The Growth and Human Capital Structure of New Firms over the Business Cycle

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Abstract

Recent research suggests that employment in young firms is more negatively impacted during economic downturns than employment in incumbent firms. This questions the effectiveness of policies that promote entrepreneurship to fight crises. We complement prior research that is mostly based on aggregate data by analyzing cyclical effects at the firm level. Using new linked employer-employee data on German start-ups we show that under constant human capital of the firms' founders, employment growth in less than 1½-year-old start-ups reacts countercyclically and employment growth in older start-ups reacts procyclically. The young start-ups realize their countercyclical growth by hiring qualified labor market entrants who might be unable to find employment in incumbent firms during crises. This mechanism is highly important in economic and management terms and has not been revealed by prior research.

Keywords: Firm growth, Entrepreneurship, Business cycle, Crisis
JEL classifications: E32, J23, L26, M13, L25, L11, D22

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1 Introduction

Apart from the drawback of the overall drop in demand, could a crisis also offer opportunities for the growth of new firms? Young firms face problems attracting skilled personnel. Compared to established firms they offer jobs with lower pay and a lower level of security. During the time it takes to get the new business up and running successfully, young firms pay less because they earn less, or perhaps even nothing (Brown and Medoff, 2003; Brixy et al., 2007; Nyström and Elvung, 2014). The jobs they offer are less secure than those in incumbent firms because young firms face a high risk of failure and do not yet offer clear career paths (Schnabel et al., 2011). Given these setbacks, one wonders how new firms are able to hire skilled staff at all. One explanation seems to be that young firms offer non-pecuniary compensation that attracts specific groups of potential employees, for example young graduates (Ouimet and Zarutskie, 2014). Young employees are more risk-affine than older employees (Dohmen et al., 2011). Moreover, being one of the first employees in a successful, fast-growing new firm might be associated with the expectation of advantages over employees entering the firm later. Nevertheless, competing for skilled personnel with well-known incumbent firms is one of the biggest problems that young firms are confronted with. A situation like the very sudden and widely unforeseen economic downturn of 2008, however, might offer a remarkable opportunity for ambitious young firms: as incumbent firms shed labor and stop taking on new employees, a new generation leaving school, vocational training, or university is faced with great difficulties finding jobs. In this paper we ask whether, in such a situation, new firms can build up a stock of human capital that they could not usually afford.

The aggregate conditions for the growth of young firms can be expected to change over the business cycle. On the one hand, periods of recession are times of re-structuring and structural change. Thus, incumbent firms that drop out of the market make space for newcomers. This should increase the growth prospects of new firms compared to established firms during crises. On the other hand, economic crises are associated with decreasing demand and hence with economic uncertainty, which might impair the conditions for firm growth. In the aftermath of the Great Recession a growing strand of literature is concerned with differing effects of crises on the employment growth of small vs. large (Moscarini and Postel-Vinay, 2012) and young vs. old firms (Fort et al., 2013; Sedlácek and Sterk, 2014; Bartz and Winkler, 2016). The most prevalent finding is that, at the aggregate level, employment in young firms is impacted more negatively by crises than employment in established firms. This is explained by a particularly low ability of young firms to attract external funds when uncertainty about the prospects of a venture's success is high during economic downturns. However, none of the prior work delivers conclusions about firm-level consequences of aggregate conditions on young entrepreneurial businesses that are the major target of policies to promote entrepreneurship during crises. We overcome this deficit in the present study.

There are two main reasons why firm-level consequences for young businesses cannot be inferred from prior research. First, in most studies firms up to five years old are classified as young firms. We argue in the present paper that this neglects important changes in firm behavior during the

first years of business. Second, measuring effects at aggregate levels does not permit a clear distinction between selection and performance effects of the business cycle on new firm growth: during recessions the opportunity costs of self-employment are generally lower than during an upswing and "recession-push" effects can be expected to lead to an increase in entrepreneurial activity, especially of poorly qualified individuals (Congregado et al., 2012). Founders' human capital, however, affects the performance of new firms and largely determines initial conditions such as start-up size (Mata and Machado, 1996; Colombo et al., 2004) and access to and conditions of credit (Åstbro and Bernhardt, 2005).

Moscarini and Postel-Vinay (2012) argue that falling opportunity costs of workers strengthen the position of small employers on labor markets during crises. We argue that this effect should be even stronger for young firms. Reduced opportunity costs for workers during crises should lower the aforementioned thresholds for accepting jobs in new ventures. In other words, recession-push effects should not only apply to firm founders but also to workers' willingness to accept jobs in new firms. During a crisis, ceteris paribus, the available pool of workers willing to accept a job in a newly founded firm can be expected to be larger than during an economic upswing. Hence, conditional on the human capital of firm founders, new firms should be able to build up a stock of human capital during recessions that they would not be able to afford during more prosperous times.

The economic downturn beginning in 2008 was by far the most severe crisis in most countries around the globe for many decades. However, whereas it triggered a large structural crisis especially in some southern European countries, most northern European countries recovered rapidly. In Germany the crisis was the most serious economic downturn since World War II, but despite the size of the decline, the recession only lasted for one year. Unemployment figures increased only slightly, not least due to great efforts to expand short-time working schemes that prevented firms from shedding workers. However, firms that used such short-time working schemes were legally prohibited from hiring new staff before ending the scheme. Thus, while only few incumbent workers became unemployed as a consequence of the Great Recession, young people who gained their qualifications during the recession were confronted with great difficulties finding work. This situation should have led to the aforementioned evasive actions, with those affected therefore either becoming self-employed or accepting relatively unattractive job offers - such as those typical of newly founded firms. To test the suggested recession-push mechanism on workers, we explicitly analyze whether career starters are more likely to be hired by new firms during the Great Recession.

Using a new and very extensive database on the development of newly founded firms in Germany, we isolate the performance effect from the selection effect of the business cycle and establish five key findings conditional on the human capital of firm founders:

1. Start-ups founded during the Great Recession are 4.4 percentage points more likely to have at least one employee at the end of their first year in business than start-ups founded before or after the Great Recession.

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2. Start-ups founded during the Great Recession hire qualified career entrants disproportionately more often compared to start-ups founded before or after the Great Recession.

3. Start-ups founded during the Great Recession are larger on average after one year in business than non-crisis cohorts, and expand their size-advantage in subsequent business years.

4. The Great Recession fosters the growth of medium-sized new firms (up to the 90th percentile of the new firm-size distribution after one year in business) but does not foster the growth of fast-growing new firms (above the 95th percentile of the new firm-size distribution after one year in business).

5. Up to $1^1/_2$-year-old start-ups grow stronger countercyclically, older start-ups grow stronger procyclically.

These findings have important policy and management implications. For politicians, our results suggest that young firms can actually make important contributions to stabilizing aggregate employment during a crisis. More particularly, crisis start-ups offer jobs for labor market entrants whose entry into incumbent firms is blocked. Consequently, managers of new firms should be aware that they can make use of recessions to hire qualified career starters.

We proceed as follows. In Section 2 we discuss important prior findings about the impact of the business cycle on the growth of young firms. In Section 3, we provide detailed information on the cyclicality of the German economy since 2007 and cyclical effects on the German labor market. In Section 4 we present our empirical strategy and models. In Section 5 we describe the data used in the analyses. In Sections 6 and 7 we present our empirical results and discuss conclusions.

2 New firm growth and the business cycle: findings and mechanisms

Entrepreneurship is often seen as a measure to overcome crises by fighting unemployment (e.g. Thurik et al., 2008; Fritsch and Noseleit, 2013a,b; Llopis et al., 2015) and stimulating productivity (Aghion et al., 2005; Bosma et al., 2011; Andersson et al., 2012; Brixy et al., 2012).

Despite the importance of the topic, little is known about how aggregate economic conditions affect new firm growth. Bartz and Winkler (2016) divide existing studies into studies of (new) firm growth and business cycle research. While the former group, like the present study, is concerned with conditional firm-level consequences of aggregate conditions, the main interest of the latter group is unconditional cyclical effects on aggregate outcomes of groups of firms, e.g. in different size or age classes. Regardless of the approach used, the majority of studies on the impact of aggregate shocks on new firm growth reveal a procyclical relationship. The underlying reasons are mainly sought in the shrinking demand and in frictions in access to financial

resources, which was especially the case in the Great Recession (Robb and Robinson, 2014).

Fort et al. (2013) emphasize the importance of firm age rather than firm size in understanding cyclical impacts on firm performance. They present evidence that the net employment growth rates of small *young* firms fall more in recessions than those of older larger businesses.[1] This is largely confirmed by the results of Zarutskie and Yang (2016), Bartz and Winkler (2016) and Sedláček and Sterk (2014). The latter analyze job creation at the cohort level and note that the job creation of a cohort is largely driven by the stronger growth potential of new firms founded during boom periods and not by changes in the number of firms over the business cycle.

The results of studies which find a disproportionately strong procyclical reaction of new firm growth are partially contradicted by Lee and Mukoyama (2015) and by Moscarini and Postel-Vinay (2012). Lee and Mukoyama (2015) analyze US manufacturing plants and conclude that plants founded in recessions are significantly larger in terms of employment and more productive than corresponding plants founded during an economic upswing.[2] Focusing on a comparison of small vs. large, rather than young vs. old firms, Moscarini and Postel-Vinay (2012) present evidence that the net job creation of large firms reacts more sensitively to the business cycle than the net job creation of small firms. They show that, relative to smaller employers, larger employers destroy more jobs when unemployment is high and create more jobs when unemployment is low. Related to our reasoning, Moscarini and Postel-Vinay (2012) argue that high unemployment eases the restrictions of small employers on labor markets to a disproportionately large extent compared to larger employers.

None of the above-mentioned studies permits robust conclusions about our main point of interest: firm-level consequences of aggregate economic conditions for young entrepreneurial businesses. Comparable to the focus of the present study, Zarutskie and Yang (2016) and Bartz and Winkler (2016) use firm-level panel data which make it possible to control for firm heterogeneity. However, in neither of the studies it is possible to compare firms founded during and before the Great Recession. Zarutskie and Yang (2016) follow only the cohort of firms founded in 2004 and compare the development of these firms before, during and after the Great Recession. Bartz and Winkler (2016) analyze a sample which is representative of the German "Mittelstand" (SMEs) but not of new firms, and concentrate mainly on revenue rather than employment growth. Apart from that, Bartz and Winkler explicitly stress that their main result, which is a disproportionately large negative impact of the Great Recession on young businesses, does not hold for sole proprietorships or for employment growth in director-founder firms. These two types of firms constitute the major part of new firm entry however. Also Lee and Mukoyama (2015) are interested in micro-level outcomes but analyze plant-level data on US manufacturing plants. Their entries include mergers, acquisitions and divestitures, which can lead to abrupt changes in firm age purely due to establishment composition issues - issues that are more likely to occur in

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[1]They define a cyclical downturn as a period of contraction in the economy measured either by increases in the unemployment rate or declines in the output or net employment growth rate (Fort et al., 2013, p. 3).

[2]To be more precise: Lee & Mukoyama do not follow the usual classification for the US, of the NBER, but "divide the sample years into two categories, good and bad, based on the growth rate of manufacturing output" (Lee and Mukoyama, 2015, p. 22).

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an economic downturn than in an upswing. Accordingly, the new plants appearing in their sample have an average size of more than 50 employees and are clearly not representative of entrepreneurial entry.

