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The pre-exit performance of German plants - How long is the “Shadow of Death”?

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– Preliminary Version - please do not quote –

Abstract

This paper deals with the question whether firms’ employment and wage performance in the periods preceding their exit can be regarded as casting a “Shadow of Death” on their final leaving the market. This aspect is of high relevance for politicians and other decision-makers, because by knowing more about possible indicators of market exit, they might have instruments at hand to detain unwanted firm deaths. This paper studies the pre-exit performance of German plants in terms of both change in employment and in wages. To this we use a comprehensive data set that covers the whole of Germany and contains monthly plant data for the years from 1999 to 2012. Carrying out detailed sector-, region- and time-specific analyses, in a first step we complement the existing literature on the pre-exit performance of plants in detailed descriptive respects. Furthermore, it is not very clear how long the “Shadow of Death” is and which influence can be attributed to factors specific to the firm, its employees or its environment. Therefore, in a second step we use statistical matching approaches to determine the length of the “Shadow of Death”.

Keywords: Plant closure, employment change, wage change, statistical matching

JEL classification: C14, J65, L25, R30

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1 Introduction

One of the most intriguing research questions in the field of Industrial Economics is the one on the impact of firm births and deaths on the development of firm employment. Within this strand of literature three groups of studies can be distinguished: the first group analyses the job and labour turnover and in detail the creation and destruction of jobs in newly founded businesses, in growing and shrinking firms as well as in business closures (Davis/Haltiwanger/Schuh, 1996, Fuchs/Weyh, 2010 or Ludewig/Weyh, 2011). The second group of studies concentrates on the post-entry performance of new firms and analyses the survival and growth of new firms (Evans, 1987, Fritsch/Weyh, 2006 or Schindele/Weyh, 2011). While these two groups are covered extensively in empirical research, so far only few studies have been dedicated to the third strand of research that looks at the end of the plant life cycle. Here, research centers on the pre-exit performance of firms and covers the reasons for closing down or the existence and appearance of specific indicators for the market exit of plants. These aspects, however, are of high relevance not only in scientific respect, but also for politicians and other decision makers, since possible evidence on symptomatic employment trajectories might help to detain unwanted firm deaths.

Empirical literature on the “Shadow of Death” is sparse and not very conclusive. Table 1 presents an overview on selected international studies. Grichiles/Regev (1995) can be seen as the first movers in investigating the performance of plants before exiting the market. They find a worse economic performance of market drop-outs among Israeli industrial firms in comparison to surviving firms and simultaneously coin the phrase “Shadow of Death” in this context. In the studies mentioned, plant performance is measured by employment, respectively the growth rate of employment, or by productivity. All four studies that refer to employment find as result that employment decreases before firm closure. For Austria, Schwerdt (2011) specifies the death of plants, but in rates of at least three years, whereas the other studies identify a length of the “Shadow of Death” of six years. The other two studies that focus on productivity instead of employment as the variable of interest also find evidence for a death in rates, but argue that its length depends on the sector and plant cohort under consideration.

Table 1: Selected empirical studies on the “Shadow of Death”

Study	Country	Period	Method	Variable	Length of the “Shadow of Death”
Grichiles/Regev (1995)	Israel	1979 – 1988	regressions	productivity Δ employment	existent, but no length specified
van der Wiel (1999)	Netherlands	1987 – 1995	descriptive	productivity	1 – 3 years
Kiyota/Takizawa (2006)	Japan	1995 – 2002	hazard models	TFP employment	5 years 6 years
Bellone et al. (2008)	France	1990 – 2002	descriptive, non-parametric matching	TFP profitability employment	at least 10 years 9 years 6 years
Carreira/Teixeira (2011)	Portugal	1991 – 2000	hazard model	productivity	0 - 9 years
Schwerdt (2011)	Austria	1978 – 1993	descriptive, regressions	employment	at least 3 years

