

**The Role of Vacancy Posting
and Unemployed Hiring in
Start-up Success**

Stefan Angel
Rainer Eppel
Elisabeth Fidrmuc
Helmut Mahringer
Andrea Weber

The Role of Vacancy Posting and Unemployed Hiring in Start-up Success

Stefan Angel, Rainer Eppel, Elisabeth Fidrmuc, Helmut Mahringer (WIFO),
Andrea Weber (CEU)

Research assistance: Georg Böhs, Lydia Grandner, Lukas Schmoigl (WIFO)

This research was funded by the Jubiläumsfonds of the Oesterreichische Nationalbank
(Project No 18315).

WIFO Working Papers 696/2025
January 2025

Abstract

Using a unique combination of Austrian administrative data, we show that start-ups' search and hiring decisions matter for their business success. Firms that report vacancies to the Public Employment Service in the early stage of their existence stay longer in the market and grow stronger. Moreover, while hiring the unemployed can benefit start-ups, the timing is crucial. Hiring within the first six months increases exit risk, whereas hiring in the second half-year reduces it. This is probably due to the nature of the positions filled. Key management positions, often filled early, seem to be better suited for other employees. Conversely, once the management team is in place, hiring the unemployed for "regular" positions fosters survival and growth. This pattern holds for different subgroups of the unemployed. Evidence of learning effects suggests that positive experiences with early PES involvement and unemployed hires encourage continued use of these practices later on.

E-Mail: stefan.angel@wifo.ac.at, rainer.eppel@wifo.ac.at, helmut.mahringer@wifo.ac.at

2025/2/W/0

© 2025 Austrian Institute of Economic Research

Media owner (publisher), producer: Austrian Institute of Economic Research
1030 Vienna, Arsenal, Objekt 20 | Tel. (43 1) 798 26 01 0 | <https://www.wifo.ac.at>
Place of publishing and production: Vienna

WIFO Working Papers are not peer reviewed and are not necessarily based on a coordinated position of WIFO. The authors were informed about the Guidelines for Good Scientific Practice of the Austrian Agency for Research Integrity (ÖAWI), in particular with regard to the documentation of all elements necessary for the replicability of the results.

Free download: <https://www.wifo.ac.at/publication/pid/56805183>

The Role of Vacancy Posting and Unemployed Hiring in Start-up Success

Stefan Angel¹, Rainer Eppel¹, Elisabeth Fidrmuc¹², Helmut Mahringer¹, and Andrea Weber¹²³

¹Austrian Institute of Economic Research (WIFO), Vienna, Austria

²Central European University (CEU), Department of Economics and Business, Vienna, Austria.

³ROCKWOOL Foundation Berlin, IZA Institute of Labour Economics, CESifo.

January, 2025

Abstract

Using a unique combination of Austrian administrative data, we show that start-ups' search and hiring decisions matter for their business success. Firms that report vacancies to the Public Employment Service in the early stage of their existence stay longer in the market and grow stronger. Moreover, while hiring the unemployed can benefit start-ups, the timing is crucial. Hiring within the first six months increases exit risk, whereas hiring in the second half-year reduces it. This is probably due to the nature of the positions filled. Key management positions, often filled early, seem to be better suited for other employees. Conversely, once the management team is in place, hiring the unemployed for 'regular' positions fosters survival and growth. This pattern holds for different subgroups of the unemployed. Evidence of learning effects suggests that positive experiences with early PES involvement and unemployed hires encourage continued use of these practices later on.

JEL classification: • D22 • J21 • J23 • J63 • J71 • M13 • M51

Keywords: Startups; Recruitment; Vacancy Posting; Hiring; Unemployed; Public Employment Service; Survival

Funding: This research was funded by the Jubiläumsfonds of the Oesterreichische Nationalbank (project no. 18315).

Acknowledgments: The authors thank Georg Böhs, Lydia Grandner and Lukas Schmoigl for their valuable assistance.

1 Introduction

As framed by the search-and-matching approach, the labour market is a dynamic process in which job-seeking workers and firms with vacancies interact. Both parties engage in a search process and face frictions, such as search costs and incomplete information. This explains why workers and firms are not immediately matched, leading to the coexistence of unemployed and vacant jobs in the economy. Public Employment Services (PES) can act as intermediaries to reduce frictions and facilitate the matching of labour supply and demand (Cahuc et al., 2014; McCall & McCall, 2008; Pissarides, 2011).

While considerable attention has been paid to workers' job search processes on the supply side of the labour market, firms' search and hiring decisions on the demand side, and their impact on firm outcomes, remain underexplored in the empirical literature (Bagger et al., 2022). Similarly, the literature on the effects of labour market policies has so far focused almost exclusively on participating workers, neglecting the effects on firms (Blasco & Pertold-Gebicka, 2013; Lechner et al., 2013).

However, understanding firms' recruitment behaviour and its impact on their performance is crucial to gain a complete picture of the matching process between firms and workers in the labour market. The recruitment process is a key challenge that directly affects firms' labour costs and overall business success (Brändle et al., 2023). Moreover, firms' decisions shape workers' outcomes and, as recent empirical research has shown, affect aggregate labour market outcomes, including trends in inequality (Card et al., 2013) and gender disparities (Card et al., 2016; Weber & Zulehner, 2014). In particular, firms can influence unemployment through their decisions to post vacancies with the PES and to hire the unemployed.

In this paper, we use a unique combination of data from the Austrian social security database (ASSD), the unemployment register and the job vacancy database of the Austrian PES ('AMS') to investigate the role of job vacancy posting and hiring behaviour of start-up firms in their business success. First, we examine the frequency with which start-ups report vacancies to the PES and fill positions with unemployed workers. We then analyse the relationship between vacancy posting and hiring of this group and firm performance, measured by firm survival and growth. Thus, we show whether firms that report vacancies to the PES or hire unemployed workers in the early stages of their start-up outperform their counterparts in terms of longer survival or stronger growth. In addition, we examine the relationship between firms' start-up decisions and their subsequent recruitment behaviour. In particular, we assess whether firms that initially engage with the PES and hire unemployed workers continue this practice as they grow, possibly due to learning effects.

Our focus on start-ups is driven by the fact that these small, dynamic enterprises are particularly sensitive to decision-making, where a single misstep can lead to failure. In addition, start-ups offer a clear timeline advantage, allowing us to observe initial decisions and their subsequent effects over time. In contrast, assessing the influence on established firms is less straightforward, as it is often unclear whether hiring unemployed workers positively affects firm performance or vice versa (Weber & Zulehner, 2010).

We focus on regular positions rather than key managerial positions. To distinguish between these categories, we follow an approach similar to Weber and Zulehner (2014). We differentiate between initial hires, made within the first six months of a firm's establishment, and subsequent hires, made in the following six months. As we show in our study, the former group consists of 'key' employees, characterized by significantly higher earnings and longer job tenure. Our primary interest is in the latter group – 'regular' hires made once the firm's management team is in place. In detail, we examine the impact of hiring specific groups of unemployed people, namely those aged

50 and over, those aged 55 and over, the short-term unemployed and the long-term unemployed. Examining both vacancy postings and total unemployed hires is crucial, as companies often recruit from this group without involving the PES.

Our analysis contributes to two strands of the literature. First, it helps to fill the gap in research on firms' search and hiring practices on the demand side of the labour market and their subsequent performance. In particular, we improve understanding of the role of the PES in firms' recruitment processes and subsequent outcomes. Vacancy data have rarely been used for academic purposes so far¹. As a result, the role of vacancy posting in the labour market is still not well understood. To the best of our knowledge, we are the first to study the relationship between PES job postings, recruitment of the unemployed and business success for (non-solo) start-ups.

Second, our analysis adds to the body of research on the determinants of start-up success. While an extensive literature has elucidated various other success factors, ranging from entrepreneurial characteristics to firm characteristics and external market conditions (e.g., competition, government support, and policies to promote innovation)², the role of hiring decisions has been largely overlooked (Azeem & Khanna, 2023). Some studies have examined the role of worker characteristics such as qualifications, age, and employment form (Koch et al., 2013). In addition, a growing empirical literature shows that some (not all) types of diversity in the composition of the workforce, such as educational diversity, positively affect firm outcomes (Blasco & Pertold-Gebicka, 2013). However, the effects of posting vacancies with the PES and hiring unemployed workers have not yet been investigated.

Recruitment of the unemployed has become even more important recently as employers in many industrialised countries have found it increasingly difficult to fill vacancies in recent years, especially since the COVID-19 pandemic (Causa et al., 2022). Moreover, labour shortages are projected to worsen in the coming years due to ageing populations and a shrinking working-age population (Riekhoff et al., 2023). Reducing unemployment is a key objective in OECD countries. At the same time, the unemployed represent an important reservoir of untapped labour potential. Better matching of the unemployed with firms can therefore contribute to reducing both unemployment and labour shortages.

From a theoretical point of view, the relationship between PES job postings, recruitment of the unemployed and firm performance is not unambiguous. On the one hand, PES involvement and the inclusion of the unemployed may have a positive effect on firm performance by quantitatively expanding the pool of potential candidates for recruitment. Previous studies show that firms are reluctant to hire from the unemployed due to perceived productivity concerns (Bertheau et al., 2023; Riekhoff et al., 2023). They may, however, underestimate the true productivity of these workers. Broadening recruitment channels to include the PES and considering a wider range of candidates could help firms to better meet their staffing needs, fill vacancies more quickly and save costs. Particularly in times of significant labour shortages, firms could benefit from reduced labour market tightness by using this untapped reserve. Moreover, only if vacancies are reported to the PES can this intermediary play an active role in facilitating employer-employee matching.

On the other hand, negative effects on firm performance are possible if vacancy posting leads to firms being flooded with unsuitable and irrelevant applications, thereby increasing screening costs (Blasco & Pertold-Gebicka, 2013), or if the hired unemployed are indeed less productive than other recruitable workers (Kugler & Saint-Paul, 2004). Lower productivity could be the result of skills depreciation during prolonged unemployment, or of unemployed people applying for a job

¹Exceptions are Bamieh and Ziegler (2022, 2023) and Mueller et al. (2024).

