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Hiring by start-ups and regional labor supply

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Content

Abstract

Young firms find it difficult to attract (skilled) workers. Using linked employer-employee data for Germany we investigate how local labor market conditions affect the hiring success of young firms. In a first step, we estimate the probability of the founder becoming an employer. In a second step we analyze how local conditions influence the probability of hiring skilled human capital. The results indicate a positive relationship between the local unemployment level and the hiring probability of young firms.

Zusammenfassung

Junge Firmen haben oft Schwierigkeiten (qualifizierte) Beschäftigte einzustellen. Basierend auf einem Linked Employer-Employee Datensatz für Deutschland untersuchen wir den Einfluss regionale Arbeitsmarktbedingungen auf die Einstellungschancen junger Firmen. Im ersten Schritt schätzen wir die Wahrscheinlichkeit, dass ein Gründer Beschäftigte einstellt. Im zweiten Schritt verwenden wir ein Heckman-Selektionsmodell und analysieren, wie regionale Bedingungen die Einstellungswahrscheinlichkeit von qualifizierten Beschäftigten beeinflussen. Die Ergebnisse zeigen einen positiven Zusammenhang zwischen der regionalen Höhe der Arbeitslosigkeit und der Einstellungswahrscheinlichkeit junger Firmen.

JEL-Klassifikation:

D22, L26, R12

Keywords:

Entrepreneurship, hiring, skilled workers, regional labor supply

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1 Introduction

Hiring the first employees is a very special challenge for start-ups[1] (Coad et al. 2017). For the many solo-entrepreneurs it constitutes a growth of at least 100 percent. However, it is not easy to find workers that are suitable for the specific challenges faced by a young firm and at the same time harmonize with the founder(s) (Coad et al. 2014; Ouimet and Zarutskie 2014). A firm's hiring success depends on firm-specific factors, like firm size and age, as well as factors external to the firm, such as the supply of skilled labor. These external factors vary across regions and depend on regional labor market conditions. There is already a large body of literature that links regional conditions with regional start-up activities (e.g. Audretsch 2007; Dejardin 2011, Fritsch and Noseleit 2013; Noseleit 2013; Glaeser et al. 2014), but whether regions with high start-up rates are also the regions with the best labor market conditions for hiring workers is a question that remains unanswered to date (Brixy and Grotz 2007; Frisch and Schroeter 2011; Audretsch et al. 2012).

By investigating the impact of regional labor market conditions on the hiring chances of newly founded firms, this paper contributes to entrepreneurial literature on hiring in start-ups (Schnabel et al. 2011; Nyström 2012; Ouimet and Zarutskie 2014; Coad et al. 2014, 2017; Dahl and Klepper 2015). Using linked employer-employee data for Germany we analyze how local labor market conditions – especially local labor supply – affect the hiring success of young firms. The central hypothesis to be tested in this paper is that young firms' chances of hiring (skilled) personnel are related to the regional supply of labor. We expect more workers to be willing to accept jobs in start-ups in regions with high unemployment than in those with low unemployment. Thus, regions with excess labor supply should provide young businesses with better chances to grow than regions with labor shortages, and should especially increase the likelihood of young firms hiring high-skilled individuals.

Understanding which start-ups are able to attract employees is of great relevance, as a firm's human resources are crucial for its economic success because "new ventures […] rely critically on individuals who join founders in their efforts to build successful companies" (Roach and Sauermann 2015: 29). For that reason this paper focuses on highly qualified individuals being hired by newly founded firms at a very early stage after the firm formation.

The paper is structured as follows: Section 2 provides an overview of the theoretical background and addresses the questions of why start-ups face problems hiring workers and which regional factors might affect their hiring success. Section 3 presents our estimation framework and section 4 the data. In section 5 we outline the results, and section 6 concludes our main findings.

[1] The terms start-ups, newly founded firms and young firms are used as synonyms in this paper.

2 Theoretical background

2.1 Why start-ups face problems hiring workers

Despite the particular importance of early employees, start-ups often face problems attracting workers (Shane 2009; Coad et al. 2014, 2017; Borggren et al. 2015; Roach and Sauermann 2015). One possible explanation for these difficulties is that start-ups have very specific recruitment practices. Compared to the more formal recruitment practices in incumbent firms, start-ups have limited resources to invest in recruitment and often rely on informal channels, like networks and recommendations, to attract employees (Cardon and Stevens 2004). Moreover, as clearly defined organizational roles and job positions are not yet established they are unable to offer a structured career path. Another argument is that, due to financial constraints, young firms have to make compromises concerning the quality of their new hires in order to save search costs (Pe'er et al. 2014).

From the employee perspective, working for a start-up is associated with certain conditions that make employment in such an establishment less attractive. Due to high failure rates within the first years after the foundation, employment in a start-up is associated with a higher risk of losing one's job than is the case in an established firm (Schnabel et al. 2011). In addition, as confirmed by several empirical studies, start-ups pay lower wages on average than established firms (Brixy et al. 2007, Nyström and Elvung 2014).

Moreover, it is difficult to obtain information about the establishment and its image, so potential employees are not able to judge whether the establishment is an attractive potential employer (Williamson et al. 2002; Aldrich and Ruef 2006; Coad et al. 2014, 2017). For these reasons, empirical findings show that start-ups are more likely than incumbent firms to employ workers with a marginal status on the labor market. Individuals working for start-ups are less highly skilled on average, have shorter job tenure and are more likely to have been unemployed before being hired (Parker 2005 Schnabel et al. 2011; Nyström 2012; Ouiment and Zarustkie 2014; Coad et al. 2014, 2017, Fackler et al. 2018).

