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Abstract

In this paper, we report results of an ongoing empirical analysis of firm dynamics in East Germany. After discussing specifics of a newly available data set with information on more than 100.000 firms, we analyze patterns of business starts and failures. Furthermore, we present preliminary results on employment, revenue and labor productivity growth in East German firms. They suggest that large East German enterprises are characterized by significant labor shedding and small or no nominal revenue growth, resulting in an apparently impressive gain in labor productivity. Small firms turn out to be the carriers of employment growth. On average, they experience the highest revenue growth rates. However, the combination of revenue and employment growth yields labor productivity increases well below those of larger firms.

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1. Introduction

At the time of German reunification in July 1990, it was widely believed by foreign and German observers that the integration of East Germany into the relatively successfully operating West German economy would be swift. Though a few dissenting voices warned against too much optimism, German unification was widely expected to kindle an economic boom comparable to the post-war "economic miracle," thus rendering the financing of the adjustment processes a rather trivial task. But by the end of 1990, it had become painfully clear to even the most optimistic (or naive) forecasters that rebuilding the East German economy would take much longer, and would constitute a much greater financial burden than assumed previously (Sinn 1991).

Franz (1993) has listed a number of reasons why the optimistic scenario was not realized - and given a realistic assessment - never should have been expected to occur in the first place. Clearly, a particularly important aspect of the initial underestimation of the problems ahead was the lack of precise information regarding the productivity of the East German economy at large and its conglomerate enterprises in particular. While several East German enterprises were producing products exported to the West until the time of unification, they did so within a completely different wage and price system, and thus it was difficult to assess their productivity. After privatization by the Treuhand corporation, the capability of the newly emerging organizations to prevail in a competitive market and to produce goods within a competitive price system sold profitably in national and international markets, has been subjected to a rigorous test with well known damaging impacts. The virtual disappearance of formerly well-established product markets in other East-Block countries has had an additional devastating effect on the survival chances of many of these enterprises.

Prior to the fall of the Iron Curtain, the East German economy was characterized by two particularly important features. On one hand, most sectors of the East German economy were dominated by large nationally owned combines, accounting for the lion's share of employment. Privatization and restructuring of these giant enterprises has become one of the major tasks for the management of the transition process. The second characteristic of the East German economy was the socialist government's attempt - more systematic and successful than in most other socialist countries - to discourage and eventually minimize any form of private enterprise. The recreation of a culture of small and medium sized enterprises that was forced away during the era between WW II and 1989 is thus the second (and no less important) prerequisite for a successful economic restructuring of East Germany.

The first task as performed by the semi-public Treuhand Corporation has led to considerable labor shedding. Thus, the recovery of the East German labor market must come to a large extent from the emergence of new firms. Nonetheless, popular

attention on economic affairs in East Germany concentrates on the privatization aspect, largely because it is handled exclusively by the highly visible Treuhand Corporation. Much less discussed is the evolution of small and medium sized businesses in East Germany not administered by the Treuhand Corporation.

Presumably, another major reason for the somewhat unbalanced discussion has been the paucity of information regarding the state of newly formed enterprises. While some data have been collected and analyzed based on registrars of business starts and discontinuations (May-Strobl et al. 1992), these data reflect only the intention to start a business. Moreover, there are only weak incentives to report a discontinuation, so these are likely to be underreported.¹ Other data were collected in a survey by the official statistical offices at the end of 1990 and have been used to estimate the number of self-employed in the East German workforce (Institut für Weltwirtschaft 1992a). In another survey conducted by the DIW (Deutsches Institut für Wirtschaftsforschung), data on approximately 6,500 manufacturing enterprises were collected between May and September of 1992 (Institut für Weltwirtschaft 1992b). While useful for the respective purposes, these data sources are nonetheless not sufficient to analyze the development of enterprises in Eastern Germany in any comprehensive way.

With this paper we attempt to reduce the existing information gap by presenting and analyzing newly available data assembled for commercial purposes by Creditreform, the largest German credit rating agency. To the best of our knowledge, this is the most comprehensive firm-level data base currently available for East Germany. In our analysis, we describe first the sectoral distribution of various cohorts of newly emerging firms and business failures. Furthermore, we analyze the development of employment, revenue and labor productivity in existing firms.

Our main results are as follows. The intersectoral distribution of newly founded firms in East Germany remained remarkably stable during the first years after the fall of the Iron Curtain, and - with the exception of a much lower share of new firms in the service sector - was quite similar to the one observed for West Germany. That similarity did not extend to the distribution of firm failures with respect to firm size: In contrast to stylized facts observed for Western countries, the likelihood of an insolvency in East Germany increases in firm size. This descriptive result is confirmed by a statistical analysis of firm survival. Among other results, our analysis also reveals a strong negative influence of firm size on employment and nominal revenue growth. However, the combination of both effects leads to a positive relationship between firm size and labor productivity growth (defined as revenue per capita). It is important to note that the apparently impressive productivity gains made by larger

¹ The registration of a business in the official registrar is relatively inexpensive and may well serve to achieve monetary benefits such as reductions in taxable income etc. Furthermore, once a business has failed, there are no opportunity costs involved in not reporting the failure. Hence, registrar data tend to overestimate the true number of new businesses and to underestimate the number of business failures or liquidations.

firms are almost exclusively based on labor shedding rather than revenue growth. In the short run, this development is unavoidable, especially for firms still under Treuhand auspices. However, labor shedding and lack of revenue growth tend to continue well beyond the date of privatization of large enterprises.

The remainder of the paper is organized as follows. In its next section, we briefly present the context to which entrepreneurs were exposed during the first phase of economic restructuring in Eastern Germany. The following section 3 contains a description of the data base. The major part of our description and analysis is contained in section 4. We conclude in section 5 with a condensation of our results, and with plans and suggestions for further research.

2. The Context for Firm and Employment Dynamics in East Germany

It appears obvious that towards a stable evolution of the labor market in the five East German states, a large portion of the jobs formerly offered by the state owned conglomerates must be replaced by jobs offered in newly formed firms. Taking the West German situation as a benchmark, at least 30 per cent of all jobs should be offered by the self-employed, including their dependent employees.² This is an extremely conservative estimate, as the larger share of limited liability firms (GmbHs) is headed by the owners themselves. Thus the percentage of employees working in these enterprises should be added to the more conservative figure.

By contrast, the self-employed played virtually no role in the economic system of the German Democratic Republic (GDR). Including assisting family members, the proportion of self employed was a mere 2.1 per cent, and their dependent employees added to this as little as 2.2 per cent. In fact, private entrepreneurial activity was actively discouraged by several measures. First of all, a large number of private businesses were expropriated between 1949 and 1972. In order to appreciate the order of magnitude of these expropriations, observe that effective March 31, 1992, some 50 700 applications had been filed towards the restitution of original property rights (May-Strobl et al. 1992). While these applications also include those filed by Jewish citizens expropriated by the Nazis between 1933 and 1945, the vast majority reflects expropriations under the former GDR government. Second, restrictions were imposed on the remaining private entrepreneurs' trade in intermediate products. Third, the self employed could hire only up to ten employees. Fourth, their investment possibilities were administratively restricted. And finally, an excessive 90 percent tax on profits effectively curtailed the incentive towards self employment.

These restrictions were eased right after the breakdown of the wall in November 1989. Already in December 1989, the regulation on the maximal number of employ-

² According to the 1987 Microcensus, 8.9 percent of the West German labor force were self employed with two dependent employees on average; an additional two percent were assisting family members.

ees was lifted, and tax allowances were introduced, in particular for assisting family members. Both, freedom of trade and a reduction in maximum taxes applicable to the crafts and the trades down to 60 percent were granted by the GDR parliament in March 1990. In anticipation of the agreement of May 18, 1990 leading to the economic and monetary union with West Germany, the number of new private enterprises increased steadily from December 1989 on.

Business starts in East Germany were subsidized by West German sources from early on after the fall of the Iron Curtain. Already in 1990, some 38 000 business starts were subsidized by the German Settlement Bank (Deutsche Ausgleichsbank, DtA) with a credit volume of DM 3.1 billion drawn from a federal aid program and the European Recovery Program component on business starts. Since the inception of the programs for the five East German states until the end of 1992, the DtA had granted subsidized loans to some 213.000 starts with a credit volume totalling DM 20 billion. The DtA maintains that the jobs offered by these businesses increased by 400.000 during 1992, and will amount to some 1.4 million jobs by the end of 1993. It also expects 1993 sales by these businesses at a level of DM 100 billion. About 50 per cent of the 1992 credit volume was granted to starts in manufacturing and the crafts. More than 50 per cent of the credit was extended to firms in Sachsen and Thüringen (Deutsche Ausgleichsbank 1993).