²e.g. Santisteban and Mauricio (2017) and Schutjens and Wever (2000).

because of pressure from the PES rather than genuine suitability for the job. In this sense, previous research has shown that monitoring and sanctions often increase exit rates from unemployment at the expense of job quality and stability (Pattaro et al., 2022). In terms of learning effects, positive experiences may encourage firms to post vacancies and recruit from the unemployed again, while negative encounters may discourage future engagement.

We find that posting vacancies to the PES in the first year after start-up is associated with higher firm survival and growth. The influence of hiring unemployed people depends crucially on the timing. Hiring in the first six months after founding is associated with a higher risk of exit. Conversely, hiring in the second half-year reduces the exit risk. This suggests that early hires often fill crucial key management positions that are not advantageously filled by the unemployed. However, hiring the unemployed for regular positions once the management team is in place is beneficial for the survival of the firm. Hiring from the previously unemployed also correlates with higher firm growth. This relationship is stronger when hiring takes place in the second half-year than in the first. Our results hold for different subgroups of the unemployed, including those aged 50 and over, those aged 55 and over, the short-term unemployed and the long-term unemployed. Furthermore, we find evidence of learning effects: start-ups that report vacancies to the PES and initially hire unemployed people are more likely to continue this practice in later years.

2 Previous literature

A large body of literature deals with determinants of growth and survival among startups (Azeem & Khanna, 2023; Santisteban & Mauricio, 2017; Soto-Simeone et al., 2020). Factors that have been studied extensively and found to be correlated with survival are entrepreneur characteristics (including experience in management, employment history, leadership skills and age), funding characteristics (such as size, the presence of a business partner and venture capital), and external market conditions (for instance competition, government support and policy fostering innovation).

A growing empirical literature shows that some types of diversity (e.g. education) in workforce composition exert a positive effect on firm performance (Garnero et al., 2016). Results for other forms of diversity, e.g. with respect to age (Bryson et al., 2020; Garnero et al., 2014; Ilmakunnas & Ilmakunnas, 2011; Pfeifer & Wagner, 2014) or gender (Pfeifer & Wagner, 2014) are mixed and/or depend on industry (Garnero et al., 2014). For Austria, Weber and Zulehner (2010, 2014) show that young firms with (more) female first hires have higher levels of success and longevity in the market. However, none of these studies from the workforce diversity literature explicitly focuses on the share of unemployed in the workforce (or more generally on diversity with respect to the pool from which current workers were recruited).

In fact, only very few studies estimate the effects of hiring from the unemployed directly. Blasco and Pertold-Gebicka (2013) use a social experiment conducted in Denmark in 2005/2006 that provided exogenous increase in counselling and monitoring for workers entering unemployment in the treated regions. In their analysis they differentiate between small (<20 employees), medium (20-100 employees) and large firms (>100 employees). The authors find two main results: first, an increase in counselling and monitoring has a positive effect on the share of previously unemployed in new hires among small and medium firms in the treated regions. Second, the greater the share of new employees who come from unemployment and spent more than half the year unemployed, the worse the economic performance of small firms (no effect for medium and large firms). They explain this result with the lower productivity of previously unemployed workers. Economic performance is measured by total factor productivity and by the difference between firm's total output and the value of inputs ('value added') per full-time employee. For large firms the effect was not statistically

significant. In contrast to our paper, Blasco and Pertold-Gebicka (2013) use a general sample of firms without a specific focus on startups.

Based on longitudinal matched employer–employee register data of all individuals and firms in Denmark from 2001–2006, Coad et al. (2017) investigate growth in sales and profits of start-ups that hire their first employee compared to those that do not. The authors show that workers transitioning from unemployment or outside the labour force are more likely to secure employment in a new venture compared to an established firm. This is in line with theory, as new firms find it more difficult to pay high wages and need to convince potential employees of a promising future in the new venture which in turn makes hiring of unemployed more likely (Bhide, 2000; Fackler et al., 2019; Parker, 2004). Coad et al. (2017) also estimate regressions to test how the first hire affects business-level performance. Employee characteristics (such as being unemployed before getting hired) are largely unable to explain the performance of the startup.

Concerning the usage of PES vacancy posting and placement services for hiring, to the best of our knowledge, there is no study on its growth and survival effects for start-ups. Kraft and Lammers (2021) analyze the impact of placement services but do not restrict their sample of firms to startups. The authors leverage the Hartz III reform of 2004 as an exogenous intervention aimed at enhancing the job matching process and compare establishments that utilize the placement services of the Federal Employment Agency with those that do not. Utilizing detailed establishment-level data from Germany, their difference-in-difference estimates indicate that firms employing the agency's recruitment services experience higher employment growth compared to firms that do not use these services.

3 Data

We can investigate the relationship between vacancy posting and hiring behaviour of Austrian start-ups and their business success thanks to the availability of excellent microdata in Austria. Specifically, we combine the Austrian Social Security Database (ASSD) with the Unemployment Register and the AMS Job Vacancy Database.

The ASSD comprises matched employer–employee data administered by the Association of Austrian Social Security Institutions, covering all employment relationships in the private sector since 1972. It contains extensive information on both employers and employees' personal attributes, as well as their employment history and gross earnings up to the maximum social security contribution base. In addition, the ASSD provides information on the location of enterprises at the level of local labour market districts, each of which corresponds to one of the 101 regional employment offices in Austria. This allows us to control for regional conditions. We derive our sample of start-up firms from the ASSD and construct a comprehensive set of firm characteristics, including industry, firm size, employment growth, turnover and employee characteristics, based on the available data.

Linking the ASSD to the Unemployment Register, which provides longitudinal unemployment histories and numerous personal characteristics of individuals registered as unemployed, allows us to distinguish between the hiring of unemployed workers and other groups of hires, such as job changers, newly arrived foreign workers, or other types of hires. In addition, we can distinguish new hires from the recall of the same worker after a temporary lay-off.

The link with AMS vacancy data allows us to observe vacancy posting and hiring through the Austrian PES. These data contain information on all vacancies posted by Austrian companies through the AMS. They provide daily information on the vacancy posting date, the desired start date of the job and the date when the vacancy was closed, either because it was filled or lapsed for

other reasons. Thus, they allow us to determine precisely whether firms report vacancies to the AMS during the start-up phase and with which result.

The AMS administers unemployment benefits and assistance, provides counselling and placement services, and implements active labour market policies. Its main task is to efficiently place jobseekers in vacancies in the regular labour market. To achieve this, it offers a wide range of services to both jobseekers and employers. Employers can report vacancies to the AMS through various channels (by telephone, in person, in writing or electronically) and commission the AMS to fill these vacancies. Personnel requirements are documented in job profiles, which form the basis for the search and placement process. The AMS receives, approves and publishes vacancies, matches them with jobseekers and selects suitable candidates. Jobseekers are informed about relevant vacancies and are either encouraged to apply on their own initiative or are directed by their AMS caseworkers to apply for specific vacancies. At the same time, the AMS provides employers with lists of potential candidates.

This matching process may also include suitable candidates who are not registered with the AMS. While the AMS's primary clientele is the unemployed, the service is also available to employed people seeking new opportunities. It is free of charge for both workers and companies. The AMS tracks and documents the results of its placement activities. A key digital tool in this process is the online platform 'eJob-Room', which functions as a job exchange. It allows jobseekers to search for vacancies and apply online, while employers can post vacancies and search for suitable candidates.

The AMS is by far the most important job platform for enterprises in Austria. The overall AMS coverage of all vacancies is high³, although it varies, e.g. by sector and educational requirements. Jobs with lower qualification requirements are more often reported to the AMS than jobs with higher qualification requirements (Mueller et al., 2024; Pohler et al., 2023). Mueller et al. (2024) found that about 19% of all hires from unemployment from 1997 to 2013 were filled through the AMS system, or 31% if recalls are excluded. As the majority of the unemployed are hired without AMS mediation, it is important to examine the influence of both vacancy posting and total hiring out of unemployment on start-up success.

To link ASSD and AMS data, we can use an existing correspondence table of establishment identifiers. However, the respective employer identifiers in the two data sources are not uniquely linked. We solve this problem by randomly sampling cases with multiple ASSD employer identifiers for an AMS employer identifier, weighting by the size of the ASSD establishment. This ensures that no vacancy is counted more than once.

3.1 Sample restrictions

We start by identifying all firms created between 2008 and 2020 and track their evolution at annual intervals in the following years. We start by identifying all firms created between 2008 and 2020 and follow their evolution at annual intervals in the following years. We thus create an annual panel of firms. We restrict our sample to start-ups that survive at least one calendar year after their creation. Thus, we follow the evolution of each firm in our sample for at least one year. Our data extend until 2022. Since we restrict the last year of foundation to 2020, we are able to observe at least two subsequent calendar years for each firm (if the firm survives).

In principle, the appearance of a new firm identifier in the ASSD qualifies as a start-up, and the disappearance of a firm identifier qualifies as a closure. However, the data require two types of

³According to data from Statistics Austria, the AMS coverage of all vacancies ranged from 43% to 61% in the period 2014-2023.

adjustment. Firstly, there are cases where an identifier does not exist continuously but reappears after a break. In other cases, an enterprise may close permanently, and the firm identifier is reassigned. We classify an event as a new firm only if no employment episodes are associated with the firm ID for more than one calendar year. Similarly, an event is classified as a firm closure only if no employment episodes are associated with the firm identifier for more than one calendar year. Secondly, there are changes in firm identifiers that should not be interpreted as closures but as the survival of an enterprise. We assume that a firm continues to exist if the industry affiliation or the labour market region remains the same for both identifiers, more than 5 employees are involved and at least 60% of the employees transfer directly from the disappearing identifier to the new one. Only if both the industry and the labour market region are different, less than 5 employees are involved or less than 60% of the employees are moving from the previous employer does the appearance of a new identifier in the ASSD qualify as a new establishment.⁴

We impose several restrictions on our initial sample of 340,464 start-up firms (see Table 1). First, we only consider firms with at least five hired employees (blue-collar and white-collar workers in regular employment, including civil servants) in the founding year or the year after. This is to avoid bias in the relationship between firm size and survival and because it is only for firms with a minimum level of hiring activity that the impact of vacancy posting and hiring behaviour on start-up success is relevant. Second, we restrict our focus to start-ups that survive at least one calendar year after their foundation. Thirdly, we exclude firms that operate in the rarely reporting sectors of agriculture, forestry and fishing, mining, private households and extra-territorial organisations. We also exclude labour leasing, because the actual economic activity of the workers in this sector is unclear and we seek to avoid distortions arising from the fact that vacancies from labour leasing companies are sometimes reported twice, once directly by the enterprise and once by one or more labour leasing agencies. Fourthly, we exclude enterprises with missing information on industry, location or wage level. As shown in Panel A of Table 1, the largest reductions in our sample results already from the first step. Our final analysis sample consists of 61,669 start-up firms.