For Germany, there are to our knowledge four studies that deal with the pre-exit performance of plants. Wagner (1999) analyzes in a predominantly descriptive way the pre-exit performance of

manufacturing firms in the federal state of Lower Saxony for the three yearly exit-cohorts 1990 to 1992. He finds no evidence for the existence of a “Shadow of Death”. Only a minor fraction of exits lived through a period of continuous employment decline of at least five years before closing down. A second result shows that only one fourth of all exits is less than five years old, implying that the fact of a liability of newness in the manufacturing sector of Lower Saxony is much lower than expected. Niese (2003), in contrast, states a death in rates in his investigation of firms in the federal state of Saxony. With regard to productivity, the exits show a deterioration already three years before closing down. Likewise, the exits’ growth rates of employment are lower in the last three years before market drop-out. Additionally, he provides evidence for a relatively low impact of environmental factors on the probability of closing down. Almus (2004) confirms the existence of a “Shadow of Death” by investigating the start-up cohorts of 1990 to 1993 that closed down until 1999. By comparing plants with the same characteristics and resorting to non-parametric matching methods, his central finding is that for those plants exiting the market the growth rate of employment is significantly lower during the last three years than for survivors. For East Germany, Almus (2004) reports a shorter period of only of about one year. A recent study by Fackler/Schnabel/Wagner (2012) uses administrative data covering the whole of Germany, thereby extending and generalizing the work by Almus (2004). The authors analyze the employment development of the exit cohorts 1980-2003 for West Germany and 1998-2003 for East Germany in the last five years of existence and compare them with surviving firms. The findings support evidence for the existence of the “Shadow of Death” in that firms shrink in all five years before market drop-out, that employment growth rates differ substantially between exits and survivors, and that this difference becomes stronger as exit approaches. Furthermore, the composition of the workforce in the exiting firms changes as compared to the survivors.

This paper extends and complements the results of Fackler/Schnabel/Wagner (2012) in two important aspects. First, we explicitly control for the age of the plants and compare exits and survivors that belong to the same market entry cohorts. This aspect is of special relevance for Germany, since the firms in the Eastern part of the country have encountered a different economic environment due to the rapid structural changes in the 1990ies and were more successful in terms of employment growth (Brixy, 1999, Fuchs/Weyh, 2010). These differences in the economic framework need to be controlled for in order to compare the adequate firms. Second, to the best of our knowledge, we are the first to not only look at employment as a measure of plant performance, but additionally scrutinize the development of wages. Resorting to a comprehensive monthly data set on all plants with at least one employee liable to social security systems, we follow the three market entry cohorts of 1999 to 2001 until the year 2012 and use the average yearly employment growth rate and the wage per employee as performance measures. We take into consideration detailed sector-, region- and time-specific information of firm performance. Similar to Almus (2004) and Fackler/Schnabel/Wagner (2012), we use a nonparametric statistical matching approach in order to isolate the factors decisive for market exit. To this end we match the exits and survivors with respect to important characteristics specific to the plants at start-up as well as to the regional environment they are located in and scrutinize the employment and wage growth in each of these two groups of firms.

The paper is structured as follows. In chapter 2, we describe our data in detail and present the statistical methods used. Chapter 3 is dedicated to the empirical analysis. We start in chapter 3.1

with descriptive results on employment and wage growth in the exiting as compared to the surviving firms. The matching results are contained in chapter 3.2. The paper concludes with some policy implications and further research questions.

2 Data and methodology

2.1 Data

For our analysis we use monthly data from the German Employee and Benefit Recipient History that is aggregated to the plant level using the included plant numbers. These numbers are assigned to the plants when they enter the database, i. e. when they record their first employee liable to social security contributions. The data is constructed and provided by the Institute of Employment Research at the Federal Employment Agency (Bundesagentur fuer Arbeit). This comprehensive database contains information on all plants throughout Germany that have at least one employee required to make social security contributions. The Social Insurance procedure was introduced in 1973 and compels employers to regularly report all changes that have occurred in the number of workers who are subject to health or unemployment insurance or who participate in a pension scheme. Since there are legal sanctions for misreporting, the data is very reliable. Next to these information the data contain socio-demographic aspects of the employees like sex, age or qualification and some plant characteristics like the affiliation to a sector or a region.

In principle, the data are currently available from 1975 to 2012. However, due to changes in the industry classification schemes in 1998 and 2008 as well as changes in the reporting procedure in 1999 the relevant time period for our analysis starts in 1999. In order to create an industry classification that is consistent throughout the observation period, we resort to the procedure of Eberle et al. (2011) and additionally take into account regional differences in the industry setup. The number of employees, which is our central variable to capture firm performance, is measured in full-time equivalents, i. e. part-time employment counts as 0.5 full-time equivalents and marginal employment is equivalent to 0.2 full-time employees. We measure the human capital endowment by the highest formal educational degree obtained by the employees. The share of low-skilled employees relates the number of employees with no formal vocational qualification, the share of medium-skilled refers to those with completed apprenticeship, and the share of high-skilled to employees with a university degree. Since in the dataset the qualification variable is not always filled in the data due to reporting inconsistencies, it is interpolated in the sense of Fitzenberger/Osikominu/Voelter (2006).