In contrast, however, start-ups also attract workers in the field of science and engineering (cf. Roach and Sauermann 2015, 2017). These workers often belong to a specific group of employees, so called "joiners" (Roach and Sauermann 2015: 1), who explicitly seek employment in an entrepreneurial environment. They are attracted by start-ups because of their preferences for the specific job attributes provided by an entrepreneurial work setting, such as a higher level of autonomy, given the smaller size and flatter organizational hierarchy. Such workers tend to be more risk-tolerant with respect to financial and career risks and share similar preferences for autonomy with the entrepreneurs themselves. Moreover, being one of the first employees in a successful, fast-growing new firm might be associated with the expectation of advantages over workers entering the firm later or entering an incumbent firm. Start-up employees may receive greater utility from the nonpecuniary benefits inherent in their

career role and may therefore be willing to work for lower wages than they would earn in other forms of employment (Roach and Sauermann 2015, 2017).

Nevertheless, competing for skilled personnel with well-known incumbent firms is one of the most serious problems encountered by young firms. So far, no research has been conducted to investigate how local conditions affect the human capital acquisition of start-ups (cf. Dahl and Klepper 2015), even though it appears reasonable to assume that start-ups' chances of hiring skilled workers vary across regions and depend on regional labor market conditions.

2.2 Regional factors affecting start-ups' hiring chances

To date, little is known about the regional characteristics influencing the growth of young firms (Audretsch et al. 2012; Borggren et al. 2015). While there is a large body of literature investigating the regional variation in new firm formation and providing evidence of regional variations in entry (Armington and Acs 2002; Lee et al. 2004; Fritsch et al. 2005; Parker 2005; Acs and Armington 2006; Sternberg 2009; Stam et al. 2010; Sorenson 2017), these studies say little about the further development of start-ups after their foundation. Yet the local conditions that facilitate the formation of new firms may not necessarily provide the best conditions for the growth of the new businesses (Brixy and Grotz 2007). Against this background, the following section discusses regional factors that are associated with start-ups' hiring chances.

2.2.1 Local labor supply

Local labor supply is an important factor for a firm's human capital acquisition, in terms of both the amount of labor available in the region and its quality (Borggren et al. 2015). Local labor supply depends on the number of potential workers available in one region, and this in turn largely depends on the number of unemployed. Both regions with labor shortages and regions with an abundance of manpower are found in Germany. Whereas the average unemployment rate for the years 2008-2012, the period analyzed here, was 8.1 percent, the regional rates at NUTS-3 level for the same period ranged from 1.1 percent to 21.0 percent (see Table A2, appendix). We therefore expect employers in regions with high demand for labor to be more constrained by the scarcity of labor, whereas in regions with more labor supply it is likely to be cheaper to fill a vacancy (Gorter et al. 2003; Blatter et al. 2012). However, it is not only the availability of labor as such that affects the hiring chances for young firms. Structural problems on the labor market can cause mismatch-unemployment, while at the same time labor shortages may exist in certain occupations. Thus, the composition of the unemployed also has to be taken into account.

Another important aspect related to regional unemployment is hiring costs. There is evidence of a negative relationship between hiring costs and the level of unemployment. Muehlemann and Pfeiffer (2016) find that a one-percentage-point increase in the local unemployment rate is associated with a decrease in average recruitment costs of 4.7 percentage points. Low unemployment strengthens the employees' bar-

gaining position and, according to the efficiency wage theory, should cause companies to pay higher wages in regions with low unemployment and vice versa. As start-ups have limited resources for investing in selection and recruitment processes, they should especially benefit from being located in regions with lower hiring costs.

2.2.2 Localization externalities

Besides the local labor supply, localization externalities also affect start-ups' hiring success. New firms are often founded in regions with a high level of entrepreneurship and start-up activities. Such regions often exhibit relatively persistent start-up rates over time, which can be explained by a regional entrepreneurship culture that is reflected by informal institutions promoting entrepreneurship, among other things. Entrepreneurship culture is understood as a collective positive understanding in the regional population oriented toward entrepreneurial values (e.g. Fritsch and Wyrwich 2017). Such regions with high start-up rates also produce role models that encourage individuals to work in an entrepreneurial environment without being founders themselves (Roach and Sauermann 2015). Therefore newly founded firms should benefit from being located in regions with higher start-ups rates because there are more individuals willing to work for a start-up in such a region.

Positive effects on the supply of skilled labor can also result from a regional concentration of firms in the same industry, the well-known localization externalities (cf. Glaeser et al. 1992). Regional specialized clusters tend to encourage the growth of firms within a cluster, for example via spillovers and the development of pooled labor markets (Audretsch et al. 2012; Delgado et al. 2014; Weterings and Marsili 2015; Litzel 2017). Labor market pooling increases the likelihood of matches, thereby reducing the effort required by start-ups when hiring workers. The pooling of labor also reduces the disadvantages for workers, making it easier for them to find new work, which might in turn lead to workers being more willing to take risks and join new firms (cf. Neffke et al. 2011). The equally well-known approach by Jacobs (1969), who argues that firms benefit from a high level of industrial diversity (so-called "Jacobs externalities"),.is closely connected with this. Knowledge generated in one industry may also be adapted in another industry. Transferring this to the regional supply of labor, start-ups from one industry can benefit from skilled workers in other industries being in close spatial proximity because a larger pool of skilled labor is available. Obviously, Jacobs and localization externalities are not mutually exclusive.

However, regional concentration is always associated with a higher level of competition. Even if a firm's product market is not local, the firm is likely to compete with local rivals in the acquisition of resources, especially labor, as firms tend to acquire most of their resources from the region in which they are located (Weterings and Marsili 2015). In regions with high start-up rates, competition among young firms for (skilled) workers is high and might hamper their recruitment opportunities. The same applies for regions with a high level of localization or Jacobs externalities, where competition results not only from a larger number of other start-ups but generally from a higher

density of firms. This is presumably one reason why existing research shows inconsistent results concerning whether new firms are "positively affected, not affected, or even negatively affected" (Wennberg and Lindqvist 2010: 222) by being located in agglomerated areas.