3.2 Variables

Our explanatory variables include indicators for whether a start-up posts vacancies with the PES or hires at least one previously unemployed⁵ person in the first twelve months after its foundation date. Primarily, we use dummy variables that are set to 1 if the firm reports at least one vacancy to the PES or hires at least one unemployed person in this one-year period. In detail, we examine the influence of hiring specific groups of unemployed, namely those aged 50 and over, those aged 55 and over, the short-term unemployed and the long-term unemployed⁶. Table 1 shows that 20% of all start-up firms post at least one vacancy with the PES and 82% hire at least one unemployed person in the first twelve months after their foundation.⁷ Among the start-ups in our sample, more firms hire at least one unemployed in the first half-year (71%) than in the second one (58%). However, the average share (including zeros) of unemployed hires in total hires is slightly higher in the 2nd half-year (38%) than in the 1st half-year (27%). Moreover, we calculate the firm's job posting rate, which is the number of vacancies posted by a firm to the PES as a percentage of the firm's hirings in its calendar year of foundation and use it as additional indicator to capture the influence of PES on survival and growth.

⁴See Weber and Zulehner (2014) for a similar approach.

⁵An unemployed person was registered as unemployed with the AMS for at least 1 day in the 2 weeks prior to job start, including persons in PES training and apprenticeship seekers.

⁶Following the definition of the 'long-term jobless' used by the Austrian PES, the long-term unemployed have been unemployed for more than one year, apart from short interruptions of a maximum of 62 days.

⁷In the initial sample of firms entering 2008-2020, the share is 46.5%. It increases to 78.6% and 80% in the second and third step of sample selection, respectively.

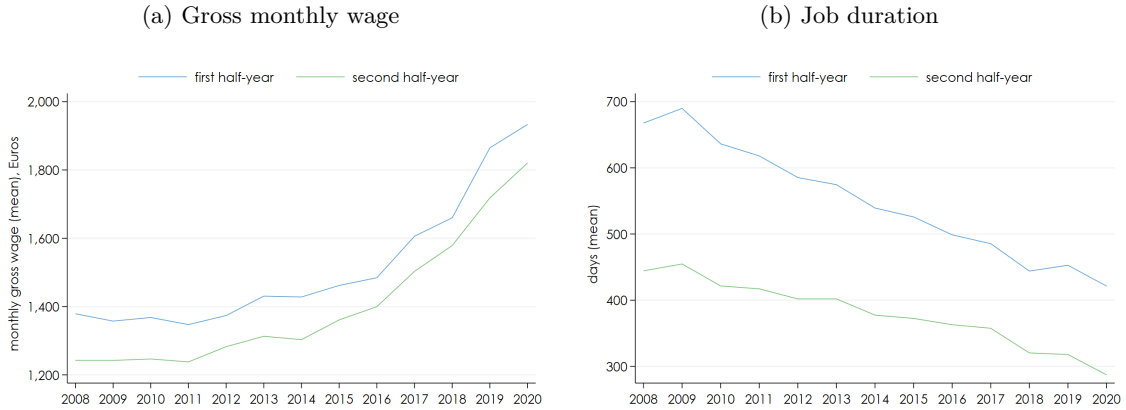
Table 1: Sample of start-up firms

Panel A: Sample of start-up firms	No. of firms	Percentage
Initial sample: Firms entering 2008-2020	340,464	
At least 5 workers during start-up	73,521	21.6
Firms surviving at least one year	67,805	19.9
Excl. agriculture, mining, households, extraterritorial organisations, labour leasing, etc.	63,332	18.6
Excl. missing information on industry, region or wage (final sample)	61,669	18.1
Panel B: Vacancy posting and hiring	Mean	SD
1 st year at least 1 hire of unemployed	0.825	0.380
1 st half-year at least 1 hire of unemployed	0.710	0.454
2 nd half-year: at least 1 hire of unemployed	0.575	0.494
Share of hires of unemployed workers relative to total hires in 1 st year	0.297	0.243
Share of hires of unemployed workers relative to total hires in 1 st HY	0.270	0.268
Share of hires of unemployed workers relative to total hires in 2 nd HY	0.381	0.351
At least 1 job vacancy posting through PES in 1 st year	0.191	0.393
Panel C: Startup success	Mean	SD
Survival time (years)	5.272	3.740
Firm growth (employment growth from year 1 to 5)	0.674	0.878
Growth in the share of previously unemployed workers from year 1 to 5	0.166	0.752
Censored observations in 2022 (relative to 61.669 startups)	0.546	0.500

Notes: Start-ups: firms that are registered as employers with the Main Association of Austrian Social Security Institutions for the first time in one of the years 2008-2020. Raw data comes in long format with firm-years as unit of observation.

An important distinction we make is the timing of recruitment: Weber and Zulehner (2014) found evidence that start-up firms first fill key managerial positions before hiring average workers. Following a similar approach, we distinguish between first hires entering the firm in the first six months after foundation and hires in the six months thereafter. Our main interest is in the latter – these ‘regular’ hires that are made once the firm's management has been established. Our assumption that key management positions are filled in the first half-year is supported by descriptive evidence: As Figure 1 shows, individuals who are hired in the first six months earn statistically significantly higher wages and stay in their jobs significantly longer than those hired in the six months thereafter.

Figure 1: Differences in job characteristics between early and later hirings



Notes: N=375,743 firm-years. The figure shows mean gross monthly wages and job tenure (days) for employees hired in the first six months after establishment and those hired in the six months thereafter. For both indicators, a two-sample t-test with equal variances indicates significant group differences in means, and a two-sample Kolmogorov-Smirnov test for equality of distribution functions (H0) is statistically significant.

To assess robustness, we also test the influence of an indicator that captures the share of unemployed hires in total hires in the first year (half year 1, half year 2) after its foundation.

As a first indicator of start-up success (dependent variable), we look at the survival of the firm. We define survival time as the period between the entry of the start-up and the firm's closure. If, by the end of the observation period (end of 2022), we cannot determine whether the disappearance of a firm identifier constitutes a firm closure in the sense that no employment episodes have existed for more than a calendar year, we mark the survival time as censored. As shown in Panel B of Table 1, the mean survival time of our sample of start-ups, censored and uncensored, is 5.1 years. 52.7% of observations are right-censored. Table 11 in the Appendix reports the Kaplan-Meier survivor function indicating a 76% (42%) chance of surviving longer than 2 (13) years.

Our second measure of start-up success is firm growth, operationalized through workforce growth. Similar to Davis and Haltiwanger (1999) and Weber and Zulehner (2014), we calculate the workforce growth rate as the relative difference in the (annual average of the) number of employees between year 1 and year 5 after foundation over the average firm size during that period, that is $gr_{it} = (x_{i(t+4)} - x_{it}) / (0.5(x_{it} + x_{i(t+4)}))$. This implies that these results are only representative for firms that survive at least 5 years. In our final sample the total employment stock grows by 67% on average. The mean growth of the share of previously unemployed workers from year 1 to 5 amounts to 17%.

Our third set of dependent variables captures learning effects. We examine the relationship between the reporting of vacancies and the hiring of the unemployed in the early start-up phase and later vacancy posting and hiring behaviour. For this, we use three dependent variables, all measured in the fifth calendar year after the year in which the firm was established: (1) an indicator equal to one if the firm reports at least one vacancy to the PES, (2) an indicator equal to one if the firm hires at least one unemployed person and (3) the share of unemployed in all hires of the firm.

Unless stated otherwise, we use the following control variables in all regressions (values refer to the foundation year): the log of the annual average number of employees⁸, the share of female employees in the total workforce, the share of employees aged 55 or older, the log of the labour turnover rate⁹, the number of newly hired white-collar workers and civil servants and their share in the total workforce, the number of active employees at the end of the year, and, as an approximation of skill levels in the workforce, the median gross monthly income of employees (measured by the social security contribution base excluding special payments, up to the maximum contribution limit). Additionally, we include fixed effects for years (up to 12), industries (up to 15), and regions (up to 83). Regions correspond to local labour market districts, some of which we group together to ensure consistent regions over time, despite changes in the administrative boundaries of geographic units.

3.3 Descriptives

The summary statistics in Table 2 give an impression of the characteristics of start-up firms, measured in the first calendar year after the founding year. The mean number of employees in our sample is between 10 and 11 persons, but at the same time has a very large standard deviation of 75. This mean is also driven by large outliers, as most enterprises (64%) employ only 1-3 persons in their first year of existence. Start-ups also have a rather young workforce with a median age of just 34 years. Women are slightly under-represented (40% on average). Accommodation and food services (tourism) is by far the most common activity for newly funded enterprises, followed by construction and ‘wholesale and retail trade (including vehicle repair)’.

We contrast all start-up firms with the sub-samples of start-ups with many unemployed hires (highest quartile) and few unemployed hires relative to total hires (lowest quartile). This way, those with many unemployed hires have lower wages, a lower labour turnover rate, a lower share of new hires who are recent immigrants, a much smaller stock of employees, and a higher share of employees in construction and accommodation and food services.

⁸We logarithmise to adjust for strong outliers.

⁹The labour turnover rate is defined as the percentage of the sum of employee inflows and outflows relative to the average number of employees over the year.

