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## Unemployment benefit duration and startup success

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# Non-technical summary

**Research Question**

Even though a relevant share of new firms is created out of unemployment, little is known about the relationship between unemployment insurance (UI) benefits and startup success. Our study investigates how potential UI benefit duration (PBD) affects the motivation for creating a firm while unemployed and the subsequent firms' success. We address the following questions: How does PBD affect the actual unemployment duration of founders? How does it consequently affect the self-assessed motivation for founding a firm and how does it influence firm success in terms of sales and employment growth? What are the potential implications for social insurance policies?

**Contribution**

To shed light on these issues we create a new comprehensive dataset on founders in Germany which links administrative data with survey data. We exploit both age cutoff- and reform-based exogenous variation in potential UI benefit duration (PBD) to identify the effect on various measures of interest. First, we estimate the effect of PBD on the actual unemployment duration of those who start up out of unemployment. Second, we estimate how PBD affects the motivation for creating a firm (distinguishing between necessity and opportunity-driven entrepreneurship). Third, we analyze the effect of PBD on startup success measured in terms of employment and sales growth over the first years in business. Finally, we rationalize our results by constructing an extended search-matching model revealing the potential underlying mechanisms, i.e., individual-level duration and composition effects. Our paper therefore contributes to literature in entrepreneurship, financial economics, and public economics.

**Results**

We find a negative overall effect of longer PBD on startup success. More specifically, our estimates suggest that longer PBD increases the actual unemployment duration of future founders, implying an UI duration elasticity of around 0.6. Via this channel of longer actual unemployment duration, longer PBD significantly increases the likelihood that individuals start firms out of necessity – compared to situations in which they start firms due to opportunity motives – by about two percentage points per month of PBD. Moreover, and foremost in the non-manufacturing sectors, we find consistent evidence for a negative effect of longer PBD on actual outcomes in terms of employment and sales growth in the first two years after starting up. Finally, we address the question whether the effects of PBD should rather be attributed to composition changes in the type of individuals who start firms out of unemployment or to individual-level effects of longer unemployment duration. Empirically, we find limited evidence for composition changes in the observable characteristics of unemployed founders in response to UI policy changes. Hence, our findings suggest that the net effect is mostly driven by individual-level duration effects, i.e., the ability of individuals to succeed as entrepreneurs steadily decreases during unemployment spells. For instance, access to credit may deteriorate with longer unemployment duration and thus financially constrain the respective startups' growth potential. The results indicate that by setting the length of PBD, the government affects the quality of firms started out of unemployment.

# Nichttechnische Zusammenfassung

**Fragestellung**

Obwohl ein relevanter Anteil an Firmen aus der Arbeitslosigkeit heraus gegründet wird, wissen wir nur wenig über den Zusammenhang zwischen der Ausgestaltung von Arbeitslosenversicherung und dem Erfolg von Startups von zuvor arbeitslosen Gründern. Unsere Studie untersucht wie die mögliche Länge des Anspruchs auf Arbeitslosengeld die Motivation zur Firmengründung sowie den Erfolg der aus der Arbeitslosigkeit entstandenen Firmen beeinflusst. Dazu adressieren wir die folgenden Fragen: Wie beeinflusst die mögliche Bezugsdauer von Arbeitslosengeld die tatsächliche Arbeitslosendauer von Gründern? Wie beeinflusst die mögliche Bezugsdauer von Arbeitslosengeld in der Folge die Motivation von zuvor arbeitslosen Gründern und ihren Unternehmenserfolg in Bezug auf Umsatz- und Beschäftigungswachstum? Was sind mögliche Implikationen für die Sozialversicherungspolitik?