3 Estimation framework

The aim of this paper is to analyze the effects of regional factors, in particular of regional labor supply, on the hiring probability of start-ups. We are able to investigate this question using linked employer-employee data for German start-ups. Start-ups are defined as all types of newly founded firms with a maximum age of three years. As the first step, we estimate a probit model in order to analyze how regional conditions affect start-ups' hiring probability in general. The second step focuses only on highly skilled hires. We therefore estimate a Heckman selection model, which is introduced in the second part of this chapter. Both models are calculated separately for hires during the first three years and for all hires during the firms' first year. The reason for this is that most non-employer start-ups either hire their first employees within the first three years after foundation or remain solo-entrepreneurs (Fairlie and Miranda 2017). The concentration on the first year follows the idea that for many young firms a minimum efficient firm-size requires hiring right from the start. Moreover, hires in these early years are of special importance for a firm's future success (Roach and Sauermann 2015).

3.1 Probit model – explaining start-ups' hiring probability

The regression equation is of the stylized form

$$H_j = \beta_0 + \beta_1 LLS_r + \beta_2 LEX_r + X_{jr} + \varepsilon_{1jr} \quad (1)$$

It explains whether a founder hires workers ($H_j = 1$) or not ($H_j = 0$) by local labor supply (LLS), localization externalities (LEX) and a set of firm- and region-specific control variables X_{jr}. The amount of the local labor supply (LLS) is of central interest in our paper. We use regional unemployment rates at NUTS-3 level as a proxy for the local labor supply. We differentiate between the unemployment rate in the respective year as a proxy for hiring costs and for the available human capital in the region and the annual development of unemployment. In order to depict structural problems on the labor market, such as mismatch, we employ the composition of the pool of unemployed according to skill level. We use skill-specific unemployment shares and include the share of all unemployed who are specialists (high-skilled), trained assistants (medium-skilled) and helpers (low-skilled).

To analyze the relationship between the different forms of localization externalities (LEX) and the hiring probability, we include the cluster index and the Krugman index at NUTS-3 level (see appendix for the calculation). In order to control for Jacobs externalities, we apply the Krugman diversification index (KI). The KI measures the absence of diversification in a region and can range from minus infinity to zero, with a more negative index indicating that a region is more specialized. The maximum value

of zero means that the local economic structure equals that of the country as a whole (cf. Dauth 2013). To capture localization externalities, we calculate the cluster index (CI), which was developed by Sternberg and Litzenberg (2004). The CI comprises three components for identifying a spatial industrial cluster: the relative industrial density, the relative industrial stock and the relative size of the establishment. The CI can range from zero to infinity, with a CI of one indicating that a region does not differ from the overall region. To identify a cluster, the CI therefore has to be at least greater than one.

Further regional controls include the founding rate, the logarithm of the population density, the level of GDP and the lagged annual GDP development. Firm-level controls are the founder's age, the founder's industry experience in years and dummy variables indicating whether the firm was founded by a team and whether at least one of the founders is female. To control for the stratification of the sample we include the year, dummies for ten industries and a dummy indicating that the firm received subsidies from the KfW Banking Group[2]. Since industry and KfW subsidies influence each other's drawing probabilities, we also include the interactions.

3.2 Selection model: explaining the probability of start-ups hiring highly skilled staff

In the second step, we analyze the probability of start-ups' hiring highly skilled workers. About half of all newly founded firms do not hire at all. To tackle the selection whether an entrepreneur (intends) to employ workers or not, we use a two-stage Heckman approach with four variables for identifying the selection.

The Heckman selection model assumes that there is a regression relationship

$$y_j = x_j\beta + u_{1j} \ , \tag{2}$$

where the dependent variable is not always observed (cf. Gronau 1974, Lewis 1974, Heckman 1976). The dependent variable for observation j is observed if γ+ u_2j>0.

The regression equation is of the stylized form:

$$Hsk_j = \beta_0 + \beta_1 LLS_r + \beta_2 LEX_r + X_{jr} + \varepsilon_{1jr_1} \tag{3}$$

It explains whether a founder hires high-skilled workers ($Hsk_j = 1$) or not ($Hsk_j = 0$) by local labor supply (LLS) localization externalities (LEX) and a set of firm- and region-specific control variables X_{jr}. The dependent variable Hsk_j is only observed for firms that employ at least one worker ($H_j = 1$), so Hsk_j is observed if the selection equation holds:

[2] We are legally bound to suppress the coefficients of this variable in publications.

$$\gamma_0 + \boldsymbol{\gamma}_1 Select_{jr} + \varepsilon_{2jr} > 0 \quad (4)$$

Based on the assumptions of the Heckman model, variables $Select_{jr}$ are needed that strongly affect the selection, meaning in our case a firm's decision to hire at least one employee, but do not affect the decision to hire highly qualified workers. As selection variables we employ investments in a start-up during the first year, the use of material resources owned by the founders, minimum efficiency business size in the industry of the start-up and necessity entrepreneurship[3].

3.2.1 Selection variables

We expect higher investments to be an indicator for growth-oriented start-ups. Therefore, we include the amount of financial resources used for investments in physical capital in the founding year. In a similar context the variable material resources is included in the selection model. This indicates the amount of material resources possessed by the founder before the business was set up. Neither of these variables is connected with the decision to hire high-skilled individuals.

A third variable for modelling the selection process is the minimum efficient business size. The smaller an industry's minimum efficient business size, the fewer resources are needed to enter the market successfully and vice versa (e.g. Fritsch and Falck 2007). Based on this evidence, we expect start-ups in industries with a larger minimum efficient business size to be more likely to hire. However, although this is a widely used measure, the explanatory power of this variable is debatable. The minimum efficient business size varies more between firms in the same industry than between firms in different industries (Fritsch 1990). Nonetheless, we expect a negative relationship between the likelihood of start-ups becoming employers and the industry's minimum efficient firm size, and include the average firm size within each industry in the selection model.