Table 2: Start-up characteristics in the calendar year of entry

Variable	All start-ups		Few unemployed		Many unemployed		p-value
	Mean	SD	Mean	SD	Mean	SD	
Share of female workers	0.40	0.36	0.40	0.36	0.37	0.37	0.00
Median worker age	34.30	8.52	35.27	9.02	34.28	8.53	0.00
Share of workers aged 25-54	0.75	0.24	0.76	0.25	0.76	0.25	0.41
Share of workers aged at least 55	0.07	0.15	0.08	0.16	0.07	0.16	0.00
Median monthly wage	1461.31	849.93	1619.27	1083.47	1390.53	653.81	0.00
Monthly wage at the first quartile	1154.31	768.14	1307.57	950.09	1097.76	632.73	0.00
Monthly wage at the third quartile	1762.50	948.60	1944.73	1225.82	1650.38	696.83	0.00
Labour turnover rate (%)	1445.69	5504.67	2289.31	8332.73	1047.76	3159.77	0.00
Share hired from unemployment ¹	0.30	0.24	0.02	0.03	0.64	0.14	0.00
Share hired from short-term unemployment ¹	0.32	0.21	0.14	0.15	0.52	0.18	0.00
Share hired from long-term unemployment ¹	0.03	0.06	0.01	0.04	0.05	0.08	0.00
Share hired from unemployment & above the age of 50 ¹	0.06	0.09	0.02	0.06	0.10	0.12	0.00
Share hired from employment	0.45	0.33	0.62	0.36	0.23	0.24	0.00
Share of new hires who are recent immigrants	9.19	18.73	14.66	26.52	4.09	10.01	0.00
Share of employees and public servants	0.98	0.07	0.98	0.09	0.98	0.07	0.00
New hires of employees and public servants	16.65	82.71	25.45	146.24	10.17	17.56	0.00
No. of employees	10.43	75.31	19.21	137.57	4.72	9.28	0.00
1-3 employees	0.64	0.48	0.58	0.49	0.72	0.45	0.00
4-6 employees	0.23	0.42	0.23	0.42	0.20	0.40	0.00
7-9 employees	0.04	0.21	0.05	0.22	0.03	0.18	0.00
10-49 employees	0.07	0.25	0.10	0.30	0.04	0.20	0.00
50-99 employees	0.01	0.08	0.01	0.12	0.00	0.04	0.00
100-249 employees	0.00	0.07	0.01	0.11	0.00	0.03	0.00
≥ 250 employees	0.00	0.05	0.01	0.09	0.00	0.01	0.00
HHI (0-100)	2.54	6.26	3.12	7.18	2.09	5.55	0.00
Manufacturing	0.05	0.22	0.07	0.26	0.04	0.20	0.00
Energy Water Supply, Waste management	0.00	0.06	0.01	0.08	0.00	0.05	0.00
Construction	0.17	0.37	0.12	0.33	0.24	0.42	0.00
Retail Trade, vehicle repair	0.15	0.36	0.15	0.36	0.14	0.35	0.01
Transportation and Storage	0.08	0.26	0.06	0.24	0.07	0.26	0.00
Accommodation and Food Service	0.27	0.44	0.20	0.40	0.30	0.46	0.00
Information and Communication	0.03	0.17	0.05	0.21	0.01	0.12	0.00
Finance and Insurance	0.01	0.09	0.01	0.11	0.00	0.06	0.00
Real Estate activities	0.02	0.13	0.03	0.16	0.01	0.11	0.00
Professional, scientific, and technical activities	0.07	0.25	0.12	0.32	0.04	0.19	0.00
Other Services	0.06	0.24	0.06	0.23	0.06	0.23	0.39
Public Admin., defense, compulsory social security	0.00	0.06	0.01	0.10	0.00	0.02	0.00
Education	0.01	0.12	0.02	0.14	0.01	0.12	0.00
Human health and social work	0.03	0.17	0.04	0.18	0.02	0.15	0.00
Arts, Entertainment, and recreation	0.02	0.15	0.03	0.17	0.02	0.14	0.00
Other Service activities	0.02	0.15	0.03	0.16	0.02	0.15	0.05
No. of firms	61669		15515		15368		

Notes: *** p<0.01, ** p<0.05, * p<0.1. All characteristics are measured in the calendar year of entry, except those with superscript 1, which are measured in the first full year after the date of entry. “Few unemployed” are firms with a share of unemployed hires in total hires in the lowest quartile (measured in their first full year of existence after entry), while “Many unemployed” are those in the highest quartile.

4 Results

4.1 Startup survival

To explore the relationship between vacancy posting and hiring decisions in the start-up phase and firm survival, we estimate Cox proportional hazards models. In the Cox regressions, our dependent variable captures the hazard of exit of a firm. First, we examine the role of hiring unemployed people, then the impact of reporting vacancies to the PES.

We find that hiring at least one unemployed person (at some point) in the first year does not have a statistically significant influence on start-up-survival (Table 3). However, when differentiating according to the time of hiring, hiring from the unemployed in the first half of the year after start-up has, on average, a negative influence on survival. More concretely, whatever the hazard rate at a particular time for the comparison group (startups that did not hire from the unemployed in the first half year), the exit hazard (i.e. the probability for going out of business) at the same time for start-ups that did hire in the first half year is $\exp(0.101) = 1.11$ times (=hazard ratio) higher or 11% higher. Conversely, hiring from the unemployed in the second half-year of start-up existence reduces the exit hazard by a factor of $\exp(-0.189) = 0.83$ (17%).

These results suggest that for key management positions, which are often filled in the very first start-up phase, it is not advantageous to fill them with the unemployed, whereas hiring the unemployed for regular positions once the management team is in place is beneficial for the survival of the firm.

Other variables that reduce the exit hazard significantly are average gross monthly wage, and the number of active employees at the end of the year. On the other hand, we find detrimental effects on firm survival for higher shares of older employees aged 55 and over and for higher labour turnover rates and for the number of hired white-collar workers in the first year of the firm's existence.

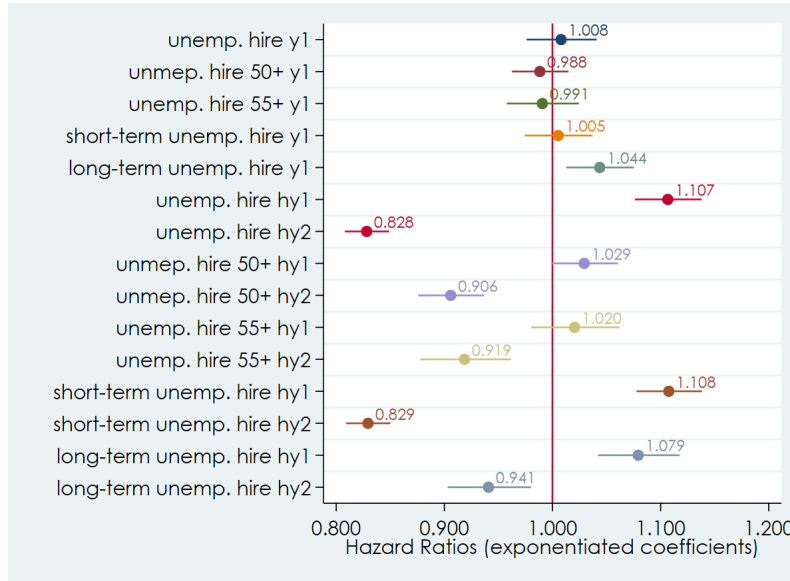
In contrast to what is found in the literature (Azeem & Khanna, 2023; Cabral & Mata, 2003; Foster et al., 2016; Kaniovski & Peneder, 2008; Persson, 2004; Vivarelli et al., 2007), the size of the workforce as measured by the log of the annual average number of employees is positively correlated with the exit hazard in our model. On the other hand, the number of active employees at the end of the first year reduces the exit hazard. Moreover, we do not observe the positive correlation between the share of white-collar workers in the workforce and survival probability found by Weber and Zulehner (2014).

Table 3: Hiring of unemployed and start-up exit hazard – main specification)

Depend. var. = exit hazard	(1)	(2)	(3)	(4)
1 st year unemployed hired	0.0588*** (0.0159)	0.00789 (0.0164)		
1 st half-year unemployed hired			0.143*** (0.0138)	0.101*** (0.0142)
2 nd half-year unemployed hired			-0.151*** (0.0124)	-0.189*** (0.0126)
Log labour turnover rate		0.196*** (0.00891)		0.196*** (0.00894)
Share of female employees		-0.380*** (0.0205)		-0.388*** (0.0205)
Log no. of employees (annual average)		0.0369*** (0.00687)		0.0357*** (0.00692)
Median gross monthly income		-0.000242*** (1.04e-05)		-0.000240*** (1.04e-05)
Share of employees 55+		0.122*** (0.0391)		0.114*** (0.0391)
Share of white-collar workers (incl. civil servants) in workforce		0.986*** (0.0916)		0.966*** (0.0915)
No. of hired white-collar workers (incl. civil servants)		0.00153*** (0.000254)		0.00158*** (0.000246)
No. of active employees at the end of the year		-0.00673*** (0.000571)		-0.00629*** (0.000559)
Other Controls				
Year (12), industry (15), and region (83) fixed effects	No	Yes	No	Yes
Observations	61,669	61,669	61,669	61,669

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimation results (log hazard ratios) are derived from Cox regressions. “1st year unemployed hired”, “1st half-year unemployed hired” and “2nd half-year unemployed hire” denote dummies indicating whether at least one unemployed person was hired in the first year after establishment/during the first six months/during the six months thereafter. Results are robust if we additionally control for posting a vacancy with the PES.

Figure 2: Hiring different types of unemployed and start-up exit hazard



Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimation results are derived from Cox regressions. The dependent variable is the hazard of exit. The explanatory variables are dummies indicating whether at least one unemployed person in the respective subgroup was hired in the first year after establishment, the first six months or the six months after that. Each line corresponds to a different Cox regression. All models control for 12 year, 15 industry, 83 region fixed effects and for workforce characteristics. $N=61,669$.

A deeper look at subgroups of unemployed does not provide evidence for broad effect heterogeneity (Figure 2). Instead, it shows very similar patterns for all the groups of unemployed considered, namely those aged 50 or over, those aged 55 or over, the short-term unemployed and the long-term unemployed. For each of them, hiring in the first half-year increases the risk of exit and hiring in the second half-year decreases the hazard of exit. In detail, the association is weaker for the long-term unemployed than for the short-term unemployed.