In addition to the variables related to the plants themselves and their employees, we include information on the plant location. The dummy variables indicate, first of all, if the plant was founded in West Germany. This is necessary, as there are still various differences between East and West Germany that also affect plant performance (see Almus, 2004). Furthermore, the kind of economic environment the plant is located in is taken into account. We use dummy variables for three different regional structures that are constructed by the BBSR¹ and classify the German NUTS3-districts

¹The *Bundesinstitut fuer Bau-, Stadt- und Raumordnung* (BBSR) deals with the fields of spatial planning, urban development, housing and building. See http://www.bbsr.bund.de/BBSR/DE/Raumb Beobachtung/Raumabgrenzungen/SiedlungsstrukturelleGebietstypen_alt/gebietstypen.html?nn=443270 for more details on the classification.

according to the number of inhabitants and the population density into agglomerations, moderately congested regions or rural areas.

As mentioned above, the plants get their plant number when they record their first employee liable to social security contributions. We define this date as the date of plant start-up. In the same way, we define the closure of a plant when it reports its last employee. In this paper, we do not differentiate between a plant start-up and market entry, because the data does not allow to differentiate between these two definitions and it is also not directly relevant for our purpose. Altogether, the data cover approximately 80 percent of total employment in Germany, the remaining 20 percent mainly consisting of civil servants and self-employed. It provides information on the number of employees in 6.5 million plants as well as on 4.2 million plant entries and 3.9 million plant exits between 1999 and 2012. This comprehensive coverage of the German firm universe offers a significant advantage compared to other studies in this field that merely rely on firm surveys (e.g. Wagner, 1999 or Almus, 2004).

2.2 Methodology

Analysing the pre-exit-performance of plants would not be extremely demanding if it were not accompanied by two methodological difficulties: the fundamental evaluation problem and the selection problem. The fundamental evaluation problem (Heckman/LaLonde/Smith, 1999: 1879) is that the pre-exit performance of exits cannot be observed simultaneously in the counterfactual situation of survival, i. e. it is not possible to observe the employment growth for the exits if they were a survivor. The selection problem, on the other hand, results in the potential of all survivors not being an adequate control group for the hypothetical state of a non-closure of a plant because the two groups differ systematically with regard to pre-exit-relevant variables.

In order to solve the evaluation and selection problem, Roy (1951) and Rubin (1980) developed an adequate approach with the so-called potential outcomes framework. This non-experimental matching approach essentially involves finding for each exit a control observation that is largely similar with regard to all the characteristics that influence the pre-exit performance. Ideally, the exits and the matched non-exits should differ only with regard to the value of the dichotomous variable indicating the exit or survival respectively (“statistical twin”). In this case, the pre-exit performance of the selected non-exits can be interpreted as a proxy for the counterfactual performance of the exits if they had survived.

To understand this argumentation better, let us define the variable of interest at this point, i. e. the pre-exit performance in its empirical realisation. We measure the pre-exit performance of a plant with its yearly growth rates of employment from five years on before closure. This year-to-year continuous growth rate, $Y_{t+1,t}$, is calculated as follows:

$$Y_{t+1,t} = \ln(\text{employment}_{t+1}) - \ln(\text{employment}_t) \quad (1)$$

The major assumption of the matching procedure is that the potential pre-exit performance of plants with the same characteristics relevant for the pre-exit performance X is statistically independent from a potential exit. This premise has found its way into the literature as the assumption of ignorable treatment assignment (Rosenbaum/Rubin, 1983: 43) and the conditional independence assumption

(CIA, Lechner, 2004: 9). It requires that X contains all of the covariates that jointly influence the likelihood of exit or survival and the pre-exit performance. It is additionally assumed that causal effects of exit or survival on individual pre-exit performance remain unaffected by whether other plants exit or survive (stable unit treatment value assumption, see Holland/Rubin, 1988: 205).