Also of great help in fostering business starts were the efforts waged by the West German business and crafts associations in assisting in the creation of similar institutions in the new East German states. However, up to today there are still strong impediments against the formation of private business in the East German states relative to the West German ones. Most important obstacles are the large number of property restitution processes still unsettled, and the very disadvantageous state of development of the public infrastructure. May-Strobl et al. (1992) estimate that by March 31, 1992 only 8.000 out of 50.700 applications towards the restitution of enterprises were settled to date. By the same date, the Treuhand Corporation had sold some 6.600 firms (or parts thereof) to private investors, and closed some 1.350 firms out of a total of 11.600 firms in its stock.

3. The Data Base

As mentioned before, the data used in this paper originate with Creditreform (Verband der Vereine Creditreform, VVC). Since 1989, Creditreform has been supplying data on West German enterprises to a research group located at the University of Mannheim and the ZEW (Centre for European Economic Research) towards studies on the dynamics of private sector employment. Originally, the data covered about 12.000 West German firms. These data are drawn from the Creditreform data base in intervals of approximately six months, and are used to generate a firm panel for a

long-term study of employment dynamics in Germany.³

Once it became apparent in 1990 that the East German political and economic system was doomed, Creditreform extended its data gathering efforts to East Germany. Since then, the Mannheim team has been given access to all available data on firms in East Germany. Firm data were extracted from the Creditreform data base in September 1991, in March 1992, and finally in October 1992. While the data have been used previously to describe the sectoral composition of firm births and demographic characteristics of East German entrepreneurs⁴ as well as to characterize firm growth in a stylized way⁵, this paper constitutes the first comprehensive analysis of the data set that also includes the most recent data.

In order to understand the estimation issues arising in working with this particular type of data, it is helpful to describe the data collection process and the data structure in more detail. Typically, firms enter the Creditreform data for two possible reasons. First, a customer or supplier firm may want to inquire about the financial situation of the respective enterprise. Business transactions usually involve short-term credit extending after delivery between billing and payment. Credit may even be longer term if orders are relationship-specific in Williamson's (1975) sense. In such cases, firms have an interest to assure that their business partners are both willing and able to redeem the credit, and in particular that they are not in immediate danger of foreclosing.⁶

Second, credit rating agencies also gather information proactively, in particular by systematically recording publicly available information on new firms.⁷ Frequently, such data become available only after an initial time lag. It is quite likely that this lag is long in East Germany, as credit rating information services have been built up only after its integration. Therefore, we cannot consider the recorded number of business starts a meaningful indicator of that component of economic development. However, we will report the sectoral composition of business starts and - with a similar disclaimer - the sectoral composition of firm failures in East Germany.

In the initial interview, VVC records information, specifically on the ownership structure of the firm, a 5-digit industry classification, the date of incorporation, legal status, management, current employment, current and past annual sales, and dates of incorporation of legal predecessors of the firm. The time of data entry is recorded together with these variables. If the information is updated at a later point, the re-

³ This panel database is described in more detail in Stahl (1991).

⁴ Harhoff (1992a, p. 11-14)

⁵ See Harhoff (1992b). The data set used in this paper was based on the first two waves of East German data. The main results described in the previous paper (especially with respect to firm size effects) are confirmed by the estimates presented here.

⁶ This raises the spectre that the selection process be systematically biased in favour of financially weak firms. However, fast-growing firms should also be of particular interest for credit rating agencies. In fact, the West German data base gathered by the same credit information agency is characterized by an average rate of insolvencies quite comparable to the insolvency rate reported in the official statistical records.

⁷ Creditreform uses several information sources in this context. The most important one is a data entry in the trade registrar (Handelsregister) which is compulsory for almost all of the larger and medium-sized firms.

spective date is again recorded with the data. Hence a change in the observed variables is recorded in our panel once a data set is extracted from the Creditreform database after the respective interview dates. Contrary to most panel data explicitly gathered for scientific purposes, the intervals between interviews are not fixed and can vary substantially. As it will turn out later, this has both drawbacks and advantages for the analysis. In particular, observing firms across variable intervals will allow us to perform a simple test with respect to the functional form of the growth relationship assumed below. For the purpose of this paper, we will assume that the intervals between interviews are exogenously given and do not display any biases.⁸ Creditreform does not delete entries from the database even when an enterprise is liquidated at some point. Naturally, the information that a firm is in financial trouble and ultimately insolvent is of particular importance to those interested in liquidity information.⁹

The various samples used in this paper constitute only part of the total East German data base. We required all firms to have at least one entry on firm size (in terms of number of employees) and a valid industry classification. Application of these criteria led to the selection of 101.941 firms. Of these, 76.851 firms also had (machine-readable) information on the date of incorporation. The latter subsample will be used to describe the sectoral composition of new firm-start-ups and of survival patterns. While we cannot as yet present a comprehensive analysis of all types of firm closures, we have information on insolvent firms that were forced to declare bankruptcy. Hence, our analysis can shed light on this type of firm failure in East Germany.¹⁰

For our exploration of employment dynamics, we further selected all 30.165 firms for which we could observe at least two interviews, with a time difference of at least two months between interviews. This restriction was necessary in order to compute a meaningful employment growth rate. Finally, there were 6.650 firms which had revenue and employment data for the years 1991 and 1992. These firms constitute our sample for the analysis of revenue and labor productivity growth.

4. Descriptive Statistics and Estimation Results

In this section of the paper we provide some descriptive data on new business starts and their survival chances in East Berlin and the five East German states covering the territory of the former German Democratic Republic (GDR). In particular, we

⁸ While it would be desirable to test whether selection for the second and for further interviews by Creditreform is subject to some form of bias, we have not undertaken this part of the analysis yet.

⁹ In principle, the Creditreform database contains several indicator variables for insolvencies and bankruptcies of various legal status. Under current law applying to East Germany, there is only one class of illiquidity resulting in legal foreclosure (Gesamtvollstreckungsverfahren).

¹⁰ Creditreform also reports simple liquidations without credit foreclosure. While this type of liquidation is the most common in West Germany (approximately 80 per cent of all liquidations do not involve credit foreclosure), its importance during the transformation process in the East is not clear yet.

provide data on the sectoral distribution of new firms and their survival rates. We then proceed to estimate a simple survival model in order to differentiate these effects in a multivariate setting. In section 4.2, we analyze the employment growth rates in the subsample of 30.165 firms described above. Finally, in section 4.3, we discuss the development of firm revenues from 1991 to 1992 in the subsample involving 6.650 firms. Having explored the development of employment and revenues enables us finally to comment in section 4.4 on the development of labor productivity in East German firms.

4.1 Business Starts and their Survival Chances

Table 4.1 records the distribution of new firm start-ups by sector¹¹ and time period since Jan. 1, 1990 and the sectoral distribution of firms founded prior to this date. Due to the fact that the Creditreform database may not be completely representative for the population of East German firms, the sectoral distributions described in Table 4.1 have to be interpreted carefully.¹² Nonetheless, they are likely to be comparable with the respective West German data from the same source.¹³ The basis for the East-West comparison is provided in Table 4.2.

Table 4.1
Distribution of East German Firms by Sector and Date of Incorporation

Date of Incorporation	Energy & Mining	Manufacturing	Construction	Trade	Transportation	Finance	Services	TOTAL
Prior to 1990	0.01%	28.9%	29.2%	26.7%	5.4%	0.03%	9.3%	100.0%
Jan. - June 90	0.4%	22.7%	17.4%	30.4%	8.1%	0.8%	20.3%	100.0%
July - Dec. 90	0.3%	18.0%	17.4%	37.4%	6.1%	1.8%	19.1%	100.0%
Jan. - June 91	0.3%	15.8%	16.8%	38.0%	5.6%	2.1%	21.2%	100.0%
July - Dec. 91	0.3%	16.3%	16.4%	36.2%	6.3%	1.5%	22.6%	100.0%
Jan. - June 92	0.3%	14.8%	21.5%	34.2%	6.1%	2.3%	20.8%	100.0%
July - Dec. 92	1.0%	14.7%	19.1%	36.2%	5.2%	2.7%	21.0%	100.0%
All Cohorts	0.3%	19.3%	19.1%	34.5%	6.3%	1.5%	19.1%	100.0%
Number of Firms in Sample	227	15656	15474	28017	5090	1252	15464	81180

- 11 Unless otherwise indicated, the data bases used here are the one described above for the five East German states, and the Mannheim Enterprise Panel for the remaining West German ones. We exclude the agricultural and nonprofit sectors from this comparison, since they are not covered in the West German sample of firms.
- 12 May-Strobl et al. (1992) report an estimate of 277 000 business starts by March 1992 which is based on the official business registrar. In our view, these numbers overstate the actual development while the totals in the last row of Table 4.1 clearly underestimate business starts in East Germany.
- 13 Discussions with Creditreform managers have led us to the conclusion that East and West German data can indeed be compared in a meaningful way, since the underlying selection and inquiry mechanisms do not differ.