The fourth selection variable is necessity-based entrepreneurship, which is associated with a lower hiring probability. Starting a business with the overriding purpose of creating a job for oneself makes it less likely to employ workers in the first few years than if the business was started for other reasons, such as maximizing income. Moreover, hiring staff is associated with certain risks. Necessity entrepreneurs may be more risk-averse when it comes to assuming responsibility for additional workers. As Coad et al. (2017) show, entrepreneurs who hire are more likely than others to have been employed before founding their business and hence unlikely to be necessity founders. Moreover, Anderson and Wadensjö (2007) find that entrepreneurs who

[3] In the causal ordering of firm growth, sales growth comes before employment growth (Moneta et al. 2013), so it seems reasonable to assume that only start-ups recording sufficient sales growth to justify the need for new employees aim to hire. Therefore revenues appears to be the obvious variable to feed the selection equation. Although revenues are reported in our sample, the variable contains many missing values due to the fact that very young firms are unable to provide information about their revenues in their first year of business.

were wage earners before, are more likely to become employers. To identify necessity founders in the selection model, we employ a dummy variable that takes the value one if the entrepreneur was unemployed in the period immediately before starting the business according to a question in the survey.

3.2.2 Variables to explain the probability of start-ups hiring highly skilled workers

As already mentioned, it is difficult for potential employees to judge whether a certain start-up is an attractive employer or not because there are no reliable signals of previous firm performance available. Hence, young firms must attract employees via other mechanisms. The founder's qualification level can serve as substitute signal of performance, making young firms founded by highly qualified entrepreneurs more attractive for employees (Bublitz et al. 2017, Coad et al. 2017). There is also evidence that teams, and specifically founding teams, tend to exhibit homophily (Ruef et al. 2003). Highly qualified entrepreneurs might prefer to recruit equally highly qualified workers, even if it is unclear whether the worker's qualification is really necessary. We therefore employ a dummy variable indicating whether the founder holds a university or technical university degree.

Innovative start-ups need skilled workers in order to grow. Although it can be assumed that the main knowledge base is with the founder(s), innovative businesses rely on qualified personnel if they intend to grow (Roach and Sauermann 2015). We expect innovative start-ups to be more likely to hire skilled employees. Especially if the innovation is complex, a young firm needs to employ sufficiently skilled personnel. There are different ways to measure firms' innovativeness. One way to depict innovativeness is by means of patents, so we use a dummy variable indicating whether or not a firm holds a patent.

4 Database and descriptive overview

For the empirical analyses in this study we use new and very extensive linked employer-employee data for Germany. The data matches the IAB/ZEW Start-Up Panel with employee register data from the employment statistics of the German Federal Employment Agency. The IAB/ZEW Start-Up Panel (since 2014, formerly KfW/ZEW Start-Up Panel; for details see Gottschalk et al. 2008; Fryges et al. 2009; Bersch et al. 2014) is a random sample of young German firms from almost all industries apart from the primary sector, the public sector and the energy sector. Information is collected by means of a yearly telephone survey (computer-aided telephone interviews, CATI). Almost all industry sectors are represented, and high-tech industries are explicitly oversampled. The random sample is drawn from the database of Creditreform, the largest credit rating agency in Germany. The sample is stratified by three criteria: the year of firm formation, the industrial sector and whether or not the firm has received support from the KfW Banking Group.

Firms are tracked from their first year of existence, which permits research on employees in the first year(s) after foundation. Each year approximately 6,000 firms are

surveyed, all of which were founded within three years prior to the interview. Firms are contacted repeatedly until they reach the age of eight years in order to track their development over time. The statistical units are start-ups run by at least one full-time entrepreneur who actively participates in business life, for example by taking out a loan, employing workers or renting business premises. The reason for this limitation is that there are many part-time entrepreneurs in Germany who start a business while simultaneously in dependent employment. Such start-ups often have only small financial needs and start without any employees.

The survey data is matched with employee register data from the employment statistics of the German Federal Employment Agency. We can thus observe in detail the build-up of a workforce in each new firm by linking it with register data on each worker's employment history. The register data from the employment statistics of the German Federal Employment Agency contain detailed information about all reportable employees with regard to their education and vocational qualifications, their occupational status, as well as the start and end dates of all employment and unemployment spells in each individual's employment history.

The calculation of the cluster index is based on data from the Establishment History Panel and regional variables are from the employment statistics of the Federal Employment Agency and the Federal Statistical Office[4].

We cover the period from 2008 to 2012 and, in order to avoid a survivorship bias, we strive to minimize the period between founding and the interview by keeping only firms that were first interviewed in the spring or summer following their year of foundation. This reduces our sample to 5,052 firms, 35 percent of which hire at least one person during the first year and 43 percent during the first three years (Table A1, appendix).

5 Results

5.1 Hiring probability and labor supply

Table 1 presents the results of the probit models. Model 1 estimates whether or not a firm generally hires during the first three years, Models 2 is restricted to firms in the first year after their foundation.