When matching exits with non-exiting firms it must be taken into account that the matching process becomes increasingly complicated the larger the number of covariates or their range of values is. Consequently, the quantity and quality of the matched pairs need to be taken into consideration when deciding which matching system to use. A two-step procedure is suitable when using larger data sets as in our case. In the first step it is necessary to achieve uniformity within the individual pairs as regards factors that influence the pre-exit performance (covariate matching). To this end, for each exit all non-exits with identical values in the relevant variables are sought for in the data. We concentrate on the start-up cohort, plant-size class and sectoral and regional affiliation of the plant as central matching variables, as these characteristics have turned out to have a substantial impact on individual pre-exit performance (e.g., Almus, 2004). In the case of metric values, demanding an identical value would inevitably lead to a considerable reduction in the number of twins. In these cases it is recommendable to specify intervals for metric parameters (see e.g. Engel, 2003 for such a procedure).

If more than one non-exit meets the identity requirements, a further step is taken to select the control unit with the closest propensity score to that of the exit from the pool of all control units that are identical in the above mentioned variables, which is then the control unit of that exit (nearest neighbour matching). This one-dimensional measure takes into account not only the variables of the covariate matching procedure but also other matching variables and represents the likelihood of plant exit or survival – depending on its characteristics. This likelihood is estimated for all plants in both groups using a probit model. The procedure of assigning control units follows the “sampling with replacement” method, such that a non-exit may be selected as a control unit more than once for different exits.

The reliability of the results obtained using a matching procedure depends on whether it is possible to achieve the greatest possible similarity between the two groups and consequently to solve the selection problem. It is to be assumed, however, that the differences between the exits and the non-exits are not limited to the observed characteristics but also cover unobservable factors. For this reason, the so-called conditional difference-in-differences estimator (DiD, see Heckman/Ichimura/Todd, 1997: 612ff) is used in a final step. Here, the focus is not on comparing the pre-exit performance in the periods following an exit but on examining the exits’ pre-exit performance between t_1 , the end of the investigation period, and t_0 , which is the year before the plant exit (first difference, $(Y_{t_1}^1 - Y_{t_0}^0 | d = 1)$) in relation to the corresponding non-closures’ pre-exit performance (second difference, $(Y_{t_1}^1 - Y_{t_0}^0 | d = 0)$). The average effect on the exits’ pre-exit performance (average treatment effect on the treated, α_{ATT}) conditional on the covariates can then be calculated as follows:

$$ATT_{DID} = [E[Y_{i,t_1}^1 - Y_{i,t_0}^1 | d = 1, p(X_{i,t_0}), Z_{i,t_0}] - E[Y_{i,t_1}^0 - Y_{i,t_0}^0 | d = 0, p(X_{i,t_0}), Z_{i,t_0}]], \quad (2)$$

where $d = 1$ represents the state of exit and $d = 0$ the state of survival, Z_{i,t_0} contains a set of individual characteristics for covariate matching and $p(\cdot)$ stands for the propensity score based on characteristics

X_{i,t_0} (contains Z_{i,t_0} and other plant-related characteristics).

3 Empirical analysis

In this section, in the first place detailed descriptive evidence is provided on the employment and wage pattern of market exits and non-exits. The second part is dedicated to the results of the statistical matching procedure on the main determinants of the “Shadow of Death”.

3.1 Descriptive evidence

Most of the entries and exits take place at the end of a quarter in a year, especially at the end of the fourth quarter. This is not surprising, because it is very common to start a new firm and close a firm at the end of a year. Of course, entries and exits take place during the whole year, but their number is only about half of that at the end of a year.

Figure 3.1 displays the mean change in employment of those firms that had entered the market between 1999 and 2001 and exited between 2010 and 2012. As a comparison, it includes the survivors (no market exit until 2013) that also became active between 1999 and 2001. It is clearly visible that employment declines in the exiting firms, whereas it increases in the surviving firms. This pattern holds for all three start-up and exit cohorts.

On average, employment decline in the exits starts between 38 and 60 months before closure. This picture is also very similar for the other cohorts under consideration. These descriptive results are in line with the findings of Almus (2004), Niese (2003) or Schwerdt (2011) that for Germany and Austria find a “Shadow of Death”. It also becomes evident that employment decline in the exiting firms first is relatively low, and only about one year before exit the decline becomes stronger. One explanation might be that the firms slowly try to cut down on employment in order to restructure themselves and only after these measures do not work out, employment decline accelerates.

