tests for the Multinominal Logit Model," *Econometrica*, 52, 1219–1239.

Hax, H., 1985, "Economic Aspects of Bankruptcy Law," *Journal of Institutional and Theoretical Economics*, 141, 80–98.

Heckman, J. J., H. Ichimura, J. Smith, and P. Todd, 1998, "Characterizing Selection Bias Using Experimental Data," *Econometrica*, 66, 1017–1098.

Heckman, J. J., H. Ichimura, and P. Todd, 1997, "Matching as an Econometric Estimator: Evidence from Evaluating a Job Training Programme," *Review of Economic Studies*, 64, 605–654.

Heckman, J. J., H. Ichimura, and P. Todd, 1998, "Matching as an Econometric Evaluation Estimator," *Review of Economic Studies*, 65, 261–294.

Heckman, J. J., R. J. LaLonde, and J. A. Smith, 1999, "The Economics and Econometrics of Active Labor Market Programs," in: Ashenfelter, O., and D. Card (eds.), *Handbook of Labor Economics*, III A, chap. 31, 1865–2097, North-Holland, Amsterdam.

Hesselman, S., and U. Stefan, 1990, "Sanierung und Zerschlagung insolventer Unternehmen - Betriebswirtschaftliche Überlegungen und empirische Ergebnisse," *Schriften zur Mittelstandsforschung*, 39 NF, Verlag Poeschel, Stuttgart.

Hinz, T., and S. H. Wilsdorf, 1999, "Das Scheitern von Betriebsgründungen in den neuen Ländern," in: Bögenhold, D., and D. Schmidt (eds.), *Eine neue Gründerzeit?* , 263–281, Verlag Fakultas, Amsterdam.

Hinz, T., and R. Ziegler, 2001, "Employment Effects of Newly Founded Businesses in East Germany," in: Riphahn, R. T., D. J. Snower, and K. F. Zimmermann (eds.), *Employment Policy in Transition - The Lessons of German Integration for the Labor Market* , chap. 4, 103–124, Springer, Berlin, Heidelberg.

Holland, P. W., 1986, "Statistics and Causal Inference," *Journal of the American Statistical Association*, 81, 945–970, (incl. comments by Cox, Granger, Glymour, Rubin, and reply by Holland).

Holtz-Eakin, D., D. Joulfaian, and H. S. Rosen, 1994a, "Entrepreneurial Decisions and Liquidity Constraints," *RAND Journal of Economics*, 25, 334–347.

Holtz-Eakin, D., D. Joulfaian, and H. S. Rosen, 1994b, "Sticking It Out: Entrepreneurial Survival and Liquidity Constraints," *Journal of Political Economy*, 102, 53–75.

Honjo, Y., 2000, "Business Failure of New Firms: An Empirical Analysis Using a Multiplicative Hazards Model," *International Journal of Industrial Organization*, 18, 557–574.

Hubbard, R. G., 1998, "Capital Market Imperfections and Investment," *Journal of Economic Literature*, 36, 193–225.

Hudson, J., 1986, "An Analysis of Company Liquidations," *Applied Economics*, 18, 219–235.

Hudson, J., 1987, "The Age, Regional, and Industrial Structure of Company Liquidations," *Journal of Business, Finance & Accounting*, 14, 199–213.

Hutchinson, R. W., 1995, "The Capital Structure and Investment Decisions of the Small Owner-Managed Firm: Some Exploratory Issues," *Small Business Economics*, 7, 231–239.

Imbens, G. W., 2000, "The Role of Propensity Score Estimating Dose-Response Functions," *Biometrika*, 87, 706–710.

Jovanovic, B., 1982, "Selection and the Evolution of Industry," *Econometrica*, 50, 649–670.

Jovanovic, B., 1993, "The Diversification of Production," *Brookings Papers on Economic Activity: Microeconomics*, 1993, 197–247.

Kalbfleisch, J. D., and R. L. Prentice, 1980, *The Statistical Analysis of Failure Time Data*, John Wiley & Sons, New York.

Klette, T., J. Møen, and Z. Griliches, 2000, "Do Subsidies to Commercial R&D Reduce Market Failure? - Microeconometric Evaluation Studies," *Research Policy*, 29, 471–495.

Lach, S., 2002, "Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel," *Journal of Industrial Economics*, 50, 369–390.

Lafontaine, F., and K. L. Shaw, 1999, "The Dynamics of Franchise Contracting: Evidence from Panel Data," *Journal of Political Economy*, 107, 1041–1080.