Next, we examine the role of posting vacancies with the PES as a newly established firm. The results of these Cox regressions (Table 4) show that this has a clear and much stronger influence on firm survival. Companies that use the PES for recruitment stay longer in the market. The hazard rate at a given point in time is $\exp(-0.832) = 0.44$ times (56%) lower for start-ups that reported vacancies to the PES in their first year of existence than for those that did not. When we use a firm's job posting rate as an alternative measure of the degree of PES involvement instead of a dummy indicator for at least one posting, this result is qualitatively robust: a higher frequency of reporting vacancies is associated with longer firm survival.

Table 4: Job vacancy posting with PES and start-up exit hazard — main specification

Depend. var. = exit hazard	(1)	(2)	(3)
1 st year PES vacancy posting	-0.909*** (0.0198)	-0.832*** (0.0202)	
Firm's job posting rate at PES			-0.0106*** (0.000385)
Controls			
Year (12), industry (15), and region (83) fixed effects	No	Yes	Yes
Workforce characteristics	No	Yes	Yes
Observations	61,669	61,669	61,669

Notes: Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimation results (log hazard ratios) are derived from Cox regressions. “1st year PES vacancy posting” denotes a dummy indicating whether at least 1 vacancy was posted with the PES in the first year after foundation. Results are robust if we additionally control for unemployed hiring in the first year or first two half years.

4.2 Startup growth

To analyse the relationship between recruitment and firm growth, we estimate a standard linear OLS regression with robust standard errors. We focus on workforce growth from year 1 to year 5 (Table 5). Thus, our results for this outcome are conditional on the firm surviving to the fifth year.

We find that companies that report vacancies to the PES in the first year of existence not only stay in the market longer, but also grow faster. Reporting at least one vacancy to the PES in the first year is associated with 16.5 percentage points higher growth in the fifth year compared to start-ups that do not report any vacancies. This result is also robust to measuring PES involvement in terms of the job posting rate: The more jobs a start-up reports to the PES, the higher its growth.

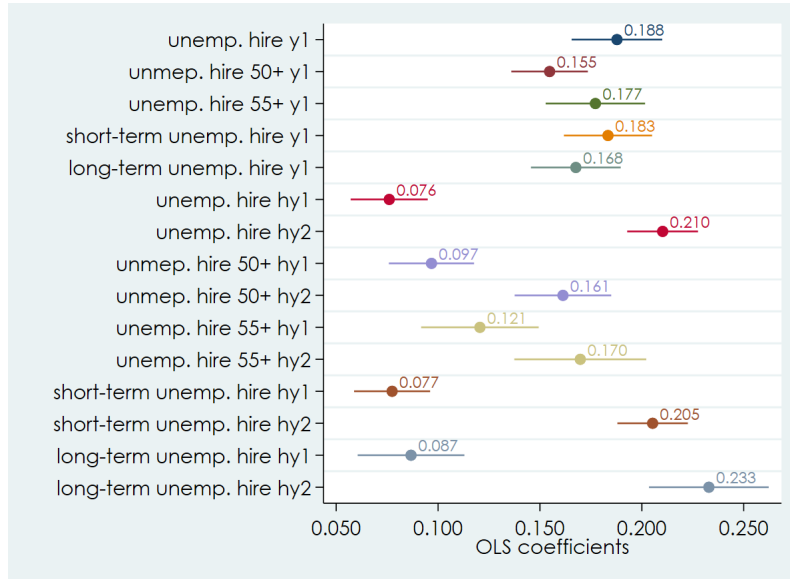
Moreover, not only vacancy posting, but also the actual hiring of unemployed people in the company is associated with high firm growth. We observe this correlation for all periods: the first half-year, the second half-year and the entire year after the company was founded. However, recruiting unemployed people in the first half-year has a significantly weaker influence than in the second half-year. The former results in an estimated growth of 7.6 percentage points, while the latter leads to an estimated growth of 21 percentage points. This pattern is also consistent across different groups of unemployed. (Figure 3).

Table 5: Determinants of firm growth (conditional on firm survival)

Dep. Var= employment growth (5 th vs. 1 st year)	(1)	(2)	(3)	(4)
1 st year unemployed hired	0.188*** (0.0113)			
1 st half-year unemployed hired		0.0760*** (0.00964)		
2 nd half-year unemployed hired		0.210*** (0.00886)		
1 st year PES vacancy posting			0.165*** (0.00957)	
Firm's job posting rate at PES				0.00181*** (0.000172)
Observations	33,702	33,702	33,702	33,702
Adj. R ²	0.254	0.264	0.254	0.250

Notes: Standard errors in parentheses. Robust S.E. *** p<0.01, ** p<0.05, * p<0.1. Estimation results are derived from OLS regressions. Intercepts not displayed. The dependent variable is firm growth. "1st year unemployed hired", "1st half-year unemployed hired" and "2nd half-year unemployed hire" denote dummies indicating whether at least one unemployed person was hired in the first year after establishment, the first six months or the six months thereafter. All models control for 10 year, 15 industry, 83 region fixed effects and for workforce characteristics.

Figure 3: Hiring different types of unemployed and start-up growth (conditional on firm survival)



Notes: Standard errors in parentheses. Robust S.E. *** p<0.01, ** p<0.05, * p<0.1. Estimation results are derived from OLS regressions. Intercepts are not displayed. The dependent variable is firm growth. The explanatory variables are dummies indicating whether at least one unemployed person in the respective subgroup was hired in the first year after establishment, the first six months or the six months after that. All models control for 10 year, 15 industry, 83 region fixed effects and for workforce characteristics.

4.3 Learning effects

Having found that posting vacancies to the PES and hiring unemployed people benefits the survival and growth of new firms, except for key positions in the initial phase, we finally examine whether start-ups learn from positive experiences and continue these practices in later years. Table 6 indeed shows that posting a job vacancy to the PES in the 1st year after founding increases the probability of posting job vacancies to the PES in the 5th year. Similarly, hiring an unemployed in the 1st year is positively correlated with the probability of hiring an unemployed in the 5th year. All of these results are robust to estimating the model with firm growth from year one to year three as an alternative dependent variable.

Table 6: Learning: subsequent hiring and vacancy posting

	(1)	(2)	(3)	(4)
Dep. Variable:	PES vacancy posting year 5	PES vacancy posting year 3	≥ 1 Unemployed hired year 5	≥ 1 Unemployed hired year 3
1 st year: PES vacancy posting	1.081*** (0.0178)	1.340*** (0.0151)		
1 st year: unemployed hired			0.452*** (0.0188)	0.482*** (0.0151)
Observations	33,702	52,726	28,157	42,856
Overall rate of model- based correct classification if cutoff = 0.5. vs. max(unconditional share)	78% vs 73.4%	81.4% vs. 73.2%	70.5% vs. 69.6%	71.4% vs. 73.7%

Notes: Standard errors in parentheses. Robust S.E. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimation results are derived from probit regressions. Intercepts not displayed. The independent variables refer to the first year after the company's founding date and indicate whether the company posted at least one vacancy to the AMS, hired at least one unemployed person. The dependent variables refer to the fifth (third) calendar year after the year in which the company was founded. All models control for 10 year, 15 industry, 83 region fixed effects and for workforce characteristics.

5 Robustness checks

5.1 Modification of the independent variables of interest

Our results are robust to a number of checks. First, we modify our independent variables of interest. Our main model uses a dummy indicating whether or not at least one previously unemployed person was hired in either the first year, the first half-year or the second half-year. Table 12 in the Appendix shows the results when we instead use all possible combinations for hiring in the first two half-years and compare the difference with two different baselines. In summary, only the exclusive hiring of the unemployed in the first half-year (and not later) appears to be detrimental. Every other combination is beneficial for survival. Thus, this robustness test confirms our previous finding that only the early hiring of unemployed persons in key positions harms firm survival, whereas filling regular jobs with the unemployed promotes it.

Concerning growth, we find the same results as in the main model (Table 5): Regardless of whether the unemployed are hired in the first or second half-year, the firm grows. However, if the

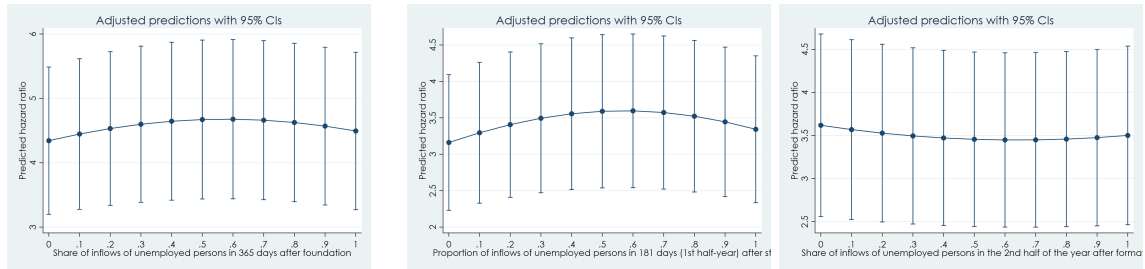
unemployed are not hired at all in the first year, the firm shrinks.

Next, we check the sensitivity of our results to using the share of unemployed in all hires (ranging from zero to one) instead of the dummy indicator. Theoretically, this share could have some saturation effect on survival and growth in the sense that too many unemployed hires are no longer beneficial, but harmful. Therefore, we examine potential non-linearities in the relationship between the share of unemployed and firm survival by including quadratic terms. We test whether there is a tipping point at which hiring an additional person from the pool of the unemployed becomes detrimental to firm survival and growth.

When modelling with linear relationships (Table 7, columns 1 & 3), we arrive at the same result as before: A higher proportion of unemployed hires at some point in the first year dampens firm survival. However, the influence is different depending on the time of hiring. A higher proportion of unemployed hires in the first half-year hampers firm survival, but the more frequent hiring of unemployed in the second half-year promotes it.