In contrast to the focus of the present study, Moscarini and Postel-Vinay (2012), Fort et al. (2013) and Sedláček and Sterk (2014) focus on aggregate rather than firm-level outcomes. As a consequence, firstly, they do not differentiate clearly between selection and performance effects at the firm level, which would be necessary to derive firm-level conclusions. Secondly, whereas Moscarini and Postel-Vinay (2012) compare small and large rather than young and old firms, Sedláček and Sterk (2014) analyze cohorts of firms and Fort et al. (2013) class all firms up to five years of age as "young" firms. This might be insufficient to fully understand cyclical reactions of newly founded firms. In addition, all three papers use the US Business Dynamic Statistics (BDS) and have in common that this database is restricted to firms with at least one employee. Therefore, it generally does not cover genuine entrepreneurial activities. In fact, it is not uncommon for some time to pass between the foundation of a new firm and the recruitment of its first worker (e.g. only about half of the firms in our sample have hired personnel by the end of their first year in business). Hence, the very first question is whether new firms employ any staff at all. A large amount of the employment dynamics of newly founded firms occurs between a state with no employees and a state with one or a few employees. These dynamics are not covered by databases comprising firms with a minimum of one employee. A further severe drawback, especially when analyzing the cyclical patterns of new firm foundation and growth, is that also the US BDS database includes mergers, acquisitions and divestitures. Hence, the aforementioned issues with respect to changes in firm age due to establishment composition issues apply here as well.[3]

So far, hardly any papers have dealt with firm-level consequences of the business cycle on new genuine entrepreneurial firms. Our reasoning that new firms face problems attracting skilled personnel and that this might change over the business cycle particularly holds for genuine new firms however. Financial restrictions affecting the ability to pay competitive wage levels attenuate rapidly during the first years of business (Brixy et al., 2007) and subsidiaries or other types of derivative new firms might be able to make use of other channels for recruiting that are not available for genuine new start-ups (e.g. transferring staff from other sites).

3 Cyclicality and the great recession in Germany

"The current crisis is touching every country in the world, including the developing countries," wrote Joseph Stiglitz in 2009. Although the crisis began as a crisis of the subprime housing-market in the US, it very rapidly spread around the globe and in Europe led to a crisis of the Euro currency. In fact, the drop in GDP hit European countries harder than the US (Ball, 2014). In Germany, the decrease in GDP in percentage points was double that in the US (OECD, 2010;

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[3]Detailed information is provided under: `http://www.census.gov/ces/dataproducts/bds/definitions.html`

Brenke et al., 2013). In contrast to the development in the US, however, in Germany the crisis turned out to be unexpectedly short. The rapid recovery began as early as one year after the first quarter with negative growth (see Figure 1). As such, there are parallels with the sharp economic downturn of the US economy in 1982/83.
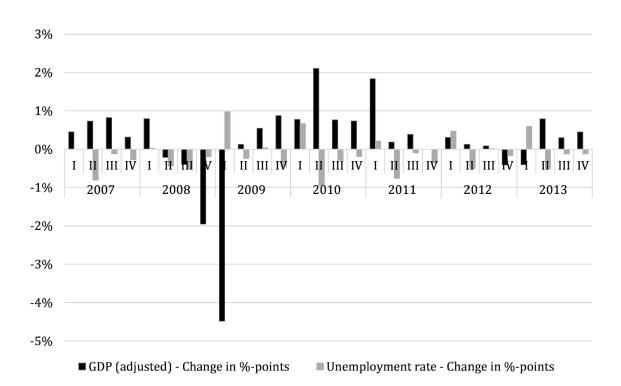
Figure 1: Development of GDP and unemployment in Germany 2007-2013 in quarters

Source: GDP. Federal Statistical Office, Unemployment: Federal Employment Agency

The Great Recession in Germany covered a period of four quarters, beginning in the second quarter of 2008 and ending with the first quarter of 2009.[4] What is remarkable is that the German economy entered the Great Recession after having been on a stable growth path during the year before and that the last quarter was the one with the deepest decline: the crisis in Germany had a rather fast and unexpected beginning and end. As Figure 1 additionally shows, the development of unemployment is not a suitable indicator for the Great Recession in Germany, as the unemployment figures were scarcely affected. German firms were on a stable growth path and were hit unexpectedly by the demand-side shock.

Having previously experienced a severe shortage of skilled workers, employers were reluctant to shed workers and tried to hoard staff (Balleer et al., 2016). This response was supported by the government via the expansion of short-time work subsidies. These are granted to estab-

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[4]There are several ways to measure cyclical developments. The most common method is to use the development of GDP (measured e.g. as periods of positive or negative growth or as deviations from the trend). See http://www.nber.org/cycles/jan2003.html or (OECD, 2010) for definitions of the term "recession" which are consistent with ours.
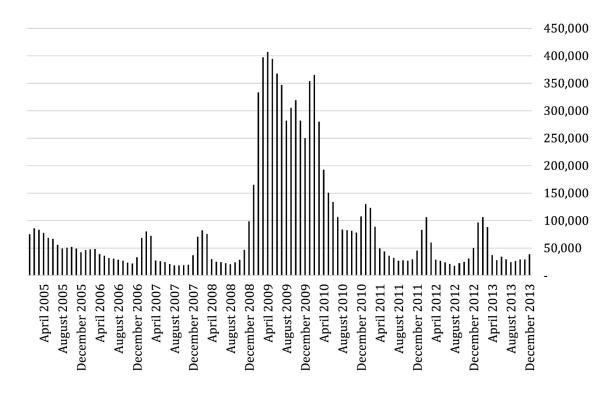
Figure 2: Development of full-time equivalent short-time work in Germany 2005-2013

lishments facing a temporary unavoidable loss of work for a minimum of one third of the staff. Because of the crisis, the conditions for entitlement to this subsidy were eased and the maximum entitlement periods were extended.[5] As Figure 2 shows, this scheme was widely used and, as the development of the labor market always lags behind that of GDP, the use peaked in May 2009 with some 1.5 million employees, when the scheme involved significantly more firms than in previous crises (Brenke et al., 2013). To allow first insights into the correlation between the business cycle and entrepreneurial activity, Figure 3 depicts the start-up rate of new businesses in Germany from 2003 to 2013. There is no apparent co-movement between the number of start-ups and the business cycle - at the very most a slight interruption in the overall declining trend at the beginning of the Great Recession in 2008. However, the marked increase visible at first glance is almost entirely explained by a change in the law. The change in the law came into force in October 2008 and led to the introduction of a new legal form of especially small limited companies (the "Unternehmergesellschaft" - UG).

The main reason for the change in the law was that in previous years increasing numbers of new firms based in Germany were registering as Limited Companies (Ltd.) in the UK due to more

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[5] "Cyclical Short-Time Working Assistance" is usually granted for up to six months. But in cases of exceptionally poor conditions on the labor market (§109 SGB III) the Federal Ministry of Labor is authorized to prolong this period up to 24 months. This leads to different maximum entitlement periods during the time analyzed in this paper. From 1 January until 30 June 2007, short-time working assistance could be claimed for up to 15 months. From 1 July to 31 December 2008 the time frame was reduced to 12 months, but from 1 January to 31 December 2009 the maximum period was extended again, this time to 24 months (Deeke, 2009; Brenke et al., 2013; Starke, 2015).
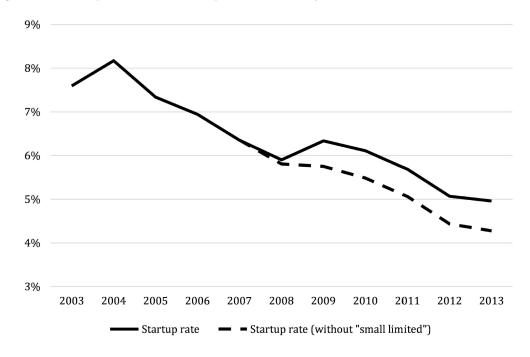
Figure 3: Development of the start-up rate in Germany 2003-2013

Notes: Number of new firms divided by the number of incumbent firms
Source: Mannheim Enterprise Panel (ZEW)

favorable conditions there with respect to limitations of liability. Hence, the Great Recession might have led to a small increase in firm foundations in Germany but most of the additional firms registered as UGs from 2009 onwards can assumed to be a "registration effect" rather than an actual increase in the number of firm foundations in Germany.

4 Models and empirical strategy

We argue in this paper that an economic crisis should alter the labor supply conditions for new ventures. To investigate such cyclical effects on the conditions for new firm growth empirically, we use new and very extensive data that cover entrepreneurial firms before, during and after the Great Recession and contain information on the performance of young firms as well as biographical data on their founders and employees.

Our main models are of the stylized form

$$Firm\ success_{it} = \gamma * Business\ Cycle + X_{it}\beta + \epsilon_{it}$$

Thus, we explain firm success in period t by cyclical influences and a set of firm-, founder-, and region-specific control variables X_{it}. We use different measures of firm success as dependent variables and different measures to approximate the business cycle as explanatory variables. We differentiate explicitly between analyses of cyclical influences at the time of firm foundation and current cyclical influences. We deliberately do not include general time trends in our models (as

is frequently done in business-cycle studies of more longitudinal character). In the rather short time frame we analyze, we expect time trends in our measures of interest to be a consequence of the business cycle for the most part. Including a time trend in the model would therefore confound the effects of the cyclical measures.[6]

4.1 Identification of causal effects

We consider the business cycle in general, as well as the Great Recession, to be exogenous shocks for the individual young firm, which is our unit of observation. In this we follow the arguments of Moscarini and Postel-Vinay (2012) for the identification of causal effects of aggregate economic conditions on single firms. While it seems plausible to assume that there is no direct reverse causality from the individual young firm to aggregate conditions, problems that remain are selection effects in the types of founders who start firms over the business cycle and anticipatory behavior of firms or prospective founders with regard to decisions to employ personnel. Selection on observable factors is tackled via our empirical strategy by inducing covariate balance over treated and non-treated firms whenever necessary. We explain the chosen procedure in more detail below.

Given the fast and steep fall in demand during the Great Recession and the sudden recovery, we argue that the start and the end of the crisis were largely unexpected and we regard anticipatory behavior as unlikely. We find support for this assumption when looking at time series of Google searches for the keywords "crisis", "financial crisis", and "economic crisis" in Germany (Figure 4). Consistent with the sequence of the Great Recession from a financial to an economic crisis, searches for the term "financial crisis" increase first and peak in September 2008 (following the insolvency of the investment bank Lehman brothers). Searches for the term "economic crisis" peak about half a year later. The more general term "crisis" shows a higher base level and two peaks but can be considered less precise since it applies to a variety of different problems. Importantly, searches for all crisis-related keywords did not begin to rise before August 2008 whereas the GDP already began decreasing from the second quarter of 2008 on. Thus, we argue that it was not apparent to founders that the economy faced an upcoming crisis until August 2008. We use this observation to motivate a robustness check of our results. To address concerns regarding selection on unobserved factors (e.g. founders risk preferences) and strategic employment decisions, we compare firms founded within the crisis but before August 2008 to firms founded before the crisis.

An additional obstacle to the identification of causal effects of the business cycle on firm performance is the accurate measurement of cyclical impacts on firms. We address this issue by demonstrating the consistency of our results using a variety of business-cycle indicators which measure both demand-side and supply-side effects and allow for differences in industry-specific and region-specific cyclical impacts.