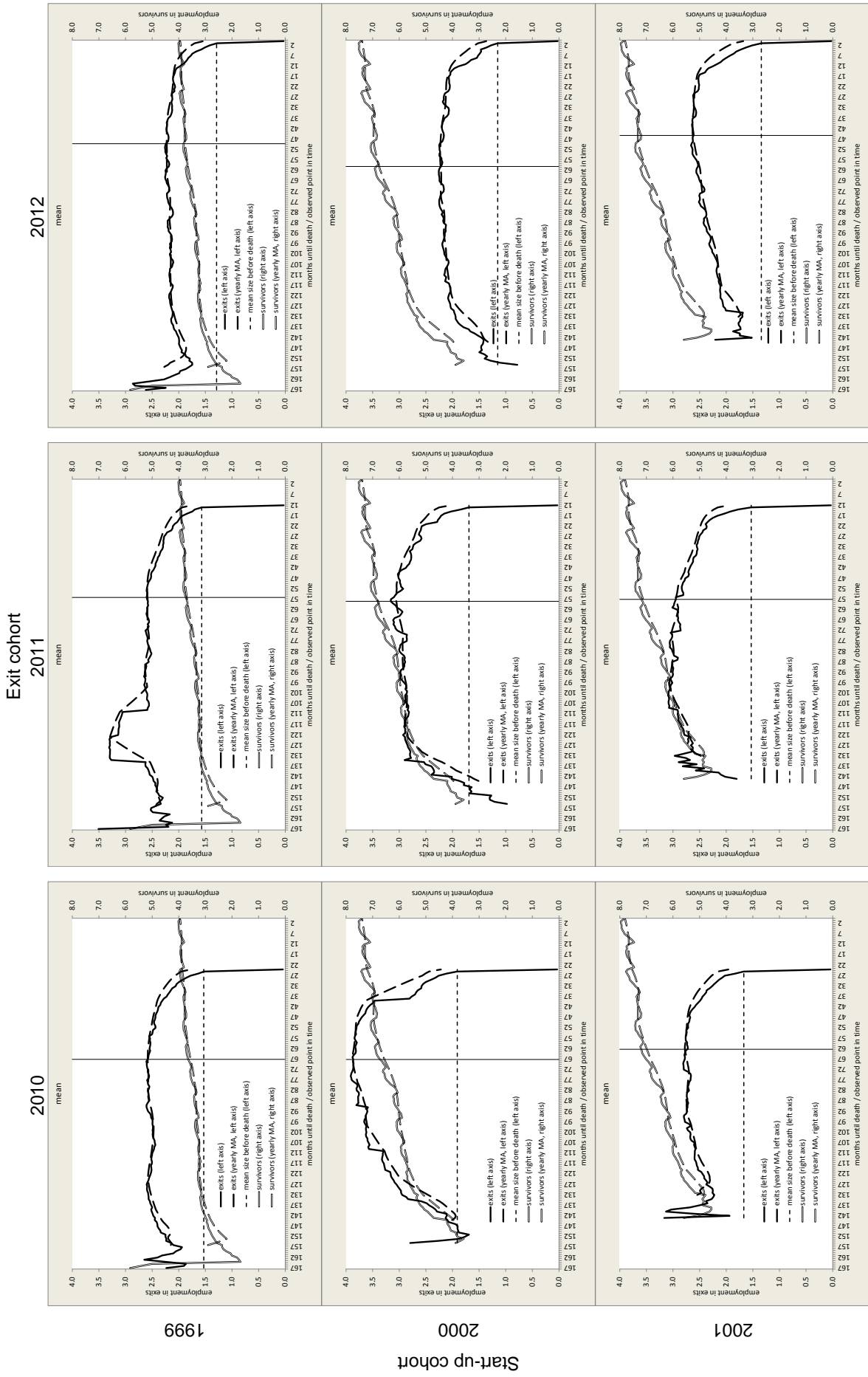
The vertical lines in 3.1 graphically mark the beginning of a “Shadow of Death” for the exits. For its calculation we resort to the moving yearly average employment change in order to take account of seasonal effects. Moving backwards from the time of market exit, we define the start of a “Shadow of Death” as the month when the level of employment is for the first time lower than in the preceding month. This pattern seems to be remarkably stable for all three start-up cohorts.

Figure 3.1 reports the mean change in the wages per employee, measured in full-time equivalents. As for employment, wages are generally lower in exits and do not grow as fast. The downward trend, however, becomes visible only relatively shortly before market drop-out. The vertical black lines graphically mark the beginning of the “Shadow of Death” in the same way as for employment. With respect to wages, there seem to be differences between the three cohorts. Especially in the exit cohorts of 2012, the wage decline start only shortly before market drop-out. Overall, wages per employee start to fall between 7 and 42 months before closure.