When including quadratic terms of our independent variables of interest, the model estimates suggest some non-linearities (Figure 4, Table 7). However, these non-linearities are rather weak and often statistically insignificant. Thus, they do not question our previous findings.

Figure 4: Predicted values for survival hazard ratio over shares of unemployed hires



Notes: 95% confidence bands displayed. The figure displays predicted values for firm exit hazard based on models from Table 7 for the full value range of a firm's share of unemployed hires in total hires in the first year, first and second half year after foundation. Predictions based on means for covariates.

Table 8 displays the results when using firm growth as a dependent variable. As can be seen from column 1, there is no significant relationship between the share of unemployed and firm growth in the model with linear terms. The share of unemployed hires in the first half-year is positively correlated with growth, while the opposite is true for the second half-year (column 3). However, non-linearities in the relationship between these variables are again likely. Therefore, we estimate a model with squared terms for the independent variables of interest (columns 2 & 4). These models show lower values for the Akaike information criterion (AIC) and statistically significant inverted U-relationships. We therefore prefer these models to the linear specification for the relationship between the share of unemployed hires and firm growth. The results suggest that, up to a share of around 40% of total hiring, adding one more unemployed worker helps growth, but beyond that it starts to hinder it (see also Figure 5).

5.2 Industry concentration

In another robustness test, we additionally control for industry concentration. Our baseline model specifications with industry dummy variables allow for differences in the competitive environment at the industry level. Alternatively, we add the Herfindahl-Hirschman index (HHI) to the Cox

Table 7: Share of unemployed hires in total hires and start-up exit hazard

Dependent Var. = exit hazard	(1)	(2) Non-linear (quadratic) effects	(3)	(4) Non-linear (quadratic) effects
1 st year share of unemployed hires	0.0875*** (0.0253)	0.257*** (0.0729)		
1 st year share of unemployed hires squared		-0.223** (0.0899)		
1 st half-year share of unemployed hires			0.131*** (0.0259)	0.453*** (0.0725)
2 nd half-year share of unemployed hires			-0.0343* (0.0204)	-0.151** (0.0638)
1 st half-year share of unemployed hires squared				-0.397*** (0.0847)
2 nd half-year share of unemployed hires squared				0.118* (0.0647)
Observations	61,669	61,669	51,692	51,692
AIC	587,125.9	587,121.6	470,708.9	470,688.8
U test ^a	N.a.	H1: Inverse U shape vs. H0: Monotone or U shape. extreme point: 0.576579 p-value= 0.0492	n.a.	1 st half year: H1: Inverse U shape vs. H0: Monotone or U shape. Extreme point: 0.5701141 p-value= 0.000587 2 nd half-year: H1: U shape vs. H0: Monotone or Inverse U shape. extreme point: 0.6403693 p-value= 0.119

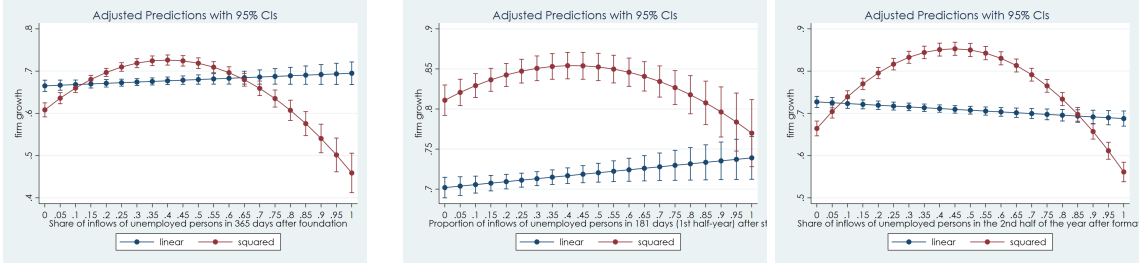
Notes: Standard errors in parentheses. Robust S.E. *** p<0.01, ** p<0.05, * p<0.1. Estimation results are derived from probit regressions. Intercepts not displayed. The independent variables refer to the first year after the company's founding date and indicate whether the company posted at least one vacancy to the AMS, hired at least one unemployed person. The dependent variables refer to the fifth (third) calendar year after the year in which the company was founded. All models control for 10 year, 15 industry, 83 region fixed effects and for workforce characteristics.

Table 8: Share of unemployed hires in total hires and start-up growth

Dependent Var. = growth	(1)	(2)	(3)	(4)
1 st year share of unemployed hires	0.0297 (0.0185)	0.591*** (0.0510)		
1 st year share of unemployed hires		-0.740*** (0.0621)		
1 st half-year share of unemployed hires			0.0371** (0.0177)	0.207*** (0.0491)
2 nd half-year share of unemployed hires			-0.0394*** (0.0130)	0.846*** (0.0421)
1 st half-year share of unemployed hires squared				-0.248*** (0.0571)
2 nd half-year share of unemployed hires squared				-0.949*** (0.0425)
Observations	33,702	33,702	29,076	29,076
Adj. R ²	0.248	0.251	0.255	0.268
AIC	77,524.63	77,383.13	66,450.54	65,920.89
U test ^a	N.a.	H1: Inverse U shape. H0: Monotone or U shape Extreme point: .3991321 p-value<0.01	n.a.	1 st half year: H1: Inverse U shape vs. H0: Monotone or U shape. Extreme point: .4172156 p-value=.0000209 2 nd half year: H1: U shape vs. H0: Monotone or Inverse U shape. extreme point: .4457502 p-value<0.01

Notes: Standard errors in parentheses. Robust S.E. *** p<0.01, ** p<0.05, * p<0.1. Estimation results are derived from OLS regressions. The dependent variable is firm growth. Intercepts not displayed. “Hiring of unemployed year1”, “Hiring of unemployed hy1” and “Hiring of unemployed hy2” denote dummies indicating if at least 1 unemployed worker was hired in the first year, first and second half year since establishment, respectively. ^aTest for presence of a U shaped (or inverse U shaped relation) with the respective independent variables of interest; implemented with Stata command *utest* based on Lind and Mehlum (2010). All models control for 10 year, 15 industry, 83 region fixed effects and for workforce characteristics.

Figure 5: Predicted values for firm growth over shares of unemployed hires in total hires



Notes: 95% confidence bands displayed. The figure displays predicted values for firm growth (see section 3.2. for a definition) based on models from Table 8 for the full observed value range of the share of unemployed hires in total hires. Predictions based on means for covariates.

regressions from Table 3, Table 4, and Table 7. The HHI is a well-established measure for industry concentration. It is the sum of all squared market shares in terms of employees of all firms in a market. In our definition, a market is equivalent to a sector in a given year (maximum of 17 sectors, Table 2). We rescale the HHI to lie between zero and 100. The lower its value the lower the market share and thus the higher the level of competition. A value of 100 corresponds to a monopoly.¹⁰ We include the HHI in our model to test whether changes in competition over time affect firm survival.¹¹ However, this is not the case. First, in none of the models do we find a statistically significant relationship between the HHI and firm survival. Second, controlling for the HHI does not change either the estimates or the statistical significance of our independent variables of interest.

As they are derived from a Cox regression, the estimates in Table 3 and Table 4 are assumed to apply for every combination of categories in our control variables (“*ceteris paribus*”). In their paper on female hiring in start-ups, Weber and Zulehner (2014) relax this assumption and find that the effect of the share of women in start-ups on the exit rate is stronger in highly competitive industries.

We apply this question to our analysis of unemployed hires and fit an interaction between our various explanatory variables of interest and the HHI. By testing for interaction effects, we now allow the influence of hiring at least one unemployed person in the first year etc. to vary with changes in the HHI. The results for these models are mixed (Table 9). First, the interaction effects are not statistically significantly different from zero for PES vacancy posting, our dummy indicating whether at least one unemployed person was hired in the first year, and the share of unemployed hired in the second half-year. Second, the negative influence of the share of unemployed hires in total hires in the first year on firm survival is significantly strengthened with increasing market

¹⁰Let i index firms, s index sectors, and t index years. Let E_{ist} be the number of employees in firm i within sector s and year t . Let T_{st} be the total number of employees in sector s and year t .

The index for sector s in year t is then calculated as:

$$HHI_{st} = \sum_i \left(\frac{E_{ist}}{T_{st}} \right)^2$$

And normalized to lie between zero and 100 by:

$$HHI_{st}^{norm} = \frac{(HHI_{st} - \min(HHI_{st}))}{(\max(HHI_{st}) - \min(HHI_{st})) * 100}$$

¹¹Tables are available upon request from the authors.

concentration, while the negative influence of hiring at least one formerly unemployed person in the first half-year on survival becomes weaker as the HHI increases. For all other treatment interactions, one of the coefficients is not statistically different from zero. Overall, the results of the models with interaction effects between our independent variables of interest and market concentration are quite sensitive to the chosen variable. We therefore refrain from drawing any general conclusions from this robustness check.

Table 9: Interaction effects with industry concentration and firm exit hazard

Dependent Var. = exit hazard Variable	(1)	(2)	(3)	(4)	(5)
1 st year unemployed hired	-0.00259 (0.0178)				
Interaction with HHI	0.00333 (0.00225)				
1 st half-year unemployed hired		0.0920*** (0.0154)			
Interaction with HHI		-0.198*** (0.0136)			
2 nd half-year unemployed hired		0.00306 (0.00203)			
Interaction with HHI		0.00348* (0.00186)			
1 st year share of unemployed hires			0.0571** (0.0271)		
Interaction with HHI			0.0113*** (0.00349)		
1 st half-year share of unemployed hires				0.113*** (0.0279)	
Interaction with HHI				-0.0372* (0.0220)	
2 nd half-year share of unemployed hires				0.00706* (0.00378)	
Interaction with HHI				0.00103 (0.00298)	
1 st year PES vacancy posting					-0.835*** (0.0218)
Interaction with HHI					0.00124 (0.00344)
HHI	-0.00220 (0.00224)	-0.00356* (0.00203)	-0.00225 (0.00198)	-0.00659** (0.00329)	-0.000102 (0.00132)
Observations	61,669	61,669	61,668	30,669	61,669

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimation results are derived from Cox regressions. The dependent variable is the hazard of exit. “Hiring of unemployed year1”, “Hiring of unemployed hy1” and “Hiring of unemployed hy2” denote dummies indicating if at least 1 unemployed worker was hired in the first year, first and second half year since establishment, respectively. All models control for 12 year, 15 industry, 83 region fixed effects and workforce characteristics.