Over the period from early 1990 to 1992, the sectoral distribution has remained remarkably stable. It differs sharply, however, from the sectoral distribution of "old" firms that were founded prior to January 1, 1990. Among these firms, the manufacturing and construction sectors dominate while trade, finance and services are clearly underrepresented when compared to the West German distribution. Comparing the sectoral distribution of firms founded after Dec. 1, 1989 to the respective one for West German firms, one can easily see that new firms in the Eastern states are more likely to emerge in manufacturing, construction and trade. Only about 20 per cent of the new East German firms emerge in the service sector, while almost 35 per cent of the respective new West German firms can be found here. The latter result is somewhat surprising in view of the fact that the former East German economy was lacking services. We therefore expected particularly high birth rates in this sector. However, the low share of these as reported in Table 4.1 may reflect the dependence of the tertiary sector on both, high disposable income and a well-developed industrial sector.

Table 4.2
Distribution of New Firms in West Germany by Sector (1991)

Date of Incorporation	Energy & Mining	Manufacturing	Construction	Trade	Transportation	Finance	Services	TOTAL
1991	0.1%	13.2%	10.6%	33.8%	4.8%	2.1%	34.8%	100.0%

One of the critical issues regarding the adjustment processes in East Germany concerns the survival rate of existing and newly founded firms. Initially, a high fluctuation and increased mortality rate among newly founded firms should be expected for a number of reasons. First, private entrepreneurship was virtually nonexistent prior to integration. Second, unless originating from West Germany, entrepreneurs are exposed to an entirely new set of regulatory constraints, which renders hardly trivial their task in the new economic system. Evaluating the costs and benefits of entrepreneurship will, at least to some degree, resemble a process of trial and error. Moreover, problems in reliably attributing ownership rights (Sinn 1991) strongly affect economic incentives and may also lead to an increase in entrepreneurial fluctuation.

As pointed out in section 2, the programs designed to promote the foundation of new enterprises in East Germany distribute considerable funds. The survival of firms may then depend partially on the screening process and decision-making criteria instituted by the funding agencies. Funding entry into already crowded markets can easily result in an excessive mortality rate. Little is known about the precise criteria that have been applied for approving start-up loans. The available information points to the fact that the DtA (Deutsche Ausgleichsbank) is aware of crowding tendencies

in certain consumer-oriented services (e.g. video shops), and it has reacted by reducing the approval rate in this area. Indeed, the failure rates reported by the DtA appear extremely low so far¹⁴. We are somewhat hesitant to accept them as the full story at this point.

In an economic system based on market principles, economists are often concerned with the failure of small or young firms. In the East German case, one has to take into account that Treuhand efforts have involved (and may continue to do so for the time being) a significant number of firm liquidations. Typically, these liquidations involve larger enterprises. Table 4.3 provides a comparison of firm size distributions between Treuhand and non-Treuhand firms in our sample. It demonstrates that the size structures differs dramatically. Whilst of the non-Treuhand enterprises, more than four in five have less than 20 employees, there are less than one in seven Treuhand enterprises belonging to this size class.

Table 4.3
Size Distribution of Non-Treuhand vs Treuhand Enterprises

Firm Size (Employees)	Non-Treuhand Enterprises	Treuhand Enterprises
1-19	82.5%	12.6%
20-49	9.1%	20.5%
50-99	4.1%	20.6%
100-199	2.4%	19.8%
200-499	1.2%	15.8%
500-999	0.4%	5.9%
1000-1999	0.2%	2.4%
>1999	0.1%	2.3%
Total	100%	100%

The next Table 4.4 shows failure rates amongst non-Treuhand and Treuhand enterprises. It suggests that the failure rate among Treuhand enterprises is almost eight times as high as among non-Treuhand firms. However, one should have in mind that a break-up of a large Treuhand enterprise into smaller independent firms so far appears in our sample as a liquidation of the old firm and the emergence of several new ones.

¹⁴ According to a recent press release only 534 of some 130 000 firms supported by DtA were liquidated so far (Deutsche Ausgleichsbank 1993).

Table 4.4
Firm Survival - Treuhand vs. Non-Treuhand Enterprises

	Nonsurvivor Firms	Survivor Firms	Total
Non-Treuhand Enterprises	0.72%	99.28%	100.0%
Treuhand Enterprises	5.81%	94.19%	100.0%
All Firms	0.82%	99.18%	100.0%
Number of Firms in Sample	835	101106	101941

In conclusion, it is not clear *ex ante* whether we should expect the failure rate of firms to rise or to fall with firms size. An initial answer based on the univariate relationship is given in Table 4.5, indicating the shares of firms in our data base reported as having not survived into the fourth wave. This suggests a positive relationship between failure rate and firm size.¹⁵

Table 4.5
Insolvency Rate of East German Firms by Firm Size

Firm Size (Employees)	Insolvency Rate
1-19	0.59%
20-49	1.12%
50-99	1.90%
100-199	2.38%
200-499	3.84%
500-999	3.41%
1000-1999	3.98%
>1999	1.35%
All Size Classes	0.82%
Number of Firms in Sample	835

Since industry, firm size and other effects may affect firm survival in a complex way, we estimate a survival equation with time elapsing between a firm's incorporation date and its date of failure as the dependent variable. Suppose that $\log T$, the logarithm of time until failure follows a normal distribution and that $\log T = X\beta + \varepsilon$, where X is a matrix of variables describing firm characteristics, β is the coefficient vector to be estimated and ε is a disturbance with normal distribution, mean zero and variance σ^2 . Note that for the enterprises that are survivors at the last interview, $\log T$ is a censored dependent variable. We estimate the coefficients via maximum likelihood.

¹⁵ Note that the total number of firms in Tables 4.3 and 4.4 differs from the number of observations used in the regression analysis below. In the latter, we used only cases without missing values for all covariates.

A short discussion of the variables included in the list of regressors is in order at this point. We follow Evans (1987a) by including the log of employment at the initial interview as a measure of initial firm size (SIZE), and the square of this term (SIZESQ). Industry effects will be controlled by including dummy variables for one-digit industries (AGRICULTURE, CONSTRUCTION, TRADE, TRANSPORT, FINANCE, SERVICE, NONPROFIT) where manufacturing is the reference group. Additional variables in the survival equation are dummies related to the legal form and the capital structure of the enterprise. In particular, we include three dummy variables for the legal form of the enterprise (KGOHG for large firms with personal liability; LTDLIAB for firms with limited liability; and other types of legal form named OTHLEGAL). The reference group are enterprises with full personal liability by the entrepreneur. We also include a dummy regressor for West German involvement in the company (WESTCAP)¹⁶ and its interaction with firm size (WESTCAP*SIZE), a dummy regressor for Treuhand enterprises (TREUHAND), and its interaction with firm size (TREUHAND*SIZE). We finally use five dummies indicating firm location by state (including East Berlin).

¹⁶ The coding of this variable is rather crude at this point. WESTCAP is zero if none of the owners has an address in West Germany or if the owners are unknown, and unity in all other cases. Thus we cannot capture West German or foreign involvement if the business address of the respective agent is in East Germany.

Table 4.6
Survival of East German Firms

Variable	Dependent Variable					
	(S1)		(S2)		(S3)	
	log(time to insolvency)		log(time to insolvency)		log(time to insolvency)	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
SIZE	-0.286	-4.189	0.116	1.663	0.095	1.372
SIZESQ	-0.020	-2.002	-0.034	-3.487	-0.030	-3.094
AGRICULTURE	0.734	2.383	0.175	0.629	0.113	0.408
CONSTRUCTION	0.748	5.661	0.457	3.856	0.454	3.858
TRADE	-0.269	-2.564	-0.309	-3.252	-0.317	-3.357
TRANSPORTATION	-0.175	-0.991	-0.277	-1.737	-0.282	-1.779
FINANCE	-0.253	-0.562	-0.394	-0.983	-0.403	-1.015
SERVICE	-0.543	-4.554	-0.468	-4.289	-0.450	-4.126
NONPROFIT	0.956	1.056	0.577	0.693	0.557	0.692
WESTCAP	-	-	0.297	1.518	0.351	1.794
WESTCAP*SIZE	-	-	-0.088	-1.719	-0.109	-2.125
TREUHAND	-	-	-1.439	-3.428	-1.425	-3.411
TREUHAND*SIZE	-	-	0.078	0.885	0.069	0.787
KGOHG	-	-	-0.197	-0.506	-0.115	-0.296
LTDLIAB	-	-	-1.237	-11.007	-1.177	-10.479
OTHLEGAL	-	-	0.026	0.092	0.036	0.126
SACHSEN-ANHALT	-	-	-	-	-0.854	-3.598
SACHSEN	-	-	-	-	-0.375	-1.629
THUERINGEN	-	-	-	-	-1.061	-4.551
BRANDENBURG	-	-	-	-	-0.321	-1.330
BERLIN(EAST)	-	-	-	-	-1.221	-4.747
σ	2.517	38.522	2.235	37.760	2.200	37.738
CONSTANT	13.645	68.803	12.914	71.980	13.468	46.061
N	76851		76851		76851	
Censored Obs.	76181		76181		76181	
log L	-3942.95		-3823.96		-3772.79	
$\chi^2(df)$	379.19(10)		617.16(16)		719.50(21)	

Reference group: Firms in manufacturing sector, Private enterprise, no West German involvement, full personal liability (Personengesellschaft); state Mecklenburg-Vorpommern.