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[6]Nevertheless, we double-checked our main results by including a linear time trend in our models. As expected, the effect sizes and the significance levels reduce slightly but our results remain qualitatively similar
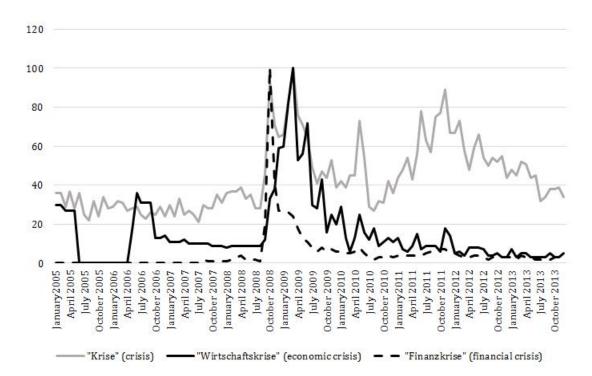
Figure 4: Google searches for crisis-related keywords in Germany

Notes: All keywords were entered in Google Trends in German. A value of 100 corresponds to the highest number of searches for a keyword in the observation period.
Source: Google Trends

4.2 Measurement of the business cycle

As a first measure we use a binary variable that identifies the quarters with a negative development of overall GDP in Germany to quantify the effects on firms founded during the 2008/09 crisis. While there is no general agreement on how to define a recession, according to a definition used by the OECD (2010) for comparing the effects of the 2008/09 crisis, a negative development of GDP in at least two consecutive quarters is a sufficient requirement to define a recession.[7]

As a second indicator, we use a time series of a quarterly GDP index (in constant prices) for Germany to control for economic development in more detail. We do not use changes in GDP since we expect different adjustment processes for similar changes from high and low levels of GDP. As an extension of this first measure we also use industry-specific quarterly GDP index series.

Since GDP series are not available on a more detailed monthly basis and GDP can be expected

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[7]According to the NBER, a recession is a period of "significant decline in economic activity spread across the economy, lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales. A recession begins just after the economy reaches a peak of activity and ends as the economy reaches its trough. Between trough and peak, the economy is in an expansion." Our definition of the Great Recession in Germany is consistent with this definition by the NBER.

to be non-stationary (although there seems to be no indication of this between 2007 and 2013), in addition we use a monthly time series of the Ifo Business Situation Indicator as the third measure of the business cycle. The Ifo Business Situation Indicator is one of two components of the Ifo Business Climate Index, a highly-regarded early indicator of the development of the German economy.[8] It is published on a monthly basis and thus offers an interesting alternative to the official statistics. Moreover, in contrast to GDP, the Ifo Business Situation Indicator is stationary by definition. Therefore, it enables us to test the robustness of results derived for GDP with regard to several aspects. Again, we also use industry-specific series as an extension.

Our main aim in this paper is to assess whether changes in the conditions on labor markets over the business cycle influence new firm behavior. To measure cyclically driven changes in the supply of labor, we use data on short-time working schemes that are offered by the German Federal Employment Agency as a fourth business cycle indicator. As shown above, the main adjustments on the labor markets over the cycle occur as a result of short-time working schemes in Germany. Unemployment rates are rather unaffected. We take the ratio of the number of full-time-equivalent short-time workers and the number of employees in a region as an indicator of a lack of demand for new hires by incumbent firms. We deliberately do not make use of short-time work in specific industries since we expect workers to be able to switch between different industries.

4.3   Empirical Strategy

Our empirical strategy consists of four steps. In the first step, we look for indications of a specific selection of founders or specific survival prospects of firms founded during the Great Recession of 2008 and 2009. In the second step, if we find indications of selectivity, we pre-process our data and calculate sampling weights to achieve covariate balance between treated (founded during the Great Recession) and non-treated observations (founded before or after the recession). The methods used are explained in more detail below. Similarly, we test for selectivity in the type of founders over the business cycle during our entire sample period from 2007 to 2013. In the third step, we analyze the impact of the aggregate conditions at the time of firm foundation by taking a detailed look at the growth and skill structure of firms that entered the market during the Great Recession of 2008/09. In the fourth step, we increase the level of detail and estimate the effect of simultaneous aggregate conditions on month-by-month firm growth. In the following we explain the four steps of our empirical strategy in more detail.

Step 1: Testing for selection on observables
First, we check for selectivity in the types of founders and the new firms' survival over the business cycle. We argue in the introduction that crises are likely to reduce the opportunity cost of self-employment. This holds true especially for low-skilled individuals. The effects of the cycle on the founding behavior of more highly skilled individuals are less clear. On the one hand,

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[8]Detailed information is available under: `http://www.cesifo-group.de/ifoHome/facts/Survey-Results/Business-Climate.html`

those with higher skill levels might also consider starting a company during a crisis because of declining career prospects as employees. On the other hand, they might refrain from starting a business of their own due to financial constraints, a lack of demand, or poor overall economic conditions. Either way, a crisis is likely to affect the human capital structure of the founders and thus their growth potential.

To check for selectivity in the types of founders, we check whether either a binary indicator for firms founded during the Great Recession or the total value of a GDP index series in the quarter of foundation significantly predicts different measures of founder human capital. Measures of founder human capital include years of industry experience, qualification levels, prior employment status and age. The latter is included to control for a potentially increasing number of career starters who set up businesses of their own during a crisis and might prefer to employ young workers of their own age (Ouimet and Zarutskie, 2014). In addition to checking for selection effects regarding the types of founders who start up businesses, we also check for different survival prospects of firms founded over the business cycle (conditional on the human capital of the founders).

Step 2: Tackling selection on observables
In the second step, we pre-process our data where necessary. As discussed in more detail in the results section, controlling for selection on observables only becomes relevant when we use the dummy for the Great Recession as binary treatment indicator. To be able to hold firm quality constant in our analyses and to identify firm-level effects, we pre-process our data by means of entropy balancing to account for selection on observables whenever we use the crisis dummy as an explanatory variable. Entropy balancing achieves balance over specified moments of selected covariates by deriving sample weights which are then used in subsequent weighted estimations (Hainmueller and Xu, 2013). In contrast to other related methods, for instance propensity score weighting, entropy balancing induces covariate balance directly, and not as the result of a propensity score matching procedure, which requires iterated re-specifications of the propensity score estimation to achieve covariate balance. Technical details on the derivation of the entropy balancing weights are provided in Appendix B.

Step 3: Estimating the effects of aggregate conditions at the time of firm foundation
In the third step of our empirical strategy, we correlate the aggregate conditions at the time of firm foundation with different dependent variables that measure the employment and workforce structure after one year in business. In an extension we also consider employment at the end of later business years. For this, we estimate models of the type

$$y_i = \alpha + \gamma * crisis_{start-up,i} + X_i\beta + \epsilon_i$$

Where $crisis_{start-up,i}$ is the binary indicator that has the value of one for firms founded during the Great Recession of 2008/09. As robustness checks, we repeat the main analyses and investigate whether the effects hold for a more detailed measure of cyclicality, namely the value of a GDP index in the quarter of firm foundation, as well. X_i is a set of firm- and founder-specific

control variables and ϵ_i is a firm-specific error component.

Since more than half of the young firms in our representative sample of German start-ups do not yet have any personnel around the time of foundation, we turn to the extensive margin of employment first and test whether the Great Recession affects the probability that a new firm has at least one employee after one year in business. Studies focusing on differences in the workforce structure of new and old firms agree that in general young firms employ young and low-skilled employees disproportionately often (Brown and Medoff, 2003; Brixy et al., 2007; Schnabel et al., 2011; Coad et al., 2014; Nyström and Elvung, 2014; Ouimet and Zarutskie, 2014; Dahl and Klepper, 2015). Recession-push arguments suggest that the opportunity costs of young professionals and low-skilled employees are likely to decrease disproportionately during crises. Since the availability of a skilled workforce is of major importance for the further development of a start-up (Dahl and Klepper, 2015), we analyze whether the Great Recession changed the structure of the start-ups' workforce in a second step. We use probit estimates and calculate robust standard errors for all binary dependent variables.

We then extend the view to the intensive margin of employment. Prior research discusses that not all new businesses have a high growth potential and that there might be cyclical influences on the share of firms that does (Sedlácek and Sterk, 2014). In fact, only a very small proportion of new firms in each cohort are responsible for the main part of the cohort's employment effect (Brüderl and Preisendörfer, 2000; Delmar et al., 2003; Coad et al., 2014). Depending on the definition used, the share of fast-growing firms within a cohort varies between 4% and 10% (Kirchhoff, 1994; Brüderl and Preisendörfer, 2000; Anyadike-Danes et al., 2015; Mazzucato and Parris, 2015). High-growth firms are particularly dependent on external financing and should therefore be especially affected by the Great Recession, which began with a crisis in the banking sector. To analyze differing effects of the crisis over the firm-size distribution and to make it possible to derive well-targeted advice from our results, we estimate conditional and unconditional quantile regressions for firm size after one year.

Finally, we also expand our analyses to cover later business years to assess whether the cyclical conditions at the time of foundation affect the longer-term growth potential of start-ups and thus their ability to help to pave the way out of crises. For this, we estimate OLS and Tobit models for average firm size after one, two, three and four years to follow the development of firm size. We choose Tobit models as a robustness check since there is a large number of firms which do not hire and we assume that the group of non-hiring firms consists partly of firms which have demand for labor but cannot afford to hire an employee. Hence, the latent variable in the Tobit model refers to firms' labor demands while the observed dependent variables measure their actual hiring behavior. Again we calculate robust standard errors.

Step 4: Generalizing the effects of aggregate conditions
In the fourth and final step of our empirical analysis, we study cyclical influences on firm growth in more detail. We use a fine-grained monthly growth model to correlate simultaneous cycli-

cal measures with the month-by-month growth of new ventures. In doing so we overcome the problem of modeling cyclical effects either on a very rough yearly level, as was mostly done in prior research, or only once at a fixed point in time in the firm's life (e.g. the time of start-up). We find that this enables us to understand the mechanisms underlying the cyclical effects much more precisely. In particular, modeling month-by-month growth allows us to address a major limitation of models which concentrate on the aggregate conditions at the time of start-up, namely that the conditions during the first years in business might differ substantially for firms founded at the beginning of a crisis (and into the decline of GDP) compared to firms founded at the end of a crisis (and into new GDP growth).

In the monthly growth models, we interact business cycle measures and firm age to test for differing impacts of aggregate conditions for firms of different ages.

We estimate growth models of the form

$$\Delta_{EMP_{i,t}-EMP_{i,t-1}} = \gamma * \text{Business Cycle}_t + \delta * EMP_{i,t-1} + X_{i,t}\beta + \alpha_i + \epsilon_{i,t}$$

$\Delta_{EMP_{i,t}-EMP_{i,t-1}}$ denotes the absolute growth (decline) of firm i between month $t-1$ and month t. $EMP_{i,t-1}$ denotes employment in firm i in month $t-1$. $X_{i,t}$ contains firm- and founder-specific control variables, $\epsilon_{i,t}$ is an individual and time-specific error term. We subsequently measure the current state of the business cycle using the above introduced GDP index series, the Ifo indicator series for the current business situations, as well as the relative shares of short-time workers in each spatial planning region.

Estimates are derived from pooled OLS models with cluster robust standard errors and, in addition, from fixed effects models. Including firm fixed effects in the specification of the robustness check can introduce bias due to a correlation between $EMP_{i,t-1}$ and the error term $\epsilon_{i,t}$ (Nickell, 1981). Such potential bias is stronger the smaller the longitudinal dimension of a panel dataset is. Since the average longitudinal dimension of our monthly panel is rather large (above 40), we follow recommendations by Judson and Owen (1999) and estimate standard fixed effects models for the robustness check.