6 Conclusions

Our analysis, based on a unique combination of Austrian administrative data, demonstrates that the job vacancy posting and hiring behaviour of start-up firms is critical to their business success. It highlights a factor that has been widely overlooked for the performance of these small, dynamic, and decision-sensitive enterprises. In particular, we show that it matters for the success of a start-up whether it reports vacancies to the PES and hires unemployed people.

First, we find evidence that firms reporting vacancies to the PES in the early stages of their start-up outperform their counterparts in terms of longer survival and stronger growth. These firms tend to stay longer in the market and grow more. Second, we observe that hiring unemployed individuals can be beneficial for start-ups, but the timing of these hires is crucial. Hiring unemployed individuals within the first six months after founding is associated with a higher risk of market exit, while hiring in the second half-year reduces this risk. This is probably due to the type of positions being filled. Early hires often include key management positions, which – as we show – is reflected in significantly higher incomes and longer job tenure. Once the management team is in place, ‘regular’ positions are filled.

Therefore, we conclude from our results that while initial key positions are better filled by other workers, hiring the unemployed for regular positions positively influences firm survival. Hiring from this group also correlates with higher firm growth. This pattern holds for all subgroups of the unemployed, including those aged 50 and over, the short-term unemployed, and the long-term unemployed. In addition, we find evidence of learning effects: start-ups that engage with the PES and recruit unemployed workers in their first year are more likely to continue this practice in subsequent years. This implies that positive experiences encourage firms to post vacancies and recruit from the unemployed again later.

Our results suggest that PES involvement and the inclusion of the unemployed in the workforce benefit firm performance by expanding the pool of potential candidates and improving labour market matching. Firms that report vacancies to the PES gain access to a wider range of jobseekers, allowing this intermediary to reduce frictions and facilitate better employer-employee matching.

Previous studies show that firms are often reluctant to hire from the unemployed due to perceived productivity concerns. However, our findings indicate that firms hiring unemployed individuals harness potentially undervalued talent. Broadening their recruitment channels to include the PES and considering a wider range of candidates may help them to better meet their staffing needs, fill vacancies more quickly, and save costs.

In terms of policy implications, our findings support efforts to increase PES involvement and to reduce barriers for firms in recruiting unemployed people. This is particularly relevant in the context of a shrinking and aging working-age population, which exacerbates labour shortages. Our findings underline that the unemployed represent an important reservoir of untapped labour potential. Better matching of the unemployed with firms can help to reduce both unemployment and labour shortages.

References

- Azeem, M., & Khanna, A. (2023). A systematic literature review of startup survival and future research agenda. *Journal of Research in Marketing and Entrepreneurship*, 26(1), 111–139. <https://doi.org/10.1108/JRME-03-2022-0040>

- Bagger, J., Fontaine, F., Galenianos, M., & Trapeznikova, I. (2022). Vacancies, employment outcomes and firm growth: Evidence from Denmark. *Labour Economics*, 75, 102103.
- Bamieh, O., & Ziegler, L. (2022). Are remote work options the new standard? Evidence from vacancy postings during the COVID-19 crisis. *Labour Economics*, 76, 102179. <https://doi.org/10.1016/j.labeco.2022.102179>
- Bamieh, O., & Ziegler, L. (2023). Gender-age differences in hiring rates and prospective wages—Evidence from job referrals to unemployed workers. *Labour Economics*, 83, 102395. <https://doi.org/10.1016/j.labeco.2023.102395>
- Bertheau, A., Larsen, B., & Zhao, Z. (2023). What Makes Hiring Difficult? Evidence from Linked Survery-Administrative Data. <https://doi.org/10.2139/ssrn.4660312>
- Bhide, A. (2000). *The origin and evolution of new businesses*. Oxford University Press, USA.
- Blasco, S., & Pertold-Gebicka, B. (2013). Employment policies, hiring practices and firm performance. *Labour Economics*, 25, 12–24. <https://doi.org/10.1016/j.labeco.2013.04.011>
- Brändle, T., Grunau, P., Haylock, M., & Kampkötter, P. (2023). Heterogeneity in firms' recruitment practices: New evidence from representative employer data. *German Journal of Human Resource Management: Zeitschrift für Personalforschung*, 37(2), 107–136. <https://doi.org/10.1177/23970022221118346>
- Bryson, A., Forth, J., Gray, H., & Stokes, L. (2020). Does Employing Older Workers Affect Workplace Performance? *Industrial Relations: A Journal of Economy and Society*, 59(4), 532–562. <https://doi.org/10.1111/irel.12265>
- Cabral, L. M. B., & Mata, J. (2003). On the evolution of the firm size distribution: Facts and theory. *American economic review*, 93(4), 1075–1090. <https://www.aeaweb.org/articles?id=10.1257/000282803769206205>
- Cahuc, P., Carcillo, S., & Zylberberg, A. (2014). *Labor economics*. MIT press.
- Card, D., Cardoso, A. R., & Kline, P. (2016). Bargaining, sorting, and the gender wage gap: Quantifying the impact of firms on the relative pay of women. *The Quarterly Journal of Economics*, 131(2), 633–686.
- Card, D., Heining, J., & Kline, P. (2013). Workplace heterogeneity and the rise of West German wage inequality. *The Quarterly Journal of Economics*, 128(3), 967–1015.
- Causa, O., Abendschein, M., Luu, N., Soldani, E., & Soriolo, C. (2022). The post-COVID-19 rise in labour shortages.
- Coad, A., Nielsen, K., & Timmermans, B. (2017). My first employee: An empirical investigation. *Small Business Economics*, 48(1), 25–45. <https://doi.org/10.1007/s11187-016-9748-3>
- Davis, S., & Haltiwanger, J. (1999). Gross job flows. In *Handbook of labor economics. Volume 3B* (pp. 2711–2805). North Holland.
- Fackler, D., Fuchs, M., Hölscher, L., & Schnabel, C. (2019). Do Start-ups Provide Employment Opportunities for Disadvantaged Workers? *ILR Review*, 72(5), 1123–1148. <https://doi.org/10.1177/0019793918814476>
- Foster, L., Haltiwanger, J., & Syverson, C. (2016). The Slow Growth of New Plants: Learning about Demand? *Economica*, 83(329), 91–129. <https://doi.org/10.1111/ecca.12172>
- Garnero, A., Kampelmann, S., & Rycx, F. (2014). The Heterogeneous Effects of Workforce Diversity on Productivity, Wages, and Profits. *Industrial Relations: A Journal of Economy and Society*, 53(3), 430–477. <https://doi.org/10.1111/irel.12064>
- Garnero, A., Kampelmann, S., & Rycx, F. (2016). Is Workforce Diversity Always Performance-enhancing? A Literature Review. *Reflets et perspectives de la vie économique*, 55(4), 81–91. <https://doi.org/10.3917/rpve.554.0081>
- Ilmakunnas, P., & Ilmakunnas, S. (2011). Diversity at the Workplace: Whom Does it Benefit? *De Economist*, 159(2), 223–255. <https://doi.org/10.1007/s10645-011-9161-x>

- Kaniovski, S., & Peneder, M. (2008). Determinants of firm survival: A duration analysis using the generalized gamma distribution. *Empirica*, 35(1), 41–58. <https://doi.org/10.1007/s10663-007-9050-3>
- Koch, A., Späth, J., & Strotmann, H. (2013). The role of employees for post-entry firm growth. *Small Business Economics*, 41(3), 733–755. <https://doi.org/10.1007/s11187-012-9456-6>
- Kraft, K., & Lammers, A. (2021). The Effects of Reforming a Federal Employment Agency on Labor Demand. <https://doi.org/10.2139/ssrn.3905064>
- Kugler, A. D., & Saint-Paul, G. (2004). How Do Firing Costs Affect Worker Flows in a World with Adverse Selection? *Journal of Labor Economics*, 22(3), 553–584. <https://doi.org/10.1086/383107>
- Lechner, M., Wunsch, C., & Scioch, P. (2013, September). Do Firms Benefit from Active Labour Market Policies? <https://doi.org/10.2139/ssrn.2327478>
- McCall, B. P., & McCall, J. J. (2008). *The Economics of Search*. <https://www.routledge.com/The-Economics-of-Search/McCall-McCall/p/book/9780415753982>
- Mueller, A. I., Osterwalder, D., Zweimüller, J., & Kettemann, A. (2024). Vacancy Durations and Entry Wages: Evidence from Linked Vacancy–Employer–Employee Data. *The Review of Economic Studies*, 91(3), 1807–1841. <https://doi.org/10.1093/restud/rdad051>
- Parker, S. C. (2004). *The Economics of Self-Employment and Entrepreneurship*. Cambridge University Press. <https://doi.org/10.1017/CBO9780511493430>
- Pattaro, S., Bailey, N., Williams, E., Gibson, M., Wells, V., Tranmer, M., & Dibben, C. (2022). The impacts of benefit sanctions: A scoping review of the quantitative research evidence. *Journal of Social Policy*, 51(3), 611–653. <https://doi.org/10.1017/S0047279421001069>
- Persson, H. (2004). The Survival and Growth of New Establishments in Sweden, 1987–1995. *Small Business Economics*, 23(5), 423–440. <https://doi.org/10.1007/s11187-004-3992-7>
- Pfeifer, C., & Wagner, J. (2014). Age and Gender Effects of Workforce Composition on Productivity and Profits: Evidence from a New Type of Data for German Enterprises. <https://papers.ssrn.com/abstract=2435036>
- Pissarides, C. A. (2011). Equilibrium in the Labor Market with Search Frictions. *American Economic Review*, 101(4), 1092–1105. <https://doi.org/10.1257/aer.101.4.1092>
- Pohler, N., Mühlböck, M., Langer, V., Gussenbauer, J., Baumgartner, K., Brunner, S., Titelbach, G., & Vogtenhuber, S. (2023). *Entwicklung eines Fachkräftebedarfsscreenings für österreich. Endbericht 2023* (tech. rep.). IHS.
- Riekhoff, A.-J., Järnefelt, N., Laaksonen, M., & Liukko, J. (2023). Labour shortages and employer preferences in retaining and recruiting older workers. *International Journal of Manpower*, 45(4), 838–863. <https://doi.org/10.1108/IJM-05-2023-0233>
- Santisteban, J., & Mauricio, D. (2017). Systematic Literature Review of Critical Success Factors of Information Technology Startups. *Academy of Entrepreneurship Journal*, 23(2). <https://www.abacademies.org/articles/systematic-literature-review-of-critical-success-factors-of-information-technology-startups-6638.html>
- Schutjens, V. A., & Wever, E. (2000). Determinants of new firm success. *Papers in Regional Science*, 79(2), 135–159. <https://doi.org/10.1111/j.1435-5597.2000.tb00765.x>
- Soto-Simeone, A., Sirén, C., & Antretter, T. (2020). New Venture Survival: A Review and Extension. *International Journal of Management Reviews*, 22(4), 378–407. <https://doi.org/10.1111/ijmr.12229>
- Vivarelli, M., et al. (2007). *Entry and post-entry performance of newborn firms* (tech. rep.). Routledge London.
- Weber, A., & Zulehner, C. (2010). Female Hires and the Success of Start-Up Firms. *American Economic Review*, 100(2), 358–361. <https://doi.org/10.1257/aer.100.2.358>