According to these results, the negative size effect persists in a multivariate setting, since the negative quadratic term dominates the linear term almost completely in (S3). In terms of sectoral patterns, the trade and service industries stand out, since firms in these sectors should have survival times significantly below those of firms in the manufacturing sector. The opposite holds for the construction sector. This is in apparent contrast to standard observations in the West, according to which enterprises in the construction sector are characterized by higher fluctuation.

Unexpectedly, West German involvement in ownership positively affects survival only for relatively small firms, which may well be due to our crude specifica-

tion. By contrast, the dummy variables describing the influence of Treuhand ownership perform according to expectations. However, it is surprising to see that amongst the legal forms of the enterprise, limited liability has a strong negative effect on the expected time to insolvency.

We finally see interesting differences in expected failure rates across the new states and East Berlin. Compared to the least industrialized state of Mecklenburg-Vorpommern, firms in Sachsen-Anhalt, Thüringen and East-Berlin have a significantly lower expected time to insolvency. It could well be that these patterns are determined by the state of economic restructuring in these regions in the sense that firms are likelier to fail when competition gets tougher in the more industrialized states. If this interpretation is correct, then the relatively high failure rates in these regions should not be a source of concern for decision makers in public policy.

However, due to the strong censoring in our sample (the time to insolvency is observed for only 0.82 per cent of the total number of firms), these results rely heavily on the distributional and functional form assumptions. While the estimates point to significant differences in the survival chances of various types of firms, we need to emphasize that the underlying assumptions have not been checked so far in specification tests. The attentive reader may also question our use of a censored normal regression, since other types of duration models may be more suitable in this context. We intend to further pursue the analysis of firm survival using those models. However, the greatest shortcoming to date is probably not one of econometric tools, but rather one of data preparation. In particular, insolvency is not the only type of firm liquidation, and it may not even be the dominant form of firm liquidation. Unfortunately, at this point we are not able to identify business dissolution that is not accompanied by insolvency or bankruptcy.

4.2 Employment Dynamics

Following Evans (1987b) and Hall (1987) we assume that the number of a firm's employees follows the descriptive relationship

$$(1) \quad B_2 = B_1 \exp\{(t_2 - t_1)f(B_1, X)\} \exp(\varepsilon)$$

where B_2 and B_1 represent the number of employees at time t_2 and t_1 respectively. X is a row vector of exogenous variables and ε is an i.i.d. disturbance. $f(\cdot)$ is a linear function of exogenous regressors X , the firm's initial size B_1 and potential interactions between these variables. In the literature this relationship is usually transformed by taking logarithms and rewriting it as

$$(2) \quad \frac{\log B_2 - \log B_1}{(t_2 - t_1)} = f(B_1, X) + \frac{\varepsilon}{(t_2 - t_1)}$$

Measuring t_2 and t_1 in years, the left-hand side can then be interpreted as an annual growth rate. The relationship in (2) can be estimated using a standard GLS approach.¹⁷ Given that the time intervals vary across observations, we do not follow this approach and instead rewrite (1) as

$$(3) \quad \frac{\log B_2}{(t_2 - t_1)} = \frac{\log B_1}{(t_2 - t_1)} + f(B_1, X) + \frac{\varepsilon}{(t_2 - t_1)}.$$

Note that the first RHS term in (3) is not collinear with $\log B_1$ due to the fact that observation intervals vary across observations. If $f(B_1, X)$ includes $\log B_1$ as a linear term, the additional information on the length of the time intervals allows us to test the hypothesis that the coefficient of the first term is equal to unity, as the specification in (1) would suggest.

In this paper, we have not dealt with the selection issue in a comprehensive way. The regression results reported below are based on a sample of surviving firms without selectivity correction. Two forms of selection bias may complicate the estimation of equation (3). First, a survivor bias may distort our results. However, given that comparatively larger firms with presumably negative employment growth drop out of the sample at a higher rate than smaller ones, the usual direction of this survivor bias may be reversed with respect to the coefficients measuring size effects.

Secondly and more importantly, we observe more than 100,000 enterprises once, but we can only obtain growth rates and a full set of explanatory variables on 30,165 firms. Hence, firm survival is only one aspect - and probably a minor one - of the selection issue at hand. For selectivity problems to arise, it does not matter whether we systematically "forget" to include firms of a certain type, or whether certain firms systematically do not survive and thus drop out of the sample. Any of these biases can constitute a problem for the consistency of our estimates. In this paper we have not yet dealt with the selection issue in a comprehensive way. The marginal distributions of the overall sample and the growth sample do not appear to differ much with respect to firm sizes and industries. Nonetheless, this observation is not sufficient to rule out selection biases. Typically, empirical researchers employ Heckman's (1979) two-step procedure to account for the possible selection bias, but we note that following Heckman's suggestion may not be optimal in our context. Since interview dates vary in our sample, the correct specification accounting for sample selectivity should be based on a duration model.

We include in our simplest growth equation presented in (E1) of Table 4.7 the

¹⁷ There may be further complications, however, especially regarding a potential errors in variables problem with respect to the initial employment measure. See Hall (1987).

very same groups of variables we have used in our survival equation, and add the firm's age linearly (AGE) and squared (AGESQ), as well as in interaction with size (SIZE*AGE). Additional controls prove to be useful for the estimation. First, the interview dates vary considerably in our sample, and thus our estimates have to be controlled for seasonal and other time-dependent effects (e.g. changes in the regulation of short-time work, employment subsidies, unemployment insurance, etc.). To safeguard against these effects, we introduce dummy variables for the quarters in which the first and the second interview took place (6 dummy variables for the first and 5 for the second interview dates). Second, we include regional indicators at the county level such as the 1990 population density (EDICHT90), 1989 employment in the secondary and the tertiary sector (BSEK89 and BTERT89), and accessibility measures via public and private transit (EBAV91 and INDV91). These data originate with the Bundesforschungsanstalt für Landeskunde und Raumordnung (BfLR 1993). Finally, we include a dummy variable for firm locations in cities with more than 100.000 inhabitants. This estimate is presented as (E2) in Table 4.7.

Finally, the estimates should be controlled for cohort effects in the firms' start up dates, as both regulatory and subsidy structures varied considerably in the time period considered here. We do this by including in (E3) cohort dummies indicating start ups by half years from 1990 on.¹⁸ Since the interview date and the cohort control dummies capture any time-contingent effects, there is little hope for an appropriate interpretation and we will not discuss them separately in the regression results presented below.

As is evident from the specification in (3), the disturbance terms in our main regression will be heteroskedastic and all estimates are therefore based on White's (1980) heteroskedasticity-robust variance-covariance estimator. The F-statistics involving the above-mentioned groups of variables are significant at the one percent level, with the exception of the group involving WESTCAP and WESTCAP*SIZE, respectively. The latter is probably due to the fact that our current specification of this variable is very crude. Overall, the parameters remain very stable with the successive inclusion of controls despite the fact that their influence is significant.

We will concentrate our discussion of the results reported in Table 4.7 on the essential explanatory variables. From the estimate, we can infer first that while the parameter on $\log B_1/(t_2-t_1)$ is significantly different from unity, it is throughout very close to that.¹⁹ We interpret this as some support for choosing the functional form specification at hand. Note that deviations from unity may also be caused by errors in variables, but even then the degree of mismeasurement would appear to be small. Second, the combined effects of SIZE, SIZESQ and SIZE*AGE imply that employ-

¹⁸ For historical reasons, cohort 1 is defined to include start-ups in December, 1989.

¹⁹ To safeguard against econometric problems arising from the extremely small standard deviation for the coefficient on $\log B_1/(t_2-t_1)$ in Table 4.7, we reestimated the relationship according to equation (2), but did not detect major discrepancies from the results reported here.

ment growth decreases with size at a decreasing rate. A firm's age contributes positively to employment growth (although at a decreasing rate) when the effects of AGE, AGESQ and SIZE*AGE are evaluated jointly. So far, we have no explanation for this result, but it may reflect the presence of selectivity problems which need to be addressed in further research.