5 Data and variables

5.1 Dataset

For the empirical analyses in this study, we use data that matches the employer data of the KfW/ZEW Start-up Panel with employee register data from the employment statistics of the German Federal Employment Agency. The KfW/ZEW Start-Up Panel is a joint research project of the KfW Group ("KfW-Bankengruppe"), the largest national publicly-owned development bank in Germany and the world, the Centre for European Economic Research (ZEW), and Creditreform, Germany's largest credit rating agency (see Fryges et al., 2010, for details on the sample design of the dataset). The dataset is a random sample of young German firms from

almost all industries (the primary sector, the public sector and the energy sector are excluded). Information is collected by means of a yearly telephone survey (computer-aided telephone interviews, CATI). The dataset is a sample taken from the Mannheim Enterprise Panel which contains basic information on almost all firms in Germany including start-ups (Almus et al., 2000; Bersch et al., 2014). The sample of the KfW/ZEW Start-up Panel is stratified by three criteria: year of firm formation, sector, and whether or not the firm received support from the "KfW Group". Stratification is controlled for by including dummy variables for the stratification cells in all regressions. The first survey wave was conducted in 2008, collecting data on firms founded in the period from 2005 to 2007. In the meantime, the KfW/ZEW Start-up Panel contains data on 15,300 firms founded between 2005 and 2012. Due to the sample design, each year new firms founded during the previous three years are added to the sample ("dynamic panel").

To reduce the risk of survivorship biases due to firms that had already survived two or three years before being included in the sample, we only keep firms that were first interviewed in the spring or summer following their year of foundation. This reduces our main regression sample to 6960 firms founded between 2007 and 2013. We use the full sample from 2005 to 2013 for robustness checks and find that our results remain robust when using the full sample.

The survey data provide information on the human capital and prior employment status of firm founders. The register data from the employment statistics of the German Federal Employment Agency yield information on the education and vocational qualifications of all reportable employees, their occupational status (including full-time or part-time employment), as well as the start and end dates of all employment and unemployment spells in each individual's employment history. The data are reported by the employing establishment and collected by the social security agencies. Employing establishments are matched with firms from the KfW/ZEW Start-up Panel using a text search algorithm via firm/establishment names and addresses (further details on the dataset and the matching procedure are provided in Appendix B). We can thus observe in detail the build-up of a workforce in each new firm and can link it with each worker's employment history. Since the data on the individual employees are collected continuously, we observe all individuals who were employed in one of the matched firms from the KfW/ZEW Start-up Panel for at least one day in the linked employer-employee dataset.

One important advantage of the latter in our setting is that there is no panel attrition other than from closed businesses. Once matched with the register data on employees we can observe the employment growth of the firms in the sample on a daily level even if they refuse to take part in subsequent waves of the survey. Since the survival status is known for all firms at any time, we are able to formally test for potentially different survivorship biases over the business cycle.

5.2 Summary statistics and further measures

Detailed information on the construction of the most important measures used in this study is provided in Table 4 in Appendix A. We report summary statistics of all dependent and control variables of our main regression sample in Table 5 in Appendix A. Summary statistics are calculated at the end of the first business year for each firm. Our total sample consists of 6960 firms (first column). 5814 of these firms were founded outside the Great Recession (second column), 1146 within the Great Recession (third column), i.e. between the second quarter of 2008 and the first quarter of 2009. 47% of all firms have at least one dependent employee at the end of their first year in business, the average number of dependent employees after one year is 1.8. We consider all reportable employees and do not restrict our sample to employment subject to social security contributions since young firms might rely disproportionately on atypical forms of employment. As a robustness check, we restricted our sample to full-time employees subject to social security contributions and found that our results remained qualitatively similar. To safeguard against potentially distorted results due to outliers, we cut the largest percentile of firms when using total employment sizes as dependent variables.

Interestingly, the share of firms with at least one dependent employee at the end of their first year in business is somewhat higher for firms founded during the Great Recession (51%). However, the summary statistics are not yet adjusted for the stratification of the sample or for distortion due to selection effects. A similar pattern emerges for the share of firms with at least one qualified employee at the end of the first business year (44% of all firms; 48% of firms founded during the crisis). 19% of firms with employees recruit career entrants (see Table 5 in Appendix A for a detailed definition of career entrants) and most of these career entrants are qualified (17% of firms). Again, firms founded during the Great Recession have a slightly higher probability of employing at least one qualified career entrant by the end of the first business year.

6 Results

6.1 Controlling for of selection on observables (Step1 and Step 2)

Checks for selectivity do not reveal any significant correlation between the GDP index series and the measures for founders' human capital, their prior employment status and firm survival (see Table 6, Table 7 and Table 8 in Appendix A for the results of the different models to test for selection on observables). When measuring cyclical effects using the binary indicator for firms founded during the Great Recession instead of the GDP index series, the results reveal some selectivity with respect to the prior employment status of founders. We find no indication of selection effects regarding founders' human capital and firm survival. For the prior employment status we find an increase in the number of founders who made the transition from dependent employment to self-employment during the Great Recession and a decrease in the number of founders making the transition from unemployment.

This result seems counter-intuitive at first sight, but is consistent with findings from data of

the Global Entrepreneurship Monitor (Hundt and Sternberg, 2014) for the same period, which reveal an increase in entrepreneurs with pull motives during the Great Recession in Germany. A consistent explanation for this finding lies once more in the extensive use of short-time working schemes. Few incumbent workers became unemployed, so only few people were pushed into entrepreneurship. On the other hand, opportunity costs for self-employment fell while people on short-time working schemes had time to pursue their own business ideas. This might have triggered a slight but significant increase in entrepreneurs with pull motives.

To ensure an unbiased measurement of the performance effect of the crisis with respect to observable selection factors, we apply entropy balancing to calculate sampling weights for observations from firms that were founded outside the Great Recession as described in the empirical strategy. We balance our sample over the first three moments of the founder's age (or that of the oldest founder in the team) and the founder's years of industry experience (or that of the most experienced founder in the team) as well as the first moments of a binary variable indicating whether one founder has a university degree, a binary variable showing whether at least one founder made a transition from unemployment when founding the firm, and a binary variable indicating whether one of the founders made a transition from dependent employment when founding the firm. We find that these measures cover the main founder-related factors that were shown to affect firm growth in prior research. To ensure that our results are not biased by the policy change regarding firms' choices of legal form, we also induce covariate balance with respect to different forms of limited liability corporations.[9] We address concerns with respect to further unobserved selection factors in a robustness check below. However, since we are able to balance our sample over up to three moments of a wide range of human capital indictors, we consider the remaining potential bias to be small.

6.2 New firm growth and aggregate conditions at the time of foundation (Step 3)

6.2.1 Extensive margin of employment

Results for the impact of aggregate conditions at the time of firm foundation on the extensive margin of employment in young firms are presented in Table 1 (see Table 9 in Appendix A for detailed results). Conditional on the founder's human capital, firms that were founded during the Great Recession have a 4.6 percentage points higher probability of having at least one employee by the end of their first year in business (Column A of Table 1). This effect decreases only slightly to 4.4 percentage points when we induce covariate balance over crisis and non-crisis cohorts by means of entropy balancing to separate the performance from the selection effect (Column B). In line with the results of the selectivity tests described above, the Great Recession has a small but positive selection effect in our sample.

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[9]The effects of covariates for which covariate balance is induced by means of entropy balancing become by definition orthogonal to the effects of the crisis dummy. Nevertheless, we decided to include the same set of control variables in all estimations to allow the reader to track the evolution of the estimates.

Table 1: Estimation results: Employment after one year in business (yes/no)

Dependendent Variable	A - Probit Dep. Employees Coef (S.E.)		B - Probit (EB) Dep. Employees Coef (S.E.)		C - Probit Dep. Employees Coef (S.E.)	
Founded during crisis (y/n)	0,046	(0,015)***	0,044	(0,015)***		
GDP in quarter of foundation					-0,004	(0,002)**
One founder with higher education	-0,017	(0,013)	-0,018	(0,018)	-0,016	(0,013)
Age of oldest founder in team in years	0,006	(0,004)*	0,008	(0,005)*	0,006	(0,004)*
Age of oldest founder in team squared	-0,000	(0,000)*	-0,000	(0,000)*	-0,000	(0,000)*
Industry experience in years (log)	0,033	(0,006)***	0,033	(0,008)***	0,033	(0,006)***
Founder was self-employed before	0,048	(0,013)***	0,037	(0,017)**	0,046	(0,013)***
Founder trans. from empl. in priv. sect.	0,073	(0,012)***	0,079	(0,016)***	0,075	(0,012)***
Control variables	Yes		Yes		Yes	
Month of foundation fixed effects	Yes		Yes		Yes	
Constant	Yes		Yes		Yes	
N / Pseudo R-sq.	6960 / 0.124		6960 / 0.131		6960 / 0.123	

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank. "EB" indicates weighted regressions with weights derived by entropy balancing.

The countercyclical performance effect is confirmed if we measure the state of the business cycle in more detail and use the GDP in the quarter of firm foundation as an explanatory variable in a robustness check: lower GDP values are related to a higher probability of having employees after one year in business (Column C). In further robustness checks, we address concerns with respect to the rather short pre-crisis period in our regression sample and additional unobserved selection factors (e.g. individuals risk preferences) or anticipatory entry strategies. First, we include the previously excluded firms in the regression sample that had been drawn into the sample of the KfW/ZEW Start-up Panel when they were two or three years old already. This extends the observation period to firms founded in 2005 and 2006. Second, we compare only firms founded within the crisis but before August 2008 (when the crisis became present in the media and the public perception) to firms founded before the crisis (see Section 4.1 for details). In both cases, our results remain qualitatively similar.

We deliberately do not control for access conditions to external financing in all presented models since changes in access to external financing are likely to be a result of changes in aggregate conditions themselves and would potentially confound the effects of aggregate conditions on firm growth. However, we ran additional robustness checks and included an additional control variable to account for self-reported difficulties in obtaining access to external financing. Including the control variable does not alter our results qualitatively.

Finding 1: *Start-ups founded during the Great Recession in Germany are 4.4 percentage points more likely to have at least one employee at the end of their first year in business than start-ups founded before or after the Great Recession.*

6.2.2 Variations in workforce composition

Re-running the baseline model for qualified employees only (Column A of Table 2) shows that the increase in the extensive margin of hiring firms is not driven by firms that hire employees from the bottom end of the qualification distribution. The probability of hiring at least one qualified employee by the end of the first year in business is 4.3 percentage points higher for firms founded during the Great Recession. Thus, this effect is of almost the same magnitude as the overall increase in the extensive margin.

Table 2: Estimation results: Structure of workforce after one year

Dependent Variable	A - Probit (EB)	B - Probit (EB)	C - Probit (EB)	D - Probit (EB)
	Qualified employees		Qualified career entrants	
	Coef (S.E.)	Coef (S.E.)	Coef (S.E.)	Coef (S.E.)
Founded during crisis (y/n)	0,043 (0,015)***	0,008 (0,010)	0,026 (0,009)***	0,039 (0,018)**
One founder with higher educ.	-0,017 (0,018)	0,000 (0,013)	0,011 (0,011)	0,030 (0,021)
Age of oldest founder in years	0,009 (0,005)*	0,002 (0,003)	-0,002 (0,003)	-0,008 (0,006)
Age of oldest founder squared	-0,000 (0,000)*	-0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Industry experience in years (log)	0,030 (0,005)*	0,000 (0,006)	0,010 (0,005)*	0,011 (0,010)
Founder self-employed before	0,040 (0,017)**	0,014 (0,013)	0,016 (0,010)	0,022 (0,020)
Founder trans. from priv. sect.	0,080 (0,016)***	0,014 (0,012)	0,014 (0,009)	0,004 (0,019)
All control variables	Yes	Yes	Yes	Yes
Month of foundation fixed effects	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes
N / Pseudo R-sq.	6960 / 0.127	3301 / 0.051	6960 / 0.088	3301 / 0.046

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank. "EB" indicates weighted regressions with weights derived by entropy balancing.