[4] www.destatis.de

Table 1
Probit model, dependent variable: firm hires or not (dummy)

	Model 1 (years 0-3)		Model 2 (first year)	
Variables at regional level				
Unemployment rate	0.016*	(0.007)	0.011	(0.008)
Development of unemployment rate	0.006	(0.035)	-0.026	(0.049)
Share of unemployed specialists (high skilled)	0.009	(0.008)	0.007	(0.010)
Share of unemployed trained assistants (medium skilled)	-0.004	(0.005)	-0.003	(0.006)
Share of unemployed helpers (low skilled)	0.005*	(0.002)	0.006	(0.003)
GDP	0.000	(0.002)	-0.004	(0.003)
GDP, variation	-0.084	(0.428)	0.712	(0.630)
Population density (log)	-0.054	(0.033)	-0.012	(0.037)
Founding rate	-0.022	(0.014)	-0.026	(0.015)
Cluster index	-0.074	(0.192)	-0.298	(0.199)
Krugman index	0.003	(0.003)	0.003	(0.004)
Variables at firm level				
Investments (ln)	0.074***	(0.008)	0.074***	(0.008)
Material resources (ln)	-0.018***	(0.005)	-0.017***	(0.005)
Necessity founding (D)	-0.423***	(0.053)	0.445***	(0.062)
Minimum efficiency business size	-0.108	(0.062)	-0.149	(0.085)
Team (D)	0.238***	(0.046)	0.149**	(0.049)
Founder female (D)	0.034	(0.053)	0.118*	(0.057)
Age of founder	-0.000	(0.002)	0.005*	(0.002)
Industry experience	0.002	(0.002)	0.004	(0.003)
Stratification controls				
Year				
2008	*base*		*base*	
2009	-0.093	(0.080)	-0.068	(0.106)
2010	-0.148*	(0.066)	-0.140	(0.078)
2011	-0.180*	(0.071)	-0.104	(0.079)
2012	-0.229**	(0.086)	0.171	(0.093)
Industry				
Cutting-edge technology manufacturing	*base*		*base*	
High-technology manufacturing	3.152	(1.862)	4.340	(2.566)
Technology-intensive services	-1.491*	(0.594)	-1.754*	(0.813)
Supply and consultancy	-0.894***	(0.263)	-0.920**	(0.348)
Non-high-tech manufacturing	-0.048	(0.129)	0.116	(0.158)
Skill-intensive services	-1.130**	(0.417)	-1.281*	(0.564)
Other business-oriented services	-0.402	(0.208)	-0.493	(0.258)
Consumer-oriented services	-1.070*	(0.471)	-1.261*	(0.642)
Construction	-0.793	(0.411)	-0.934	(0.553)
Retail and wholesale	-0.935**	(0.357)	-1.011*	(0.483)
Constant	0.89	-0.845	0.774	-1.135
N	8,634		4,233	

Note: Probit regression, marginal effects. Standard errors in parentheses. */**/*** indicates statistical significance:*p<0.05, **p<0.01, ***p<0.001

Source: IAB/ZEW Start-Up Panel, own calculations.

The coefficient for the regional unemployment rate is positive and significant. This shows that a higher level of regional unemployment is associated with a higher hiring

probability. This result indicates that start-ups can indeed benefit from being located in regions with higher unemployment. However, this effect is only statistically significant when we consider the whole period of three years. For firms in their first year of operation the coefficient also is positive but not significant, which might be due to the smaller number of observations. Regarding the skill-specific unemployment shares, only a larger share of low-skilled unemployed persons is associated with a higher hiring probability. One interpretation could be that regions with a larger share of low-skilled unemployed persons are associated with a high level of unemployment, an increasing unemployment rate and decreasing GDP, i.e. economically weak regions (see Table A3, appendix). Localization externalities, namely the cluster index, the Krugman index and the founding rate do not show to have significant effects on the hiring probability of young firms.

Regarding control variables at firm level, as expected investments are positively related to the hiring probability, whereas unexpectedly the use of material resources is negatively related to the hiring probability. The use of material resources owned by the founder prior to founding the business seems to be an indicator of a start-up that was not growth-oriented[5] . Both coefficients are highly statistically significant for firms observed during the whole three-year period as well as for firms observed only in the first year of operation. The same applies for businesses founded out of necessity. Founders starting their business out of unemployment are associated with a 42 percentage-points lower probability of employing workers (45 percentage-points for firms in the first year of their existence). This result clearly confirms the findings of previous studies, which show that entrepreneurs who were employed before founding the business are more likely to become employers (cf. Anderson and Wadensjö 2007, Coad et al. 2017). Minimum efficiency business size - which is surveyed at industry level – is not statistically significant. However, this variable is highly correlated with the industry variables and becomes significant if the industry variable is not included.

5.2 Hiring of skilled workers

In the following, we concentrate on the likelihood of new firms hiring high-skilled workers. As stated in the previous section, this affords a Heckman selection model. The Wald test of independent equations (Table 2) verifies that there is a selection of firms hiring in general and firms hiring highly skilled human capital.

[5] In the survey, firms are asked whether, when founding the start-up, the founder used material resources already in his or her possession prior to starting the venture. The explanation that firms with a smaller amount of material resources are more growth-oriented could be based on the idea that those firms plan to grow larger right from the beginning and therefore invest in material, rather than using material resources owned by the founder beforehand. Using material resources privately owned by the founder is associated with smaller, solo-entrepreneurial firms.

Table 2
Heckman selection model. Dependent variable: firm hires highly skilled workers or not (dummy)