Table 4.7
Employment Growth Equations

Variable	Dependent Variable					
	(E1)		(E2)		(E3)	
	log B ₂ /(t ₂ -t ₁)		log B ₂ /(t ₂ -t ₁)		log B ₂ /(t ₂ -t ₁)	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
log B ₁ /(t ₂ -t ₁)	0.995	437.981	0.990	293.788	0.990	293.917
SIZE	-0.272	-25.183	-0.265	-25.457	-0.259	-24.684
SIZESQ	0.009	9.138	0.009	9.093	0.009	9.014
AGE	-0.003	-0.520	-0.007	-1.106	0.017	2.322
AGESQ	-0.0009	-0.199	0.0002	0.457	-0.001	-2.246
SIZE*AGE	0.007	4.383	0.007	4.373	0.005	3.623
AGRICULTURE	0.023	1.119	0.020	0.998	0.023	1.104
ENERGY	0.247	7.050	0.238	6.805	0.238	6.800
CONSTRUCTION	0.169	19.805	0.164	19.390	0.164	19.492
TRADE	-0.053	-6.522	-0.056	-6.921	-0.054	-6.724
TRANSPORTATION	0.016	1.339	0.008	0.678	0.009	0.685
FINANCE	-0.207	-6.511	-0.212	-6.585	-0.212	-6.630
SERVICE	-0.063	-5.472	-0.067	-5.780	-0.065	-5.586
NONPROFIT	0.069	2.702	0.069	2.721	0.073	2.846
WESTCAP	0.0005	0.024	0.0007	0.033	-0.002	-0.109
WESTCAP*SIZE	-0.003	-0.520	-0.003	-0.518	-0.002	-0.342
TREUHAND	-0.037	-0.654	-0.023	-0.400	-0.018	-0.312
TREUHAND*SIZE	-0.022	-1.872	-0.024	-2.024	-0.025	-2.083
KGOHG	0.266	12.739	0.257	12.198	0.249	11.815
LTDLIAB	0.223	17.035	0.216	16.493	0.216	16.187
OTHLEGAL	0.217	11.285	0.219	11.159	0.223	11.453
SACHSEN-ANHALT	0.020	1.425	0.018	1.180	0.017	1.146
THUERINGEN	0.026	1.840	0.025	1.628	0.024	1.554
SACHSEN	0.022	1.592	0.004	0.247	0.004	0.253
BRANDENBURG	0.046	3.120	0.033	2.153	0.033	2.197
BERLIN (EAST)	0.016	0.866	-0.105	-2.652	-0.107	-2.708
EDICHT90	-	-	0.0002	2.068	0.00002	2.008
BSEK89	-	-	0.0001	0.433	0.0002	0.465
BTERT89	-	-	0.0006	1.191	0.0005	1.142
EBAV91	-	-	3.58e-06	0.521	3.15e-06	0.459
INDV91	-	-	9.04e-06	1.453	9.96e-06	1.599
CITY	-	-	-0.040	-2.036	-0.039	-1.952
Controls for Interview Date	-	-	included		included	
Controls for Cohorts	-	-	-	-	included	
CONSTANT	0.443	14.334	0.417	9.981	0.339	7.032
N	30615		30165		30165	
S.E.E.	0.658		0.657		0.656	

Reference Group: E1, E2 and E3: Firms in manufacturing sector, private enterprise, no West German involvement, with full personal liability (Personengesellschaft), located in Mecklenburg-Vorpommern. E2: With date of first (second) interview in second quarter of 1991(2). E3: With date of incorporation prior to Nov. 30, 1989.

As expected, employment growth is considerably higher in the energy and the construction sectors than in the reference sector (manufacturing). The negative coefficients for the trade, finance, and service sectors are somewhat surprising. Keep in mind, however, that our employment growth equation is conditioned on the existence and survival of firms, so employment growth due to business start-ups and deaths is not accounted for.

According to our estimates, the involvement of West German capital does also not significantly affect employment growth. Again, this could be due to our preliminary specification of WESTCAP. Conversely, for Treuhand enterprises the negative size effect is even stronger than for other firms, as demonstrated -by the significant coefficient on TREUHAND*SIZE in both (E2) and (E3). Compared to firms under personal ownership with full liability, all firms involving other legal forms exhibit substantially higher employment growth rates. Observe in particular the strong positive effect on limited liability, which is in contrast to the strong negative effect in the survival equation. Apparently, limited liability firms are characterized by a dichotomous development. They either survive only for a short time period; or they grow fast.

The regional variables also reveal some differences in employment growth across the five new states and East-Berlin. Most striking is the strong negative growth effect (-10.7 per cent in (E3)) for firms located in East Berlin while firms in Brandenburg grow moderately faster (3.3 per cent) than firms in the reference state of Mecklenburg-Vorpommern. Also, Sachsen and Thüringen do not fare strongly. Again, this might reflect the fact that business births (and deaths) are not accounted for here. Alternatively, hidden industry effects may account for this.

4.3 Revenue Growth

Our analysis of revenue growth in the period 1991/92 is based on an even more restricted subsample of 6 650 firms. This subsample was obtained by first selecting all survivor observations in our sample with 1991 revenues and 1992 revenue expectations. About seventy per cent of the 1992 revenue expectations were reported after June 1992 and were based on the actual development over the first six months of 1992.²⁰ Since a number of firms reporting 1991 revenues were actually founded in

²⁰ We acknowledge that the use of self-reported revenue estimates poses important issues regarding data reliability. Nonetheless, we think that these data can be used to describe some stylized facts. In the West German database (also supplied by Creditreform) revenue expectations and actually measured revenues are highly correlated (Pearson correlation coefficient 0.824) and the data do not exhibit any obvious biases towards over- or under-estimation. Nonetheless, we plan to conduct a more detailed analysis of revenue development in East German firms based on actual 1992 revenue figures once these become available with the next Creditreform data release.

1991, we dropped firms from the sample which had been incorporated after Dec. 30, 1990. After computing the revenue growth rates, we excluded observations in the lower and upper one percent quantiles, since we discovered some evidence for implausible revenue developments, probably due to mergers or acquisitions of firms. In the remaining sample of 6 650 firms the average revenue growth rate was 0.247 and the median was 0.182. We again do not attempt to correct for selection biases in this and the next section.

Before presenting our results on revenue growth, it is informative to describe the 1991 situation in terms of absolute revenue levels, in order to account for base effects. We use $\log(\text{revenues } 1991)$ as our dependent variable and regress this measure on the company's size in 1991 (SIZE91 , defined as $\log(\text{employees } 1991)$) and its square, industry dummy variables, dummy variables characterizing the legal form of the enterprise, and cohort variables defining by the date of incorporation. Since the size of the enterprise may vary over the course of 1991 due to seasonal or other reasons, we also include dummy variables for the quarter in which the size measure was taken. Moreover, we include the variables TREUHAND and WESTCAP (and interactions with SIZE91) in order to account for further differences among the types of firms in the sample.

The results of this regression are reported as specification (R1) in Table 4.8. Both size variables are significant, but their aggregate effect implies that revenues increase at a rate considerably less than unity with firm size. Hence revenues per employee in 1991 decline with firm size. Given the history of most large firms in the East, this is not surprising at all, but this result is important to put the revenue growth results into perspective. Our results in (R1) also demonstrate the usefulness of including variables that characterize the legal form of the enterprise. 1991 revenue levels of the "larger" forms of enterprises with full personal liability (KGOHG) are significantly higher than those of the reference group. Enterprises that take the form of limited liability (GMBH) or publicly traded firms (AG's) display even higher revenue levels. Not surprisingly, Treuhand enterprises are characterized by revenue levels significantly below those of new or already privatized enterprises, and this effect does not appear to vary with firm size, as the insignificant coefficient of the interaction term $\text{TREUHAND} * \text{SIZE91}$ indicates. The results in (R1) also demonstrate that most firms with West German capital involvement actually start at lower revenue levels than firms without this. This astonishing result may indicate problems with our WESTCAP variable as discussed in section 4.3. Dropping this variable from the regression does not affect the other coefficients in a major way, however. Finally, cohort and interview date controls are neither individually nor jointly significant in this regression.