Larsson, L., 2002, "Evaluating Social Programs: Active Labor Market Policies and Social Insurance," IFAU - Institute for Labour Market Policy Evaluation, Dissertation Series 2002:1.

Lawrence, B. S., 1997, "The Black Box of Organizational Demography," *Organization Science*, 8, 1–22.

Lechner, M., 1999, "Earnings and Employment Effects of Continuous Off-the-Job Training in East Germany after Unification," *Journal of Business & Economic Statistics*, 17, 74–90.

Lechner, M., 2000, "An Evaluation of Public Sector Sponsored Continuous Off-the-Job Training in East Germany after Unification," *Journal of Human Resources*, 35, 347–375.

Lechner, M., 2001a, "Identification and Estimation of Causal Effects of Multiple Treatments under the Conditional Independence Assumption," in: Lechner, M., and F. Pfeiffer (eds.), *Econometric Evaluations of Active Labour Market Policies in Europe*, ZEW Economic Studies 13, 43–58, Physica, Heidelberg.

Lechner, M., 2001b, "A Note on the Common Support Problem in Applied Evaluation Studies," University of St. Gallen, mimeo.

Lechner, M., 2002a, "Programme Heterogeneity and Propensity Score Matching: An Application to the Evaluation of Active Labour Market Policies," *Review of Economics and Statistics*, 84, 205–220.

Lechner, M., 2002b, "Some Practical Issues in the Evaluation of Heterogeneous Labour Market Programmes by Matching Methods," *Journal of the Royal Statistical Society-Series A*, 165, 59–82.

Lehmann, E., and D. Neuberger, 2001, "Do Lending Relationships Matter?," *Journal of Economic Behavior & Organization*, 45, 339–359.

Lerner, J., 1999, "The Government as Venture Capitalist: The Long-Run Impact of the SBIR Program," *Journal of Business*, 72, 285–318.

Lerner, J., 2002, "When Bureaucrats meet Entrepreneurs: The Design of Effective Public Venture Capital Programmes," *Economic Journal*, 112, F73–F84.

Lessat, V., J. Hemer, T. Eckerle, M. Kulicke, G. Licht, E. Nerlinger, M. Steiger, and F. Steil, 1999, *Beteiligungskapital und technologieorientierte Unternehmensgründungen: Markt, Finanzierung, Rahmenbedingungen*, Gabler, Wiesbaden.

Li, J., and S. Guisinger, 1990, "Comparative Business Failures of Foreign-controlled Firms in the United States," *Journal of International Business Studies*, 22, 209–224.

Liebermann, M. B., 1990, "Exit from declining industries: "Shakeout" or "Stakeout"?," *RAND Journal of Economics*, 21, 538–554.

Lin, D. Y., and L. J. Wei, 1989, "The Robust Inference for the Cox Proportional Hazards Model," *Journal of the American Statistical Association*, 84, 1074–1078.

Lindh, T., and H. Ohlsson, 1996, "Self-Employment and Windfall Gains: Evidence from the Swedish Lottery," *Economic Journal*, 106, 1515–1526.

Machauer, A., and M. Weber, 1998, "Bank Behavior Based on Internal Credit Ratings of Borrowers," *Journal of Banking and Finance*, 22, 1355–1383.

Maddala, G., 1983, *Limited-Dependent and Qualitative Variables in Econometrics*, Cambridge University Press, Cambridge, MA, 1 edn.

Manski, C. F., and S. R. Lerman, 1977, "The Estimation of Choice Probabilities from Choice Based Samples," *Econometrica*, 45, 1977–1988.

Manski, C. F., and D. McFadden, 1981, *Structural Analysis of Discrete Data with Econometric Applications*, MIT Press, Cambridge, MA.

Mata, J., and P. Portugal, 1994, "Life Duration of New Firms," *Journal of Industrial Economics*, 42, 227–245.

Mata, J., P. Portugal, and P. Guimarães, 1995, "The Survival of New Plants: Start-up Conditions and Post-Entry Evolution," *International Journal of Industrial Organization*, 13, 459–481.

May-Strobl, E., and M. Paulini, 1994, "Die Entwicklung junger Unternehmen in den neuen Bundesländern," *Schriften zur Mittelstandsforschung*, 62 NF, Verlag Poeschel, Stuttgart.

McKernan, S.-M., 2002, "The Impact of Microcredit Programs on Self-employment Profits: Do Noncredit Program Aspects Matter?," *Review of Economics and Statistics*, 84, 93–115.