To explain in more detail the mechanisms that drive our results, we concentrate on the human capital composition of firms that had hired at least one employee by the end of their first year in business. This makes it possible to assess whether the quality of human capital acquired by new ventures varies depending on whether the firm was founded during or outside of the crisis. As the results provided in Column B of Table 2 show, firms founded during the crisis are not disproportionately more or less likely to hire qualified employees. They are therefore more likely to hire employees, but the skill structure remains constant. A closer look reveals, however, that young firms founded during the crisis have a disproportionately high probability of hiring qualified career entrants (Column C-D of Table 2). The Great Recession increases the probability of hiring a qualified career entrant both among all firms and among hiring firms.

Hence, firms founded during the recession have a higher probability of hiring employees at all and manage to keep the skill structure of the workforce constant. To meet their demand for skilled labor, they are disproportionately more likely to hire qualified career entrants. This is the effect that we expected from the use of short-time working schemes during the crisis. Again, all results remain qualitatively similar when we use the GDP in the quarter of firm foundation as an explanatory variable to check robustness.

Finding 2: *The Great Recession does not alter the qualification structure of the start-ups' workforce in general. But start-ups founded during the Great Recession hire qualified career entrants disproportionately more often compared with start-ups founded before or after the Great Recession.*

6.2.3 Intensive margin of employment

Development of the average firm size

Whether the detected countercyclical growth pattern of start-ups founded during the Great Recession also translates into long-term growth (or whether the growth effect levels out after the end of the recession) is clearly important in economic and management terms. Thus, we follow the development of the intensive margin of employment in young firms until the end of the fourth business year (Figure 5). For Figure 5, we derive sampling weights using the entropy balancing algorithm as before and calculate predicted values from weighted regression separately for firms founded during the Great Recession and firms founded outside the Great Recession. We predict the number of employees at the mean values of all other covariates and run separate regressions with recalculated weights for each business year to ensure balanced samples.[10]

Firms founded during the crisis are larger on average after one year in business than firms set up before or after the crisis. Importantly, this effect does not level out after the recession ends and the economy picks up again but becomes even stronger. The crisis cohort is thus able to transform the better starting conditions into long-term growth. This finding corroborates literature that points out the importance of starting conditions for long-term firm success. After four years in business, firms founded during the Great Recession have on average hired one employee more than firms founded outside the Great Recession. Given the small size of the average start-up, this employment size is about 40% larger. The difference between crisis and non-crisis cohorts is significant at conventional significance levels for all business years according to both OLS and Tobit models.

Finding 3: *Start-ups founded during the Great Recession are larger on average after one year in business than non-crisis cohorts, and expand their size-advantage in subsequent business years.*

Recession effects over the firm-size distribution

These findings lead to the question whether start-ups are affected likewise over the entire firm-size distribution. The results of conditional quantile regressions (Table 11 in Appendix A) show no impact of the Great Recession on firm size after one year when a founder starts a rather small business (up to the 72nd percentile of the conditional firm size distribution). A positive impact of the Great Recession is detected when a founder sets up a medium-sized business (between the 73rd and the 90th percentiles of the conditional firm size distribution). When a founder starts up

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[10] As the number of business years increases, the number of "after crisis" foundations usable for the in-sample predictions decreases (since the data only cover a time period until the end of 2013 so far). To guarantee a sufficient number of "out of crisis" observations in the comparison group, we repeated the analyses and also included firms founded in 2005 and 2006 as a robustness check. This does not change the results qualitatively.
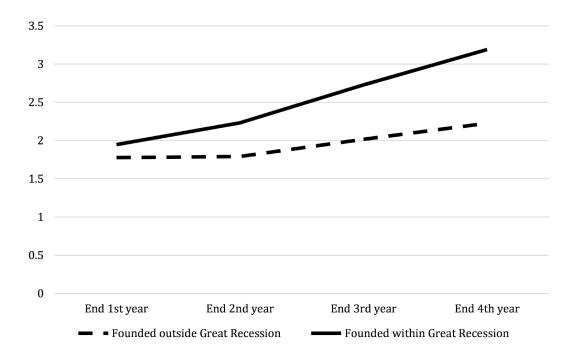
Figure 5: Development of predicted number of employees

Notes: Predicted number of employees conditional on the human capital of firm founders. Values fitted from weighted OLS models for crisis and out-of-crisis foundations at the mean values of all other covariates. Covariate balance is induced between crisis and out-of-crisis foundations for each business year using weights derived from entropy balancing. The difference between crisis and out-of-crisis foundations are significant (below a 10% significance level) according to OLS and Tobit models at all points in time. Marginal effects of the crisis dummy according to the weighted OLS model: 0.169*after one year, 0.441*** after two years, 0.712*** after three years, 0.964*** after four years. Marginal effects of the crisis dummy according to the weighted Tobit model: 0.200** after one year, 0.602*** after two years, 0.833*** after three years, 1.086*** after three years. Significance levels: *** 1%, ** 5%, * 10%. Models estimated with robust standard errors.

a very large business (above the 95th percentile of the conditional firm size distribution) we find evidence of a negative impact of the crisis. Thus, founders of very fast-growing start-ups seem to be negatively impacted by the crisis, whereas middle-sized businesses are positively affected by the crisis.

To provide results that are better comparable with existing studies that focus on the aggregate employment effects of firm cohorts, we repeat the analyses with unconditional quantile regressions (see Firpo et al., 2009, for details on the unconditional quantile approach.).[11] Notably, when using unconditional quantiles the positive effect of the crisis already emerges for smaller start-ups from the 55th percentile onwards. At the top end of the unconditional distribution, the effect turns negative, as it does for conditional quantiles, but remains insignificant.

Finding 4: *The Great Recession fosters the growth of medium-sized new firms (up to the 90th percentile of the new firm-size distribution after one year in business) but does not foster the growth of fast-growing new firms (above the 95th percentile of the new firm-size distribution after one year in business).*

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[11]The results of the unconditional quantile regressions are available from the authors upon request.

6.3 Generalization: month-by-month employment growth and labor supply (Step 4)

In the last step, we go beyond the analysis of cyclical conditions at the time of firm foundation. To permit a better understanding of the mechanisms that lead to cyclical differences in the growth of young firms, we aim to measure the impacts of the business cycle and of supply-side effects on labor markets over the business cycle more directly. To this end, we use a more detailed time-scale and estimate the dependence of month-by-month employment growth of new ventures on simultaneous aggregate conditions (Table 3; Table 10 in Appendix A for detailed results).

First, we use the value of the GDP index series as the explanatory variable in the month-by-month growth model (Column A). Since prior research has shown that cyclical effects might be strongly influenced by firm age we interact GDP with firm age. Firm age is a major predictor of firms' financial resources and the ability to pay competitive wages. The creditworthiness of young firms can be expected to increase at an early stage if the business model proves successful, as can their ability to pay market wages. The results reveal a discontinuous response to GDP dependent on firm age. The employment growth of firms aged up to one and a half years follows a countercyclical pattern, whereas the employment growth of older firms reacts procyclically. This result is confirmed if the GDP measure is differentiated for industries (see appendix), if we use the Ifo Business Situation Index as a measure of the business cycle to ensure stationarity of the time series (Column B) and if we use fixed-effects regressions instead of pooled OLS to take into account a larger share of unobserved heterogeneity between firms (Column C).

To measure supposed supply-side effects directly, we use the share of the working population in short-time working schemes, split by district and month, as measure of the career-entry opportunities available to jobseekers (Column D). The findings confirm the results for the other business cycle indicators and support our prior assumption: when the level of short-time work in a region is higher, very young firms grow more strongly. As they become older (and potentially less financially restricted) negative demand-side effects prevail and firms grow less strongly when aggregate conditions are less favorable.

Two effects might therefore have contributed to the (longer-term) growth advantage of start-ups founded during the Great Recession in Germany. First, while they were very young, they profited from reduced competition on labor markets during the crisis. Second, since the crisis lasted only one year in Germany, start-ups were able to profit from increasing demand immediately as they grew older and the economy simultaneously picked up again.

Our results are consistent with those of prior research which show that young firms grow procyclically in general. As long as we do not allow for a discontinuous impact of the business cycle dependent on firm age, our data show a procyclical relationship between aggregate conditions and firm growth (Table 10 in Appendix A). Hence, treating cohorts of young firms up to the age of several years as one homogeneous group overlooks important employment dynamics during

Table 3: Estimation results: Month-by-month growth

Dependent Variable	A - OLS Empl. Growth Coef (S.E.)	B - OLS Empl. Growth Coef (S.E.)	C - FE Empl. Growth Coef (S.E.)	D - OLS Empl. Growth Coef (S.E.)
Current GDP	-0,831 (0,095)***		-0,334 (0,125)***	
GDP # Firm age	0,519 (0,044)***		0,368 (0,055)***	
IFO bus. sit. index in industry		-0,659 (0,169)***		
IFP index in industry # Firm age		0,464 (0,070)***		
Share short-time work in RoR				1,874 (0,540)***
Share s.-t. work in RoR # Firm age				-1,707 (0,271)***
Employment at end of last period	-0,002 (0,001)**	-0,002 (0,001)**	-0,072 (0,004)***	-0,002 (0,001)**
Age of firm in years	-0,555 (0,046)***	-0,028 (0,002)***	-0,378 (0,057)***	-0,014 (0,001)***
All control variables and constant	Yes	Yes		Yes
Month of foundation fixed effects	Yes	Yes		Yes
Month fixed effects	Yes	Yes		Yes
N / Pseudo R-sq.	308997 / 0.006	308997 / 0.006	308997 / 0.045	308997 / 0.006

Notes: Significance levels: *** 1%, ** 5%, * 10%; cluster robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; regions are defined as spatial planning regions ("Raumordungsregionen"); additional control variable in all regressions: funding by KfW bank

the first years of firm life.

Finding 5: *Up to 1$\frac{1}{2}$-year-old start-ups grow stronger countercyclically, older start-ups grow stronger procyclically.*

7   Concluding discussion

We analyze whether changes in the supply of labor over the business cycle affect the growth and human capital formation of new ventures. New ventures are seen by many politicians and economists as an important measure to overcome structural problems and fight increasing unemployment during an economic crisis. In contrast, research on the responses of firms to aggregate conditions generally agrees that young firms suffer more severely from crises in terms of employment than larger established firms (Fort et al., 2013; Sedlácek and Sterk, 2014; Bartz and Winkler, 2016; Zarutskie and Yang, 2016). However, these analyses either do not identify genuine entrepreneurial activity or use aggregate data at the cohort level, which does not allow a distinction between cyclical effects on the growth conditions of young firms and selection effects with respect to the type of founders who start up firms.

To overcome these drawbacks we constructed a new and very extensive representative linked employer-employee dataset on new German ventures which makes it possible to take such selection effects into account. We show that, conditional on the human capital of founders, new firms founded during the Great Recession of 2008/09 have a 4.4 percentage-points higher probability of hiring at least one employee during their first year in business compared to firms founded outside of the recession. Furthermore, firms in the recession cohort are larger on average than

new firms founded outside of the recession, and even expand their average size advantage as they grow older. The countercyclical growth advantage does not hold for fast-growing new firms or when firms become older than one and a half years of age however. The increase in employment of the crisis cohort is realized in large parts by means of hiring a disproportionately large share of career entrants. This finding relates directly to the use of short-time working schemes as a main measure to fight unemployment in Germany during the Great Recession. Firms that used short-time working schemes were legally prohibited from hiring additional personnel. This blocked entry into incumbent firms for career starters and lowered their opportunity costs of employment in a new business.