	Model 1 (years 0-3)		Model 2 (first year)	
Variables at regional level				
Unemployment rate	0.005	(0.003)	0.007*	(0.005)
Development of unemployment rate	-0.006	(0.017)	0.000	(0.023)
Share of unemployed specialists (high skilled)	0.011**	(0.004)	0.018**	(0.006)
Share of unemployed trained assistants (medium skilled)	-0.004	(0.002)	-0.005	(0.003)
Share of unemployed helpers (low skilled)	0.001	(0.001)	0.001	(0.002)
GDP	0.001	(0.001)	0.001	(0.001)
GDP, variation	-0.290	(0.249)	-0.825*	(0.395)
Population density (log)	-0.005	(0.013)	-0.012	(0.019)
Founding rate	-0.012*	(0.005)	-0.020*	(0.007)
Cluster index	0.001	(0.002)	-0.001	(0.002)
Krugman index	0.058	(0.076)	0.015	(0.105)
Variables at firm level				
Patents (D)	0.123**	-0.042	0.075	(0.050)
Team (D)	0.021	(0.018)	0.011	(0.025)
Founder holds university degree D)	0.144***	-0.018	0.132***	(0.026)
Founder female (D)	-0.005	(0.019)	-0.019	(0.028)
Age of founder	0.004***	(0.001)	0.004***	(0.001)
Industry experience	-0.002**	(0.001)	-0.002	(0.001)
Stratification controls				
Year				
2008	*base*		*base*	
2009	0.079	(0.044)	0.105	(0.061)
2010	0.051	(0.034)	0.094*	(0.044)
2011	0.080*	(0.033)	0.120**	(0.045)
2012	0.095*	(0.037)	0.075	(0.042)
Industry				
Cutting-edge technology manufacturing	*base*		*base*	
High-technology manufacturing	-0.046	(0.059)	-0.037	(0.086)
Technology-intensive services	0.049	(0.043)	0.006	(0.066)
Supply and consultancy	0.125**	(0.046)	0.054	(0.076)
Non-high-tech manufacturing	-0.140**	(0.045)	-0.120	(0.072)
Skill-intensive services	0.102	(0.060)	0.092	(0.088)
Other business-oriented services	-0.142**	(0.054)	-0.119	(0.082)
Consumer-oriented services	-0.062	(0.049)	-0.093	(0.070)
Construction	-0.122**	(0.043)	-0.151*	(0.071)
Retail and wholesale	-0.072	(0.042)	-0.173*	(0.070)
constant	0.251	(0.149)	0.329	(0.194)
Select				
Main selection variables				
Investments (ln)	0.074***	(-0.007)	0.075***	(0.008)
Material resources (ln)	-0.018***	(-0.005)	-0.017***	(0.005)
Necessity founding (D)	-0.424***	(-0.053)	-0.444***	(0.061)
Minimum efficiency business size	-0.116	(-0.062(	-0.156	(0.087)

	Model 1 (years 0-3)		Model 2 (first year)	
Regional, firm-level and stratification controls included				
Constant	0.91	(-0.791)	0.837	(-0.893)
Number of observations	8,631		4,232	
Censored	5,100		2,797	
Uncensored	3,531		1,435	
Wald test of indep. equations	$Chi^2(1)$= 13.72, Prob > chi^2=0.0002		$Chi^2(1)$= 8.40 Prob > chi^2=0.0038	

Note: Heckman selection model. The coefficients are calculated using OLS. To take into account that the dependent variable is binary we estimate the same models with Heckprobit, but as the results are the same we only show the OLS coefficients. Standard errors in parentheses. */**/*** indicates statistical significance: *p<0.05, **p<0.01, ***p<0.001

Source: IAB/ZEW Start-Up Panel, own calculations.

The results show that the level of regional unemployment has a positive impact on recruitment in the first year. These very young firms also have a higher hiring probability in regions with decreasing GDP. This differs from the models for overall hiring and underlines the need for skilled human capital for very young firms shortly after their foundation. Moreover, it shows that they can indeed benefit from being located in economically weaker regions. Special attention should be paid to the composition of the regional unemployment. Here we find a large share of high-skilled unemployed persons to have a positive effect. The obvious explanation for this result is that in regions with a large share of skilled unemployed persons, more human capital is available on the labor market. In addition, regions with a large share of highly skilled unemployed are associated with a lower level of unemployment and with high population density, so are most likely well-performing urban areas (see Table A3, appendix). It appears reasonable to expect that especially high-tech start-ups benefit from a higher level of unemployed specialists because they particularly rely on skilled workers. To test this relationship, we interact the share of unemployed specialists and a high-tech dummy. Contrary to our expectation the interaction term is statistically insignificant. The founding rate is negatively associated with the probability of hiring highly skilled workers. The reason for this could be that increased competition in entrepreneurial regions mitigates the positive effects associated with entrepreneurial regions such as a greater willingness to work for a newly founded firm.

A closer look at the control variables at firm level yields additional interesting findings. As expected, more innovative firms are more likely to hire skilled human capital. Holding a patent is associated with an increase in the probability of hiring highly skilled workers by 12 percentage points; for firms in the first years of their existence this variable is not statistically significant, but the coefficient also indicates a positive relationship. One explanation is that young firms need some time to apply for a patent. The founder's qualification level is also positively related to the outcome variable. Holding a university degree is associated with a 14 percentage-point higher probability of hiring skilled employees for all firms and with a 13 percentage-point higher hiring probability for firms in their first year. This finding confirms results of previous studies indicating that young firms with highly qualified founders are able to hire better qualified workers. One possible explanation for this is that the founder's qualification level serves as substitute signal for firm performance (cf. Bublitz et al. 2017; Coad et al.

2017). In addition, highly qualified founders might prefer to recruit equally qualified workers, especially during the very early period of firm formation when employees often fill the role of “joiners” or “entrepreneurial employees” working closely together with the entrepreneur (cf. Road and Sauermann 2015). Another possibility is that they tend to recruit friends they made while at university.

5.3 Robustness tests

Several papers report of cyclical effects on business entry but also on new-firm growth (Fort et al., 2013; Bartz and Winkler, 2016; Sedlacek and Sterk, 2017). A common finding in these studies is that employment in young businesses is impacted more negatively by crises than that in established businesses. Cyclical effects are already controlled for by GDP and the necessity variable for the founder’s motivation. Nevertheless, we exclude the years of the Great Recession, 2008 and 2009. We see that the coefficients of the main variables of interest remain statistically significant (most likely due to a smaller number of observations) and for those which become insignificant, the direction of the effect remains consistent (see table A4 (models 1 and 2), appendix).

Moreover, the first employee hired by a new firm might tend to be someone for administrative purposes (e.g. a secretary), who is likely to be skilled, but not highly skilled. To control for this effect, we include the total number of employees in the founding year (see table A4 (models 3 and 4), appendix). Thus, the individuals hired in this model are not the first ones hired. The variable for all employees in the founding year is statistically significant and positive, indicating that start-ups that are already employers are more likely to hire in general and also more likely to hire highly skilled labor. Nevertheless, there are no significant changes in our main variables.