Meager, N., 1996, "From Unemployment to Self-employment: Labour Market Policies for Business Start-up," in: Schmid, G., J. O'Reilly, and K. Schömann (eds.), *International Handbook of Labour Market Policy and Evaluation* , chap. 16, 489–519, Edward Elgar, Cheltenham, U.K. and Lyme, N.H.

Mills, D. E., and L. Schumann, 1985, "Industry Structure with Fluctuating Demand," *American Economic Review*, 75, 758–767.

Morduch, J., 1998, "Does Microfinance Really Help the Poor? New Evidence from Flagship Programs in Bangladesh," mimeo, Harvard University and Stanford University.

Morduch, J., 1999, "The Microfinance Promise," *Journal of Economic Literature*, 37, 1569–1614.

Nguyen, P. v., U. Kaiser, and F. Laisney, 2000, "The Performance of German Firms in the Business-related Service Sectors: A Dynamic Analysis," ZEW-Discussion Paper 00-32, Mannheim.

Pakes, A., and R. Ericson, 1998, "Empirical Implications of Alternative Models of Firm Dynamics," *Journal of Economic Theory*, 79, 1–45.

Petersen, M. A., and R. G. Rajan, 1994, "The Benefits of Lending Relationships: Evidence from Small Business Data," *Journal of Finance*, 49, 3–37.

Petersen, M. A., and R. G. Rajan, 1995, "The Effect of Credit Market Competition on Lending Relationships," *Quarterly Journal of Economics*, 110, 407–442.

Petersen, M. A., and R. G. Rajan, 1997, "Trade Credit: Theories and Evidence," *Review of Financial Studies*, 10, 661–691.

Petersen, T., 1995, "Analysis of Event Histories," in: Arminger, G., C. C. Clogg, and M. E. Sobel (eds.), *Handbook of Statistical Modeling of the Social and Behavioral Sciences* , chap. 9, 453–517, Plenum Press, New York and London.

Pfeiffer, F., and F. Reize, 2000, "Business Start-ups by the Unemployed - An Econometric Analysis Based on Firm Data," *Labour Economics*, 7, 629–663.

Phillips, B. D., and B. A. Kirchhoff, 1989, "Formation, Growth and Survival; Small Firm Dynamics in the U.S. Economy," *Small Business Economics*, 1, 65–74.

Pitt, M. M., 1998, "Reply to Jonathan Morduch's 'Does Microfinance Really Help the Poor? New Evidence from Flagship Programs in Bangladesh'," mimeo, Brown University.

Pitt, M. M., and S. R. Khandker, 1998, "The Impact of Group-Based Credit Programs on Poor Households in Bangladesh: Does the Gender of Participants Matter?," *Journal of Political Economy*, 106, 958–996.

Prantl, S., 1997, "Die Kausalitätsbegriffe von Granger/Sims und Rubin: Theoretischer Zusammenhang und praktische Relevanz," mimeo, Universität Mannheim.

Ragnitz, J., 2000, "Die Zukunft der Ost-Förderung," *Wirtschaftsdienst*, 2000/IV, 225–229.

Roland Berger Forschungs-Institut, 1995, "Effizienzanalyse öffentlicher Wirtschaftsförderung anhand einer Repräsentativbefragung von kleinen und mittleren Unternehmen in den neuen Bundesländern - Bedeutung, Einfluss und Wirkung der ERP-Förderung," Gutachten erstellt im Auftrag des Bundesministeriums für Wirtschaft.

Rose, D. C., 1992, "Bankruptcy Risk, Firm-Specific Managerial Human Capital and Diversification," *Review of Industrial Organization*, 7, 65–73.

Rosenbaum, P. R., and D. B. Rubin, 1983, "The Central Role of the Propensity Score in Observational Studies for Causal Effects," *Biometrika*, 70, 41–55.

Roy, A. D., 1951, "Some Thoughts on the Distribution of Earnings," *Oxford Economic Papers*, 3, 135–146.

Rubin, D. B., 1974, "Estimating Causal Effects of Treatments in Randomized and Nonrandomized Studies," *Journal of Educational Psychology*, 66, 688–701.

Rubin, D. B., 1977, "Assignment of Treatment Group on the Basis of a Covariate," *Journal of Educational Statistics*, 2, 1–26.

Rubin, D. B., 1980, "Discussion of 'Randomisation Analysis of Experimental Data in the Fisher Randomization Test' by D. Basu," *Journal of the American Statistical Association*, 75, 591–593.

Rubin, D. B., 1986, "Discussion of 'Statistics and Causal Inferencc' by Paul W. Holland," *Journal of the American Statistical Association*, 81, 961–962.