The dependent variable in our growth equations (R2) and (R3) is revenue growth (REVGROWTH) defined as $\log(\text{revenues } 1992) - \log(\text{revenues } 1991)$, where revenues are defined nominally. We regress this measure on the same set of variables

used in the specification (R1). Note that we exclude the employment growth rate from our list of regressors. Our rationale for this decision is that revenues of firms in the new Eastern states are more likely to be affected by capital shortages, lack of marketing skills, the development in product markets, etc. In other terms: we assume that firms are operating at the "potential revenue frontier", which is presumably not affected by labor shortages. The company's size and age may nonetheless be important determinants, since it is likely that comparatively large and old enterprises face considerable problems in adapting to the new market conditions. The results of the revenue growth regressions are reported in Table 4.8.²¹

Table 4.8
Revenues (1991) and Revenue Growth (1991-1992)

Variable	Dependent Variable					
	(R1)		(R2)		(R3)	
	log(revenues 1991)		REVGROWTH		REVGROWTH	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
SIZE91	0.617	22.824	-0.032	-4.013	-0.025	-3.012
SIZE91SQ	0.014	3.672	-0.002	-2.164	-0.002	-2.323
AGRICULTURE	0.014	0.146	-0.058	-1.856	-0.058	-1.871
ENERGY	1.153	3.874	0.105	1.141	0.097	1.078
CONSTRUCTION	0.164	5.868	0.007	0.623	0.006	0.558
TRADE	0.508	15.662	-0.062	-5.812	-0.062	-5.869
TRANSPORTATION	0.089	1.878	-0.019	-1.097	-0.019	-1.081
FINANCE	0.555	2.641	-0.043	-0.940	-0.044	-0.962
SERVICE	0.095	2.218	-0.027	-1.858	-0.029	-2.007
NONPROFIT	0.331	0.992	-0.120	-2.774	-0.115	-2.585
WESTCAP	0.169	2.041	-0.037	-3.437	0.015	0.024
WESTCAP*SIZE91	-0.063	-3.383	-	-	-0.014	-2.471
TREUHAND	-0.582	-2.280	-0.056	-2.942	-0.125	-1.833
TREUHAND*SIZE91	0.068	1.436	-	-	0.014	1.033
KGOHG	0.482	4.477	0.004	0.141	-0.005	-0.168
LTDLIAB	0.633	11.250	0.053	3.658	0.035	2.121
OTHLEGAL	0.504	6.410	-0.044	-1.772	-0.061	-2.335
COH_TRANSITION	-0.009	-0.244	0.040	3.231	0.042	3.346
COH_HY2_90	-0.024	-0.680	0.040	3.370	0.043	3.558
QUARTER 2_91	-0.047	-1.399	0.011	1.010	0.011	0.965
QUARTER 3_91	0.004	0.131	0.019	1.660	0.018	1.631
QUARTER 4_91	-0.056	-1.322	-0.014	-0.924	-0.014	-0.934
CONSTANT	12.052	223.843	0.324	19.132	0.316	18.303
N	6650		6650		6650	
S.E.E.	0.860		0.299		0.299	

Reference group: Firm in manufacturing sector, private ownership without West German involvement, full personal liability (Personengesellschaft), founded prior to Nov 30, 1989; interview measuring 1991 firm size occurred during first quarter of 1991. All t-statistics are based on White's

²¹ White's (1980) heteroskedasticity correction is used in all of the regressions, since we reject the null hypothesis of homoskedasticity quite easily in Breusch-Pagan tests.

The regressions (R2) and (R3) demonstrate quite clearly that revenue growth is strongest among small firms. In specification (R2), the coefficients on SIZE91 and SIZE91SQ are negative and jointly highly significant at the one percent level. Revenue growth rates decline with firm size at an increasing rate. Small firms experience revenue growth in all of the one-digit industries. However, only the coefficients for the trade and nonprofit sectors are significant, indicating a revenue growth rate below that of the other industries. As before, the legal form of the enterprise appears to be an interesting indicator for revenue growth. The revenue growth rates of firms with restricted personal liability (LTDLIAB) are particularly strong, while the large forms of personally held enterprises (KGOHG, i.e. Kommanditgesellschaften and Offene Handelsgesellschaften) do not differ notably from the reference case, firms with full personal liability of the owner. One should point out again that sample selection issues are important in this context. Surviving firms with limited liability perform better, but this legal form also raises the probability of being in the non-survivor sample (see Table 4.6). This result is consistent with the notion of a risk-return trade-off. The residual group of legal forms (OTHLEG) is performing particularly badly in terms of revenue growth - the reason is not quite clear, but these may well be firms who have maintained their old structure and business entity as Genossenschaften.

Treuhand-held enterprises are characterized by below-average revenue growth, and the interaction with firm size is statistically not significant. While these effects are easily reconcilable with economic intuition, the negative coefficient on WESTCAP in (R2) would be surprising, if that variable would correctly measure West German involvement. The result suggests that the presence of West German capital is correlated with lower revenue growth over the 1991/92 period. One possible explanation could be that the initial 1991 revenue levels of firms which have attracted western capital are relatively high in 1991 to start with. But this explanation is ruled out by the results from specification (R1). For optimistic observers, the same explanation could hold with respect to the negative TREUHAND coefficient, but this is clearly also rejected by specification (R1). Thus the combined results of (R2) and (R1) do not promise a bright future for those enterprises still under Treuhand auspices. We will come back to this result in our final section.

Finally, the cohort variables in these regressions reveal an interesting pattern. The reference group consists of enterprises founded prior to November 30, 1989. This group has significantly lower revenue growth than the other two cohorts (COH_TRANSITION for enterprises founded during the transition period from Dec. 1, 1989 to June 30, 1990; and COH_HY2_90 for firms founded during the second half of 1990) although all three groups do not differ significantly in terms of their 1991 revenue levels. This pattern may reveal either age effects, or significant differences between firms founded prior to November 1989 and those emerging during the

transition period and after the currency union. For researchers concerned with patterns of firm growth, age dependence is a widely accepted hypothesis while cohort variables are often introduced as a mere control device. While we cannot distinguish here between age and cohort effects, we intuitively favor the cohort argument and suggest that the tremendous changes in the East German system have brought a new type of entrepreneur into the economic arena. As a second cohort explanation, firms emerging after November 1989 may be offering product and service bundles within all sectors, that are more amenable to growth than those served by the firms which endured the socialist regime. As our database grows further, we will hopefully be able to distinguish empirically between these explanations.

4.4 Labor Productivity Growth

For the purposes of our analysis, we define labor productivity as nominal revenue per capita. In principle, the employment and the revenue growth equations unambiguously determine labor productivity development, since

$$(4) \quad \log \frac{\text{labor productivity } 1992}{\text{labor productivity } 1991} = \log \frac{\text{revenues } 1992}{\text{revenues } 1991} - \log \frac{\text{employees } 1992}{\text{employees } 1991}$$

For ease of interpretation, however, we estimate a separate labor productivity equation on the basis of the sample described and used in section 4.3.²² The set of covariates is also the same as in section 4.3. The number of observations in these regressions is slightly smaller than in section 4.3, as for a few firms information on revenues was available for 1991 and 1992, but the number of employees was obtained only for 1991. The mean of labor productivity growth in this sample of 6 541 firms was 0.168, the median was 0.159. The results of our analysis are summarized in Table 4.9. They are just an alternative way to put our previous results into perspective.

Hence, the first column of results (specification (P1)) is in essence a restatement of the first revenue equation (R1). We include these results in Table 4.9, because the results of our growth equations must always be considered in the context of the 1991 situation. As discussed above, labor productivity is decreasing with firm size in our sample, even if the significantly positive coefficient on SIZE91SQ is taken into account.²³ Note that in comparison to the reference group of firms with full personal

²² For this analysis we implicitly define employment growth as $\log(\text{employees } 1992) - \log(\text{employees } 1991)$, neglecting the fact that the time difference between 1991 and 1992 observations varies across firms. As a control we introduce dummy variables for the quarters in which the respective interviews were taken. For our results, this change in variables does not have any major effects, since the two measures of employment growth are highly correlated ($r=0.940$) in the reduced sample used here.

²³ The maximum value of SIZE91 is 10.31 in this sample.

liability, the other legal forms of enterprises are characterized by a considerably (and significantly) higher labor productivity in 1991. The coefficients regarding Treuhand firms and enterprises in at least partial West German ownership (WESTCAP) were already discussed above.

We now turn to the labor productivity growth estimates presented in (P2) and (P3). In the preceding sections, we discussed already that nominal revenue and labor growth display similar patterns. Revenue growth and employment growth are strongest among small firms and decrease with firm size. The result of these two tendencies could be ambiguous, but our results in Table 4.9 demonstrate that labor shedding dominates weak revenue growth in larger firms. Labor productivity growth increases with firm size. However, it would not be appropriate in our opinion to take an optimistic view (however desirable) regarding the growth and survival chances of large privatized enterprises and Treuhand firms. Increasing labor productivity is certainly an important goal for these firms in the short run, but the true test of viability is the building of new revenue sources. Without developing new competitive products and without finding substitutes for lost markets in the East these enterprises are unlikely to survive on their own. But at least at this point we see very little evidence of revenue growth that would entitle us to an optimistic view in this matter.