6 Conclusions

We investigate how the local supply of labor affects the hiring decisions of start-ups. We differentiate between the growth chances as such and, more particularly, the probability of hiring high-skilled workers. Using a new linked employer-employee dataset on large cohorts of newly founded businesses we are able to further differentiate between start-ups during their first three years after foundation and really young firms in their first year. We find that with increasing unemployment, new firms are more likely to hire. Moreover, the results show that a higher level of regional unemployment is related to a higher probability of hiring highly skilled individuals for firms in the first year of their existence. In addition, the probability of hiring high-skilled workers is mainly driven by the composition of the regional unemployment, where a large share of high-skilled unemployed persons is positively related to a higher probability of hiring high-skilled individuals.

Our results confirm the role of start-ups for regional economic development. Start-ups can benefit from being located in regions with higher unemployment, but on the other hand especially regions with high unemployment should benefit from new firms’ stronger ability to grow. Future research could take up this point and attempt to shed

light on the role of young firms for the integration of unemployed individuals into the labor market, especially in economically weak regions. However, the fact remains that entrepreneurial activities are less prevalent in these regions. Therefore our results confirm the need for policies to foster entrepreneurial activities in economically weak regions.

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Appendix

Calculation of the Krugman Index

$$KI_{irt} = -\sum_{i'=1, i' \neq i}^{N} \left| \frac{e_{i'rt}}{e_{rt}} - \frac{e_{i't}}{e_{rt}} \right|$$

The standard Krugman diversification index (KI) measures the absence of diversification in region r in industry i at time t. It can range from minus infinity to zero, with a more negative index indicating that a region is more specialized (Dauth 2013).

Calculation of the cluster index

$$CI_{ij} = ID_{ij} \times IS_{ij} \times \frac{1}{SB_{ij}} = \frac{\frac{e_{ij}}{\sum_{i=1}^{n} e_{ij}}}{\frac{i_i}{\sum_{i=1}^{n} i_i}} \times \frac{\frac{b_{ij}}{\sum_{i=1}^{n} b_{ij}}}{\frac{a_i}{\sum_{i=1}^{n} a_i}}$$

The cluster index comprises three components for identifying a spatial industrial cluster: the relative industrial density ID_{ij}, the relative industrial stock IS_{ij} and the relative size of the establishment SB_{ij}. While j labels the respective industry and i the inhabitants of the respective sub-region, e_{ij} denotes the number of employed people, b_{ij} the number of firms, a_i the reciprocal of the size of the area and i_j the reciprocal of the number of inhabitants of the region in question. The cluster index can range from zero to infinity, with a CI of one indicating that a region does not differ from the overall region (Sternberg and Litzenberg 2004).

Table A1
Descriptive statistics of dependent variables

Variable (dummies)		mean	N
Period 0-3 years			
	Hires	0.43	10,274
	Highly skilled hires	0.23	4,368
Period first year			
	Hires	0.35	5,052
	Highly skilled hires	0.28	2,713

Source: IAB/ZEW Start-Up Panel, own calculations.

Table A2
Descriptive statistics of independent variables

Variable	Mean	SD	Min	Max
Unemployment rate	8.14	3.58	1.41	21.04
Development of unemployment rate	-0.40	0.71	-3.85	3.04
Share of unemployed specialists (high skilled)	9.94	3.73	2.90	27.41
Share of unemployed trained assistants (medium skilled)	42.61	5.46	12.86	58.18
Share of unemployed helpers (low skilled)	35.58	9.25	4.08	57.31
GDP (in thousand €)	33.11	14.24	12.71	127.05
GDP, variation	-0.02	0.05	-0.33	0.31
Founding rate	7.54	1.85	1.42	14.82
Cluster index	4.75	7.27	0.03	59.31
Krugman index	-0.31	0.13	-1.05	-0.07
Patents (D)	0.05	-	0.00	1.00
Team (D)	0.32	-	0.00	1.00
Founder holds university degree (D)	0.42	-	0.00	1.00
Founder female (D)	0.20	-	0.00	1.00
Age of founder	42.27	10.28	17.00	82.00
Industry experience	15.13	9.76	0.00	52.00
Investments (ln)	9.07	3.21	0.00	16.12
Material resources (ln)	5.45	4.56	0.00	14.60
Necessity founding (D)	0.14	-	0.00	1.00
Minimum efficiency business size	8.33	7.54	3.00	43.87
Industry				
Cutting-edge technology manufacturing	0.04	-	0.00	1.00
High-technology manufacturing	0.04	-	0.00	1.00
Technology-intensive services	0.21	-	0.00	1.00
Supply and consultancy	0.07	-	0.00	1.00
Non-high-tech manufacturing	0.10	-	0.00	1.00
Skill-intensive services	0.06	-	0.00	1.00
Other business-oriented services	0.06	-	0.00	1.00
Consumer-oriented services	0.13	-	0.00	1.00
Construction	0.12	-	0.00	1.00
Retail and wholesale	0.16	-	0.00	1.00
Motivation for business formation				
Necessity	0.81	-	0.00	1.00
Opportunity	0.15	-	0.00	1.00
Other	0.01	-	0.00	1.00
Year				
2008	0.13	-	0.00	1.00
2009	0.20	-	0.00	1.00
2010	0.24	-	0.00	1.00
2011	0.23	-	0.00	1.00
2012	0.21	-	0.00	0.00

Source: IAB/ZEW Start-Up Panel, own calculations.