Rubin, D. B., 1990, "Formal Modes of Statistical Interference for Causal Effects," *Journal of Statistical Planning and Inference*, 25, 279–292.

Rubin, P. H., 1978, "The Theory of the Firm and the Structure of the Franchise Contract," *Journal of Law & Economics*, 21, 223–233.

Sachverständigenrat, 2000/2001, *Chancen auf einen höheren Wachstumspfad*, Sachverständigenrat zur Begutachtung der Gesamtwirtschaftlichen Entwicklung, Metzler-Poeschel, Stuttgart.

Schary, M. A., 1991, "The Probability of Exit," *RAND Journal of Economics*, 22, 339–353.

Scherer, F. M., and D. Ross, 1990, *Industrial Market Structure and Economic Performance*, Houghton Mifflin Company, Boston, MA, 3 edn.

Schiantarelli, F., 1996, "Financial Constraints and Investment: A Critical Survey of the International Evidence," *Oxford Review of Economic Policy*, 12, 70–89.

Schoar, A. S., 2002, "Effects of Corporate Diversification on Productivity," *Journal of Finance*, 57, 2379–2403.

Sinn, H.-W., 1995, "Staggering Along: Wages Policy and Investment Support in East Germany," *Economics of Transition*, 3, 403–426.

Sinn, H.-W., 2002, "Germany's Economic Unification: An Assessment After Ten Years," *Review of International Economics*, 10, 113–128.

Small, K. A., and C. Hsiao, 1985, "Multinominal Logit Specification Tests," *International Economic Review*, 26, 619–627.

Sobel, M. E., 1995, "Causal Inference in the Social and Behavioral Sciences," in: Arminger, G., C. C. Clogg, and M. E. Sobel (eds.), *Handbook of Statistical Modeling for the Social and Behavioral Sciences* , 1–38, Plenum Press, New York.

Steil, F., 1997, "Unternehmensgründungen in Ostdeutschland," in: Harhoff, D. (ed.), *Unternehmensgründungen - Empirische Analysen für die alten und neuen Bundesländer* , 29–72, Nomos, Baden-Baden.

Stiglitz, J. E., and A. Weiss, 1981, "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, 71, 393–410.

Storey, D., and P. Wynarczyk, 1997, "The Survival and Non Survival of Micro Firms in the UK," *Review of Industrial Organization*, 11, 209–229.

Storey, D. J., 1994a, "The Role of Legal Status in Influencing Bank Financing and New Firm Growth," *Applied Economics*, 26, 129–136.

Storey, D. J., 1994b, *Understanding the Small Business Sector*, Routledge, London.

Sutton, J., 1997, "Gibrat's Legacy," *Journal of Economic Literature*, 35, 40–59.

Taylor, M., 2001, "Self-Employment and Windfall Gains in Britain: Evidence from Panel Data," *Economica*, 68, 539–565.

Taylor, M. P., 1999, "Survival of the Fittest? An Analysis of Self-Employment Duration in Britain," *Economic Journal*, 109, C140–C155.

Toivanen, O., and P. Niininen, 2000, "Investment, R&D, Subsidies and Credit Constraints," Helsinki School of Economics, mimeo.

Troske, K. R., 1996, "The Dynamic Adjustment Process of Firm Entry and Exit in Manufacturing and Finance, Insurance, and Real Estate," *Journal of Law & Economics*, 39, 705–735.

Verbeek, M., 2000, *A Guide to Modern Econometrics*, John Wiley and Sons, Chichester.

Wagner, J., 1994, "The Post-Entry Performance of New Small Firms in German Manufacturing Industries," *Journal of Industrial Economics*, 62, 141–154.

Wagner, W. G., J. Pfeffer, and C. A. O'Reilly, 1984, "Organizational Demography and Turnover in Top-Management Groups," *Administrative Science Quarterly*, 29, 74–92.

Wallsten, S. J., 2000, "The Effects of Government-Industry R&D Programs on Private R&D: The Case of the Small Business Innovation Research Program," *RAND Journal of Economics*, 31, 82–100.

Welch, I., 1997, "Why is Bank Debt Senior? A Theory of Asymmetry and Claim Priority Based on Influence Costs," *Review of Financial Studies*, 10, 1203–1236.

White, M. J., 1989, "The Corporate Bankruptcy Decision," *Journal of Economic Perspectives*, 3, 129–151.

Winer, B., D. Brown, and K. Michels, 1991, *Statistical Principles in Experimental Design*, McGraw-Hill, New York, NY, 3 edn.