Our results complement the findings of several prior studies. First, the finding that new firms grow more strongly during adverse economic conditions and that this is most likely due to a better supply of labor, refines results obtained by Moscarini and Postel-Vinay (2012) for small firms. Moscarini and Postel-Vinay (2012) document that the net job creation of large employers reacts more sensitively to the business cycle than the net job creation of smaller firms. They argue that small firms benefit disproportionately from an increase in the supply of unemployed workers during adverse economic conditions compared to larger employers. We find that short-time working schemes blocked entry into incumbent businesses for career entrants, which in turn increased the supply of career entrants for new businesses. Importantly, while Moscarini and Postel-Vinay (2012) show that adverse economic condition increase the relative position of small compared to large employers on labor markets, we show that a crisis can even have a positive impact in absolute terms on young firms.

Second, our result that the start-ups responses to cyclical conditions change over the firm size distribution helps to better connect the findings of Moscarini and Postel-Vinay (2012) and findings of Sedlácek and Sterk (2014). Sedlácek and Sterk (2014) detect a larger aggregate employment growth potential for cohorts of new firms when founded during an expansion and explain this finding by variations in the demand conditions for entering new firms over the business cycle. Their framework does not address whether newly founded firms can take advantage of an increase in labor supply during crises however. Our finding that conditional on the human capital of the founder the bulk of small and medium size new firms profits in terms of employment growth during a crisis - but that the effect is adverse for young high-growth firms - facilitates a more detailed understanding of the conditions under which positive supply or negative demand effects prevail. Moreover, our result that new firms founded during the Great Recession of 2008/09 are able to expand their average size advantage as they grow older is in line with Sedlácek and Sterk (2014), who also find a strong and lasting impact of the economic conditions at firm birth on long-term firm performance.

Third, our result that a disproportionately large share of new firms founded during the crisis employ qualified career entrants refines results obtained by Ouimet and Zarutskie (2014) who observe that young firms employ skilled young workers disproportionately often in general and often remunerate young workers better than established firms would. Thus, young employees

seem to be comparably more productive when employed in young businesses. Hence, the disproportionately large share of career entrants employed in the crisis cohort could be one reason for the expansion of the size advantage of the crisis cohort in subsequent business years.

Our findings have important implications for policy, firms hiring strategies, and further research. First of all, it is important to note from a policy perspective that the average size start-ups grow countercyclically and hence stabilize aggregate employment during crises. This effect is largely driven by the hiring of career starters by new firms. Since prior research suggests that especially young founders prefer to hire young workers, fostering entrepreneurship by means of well-qualified career starters might be a way to complement short-time working subsidies and might help to pave the way out of high youth unemployment in some European countries. However, very fast-growing young firms, which are normally responsible for the bulk of a cohort's aggregate employment effect, cannot contribute to this countercyclical stabilizing effect. While conditions on labor markets should relax for very fast-growing young firms during recessions as well, it seems likely that they are restricted by decreasing demand or more complicated access to external sources of finance. This pattern suggests in turn that the majority of new firms is unable to grow optimally during times of economic upswing.

Second, from a firm perspective, founders and managers of young firms should be aware that they might be able to attract qualified career entrants more easily during times of economic downturn. Thus, market entry during a crisis might be a clever strategy especially for firms that rely on qualified personnel.

Third, from a methodological perspective, studies that analyze firms' responses to business cycles and economic and financial uncertainty should be aware that these responses change during the first business years of new ventures already. Combining firms up to the age of several years into one analysis group for comparative studies can blur the results and the implications drawn from these results.

The fact that we only exploit one single recession, which was also an exceptional crisis, both in the magnitude of the decline and its unusual brevity, restricts the transferability to other crises to some extent and calls for a review of our results using datasets that cover a longer time period and other countries. However, the mechanisms shown in the present paper should arguably apply to other settings as well. Short-time working schemes are used to secure employment in most OECD countries (Balleer et al., 2016) and the large increase in youth unemployment in many European countries since the beginning of the Great Recession bears witness to the comparably weak position of young professionals in many labor markets.

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A Appendix: Tables

Table 4: Derivation of measures

Variable	Definition
Dependent employees	All employees reportable to the Federal Employment Agency. This includes full-time and part-time employees subject to social security contributions, atypical employment (mini jobber), apprentices and interns.
Qualified employee	Employees with vocational training or a university degree as their highest skill level
Career entrant	Employees with their first reported employment spell after achieving their highest qualification
	To safeguard against measurement errors due to career entry in a foreign country or as a self-employed person (neither of which would be registered by the German Federal Employment Agency) we use age restrictions dependent on the highest qualification. To be classified as a career entrant employees must be
	- aged 20 or younger if they have no formal qualification
	- aged 30 or younger if their highest qualification is a high-school diploma or a vocational training qualification.
	- aged 35 or younger if their highest qualification is a university degree.
Qualified career entrant	Career entrant with a vocational qualification or a university degree as their highest qualification
Founded during crisis	Firm founded between April 2008 and March 2009
Founder with higher education	The founder or at least one founder in the team holds a university degree
Industry experience in years	The years of self-reported industry experience of the founder (or the founder with the longest experience in the team).
Founder self-employed before	The founder was self-employed before founding the present business.

Table 5: Summary statistics

Variable	Unit	All firms					Firms founded outside 2008/09 crisis					Firms founded during 2008/09 crisis				
		N	Mean	S.D.	Min	Max	N	Mean	S.D.	Min	Max	N	Mean	S.D.	Min	Max
Employees after one year in business	(y/n)	6960	0,47	0,50	0,00	1,00	5814	0,47	0,50	0,00	1,00	1146	0,51	0,50	0,00	1,00
Qualified employee after one year in busin.	(y/n)	6960	0,44	0,50	0,00	1,00	5814	0,44	0,50	0,00	1,00	1146	0,48	0,50	0,00	1,00
Job starter employed after one year in busin.	(y/n)	3301	0,19	0,39	0,00	1,00	2722	0,19	0,39	0,00	1,00	579	0,21	0,41	0,00	1,00
Qual. job starter empl. after one year in busin.	(y/n)	3301	0,17	0,37	0,00	1,00	2722	0,16	0,37	0,00	1,00	579	0,20	0,40	0,00	1,00
Founded during crisis (y/n)	(y/n)	6960	0,16	0,37	0,00	1,00	5814	0,00	0,00	0,00	0,00	1146	1,00	0,00	1,00	1,00
GDP in quarter of foundation	Index	6960	100,92	2,83	95,50	104,23	5814	101,12	2,73	95,50	104,23	1146	99,92	3,12	95,56	102,69
One founder with higher education	(y/n)	6960	0,40	0,49	0,00	1,00	5814	0,40	0,49	0,00	1,00	1146	0,41	0,49	0,00	1,00
Age of oldest founder in team in years	Log	6960	40,75	10,28	17,00	84,00	5814	40,67	10,27	17,00	84,00	1146	41,14	10,34	18,00	72,00
Industry experience in years (log)	(y/n)	6960	2,27	0,99	0,00	3,95	5814	2,28	0,98	0,00	3,95	1146	2,24	1,02	0,00	3,91
Founder was self-employed before	(y/n)	6960	0,37	0,48	0,00	1,00	5814	0,37	0,48	0,00	1,00	1146	0,36	0,48	0,00	1,00
Founder trans. from empl. in priv. sect.	(y/n)	6960	0,57	0,50	0,00	1,00	5814	0,56	0,50	0,00	1,00	1146	0,61	0,49	0,00	1,00
High-technology manufacturing	(y/n)	6960	0,08	0,27	0,00	1,00	5814	0,08	0,27	0,00	1,00	1146	0,08	0,28	0,00	1,00
Technology-intensive services	(y/n)	6960	0,22	0,41	0,00	1,00	5814	0,22	0,41	0,00	1,00	1146	0,23	0,42	0,00	1,00
Software supply and consultancy	(y/n)	6960	0,08	0,27	0,00	1,00	5814	0,08	0,27	0,00	1,00	1146	0,07	0,26	0,00	1,00
Non-high-tech manufacturing	(y/n)	6960	0,10	0,30	0,00	1,00	5814	0,10	0,30	0,00	1,00	1146	0,10	0,29	0,00	1,00
Skill-intensive services	(y/n)	6960	0,06	0,24	0,00	1,00	5814	0,06	0,24	0,00	1,00	1146	0,06	0,24	0,00	1,00
Other business-oriented services	(y/n)	6960	0,06	0,24	0,00	1,00	5814	0,06	0,24	0,00	1,00	1146	0,05	0,21	0,00	1,00
Consumer-oriented services	(y/n)	6960	0,13	0,33	0,00	1,00	5814	0,13	0,33	0,00	1,00	1146	0,13	0,33	0,00	1,00
Construction	(y/n)	6960	0,11	0,31	0,00	1,00	5814	0,11	0,32	0,00	1,00	1146	0,10	0,30	0,00	1,00
Retail & wholesale	(y/n)	6960	0,16	0,37	0,00	1,00	5814	0,16	0,36	0,00	1,00	1146	0,19	0,39	0,00	1,00
Limited liability (GmbH)	(y/n)	6960	0,35	0,48	0,00	1,00	5814	0,35	0,48	0,00	1,00	1146	0,38	0,49	0,00	1,00
Limited liability (UG)	(y/n)	6960	0,06	0,24	0,00	1,00	5814	0,07	0,25	0,00	1,00	1146	0,04	0,19	0,00	1,00
Founded in January	(y/n)	6960	0,14	0,35	0,00	1,00	5814	0,15	0,35	0,00	1,00	1146	0,12	0,33	0,00	1,00
Founded in February	(y/n)	6960	0,09	0,29	0,00	1,00	5814	0,09	0,29	0,00	1,00	1146	0,09	0,29	0,00	1,00
Founded in March	(y/n)	6960	0,11	0,31	0,00	1,00	5814	0,11	0,31	0,00	1,00	1146	0,11	0,32	0,00	1,00
Founded in April	(y/n)	6960	0,12	0,32	0,00	1,00	5814	0,11	0,32	0,00	1,00	1146	0,14	0,34	0,00	1,00
Founded in May	(y/n)	6960	0,10	0,30	0,00	1,00	5814	0,10	0,30	0,00	1,00	1146	0,12	0,32	0,00	1,00
Founded in June	(y/n)	6960	0,08	0,28	0,00	1,00	5814	0,09	0,28	0,00	1,00	1146	0,07	0,26	0,00	1,00
Founded in July	(y/n)	6960	0,09	0,28	0,00	1,00	5814	0,08	0,28	0,00	1,00	1146	0,10	0,31	0,00	1,00
Founded in August	(y/n)	6960	0,08	0,26	0,00	1,00	5814	0,08	0,27	0,00	1,00	1146	0,07	0,25	0,00	1,00
Founded in September	(y/n)	6960	0,07	0,25	0,00	1,00	5814	0,07	0,26	0,00	1,00	1146	0,06	0,24	0,00	1,00
Founded in October	(y/n)	6960	0,07	0,25	0,00	1,00	5814	0,07	0,26	0,00	1,00	1146	0,05	0,23	0,00	1,00
Founded in November	(y/n)	6960	0,04	0,19	0,00	1,00	5814	0,04	0,19	0,00	1,00	1146	0,04	0,19	0,00	1,00
Founded in December	(y/n)	6960	0,02	0,13	0,00	1,00	5814	0,02	0,13	0,00	1,00	1146	0,02	0,14	0,00	1,00
Highly qualified population (share)	Share	6960	5,64	4,29	0,60	35,70	5814	5,70	4,35	0,60	35,70	1146	5,35	3,95	0,60	28,30
Demographic potential of region	Log	6960	6,15	0,82	3,95	7,85	5814	6,15	0,82	3,95	7,85	1146	6,16	0,81	4,00	7,83

Notes: additional control variable in all regressions: funding by KfW bank.