With regard to Treuhand enterprises the picture is even more sobering. In terms of labor productivity growth, Treuhand firms look very impressive - the TREUHAND coefficient in specification (P2) is significant and indicates that Treuhand firms experience productivity growth at a rate of 15 per cent above that of comparable enterprises not managed by Treuhand. However, this statistic is so strong only due to an extremely unfavorable starting position. In terms of revenues and revenue growth, the starting position in 1991 is unfavorable and the revenue development in the 1991/92 period is negative, too (see Table 4.8, (R1) and (R2)). We will return to this point in our final section.

Table 4.9
Labor Productivity (1991) and Productivity Growth (1991-1992)

Variable	Dependent Variable					
	(P1)		(P2)		(P3)	
	log(productivity 1991)		PRGROWTH		PRGROWTH	
	Coefficient	t-Statistic	Coefficient	t-Statistic	Coefficient	t-Statistic
SIZE91	-0.385	-14.241	0.271	12.837	0.273	12.962
SIZE91SQ	0.015	3.752	-0.012	-3.622	-0.011	-3.259
AGRICULTURE	0.013	0.137	-0.089	-1.603	-0.088	-1.604
ENERGY	1.150	3.866	-0.393	-2.452	-0.395	-2.448
CONSTRUCTION	0.163	5.837	-0.246	-13.020	-0.247	-13.106
TRADE	0.507	15.615	-0.020	-1.027	-0.021	-1.035
TRANSPORTATION	0.088	1.854	-0.063	-1.894	-0.062	-1.886
FINANCE	0.554	2.634	0.234	2.304	0.234	2.307
SERVICE	0.094	2.195	-0.025	-0.891	-0.026	-0.917
NONPROFIT	0.330	0.989	0.038	0.134	0.040	0.140
WESTCAP	0.169	2.047	-0.009	-0.464	0.012	0.190
WESTCAP*SIZE91	-0.064	-3.408	-	-	-0.006	-0.381
TREUHAND	-0.577	-2.260	0.150	4.446	0.149	1.015
TREUHAND*SIZE91	0.067	1.412	-	-	0.0003	0.012
KGOHG	0.482	4.476	-0.236	-4.057	-0.240	-3.971
LTDLIAP	0.634	11.252	0.261	-8.125	-0.268	-6.230
OTHLEGAL	0.504	6.411	-0.233	-4.764	-0.240	-4.402
COH_TRANSITION	-0.010	-0.261	0.026	1.053	0.026	1.070
COH_HY2_90	-0.023	-0.663	0.020	0.860	0.021	0.885
QUARTER_2_91	-0.046	-1.364	0.023	1.019	0.023	1.011
QUARTER_3_91	0.005	0.161	0.006	0.250	0.006	0.244
QUARTER_4_91	-0.056	-1.310	0.027	0.885	0.027	0.885
QUARTER_2_92	-	-	0.067	3.368	0.067	3.368
QUARTER_3_92	-	-	0.039	2.298	0.039	2.293
CONSTANT	12.054	223.447	-0.305	-7.341	-0.308	-7.358
N	6641		6641		6641	
S.E.E.	0.860		0.554		0.554	

Reference Group: Firm founded prior to Nov 31, 1989; interviews measuring 1991 and 1992 firm size occurred during the first quarter of the respective year; firm with full personal liability ("Personengesellschaft"); manufacturing sector. All regression results are based on White's (1980) heteroskedasticity-robust variance-covariance estimator.

5. Concluding Remarks

We conclude by summarizing and sketching plans for future research. The better part of our analysis to date of the evolution of adjustment of the East German industry is condensed in Figures 1a-1d depicting how revenues, employment and labor productivity developed from 1991 to 1992 in the four sectors manufacturing,

construction, trade, and services.²⁴

Insert Figures 1a-1d about here

The figures show a strong pattern more or less common to all sectors, namely that labor productivity growth increases strongly with firm size. This would be most comforting, were the productivity increases obtained mostly from revenue increases. However, the figures also show that both revenue growth and employment growth decline with firm size, and that the latter decline is much more pointed than the former. Hence the increase in productivity growth observed for the larger firms is largely due to labor shedding.

Observe finally that growth in labor productivity amongst the small firms is negative, with construction and trade leading this pattern. Several factors may account for this. One obvious candidate is mismeasurement in our productivity variable, since it does not account for wage differences across different groups of employees. Industries with a high proportion of unskilled or semi-skilled labor may therefore appear to have negative productivity growth. Trade and construction are two particularly suitable candidates for such an effect. As an alternative explanation, firms in the construction sector may well have enhanced their capacity in anticipation of an incipient construction boom. A more detailed analysis of these two sectors is called for.

As another result worth emphasizing and not reflected in these figures, the frequency of new business starts is relatively high in manufacturing, construction, and trade, while it is low in the service sector. As services were certainly undersupplied in the former GDR, one would expect the contrary, namely a higher rate of business starts in this sector than in West Germany. As an explanation for this anomaly, we suggest that services rely both on sufficiently high personal disposable income and a well-developed secondary sector.

The pattern of firm failures diverges even more from the one we customarily expect. Most important is the decrease in firm longevity with increasing firm size. We also see that Treuhand firms perform worst with respect to revenue growth which is probably the most important indicator of long-term development. In our interpretation, these results indicate that the stock of firms remaining with the Treuhand corporation suffers from a selection process in which the relatively good performers become privatized, and the worst ones remain.

The results reported in this paper do not yet represent as detailed an account of firm dynamics in Eastern Germany as would be desirable. A lot of work remains to be done. First, some econometric problems have to be given more attention than we did in this paper. In particular, the possibility of selection biases needs to be taken into

²⁴ The figures are based on separate regressions for each industry of revenue and labor productivity on the explanatory variables used as above, but with grouped employment data. All point estimates refer to the following reference case: interviews in the first quarters of 91 and 92, and startup date between Dec. 89 and June 90.

account. Second, when analyzing the evolution of firms in East Germany, the previous history of firms and its management or owner(s) should be of some influence. In particular, it is likely that firms will exhibit different paths of development, depending on whether they were sold off by the Treuhand corporation to some Eastern or Western private owner, or they were reprivatized within a restitution process; whether they were started as a spin-off from one of the large vertically integrated firms of the former GDR or from a Western firm, or they were started from scratch. It will be similarly interesting to observe and analyze the pattern of firm liquidations in East Germany, those with credit foreclosure and simple business discontinuations. Currently, sixty jobs are lost per default with credit foreclosure, amounting to a total of approximately 70 000 jobs per year. The total number of jobs lost due to closings without credit foreclosure is likely to be even higher. While we expect the average number of job losses to decrease over time, firm defaults will contribute in large part to labor shedding for some time to come.

In this paper, we have provided a first analysis of a new and comprehensive data set on firms in the five Eastern states of Germany. It is a first step into a politically important area of research, as the data describe the labor demand in a region that in all likelihood will be plagued by high unemployment in the foreseeable future. We are currently looking at a disequilibrium, in which we want to study the behavior of firms in the relevant labor and output markets within a historically unique situation. In further developing and analyzing a comprehensive data base on the evolution of East German firms and their Western counterparts, we hope to contribute to analysis and policy development in this important phase of economic, social and political development of Germany.

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Figure 1a

Revenue, Employment and Labor Productivity Growth (1991-1992) by Firm Size - Manufacturing

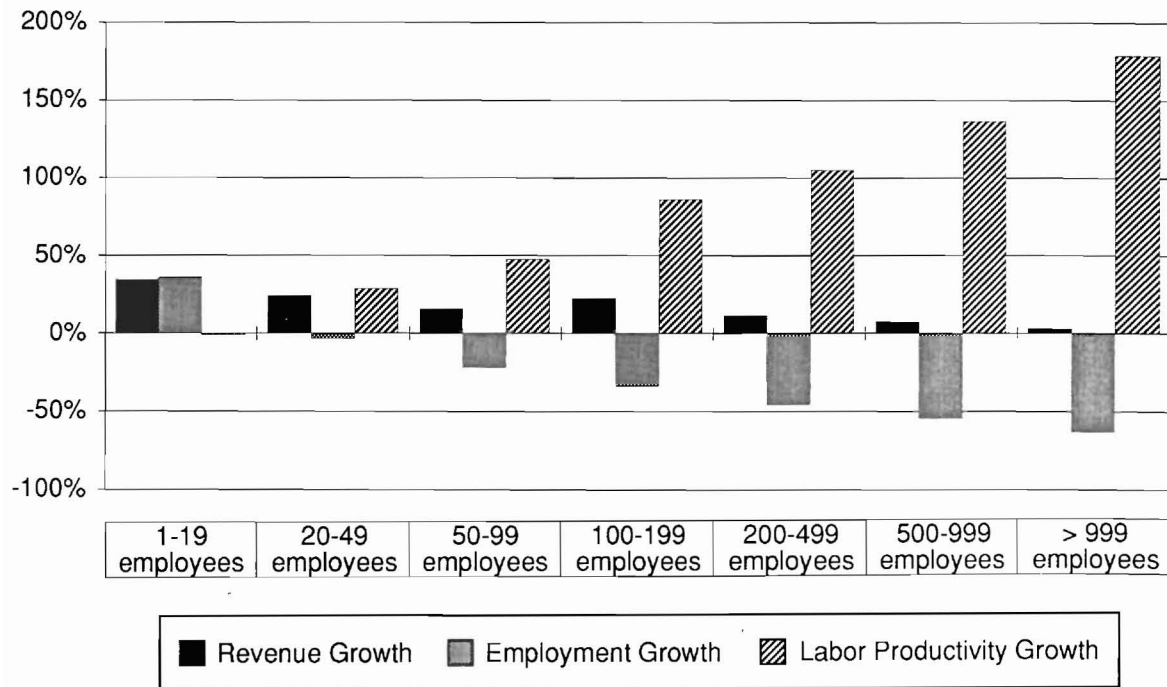


Figure 1b

Revenue, Employment and Labor Productivity Growth (1991-1992) by Firm Size - Construction