Weber, A., & Zulehner, C. (2014). Competition and gender prejudice: Are discriminatory employers doomed to fail? *Journal of the European Economic Association*, 12(2), 492–521. <https://doi.org/10.1111/jeea.12048>

A Appendix

Table 10: Distribution of first years of start-ups

	All new firms		Mostly no hires of unemployed		Mostly hires of unemployed		p-value for difference
	Mean	SD	Mean	SD	Mean	SD	
2008	0.078	0.268	0.073	0.260	0.083	0.275	0.002
2009	0.076	0.265	0.065	0.246	0.091	0.288	0.000
2010	0.074	0.261	0.063	0.243	0.088	0.283	0.000
2011	0.075	0.264	0.081	0.272	0.073	0.261	0.016
2012	0.077	0.267	0.079	0.270	0.071	0.257	0.008
2013	0.074	0.263	0.079	0.269	0.070	0.255	0.003
2014	0.079	0.270	0.085	0.279	0.076	0.264	0.002
2015	0.078	0.268	0.084	0.278	0.077	0.267	0.028
2016	0.076	0.264	0.075	0.263	0.076	0.265	0.589
2017	0.074	0.262	0.069	0.254	0.075	0.263	0.069
2018	0.070	0.255	0.067	0.250	0.068	0.252	0.651
2019	0.092	0.289	0.099	0.299	0.076	0.265	0.000
2020	0.077	0.266	0.082	0.274	0.076	0.265	0.082
No. of firms	61669		15515		15368		

Notes: *** p<0.01, ** p<0.05, * p<0.1. Maximum observation period 2008-2022. “Mostly no hires of unemployed” are firms with a share of unemployed in total hires in the lowest quartile, while “Mostly hires of unemployed” are those in the highest quartile.

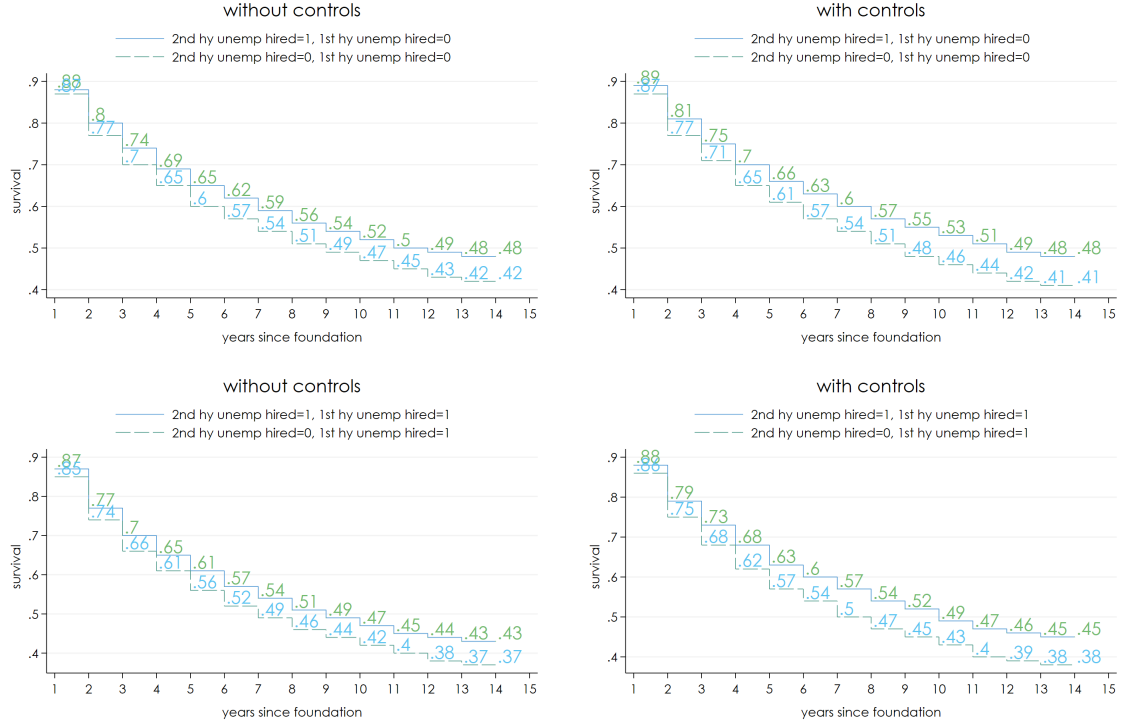
Table 11: Kaplan-Meier survivor function

Year	At risk	Fail	Lost	Survivor function	Std. error	[95 % conf. int.]	
1	61669	8326	0	0.8650	0.0014	0.8623	0.8677
2	53343	6194	4293	0.7645	0.0017	0.7612	0.7679
3	42856	3794	4517	0.6969	0.0019	0.6932	0.7005
4	34545	2632	2913	0.6438	0.0020	0.6398	0.6477
5	29000	2024	2769	0.5988	0.0021	0.5947	0.6029
6	24207	1421	2645	0.5637	0.0022	0.5594	0.5679
7	20141	1092	2540	0.5331	0.0022	0.5287	0.5375
8	16509	871	2372	0.5050	0.0023	0.5004	0.5095
9	13266	591	2138	0.4825	0.0024	0.4778	0.4872
10	10537	437	2045	0.4625	0.0025	0.4576	0.4673
11	8055	343	2024	0.4428	0.0026	0.4377	0.4479
12	5688	201	1860	0.4271	0.0027	0.4218	0.4325
13	3627	87	1850	0.4169	0.0029	0.4113	0.4225
14	1690	0	1690	0.4169	0.0029	0.4113	0.4225

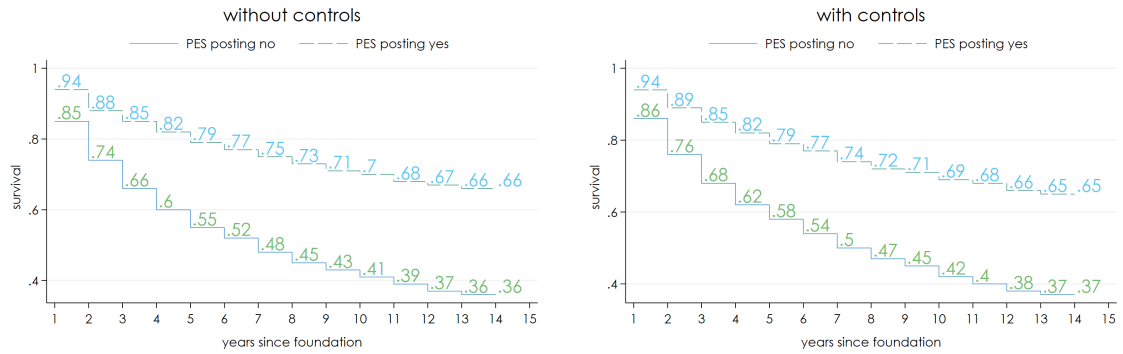
Notes: N=61,669 firms.

Figure 6: Plots of survival functions for different groups

(a) 1st/2nd half-year unemployed hired



(b) 1st year PES vacancy posting



Notes: N=61,669 firms. Cox regressions control for Industry and region fixed effects and for workforce characteristics (see section 3) but not for year fixed effects. Covariates are set to mean values.

Table 12: Hiring of unemployed and firm performance — alternative treatment definitions

	(1)	(2)	(3)	(4)
Dependent Variable:	exit hazard Cox	exit hazard Cox	growth OLS	growth OLS
1 st half-year unemployed hired=no & 2 nd half-year unemployed hired=no	Ref. cat.	-0.165*** (0.0187)	Ref. cat.	-0.0505*** (0.0132)
1 st half-year unemployed hired=yes & 2 nd half-year unemployed hired=no	0.165*** (0.0187)	Ref. cat.	0.0505*** (0.0132)	Ref. cat.
1 st half-year unemployed hired=no & 2 nd half-year unemployed hired=yes	-0.0837*** (0.0236)	-0.248*** (0.0219)	0.174*** (0.0155)	0.123*** (0.0146)
1 st half-year unemployed hired=yes & 2 nd half-year unemployed hired=yes	-0.0642*** (0.0177)	-0.229*** (0.0148)	0.278*** (0.0123)	0.227*** (0.0107)
Observations	61,669	61,669	33,702	33,702

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Estimation results (log hazard ratios) are derived from Cox regressions (exit hazard) and OLS (growth). “1st year unemployed hired”, “1st half-year unemployed hired” and “2nd half-year unemployed hire” denote dummies indicating whether at least one unemployed person was hired in the first year after establishment/during the first six months/during the six months thereafter. All models control for 12 year, 15 industry, 83 region fixed effects and for workforce characteristics. Intercepts not displayed.