Table 6: Selection effects during Great Recession: Human capital and prior employment status of founders

Dependendent Variable	A - OLS Age of Founder Coef (S.E.)	B - OLS Industry experience Coef (S.E.)	C - Probit Highly qual. Founder Coef (S.E.)	D - Probit Transit fr. dep. Emp. Coef (S.E.)	E - Probit Transit fr. unempl. Coef (S.E.)
Founded during crisis	0,007 (0,008)	-0,023 (0,032)	0,007 (0,014)	-0,039 (0,012)***	0,060 (0,016)***
Technology-intensive services	-0,099 (0,012)***	-0,204 (0,045)***	0,045 (0,021)**	0,033 (0,018)*	-0,020 (0,024)
Software supply and consultancy	-0,190 (0,015)***	-0,494 (0,056)***	0,034 (0,026)	-0,020 (0,024)	-0,112 (0,029)***
Non-high-tech manufacturing	-0,102 (0,014)***	-0,244 (0,054)***	-0,204 (0,025)***	0,066 (0,020)***	0,029 (0,028)
Skill-intensive services	-0,054 (0,015)***	-0,142 (0,056)**	0,081 (0,027)***	0,014 (0,024)	0,001 (0,031)
Other business-oriented services	-0,149 (0,016)***	-0,562 (0,064)***	-0,177 (0,028)***	0,059 (0,023)**	0,036 (0,032)
Consumer-oriented services	-0,143 (0,013)***	-0,615 (0,054)***	-0,194 (0,023)***	0,043 (0,020)**	-0,032 (0,027)
Construction	-0,172 (0,013)***	-0,036 (0,048)	-0,354 (0,026)***	0,097 (0,020)***	0,024 (0,028)
Retail & wholesale	-0,138 (0,013)***	-0,603 (0,052)***	-0,231 (0,022)***	0,067 (0,019)***	0,005 (0,026)
Highly qualified population (share)	-0,000 (0,001)	-0,007 (0,003)**	0,015 (0,001)***	-0,003 (0,001)**	-0,002 (0,002)
Demographic potential of region	0,013 (0,004)***	-0,024 (0,016)	0,042 (0,007)***	-0,003 (0,006)	-0,014 (0,008)*
Month of foundation fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N / (Pseudo) R-sq.	6960 / 0,045	6960 / 0,064	6960 / 0,132	6960 / 0,026	6960 / 0,013

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank.

Table 7: Selection effects over business cycle: Human capital and prior employment status of founders

Dependendent Variable	A - OLS Age of Founder Coef (S.E.)	B - OLS Industry experience Coef (S.E.)	C - Probit Highly qual. Founder Coef (S.E.)	D - Probit Transit fr. dep. Emp. Coef (S.E.)	E - Probit Transit fr. unempl. Coef (S.E.)
GDP in quarter of foundation	0,001 (0,001)	0,007 (0,004)	-0,000 (0,002)	-0,000 (0,001)	0,003 (0,002)
Technology-intensive services	-0,098 (0,012)***	-0,201 (0,045)***	0,044 (0,021)**	0,033 (0,018)*	-0,018 (0,024)
Software supply and consultancy	-0,189 (0,015)***	-0,492 (0,056)***	0,034 (0,026)	-0,019 (0,024)	-0,112 (0,029)***
Non-high-tech manufacturing	-0,101 (0,014)***	-0,239 (0,054)***	-0,204 (0,025)***	0,066 (0,021)***	0,032 (0,028)
Skill-intensive services	-0,053 (0,015)***	-0,140 (0,056)**	0,081 (0,028)***	0,015 (0,024)	0,002 (0,031)
Other business-oriented services	-0,148 (0,016)***	-0,559 (0,064)***	-0,178 (0,028)***	0,060 (0,023)***	0,035 (0,032)
Consumer-oriented services	-0,142 (0,013)***	-0,614 (0,054)***	-0,193 (0,023)***	0,042 (0,020)**	-0,030 (0,027)
Construction	-0,171 (0,013)***	-0,031 (0,048)	-0,355 (0,026)***	0,097 (0,020)***	0,026 (0,028)
Retail & wholesale	-0,137 (0,013)***	-0,601 (0,052)***	-0,231 (0,022)***	0,065 (0,019)***	0,009 (0,026)
Highly qualified population (share)	-0,000 (0,001)	-0,007 (0,003)**	0,015 (0,001)***	-0,003 (0,001)**	-0,003 (0,002)*
Demographic potential of region	0,014 (0,004)***	-0,023 (0,016)	0,042 (0,007)***	-0,003 (0,006)	-0,013 (0,008)
Month of foundation fixed effects	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes
N / (Pseudo) R-sq.	6960 / 0,045	6960 / 0,064	6960 / 0,132	6960 / 0,024	6960 / 0,012

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank.

Table 8: Selection effects during Great Recession and over business cycle: Firm survival

Dependent Variable	A - Probit Exit within 2 years Coef (S.E.)	B - Probit Exit within 3 years Coef (S.E.)	C - Probit Exit within 4 years Coef (S.E.)	D - Probit Exit within 2 years Coef (S.E.)	E - Probit Exit within 3 years Coef (S.E.)	F - Probit Exit within 4 years Coef (S.E.)
Founded during crisis	-0,006 (0,008)	0,001 (0,011)	0,010 (0,013)			
GDP in quarter of foundation				0,000 (0,001)	-0,001 (0,002)	-0,001 (0,002)
One founder with higher education	-0,009 (0,007)	-0,006 (0,010)	-0,009 (0,013)	-0,009 (0,007)	-0,006 (0,010)	-0,009 (0,013)
Age of oldest founder in team in years	-0,003 (0,002)	-0,005 (0,003)*	-0,005 (0,003)	-0,003 (0,002)	-0,005 (0,003)*	-0,005 (0,003)
Age of oldest founder in team squared	0,000 (0,000)**	0,000 (0,000)**	0,000 (0,000)**	0,000 (0,000)**	0,000 (0,000)**	0,000 (0,000)**
Industry experience in years (log)	-0,011 (0,003)***	-0,023 (0,005)***	-0,027 (0,006)***	-0,011 (0,003)***	-0,023 (0,005)***	-0,027 (0,006)***
Founder was self-employed before	0,004 (0,007)	0,011 (0,010)	0,029 (0,013)**	0,004 (0,007)	0,010 (0,010)	0,028 (0,013)**
Founder trans. from empl. in priv. sect.	-0,015 (0,006)***	-0,013 (0,009)	-0,028 (0,011)**	-0,016 (0,006)***	-0,013 (0,009)	-0,027 (0,011)**
Technology-intensive services	-0,002 (0,012)	-0,000 (0,018)	-0,019 (0,024)	-0,002 (0,012)	-0,001 (0,018)	-0,019 (0,024)
Software supply and consultancy	0,011 (0,014)	0,022 (0,022)	0,042 (0,028)	0,011 (0,014)	0,022 (0,022)	0,042 (0,028)
Non-high-tech manufacturing	-0,004 (0,014)	0,002 (0,021)	0,014 (0,027)	-0,004 (0,014)	0,002 (0,021)	0,014 (0,027)
Skill-intensive services	0,003 (0,015)	-0,003 (0,024)	0,003 (0,031)	0,002 (0,015)	-0,003 (0,024)	0,003 (0,031)
Other business-oriented services	0,019 (0,015)	0,022 (0,023)	0,054 (0,030)*	0,019 (0,015)	0,022 (0,023)	0,053 (0,030)*
Consumer-oriented services	0,017 (0,013)	0,032 (0,020)	0,052 (0,026)**	0,017 (0,013)	0,032 (0,020)	0,053 (0,026)**
Construction	-0,016 (0,015)	-0,024 (0,022)	-0,019 (0,027)	-0,016 (0,015)	-0,025 (0,022)	-0,019 (0,027)
Retail & wholesale	0,011 (0,013)	0,025 (0,019)	0,047 (0,025)*	0,011 (0,013)	0,025 (0,019)	0,047 (0,025)*
Highly qualified population (share)	0,001 (0,001)	-0,001 (0,001)	-0,003 (0,002)*	0,001 (0,001)	-0,001 (0,001)	-0,003 (0,002)*
Demographic potential of region	0,004 (0,004)	0,005 (0,006)	0,016 (0,007)**	0,004 (0,004)	0,005 (0,006)	0,016 (0,007)**
Month of foundation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Legal form	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes
N / (Pseudo) R-sq.	6960 / 0.047	5890 / 0.029	4906 / 0.033	6960 / 0.047	5890 / 0.029	4906 / 0.033

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank.

Table 9: Estimation results: Employment after one year in business (yes/no) - detailed

Dependent Variable	A - Probit Dep. Employees Coef (S.E.)	B - Probit (EB) Dep. Employees Coef (S.E.)	C - Probit Dep. Employees Coef (S.E.)
Founded during crisis (y/n)	0,046 (0,015)***	0,044 (0,015)***	
GDP in quarter of foundation			-0,004 (0,002)**
One founder with higher education	-0,017 (0,013)	-0,018 (0,018)	-0,016 (0,013)
Age of oldest founder in team in years	0,006 (0,004)*	0,008 (0,005)*	0,006 (0,004)*
Age of oldest founder in team squared	-0,000 (0,000)*	-0,000 (0,000)*	-0,000 (0,000)*
Industry experience in years (log)	0,033 (0,006)***	0,033 (0,008)***	0,033 (0,006)***
Founder was self-employed before	0,048 (0,013)***	0,037 (0,017)**	0,046 (0,013)***
Founder trans. from empl. in priv. sect.	0,073 (0,012)***	0,079 (0,016)***	0,075 (0,012)***
Technology-intensive services	-0,173 (0,023)***	-0,170 (0,032)***	-0,174 (0,023)***
Software supply and consultancy	-0,221 (0,028)***	-0,229 (0,039)***	-0,223 (0,028)***
Non-high-tech manufacturing	-0,032 (0,027)	-0,009 (0,037)	-0,035 (0,027)
Skill-intensive services	-0,133 (0,030)***	-0,150 (0,039)***	-0,134 (0,030)***
Other business-oriented services	-0,045 (0,030)	-0,051 (0,042)	-0,048 (0,030)
Consumer-oriented services	0,023 (0,026)	0,009 (0,036)	0,023 (0,026)
Construction	-0,038 (0,027)	-0,048 (0,036)	-0,041 (0,027)
Retail & wholesale	-0,075 (0,025)***	-0,074 (0,034)**	-0,076 (0,025)***
Limited liability (GmbH)	0,310 (0,013)***	0,312 (0,016)***	0,311 (0,013)***
Limited liability (UG)	0,071 (0,025)***	0,115 (0,038)***	0,065 (0,025)***
Highly qualified population (share)	0,000 (0,001)	0,001 (0,002)	0,000 (0,001)
Demographic potential of region	-0,010 (0,008)	-0,007 (0,010)	-0,010 (0,008)
Month of foundation fixed effects	Yes	Yes	Yes
N / Pseudo R-sq.	6960 / 0.124	6960 / 0.131	6960 / 0.123

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank. "EB" indicates weighted regressions with weights derived by entropy balancing.