3.2 Matching results

Results of the covariate matching are depicted in table 2. As mentioned in chapter 2.2, it is necessary to carry out before using the difference-in-differences procedure in order to reduce the number of potential

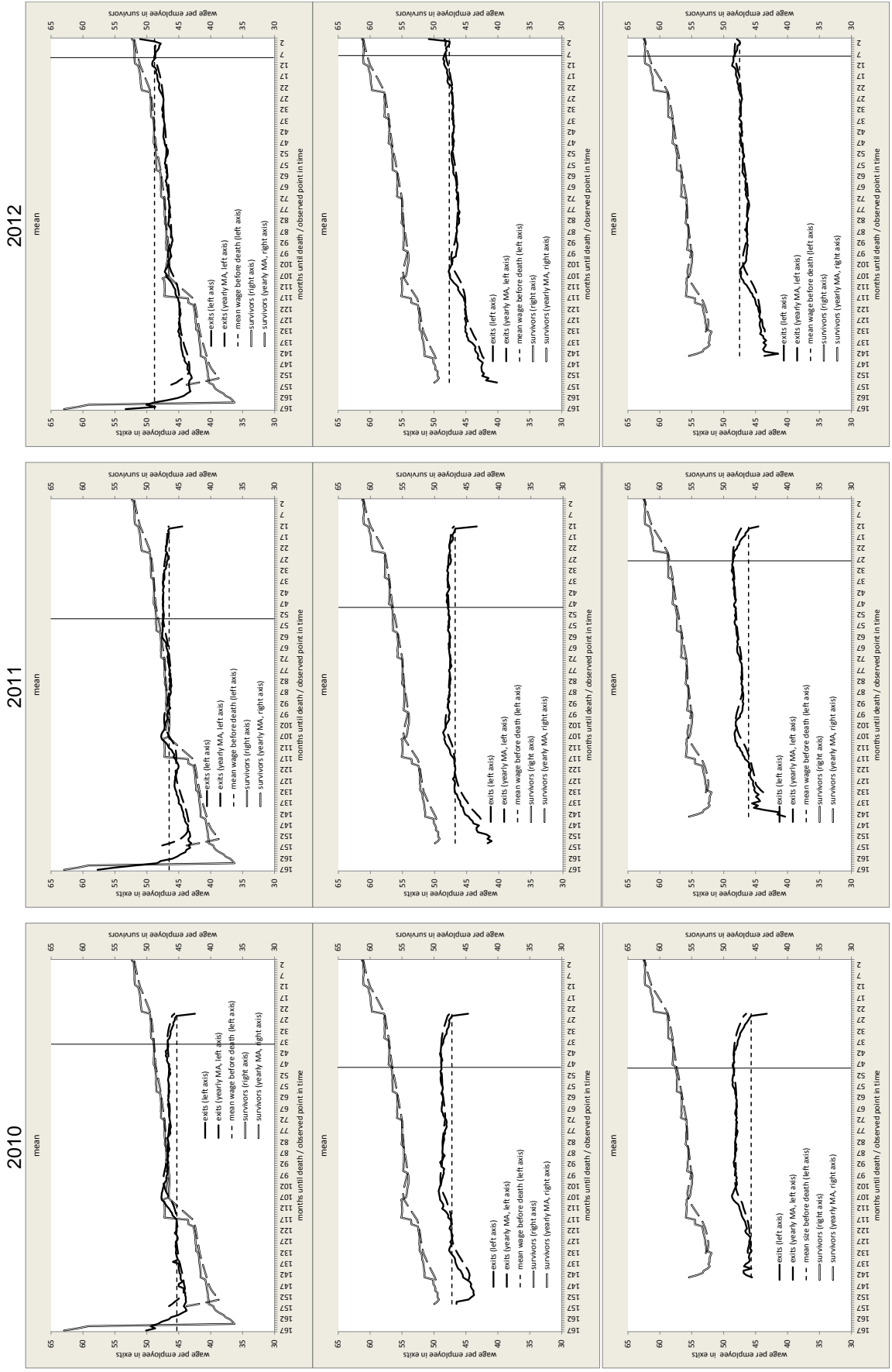
Figure 1: Employment in exiting and surviving firms, 2010 to 2012 (cohorts of 1999 to 2001)



Start-up cohort

Figure 2: Wage per employee (in full-time equivalents) in exiting and surviving firms, 2010 to 2012 (cohorts of 1999 to 2001)