Table A3
Regression of regional variables on skill-specific unemployment shares

	High skilled (1)		Medium skilled (2)		Low skilled (3)	
Unemployment rate	-0.506***	(0.042)	0.047	(0.070)	0.373**	(0.118)
Development of unemployment rate	-0.065	(0.070)	0.032	(0.160)	0.656**	(0.237)
GDP (in thousand €)	0.006	(0.029)	-0.128***	(0.022)	0.02	(0.054)
GDP, variation	-0.647	(1.522)	-3.501	(2.249)	-21.984***	(4.208)
Population density (log)	1.193***	(0.246)	-1.870***	(0.359)	0.787	(0.683)
Cluster index	-0.076	(0.581)	0.239	(0.798)	1.137	(1.521)
Krugman index	-1.595	(1.392)	-9.352***	(2.064)	-2.919	(3.548)
Constant	5.582***	(1.146)	54.632***	(1.820)	26.711***	(3.154)
Number of observations	1,809		1,809		1,809	
R^2	0.347		0.234		0.060	

Note: OLS regression. The dependent variable indicates the share of high-skilled (1) medium-skilled (2) and low-skilled (3) unemployed persons at NUTS-3 level. Standard errors in parentheses. */**/*** indicates statistical significance: *p<0.05, **p<0.01, ***p<0.001

Source: BHP, Destatis; own calculations.

Table A4
Heckman selection model. Dependent variable: firm hires highly skilled individual or not (dummy)

	Model 1 (years 0-3)		Model 2 (first year)		Model 3 (years 0-3)		Model 4 (first year)	
Variables at regional level								
Unemployment rate	0.003	(0.004)	0.008	(0.007)	0.005	(0.003)	0.008	(0.004)
Development of unemployment rate	-0.016	(0.022)	0.007	(0.036)	-0.005	(0.017)	0.006	(0.023)
Share of unemployed specialists (high skilled)	0.008*	(0.004)	0.017*	(0.008)	0.010**	(0.004)	0.016**	(0.006)
Share of unemployed trained assistants (medium skilled)	-0.001	(0.002)	-0.007	(0.004)	-0.003	(0.002)	-0.004	(0.003)
Share of unemployed helpers (low skilled)	0.001	(0.001)	0.001	(0.002)	0.001	(0.001)	0.001	(0.002)
GDP	0.001	(0.001)	0.003	(0.002)	0.001	(0.001)	0.001	(0.001)
GDP, variation	-0.511	(0.321)	-1.408**	(0.531)	-0.256	(0.245)	-0.791*	(0.386)
Population density (log)	0.011	(0.015)	-0.008	(0.027)	-0.008	(0.013)	-0.015	(0.019)
Founding rate	-0.008	(0.006)	-0.017	(0.010)	-0.009	(0.005)	-0.015**	(0.007)
Cluster index	0.002	(0.002)	-0.002	(0.003)	0.002	(0.002)	-0.000	(0.002)
Krugman index	0.066	(0.085)	-0.016	(0.150)	0.086	(0.073)	0.057	(0.100)
Variables at firm level								
Number of employees in founding year					0.008***	(0.002)	0.009***	(0.002)
Team (D)	0.018	(0.021)	0.049	(0.039)	0.015	(0.018)	-0.002	(0.025)
Founder holds university degree (D)	0.156***	(0.023)	0.140***	(0.038)	0.142***	(0.018)	0.129***	(0.025)
Founder female (D)	0.002	(0.022)	0.019	(0.038)	-0.004	(0.019)	-0.018	(0.029)
Age of founder	0.003***	(0.001)	0.003	(0.002)	0.003***	(0.001)	0.004**	(0.001)
Industry experience	-0.002*	(0.001)	-0.001	(0.002)	-0.003**	(0.001)	-0.003*	(0.001)
Stratification controls								
Year								
2008					*base*		*base*	
2009					0.077	(0.043)	0.103	(0.061)
2010	*base*		*base*		0.052	(0.033)	0.092*	(0.043)

	Model 1 (years 0-3)		Model 2 (first year)		Model 3 (years 0-3)		Model 4 (first year)	
2011	0.033	(0.021)	0.025	(0.044)	0.084**	(0.031)	0.118*	(0.043)
2012	0.061*	(0.025)	-0.008	(0.041)	0.093**	(0.035)	0.073	(0.041)
			Further stratification controls included					
constant	0.095	(0.172)	0.358	(0.276)	0.216	(0.144)	0.287	(0.192)
Select								
Main selection variables								
Investments (ln)	0.066***	(0.008)	0.061***	-0.01	0.059***	(0.008)	0.056***	(0.009)
Material resources (ln)	-0.021***	(0.005)	-0.021**	-0.007	-0.020***	(0.005)	-0.019***	(0.005)
Necessity founding (D)	-0.436***	(0.060)	-0.464***	(0.078)	-0.349***	(0.053)	-0.353***	(0.060)
Minimum efficiency business size	-0.111	-0.073	-0.142	-0.117	-0.138*	(0.062)	-0.197*	(0.088)
Number of employees in founding year					0.065***	(0.017)	0.079***	(0.017)
Constant	1.159	-0.933	1.034	-1.517	1.190	(0.788)	1.332	(1.102)
Number of observations	5,999		2,379		8,631		4,232	
Censored	3,541		1,581		5,100		2,797	
Uncensored	2,458		798		3,531		1,435	
Wald test of indep. equations	$Chi^2(1)= 11.83$ Prob > $chi^2=0.0006$		$Chi^2(1)= 1.80$, Prob > $chi^2=0.1803$		$Chi^2(1)= 13.69$, Prob > $chi^2=0.0002$		$Chi^2(1)= 17.59$, Prob > $chi^2=0.0000$	

Note: Heckman selection model. The coefficients are calculated using OLS. To take into account that the dependent variable is binary we estimate the same models using Heckprobit, but as the results are the same we only show the OLS coefficients. Standard errors in parentheses. */**/*** indicates statistical significance: *p<0.05, **p<0.01, ***p<0.001

Source: IAB/ZEW Start-Up Panel, own calculations.

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