Table 10: Estimation results: Monthly growth - detailed

Dependent Variable	A - OLS Empl. Growth Coef (S.E.)	B - OLS Empl. Growth Coef (S.E.)	C - OLS Empl. Growth Coef (S.E.)	D - OLS Empl. Growth Coef (S.E.)	E - OLS Empl. Growth Coef (S.E.)	F - OLS Empl. Growth Coef (S.E.)	G - OLS Empl. Growth Coef (S.E.)	H - OLS Empl. Growth Coef (S.E.)
Current GDP	0,032 (0,045)	-0,831 (0,095)***						
GDP # Firm age		0,519 (0,044)***						
Current GDP in industry			0,025 (0,014)*	-0,084 (0,022)***				
GDP in industry # Firm age				0,061 (0,008)***				
IFO bus. sit. index in industry					0,164 (0,091)*	-0,659 (0,169)***		
IFP index in industry # Firm age						0,464 (0,070)***		
Share short-time work in RoR							-0,825 (0,256)***	1,874 (0,540)***
Share s.-t. work in RoR # Firm age								-1,707 (0,271)***
Employment at end of last period	-0,002 (0,001)***	-0,002 (0,001)**	-0,002 (0,001)***	-0,002 (0,001)***	-0,002 (0,001)**	-0,002 (0,001)**	-0,002 (0,001)**	-0,002 (0,001)**
Age of firm in years	-0,017 (0,001)***	-0,555 (0,046)***	-0,017 (0,001)***	-0,083 (0,009)***	-0,017 (0,001)***	-0,028 (0,002)***	-0,017 (0,001)***	-0,014 (0,001)***
One founder with higher education	0,005 (0,003)	0,005 (0,003)*	0,005 (0,003)	0,004 (0,003)	0,005 (0,003)	0,005 (0,003)	0,005 (0,003)	0,005 (0,003)*
Age of oldest founder in team in years	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)	0,001 (0,001)
Age of oldest founder in team squared	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**	-0,000 (0,000)**
Industry experience in years (log)	0,005 (0,002)***	0,006 (0,002)***	0,005 (0,002)***	0,006 (0,002)***	0,005 (0,002)***	0,005 (0,002)***	0,005 (0,002)***	0,006 (0,002)***
Founder was self-employed before	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)	0,002 (0,003)
Founder trans. from empl. in priv. sect.	0,010 (0,003)***	0,009 (0,003)***	0,010 (0,003)***	0,010 (0,003)***	0,010 (0,003)***	0,010 (0,003)***	0,010 (0,003)***	0,010 (0,003)***
Technology-intensive services	-0,022 (0,006)***	-0,022 (0,006)***	-0,024 (0,006)***	-0,027 (0,006)***	-0,024 (0,006)***	-0,030 (0,006)***	-0,022 (0,006)***	-0,022 (0,006)***
Software supply and consultancy	-0,028 (0,007)***	-0,028 (0,007)***	-0,029 (0,007)***	-0,030 (0,007)***	-0,030 (0,007)***	-0,036 (0,007)***	-0,028 (0,007)***	-0,028 (0,007)***
Non-high-tech manufacturing	0,001 (0,007)	0,000 (0,007)	0,001 (0,007)	0,001 (0,007)	0,001 (0,007)	0,001 (0,007)	0,001 (0,007)	0,001 (0,007)
Skill-intensive services	-0,032 (0,007)***	-0,031 (0,007)***	-0,035 (0,007)***	-0,039 (0,007)***	-0,034 (0,007)***	-0,040 (0,007)***	-0,032 (0,007)***	-0,032 (0,007)***
Other business-oriented services	-0,002 (0,008)	-0,003 (0,008)	-0,003 (0,008)	-0,003 (0,009)	-0,005 (0,009)	-0,011 (0,009)	-0,003 (0,008)	-0,003 (0,008)
Consumer-oriented services	-0,012 (0,007)*	-0,012 (0,007)*	-0,012 (0,007)*	-0,011 (0,007)	-0,014 (0,007)**	-0,020 (0,007)***	-0,012 (0,007)*	-0,012 (0,007)*
Construction	-0,007 (0,006)	-0,008 (0,006)	-0,008 (0,006)	-0,010 (0,006)*	-0,008 (0,006)	-0,008 (0,006)	-0,007 (0,006)	-0,007 (0,006)
Retail & wholesale	-0,022 (0,006)***	-0,023 (0,006)***	-0,022 (0,006)***	-0,022 (0,006)***	-0,025 (0,006)***	-0,031 (0,006)***	-0,022 (0,006)***	-0,022 (0,006)***
Limited liability (GmbH)	0,062 (0,004)***	0,061 (0,004)***	0,062 (0,004)***	0,061 (0,004)***	0,062 (0,004)***	0,061 (0,004)***	0,062 (0,004)***	0,061 (0,004)***
Limited liability (UG)	0,005 (0,005)	0,002 (0,005)	0,005 (0,005)	0,004 (0,005)	0,005 (0,005)	0,005 (0,005)	0,004 (0,005)	0,003 (0,005)
Highly qualified population (share)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Demographic potential of region	-0,000 (0,002)	-0,000 (0,002)	-0,000 (0,002)	-0,000 (0,002)	-0,000 (0,002)	-0,001 (0,002)	-0,001 (0,002)	-0,001 (0,002)
Month of foundation fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N / Pseudo R-sq.	308997 / 0,006	308997 / 0,006	308997 / 0,006	308997 / 0,006	308997 / 0,006	308997 / 0,006	308997 / 0,006	308997 / 0,006

Notes: Significance levels: *** 1%, ** 5%, * 10%; cluster robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank.

Table 11: Estimation results: Conditional quantile regressions

Dependent Variable Quantile	# Dep. Empl. 70 Coef (S.E.)	# Dep. Empl. 72 Coef (S.E.)	# Dep. Empl. 74 Coef (S.E.)	# Dep. Empl. 76 Coef (S.E.)	# Dep. Empl. 78 Coef (S.E.)
Founded during crisis (y/n)	0,000 (0,118)	0,000 (0,057)	0,236 (0,116)**	0,144 (0,103)	0,262 (0,117)**
One founder with higher education	-0,000 (0,055)	0,000 (0,041)	0,059 (0,063)	0,051 (0,092)	0,112 (0,093)
Age of oldest founder in team in years	-0,000 (0,016)	-0,000 (0,012)	-0,012 (0,016)	-0,012 (0,022)	-0,011 (0,019)
Age of oldest founder in team squared	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Industry experience in years (log)	0,000 (0,031)	0,000 (0,020)	0,063 (0,030)**	0,062 (0,037)*	0,097 (0,038)**
Founder was self-employed before	0,000 (0,073)	-0,000 (0,055)	0,179 (0,083)**	0,163 (0,119)	0,262 (0,106)**
Founder trans. from empl. in priv. sect.	0,000 (0,049)	0,000 (0,036)	0,157 (0,051)***	0,137 (0,072)*	0,206 (0,089)**
N	6929	6929	6929	6929	6929

Dependent Variable Quantile	# Dep. Empl. 80 Coef (S.E.)	# Dep. Empl. 82 Coef (S.E.)	# Dep. Empl. 84 Coef (S.E.)	# Dep. Empl. 86 Coef (S.E.)	# Dep. Empl. 88 Coef (S.E.)
Founded during crisis (y/n)	0,344 (0,137)**	0,267 (0,131)**	0,326 (0,143)**	0,362 (0,141)**	0,258 (0,131)**
One founder with higher education	0,157 (0,098)	0,186 (0,120)	0,240 (0,107)**	0,263 (0,139)*	0,329 (0,107)***
Age of oldest founder in team in years	-0,016 (0,020)	-0,019 (0,025)	-0,014 (0,029)	-0,006 (0,034)	-0,012 (0,035)
Age of oldest founder in team squared	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)	0,000 (0,000)
Industry experience in years (log)	0,132 (0,041)***	0,155 (0,046)***	0,155 (0,049)***	0,125 (0,071)*	0,151 (0,062)**
Founder was self-employed before	0,415 (0,126)***	0,469 (0,137)***	0,498 (0,137)***	0,641 (0,159)***	0,720 (0,124)***
Founder trans. from empl. in priv. sect.	0,326 (0,094)***	0,372 (0,095)***	0,465 (0,088)***	0,543 (0,114)***	0,628 (0,107)***
N	6929	6929	6929	6929	6929

Dependent Variable Quantile	# Dep. Empl. 90 Coef (S.E.)	# Dep. Empl. 92 Coef (S.E.)	# Dep. Empl. 94 Coef (S.E.)	# Dep. Empl. 96 Coef (S.E.)	# Dep. Empl. 98 Coef (S.E.)
Founded during crisis (y/n)	0,318 (0,123)***	0,130 (0,174)	-0,140 (0,221)	-0,433 (0,224)*	-1,313 (0,485)***
One founder with higher education	0,280 (0,127)**	0,476 (0,190)**	0,668 (0,248)***	0,584 (0,334)*	0,464 (0,480)
Age of oldest founder in team in years	-0,005 (0,035)	-0,021 (0,050)	-0,019 (0,067)	0,007 (0,064)	0,078 (0,089)
Age of oldest founder in team squared	0,000 (0,000)	0,000 (0,001)	0,000 (0,001)	0,000 (0,001)	-0,001 (0,001)
Industry experience in years (log)	0,136 (0,059)**	0,171 (0,082)**	0,166 (0,122)	0,173 (0,183)	0,264 (0,193)
Founder was self-employed before	0,743 (0,130)***	0,733 (0,169)***	0,685 (0,249)***	0,956 (0,309)***	0,809 (0,454)*
Founder trans. from empl. in priv. sect.	0,719 (0,116)***	0,715 (0,155)***	0,868 (0,207)***	1,013 (0,242)***	1,014 (0,428)**
N	6929	6929	6929	6929	6929

Notes: Significance levels: *** 1%, ** 5%, * 10%; robust standard errors in parentheses; baseline category for industries: high-tech manufacturing; additional control variable in all regressions: funding by KfW bank. Effects for quantiles 69 and below close to zero and insignificant.

B   Appendix: Technical Details

B.1   Entropy balancing

In contrast to other related methods, for instance propensity score weighting, entropy balancing induces covariate balance directly, and not as the result of a propensity score matching procedure, which requires iterated re-specifications of the propensity score estimation to achieve covariate balance. The sampling weights are chosen as the solution to the minimization problem

$$min_{w_i} H(w) = \sum_{\{i|D=0\}} h(w_i)$$

Under the constraints that

$$\Sigma_{(i|D=0)} w_i c_{ri}(X_i) = m_r \text{ with } r \in 1, ...R \text{ and}$$
$$\Sigma_{(i|D=0)} w_i = 1 \text{ and}$$
$$w_i \geq 0 \text{ for all } i \text{ such that } D = 0$$

w_i denotes the weights for each observation from the control group. $h(w_i)$ is a distance measure which measures the distance between the chosen weights and a set of base weights. $w_i c_{ri}(X_i) = m_r$ denotes the balance constraints for the R moments to balance for each covariate (for further details we refer to Hainmueller (2011)). Entropy balancing therefore induces covariance balance directly and explicitly minimizes the weight given to each observation from the control group.

B.2   Details on the linked employer-employee dataset and the matching procedure

The employment statistics contain information on all reportable employees subject to social security contributions in Germany. This includes apprentices, interns and people in marginal part-time employment. All notifications on an individual's spells of employment and unemployment can be linked with the aid of a unique person-specific identifier, thereby revealing an employment history for each employee. A further identifier makes it possible to match the employees to establishments. However, there is no unique identifier to match establishments to firms. Therefore, we matched establishments to firms in the KfW/ZEW Start-up Panel using a text search algorithm via firm/establishment names and addresses. The text search algorithm is described in detail in Appendix B of Czarnitzki et al. (2015) and has proved to deliver very reliable results in various settings.

In the matching procedure we were able to find about 90% of the firms in the KfW/ZEW Start-up Panel that reported having employees in the yearly telephone surveys. We removed firms from the sample which reported that they had reportable employees but which we were unable to find during the matching procedure. In addition, to safeguard against false matches, all matches were double-checked manually and we excluded the matches in the 1st and 100th percentile of the difference between self-reported and process-generated firm sizes from the sample. The

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correlation coefficient between self-reported and process-generated firm sizes in the final firm-year panel dataset is slightly above 0.95.