Exit cohort



Start-up cohort

survivors in the process data. In the first column descriptive statistics of the central variables for all 378,373 observations in the data set are provided. These are all firms that were founded between 1999 and 2001 and survived at least until the end of 2009. The last three columns contain information on the results of the covariate matching. In column 2, all exits are included that have a surviving plant as a statistical twin. Since we use the “sampling with replacement” method, one survival can be used as a statistical twin for more than one exit. The variables that have to be identical for both exits and survivors are the start-up cohort, the plant-size class, the sectoral affiliation at the 2-digit classification level and the regional origin as measured by the location in one labor-market region. The last two columns in table 1 feature separate statistics for the exits and the survivors.

For the estimation of the propensity score as well as the treatment effect we first resort to the nearest neighbour matching with replacement using the Stata module PSMATCH2 by Leuven/Sianesi (2003). It selects the best control matches for each firm in the treatment group, and one non-treatment (survivor) can be used as comparison for several treatments (exits). The outcome variable is the growth rate of employment as specified in section 2.2 at several points in time after start-up. Since in figure 3.1 we could observe the maximum length of the shadow of death of about five years, we consider in the matching process the last five years before market exit respectively the 7th to 11th years after start-up, since it must be controlled for the age of the establishments. Taking into consideration the variables listed in table 2 and the fact that there needs to be accordance between treatments and controls with respect to start-up cohorts, plant-size class, 2-digit industry and labour-market region, there remain statistically significant differences in the employment growth rates as evidenced in table 3.

It is interesting to note that the difference in the employment growth rates between the exits and survivors increases with the time left until market exit, which is also confirmed by Fackler/-Schnabel/Wagner (2012). This difference increases especially strongly between the tenth and the eleventh year of observation. This implies that the decline of employment in the exits does not follow a linear trend, as was already visible in figure 3.1.

Regarding the matching quality it becomes evident that in all models in 4 there remain no statistically significant differences that exceed a bias of more than three percent (see Caliendo/Kopeinig, 2008). Further tests on the matching quality like the pseudo R^2 give evidence on the stability of the results.

In spite of the fact that with the propensity score matching a causal relationship is analyzed there remain variables that exert an influence on firm employment change but are not or cannot be taken into consideration. To account for a possible bias of the matching results arising from unobserved factors we conduct a sensitivity analysis proposed by Rosenbaum (2002). The so-called Rosenbaum bounds approach allows to determine how strongly an unobserved variable must affect the selection process of a firm into the treatment group in order to invalidate the conclusions on the causal relationships drawn from the matching analysis. The sensitivity analysis attests a high resilience to the results independent from the point of time to which the growth rate of employment is observed. Even if the selection bias has a relation of 1.7 to 1 (as in case of the employment growth rate after 11 years of market entry), the treatment effect is still negative and significant. Averaged over the five considered growth rates of employment, the results remain negative and significant, with a selection bias of 1.4

Table 2: Descriptive statistics of selected variables for the whole sample and the data after covariate matching