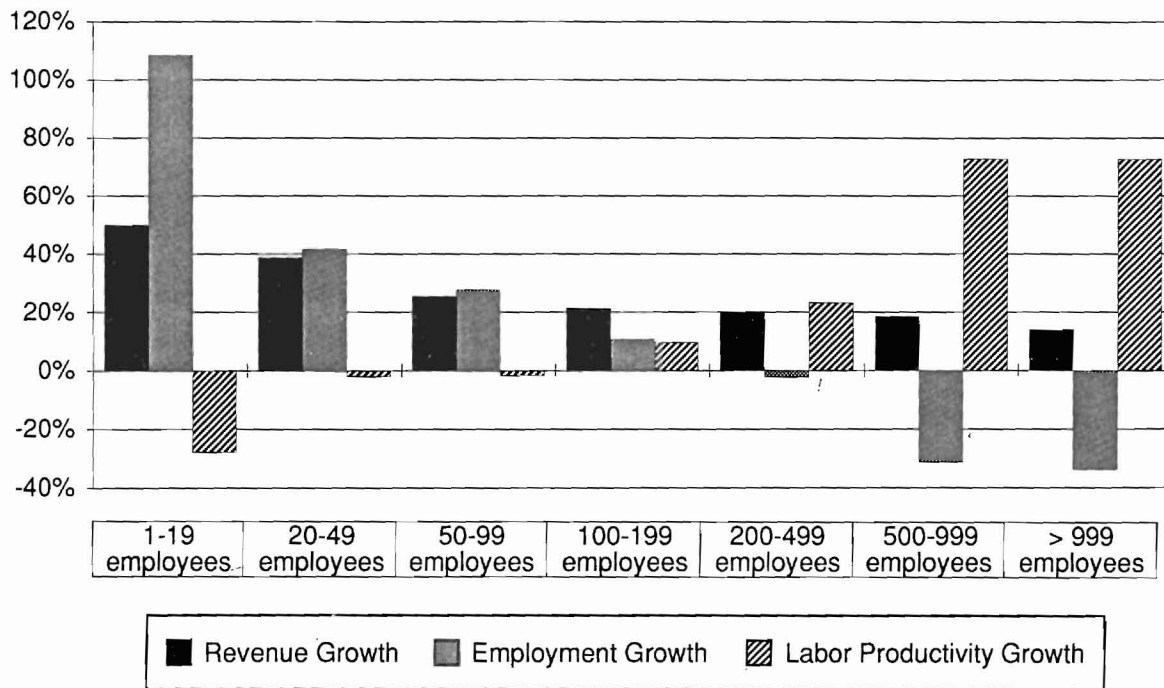


Figure 1c

Revenue, Employment and Labor Productivity Growth (1991-1992) by Firm Size - Trade

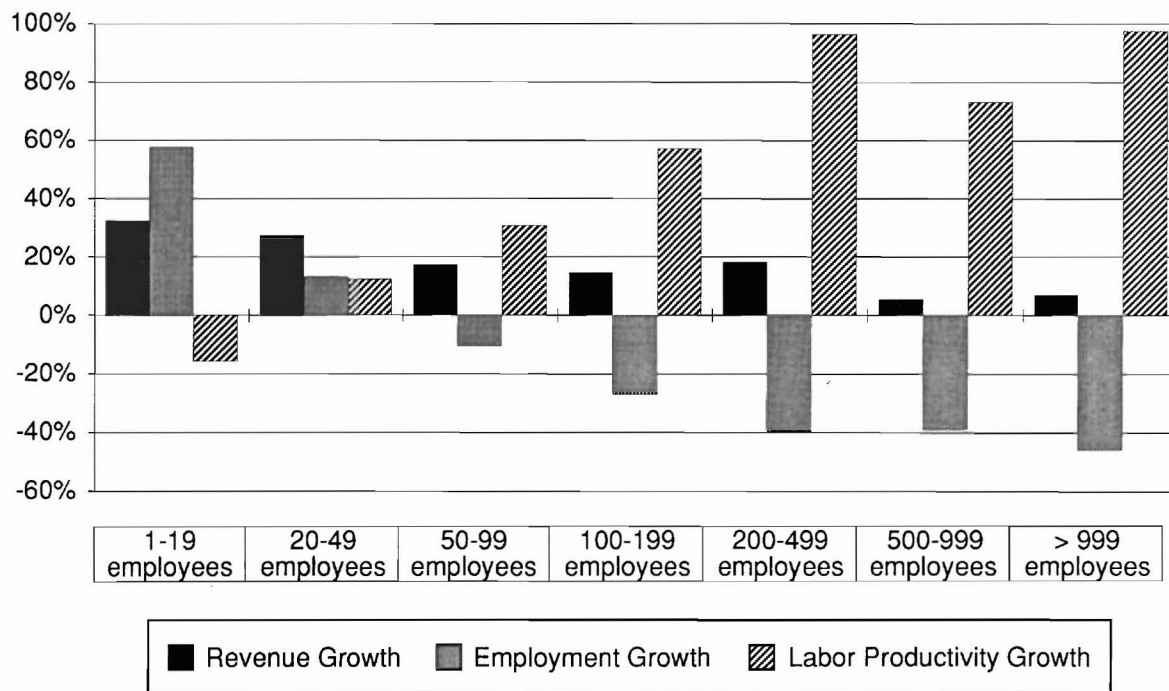
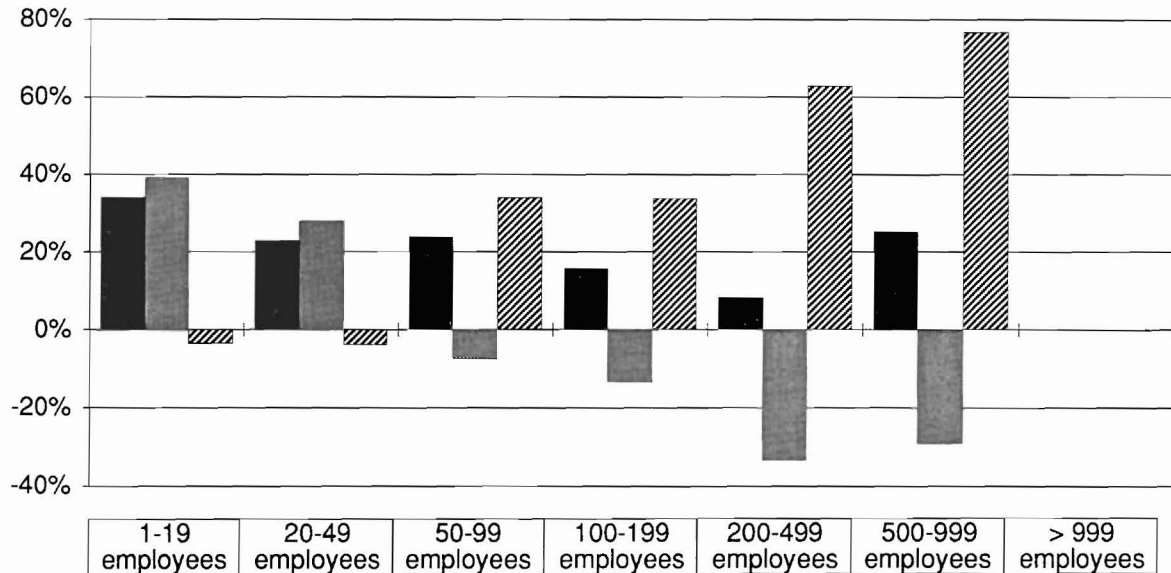


Figure 1d

Revenue, Employment and Labor Productivity Growth (1991-1992) by Firm Size - Services



Revenue Growth
 Employment Growth
 Labor Productivity Growth