Variable	whole sample	data after covariate matching		
		whole	treatment exits	selected controls survivors
Size at start-up	2.498	1.289	1.259	1.301
Average growth rate in percent in				
the first year of existence	1.670	0.901	0.671	0.984
the second year of existence	0.237	0.229	0.100	0.273
the third year of existence	0.140	0.143	0.073	0.165
the fourth year of existence	0.115	0.116	0.048	0.139
the fifth year of existence	0.131	0.131	0.079	0.148
the sixth year of existence	0.116	0.118	0.069	0.134
the seventh year of existence	0.112	0.111	0.060	0.127
the eighth year of existence	0.098	0.099	0.040	0.118
the ninth year of existence	0.084	0.087	0.020	0.107
the tenth year of existence	0.072	0.069	-0.011	0.089
the eleventh year of existence	0.058	0.058	-0.144	0.080
the twelfth year of existence	0.049	0.048	-0.219	0.068
the thirteenth year of existence	0.038	0.035	-0.049	0.050
Start-up cohort				
1999	0.523	0.544	0.529	0.550
2000	0.244	0.233	0.243	0.230
2001	0.234	0.223	0.229	0.221
Exit cohort / survival				
2010	0.064	0.069	0.263	
2011	0.063	0.068	0.259	
2012	0.114	0.125	0.477	
2013	0.760	0.739		1.00
Sector				
Agriculture, hunting and forestry	0.028	0.027	0.030	0.026
Fishing	0.000	0.000	0.000	0.000
Mining and quarrying	0.001	0.000	0.000	0.000
Manufacturing	0.060	0.029	0.034	0.028
Electricity, gas and water supply	0.002	0.001	0.001	0.000
Construction	0.076	0.080	0.082	0.080
Wholesale and retail trade etc.	0.172	0.178	0.179	0.177
Hotels and restaurants	0.065	0.070	0.089	0.063
Transport, storage and communication	0.037	0.030	0.036	0.029
Financial intermediation	0.028	0.025	0.027	0.024
Real estate, renting and business activities	0.308	0.332	0.316	0.337
Public administration and defence etc.	0.006	0.004	0.003	0.005
Education	0.016	0.014	0.014	0.014
Health and social work	0.079	0.082	0.049	0.094
Other service activities	0.099	0.100	0.095	0.101
Private households with employed persons	0.043	0.048	0.061	0.044
Extra-territorial organisations	0.001	0.001	0.001	0.001
Human capital endowment				
share of low-skilled	0.199	0.206	0.235	0.195
share of medium-skilled	0.662	0.652	0.625	0.661
share of high-skilled	0.054	0.052	0.044	0.055
share of missing qualification	0.086	0.091	0.095	0.090
daily wage per full-time equivalent in Euro	47.98	46.09	43.56	47.02
share of women	0.560	0.580	0.560	0.587
Regional origin				
founded in West Germany	0.833	0.842	0.832	0.845
Agglomeration	0.477	0.502	0.497	0.504
Moderately congested region	0.311	0.304	0.302	0.305
Rural area	0.213	0.195	0.202	0.192
number of observations	378,373	334,647	87,410	247,237

Table 3: Employment growth rates for exiting versus surviving establishments, matched sample

Growth rate in the ... year after start-up	Treatments	Controls	Difference
7th	0.042	0.106	-0.064***
8th	0.032	0.098	-0.067***
9th	0.003	0.089	-0.086***
10th	-0.006	0.087	-0.093***
11th	-0.070	0.069	-0.140***

*** denotes significance at the 1-percent level.

Table 4: Balancing of selected variables after matching

Variables	Growth rate in the ... year after start-up									
	7th		8th		9th		10th		11th	
	bias	Significant differences	bias	Significant differences	bias	Significant differences	bias	Significant differences	bias	Significant differences
Start-up size	0.2	no	0.9*		0.4	no	-0.2	no	-1.1**	
Share of high-skilled	0.9*		1.1**		0.3	no	0.4	no	0.7	no
Share of medium-skilled	0.6	no	0.3	no	0.1	no	0.3	no	1.4**	
Share of low-skilled	-0.4	no	0.2	no	0.3	no	-0.2	no	-0.9	no
Share of women	-0.9*		-1.4**		-1.2**		-0.8	no	-1.6**	
Daily wage per full-time equiv.	-1.7***		-1.4***		-1.3**		-1.5**		-0.4	no
Start-up cohort	Identical via pre-selection									
Plant-size class	Identical via pre-selection									
2-digit Industry code	Identical via pre-selection									
Labor-market region	Identical via pre-selection									
Pseudo R^2	0.000		0.000		0.000		0.000		0.000	

*** denotes significance at the 1-percent level, ** at the 5-percent level and * at the 10-percent level.

to 1.

As to the robustness of the results we plan to conduct to further matching procedures. Furthermore, the respective start-up and exit cohorts should be analyzed separately. Matching across changes in the wage per employee in full-time equivalents is work in progress. Here, the descriptive analysis suggest a much shorter shadow of death which might also be less stable with regard to the respective exit cohort.

4 Conclusions

This paper investigates whether the performance of firms in terms of employment and wages in the periods before market drop-out can be regarded as casting a “Shadow of Death” on their exit. Using comprehensive data on German plants, we follow the performance of the market entry cohorts from 1999 to 2001 that exited between 2010 and 2012. Descriptive evidence shows that, on average, employment change differs markedly between exits and survivors. Employment decline in the exits starts between 38 and 60 months before closure, whereas wages per employee start to fall between 7 and 42 months before closure. These findings provide evidence on the existence of a “Shadow of Death” and, for employment, corroborate the results of Almus (2004) and Fackler/Schnabel/Wagner (2012). The results of the propensity score matching confirm the robustness of our findings for employment growth.

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