**Beitrag**

Um diese Fragen zu klären, erstellen wir einen neuen umfassenden Datensatz zu Gründern in Deutschland, der administrative Daten mit Umfragedaten verknüpft. Wir nutzen sowohl altersbedingte als auch reformbedingte exogene Variation in der potenziellen Bezugsdauer von Arbeitslosengeld (PBD), um den Effekt auf verschiedene Variablen zu identifizieren. Zunächst schätzen wir den Effekt der PBD auf die tatsächliche Arbeitslosendauer von Individuen, die aus der Arbeitslosigkeit heraus gründen. Darauf aufbauend schätzen wir wie sich Änderungen in der PBD auf die Motive zur Unternehmensgründung auswirken, wobei wir zwischen Gründungen aus Not (wirtschaftliche Alternativlosigkeit) und chancenbasiertem Unternehmertum unterscheiden. Zuletzt analysieren wir Auswirkungen der PBD auf den Gründungserfolg, gemessen an der Beschäftigungs- und der Umsatzentwicklung in den ersten Jahren nach Unternehmensgründung. Abschließend interpretieren wir unsere Ergebnisse anhand eines dafür kreierten erweiterten Search-Matching-Modells, das die potenziell zugrunde liegenden Mechanismen aufzeigt, indem es sowohl Kompositionsänderungen als auch Effekte auf individueller Ebene während der Arbeitslosigkeitsdauer berücksichtigt. Durch diese Schwerpunkte leistet unsere Studie Beiträge zur Forschung über Unternehmertum und Unternehmensgründungen, zu finanzökonomischer Forschung sowie zur Literatur im Bereich öffentlicher Finanzwirtschaft.

**Ergebnisse**

Unsere Analysen zeigen einen negativen Gesamteffekt einer längeren potenziellen Bezugsdauer von Arbeitslosengeld (PBD) auf Gründungserfolg. Insbesondere legen unsere Schätzungen nahe, dass eine längere PBD die tatsächliche Arbeitslosigkeitsdauer künftiger Gründer erhöht und dabei eine Elastizität der Arbeitslosenversicherungsdauer von etwa 0,6 impliziert. Durch die längere tatsächliche Arbeitslosigkeitsdauer erhöht eine längere PBD die Wahrscheinlichkeit, dass Individuen Unternehmen aus der Not heraus gründen – im Vergleich zu Situationen, in denen Unternehmen aufgrund wahrgenommener Chancen gegründet werden – erheblich (um etwa zwei Prozentpunkte pro Monat PBD). Vor allem im nicht Verarbeitenden Gewerbe finden wir darüber hinaus konsistente Hinweise auf einen negativen Effekt längerer PBD auf den Unternehmenserfolg (gemessen als

Beschäftigungs- und Umsatzwachstum in den ersten beiden Jahren nach Gründung). Bezüglich der Frage, ob die gezeigten Auswirkungen der PBD eher auf Kompositionseffekte zurückzuführen sind oder eher auf individuelle Änderungen während der Arbeitslosigkeitsdauer, finden wir empirisch nur begrenzt Hinweise auf Kompositionseffekte in den beobachtbaren Merkmalen arbeitsloser Gründer als Reaktion auf Änderungen der Arbeitslosenversicherung. Daher legen unsere Ergebnisse nahe, dass der Nettoeffekt hauptsächlich durch Effekte längerer Arbeitslosigkeit auf individueller Ebene bestimmt wird, d.h., die Fähigkeit von Einzelpersonen, als Unternehmer erfolgreich zu sein, nimmt während der Arbeitslosigkeit stetig ab. Beispielsweise kann sich der Zugang zu Krediten mit längerer Arbeitslosigkeit verschlechtern und somit das Wachstumspotenzial der gegründeten Firmen finanziell einschränken. Unsere Ergebnisse zeigen somit, dass die Regierung durch die Festlegung der Dauer der PBD die Qualität von Unternehmen beeinflusst, die aus der Arbeitslosigkeit heraus gegründet werden.

Deutsche Bundesbank Discussion Paper No 31/2024

# Unemployment Benefit Duration and Startup Success

Sebastian Camarero Garcia* Martin Murmann†

**Abstract**

Business creation is economically important, and unemployment precedes the creation of a substantial share of new firms. Yet, most research has focused on analyzing the effects of unemployment insurance policies on re-employment outcomes, ignoring self-employment. In this paper, we analyze how the potential duration of unemployment benefits, a fundamental design choice of unemployment insurance systems, affects whether new firms are founded out of opportunity or necessity and their growth potential. To this end, we construct a comprehensive dataset on German firm founders that links administrative social insurance information with business survey data. Exploiting reform and age-related exogenous variation in the potential duration of unemployment benefits, we find that longer potential benefit duration implies longer actual unemployment and, as a consequence, more necessity entrepreneurship and worse startup outcomes in terms of sales and employment growth. We explain this overall effect of potential benefit duration through a mix of compositional and individual-level duration effects. Our findings underline that new firms started out of unemployment are a highly heterogeneous group and suggest that the (optimal) design of unemployment insurance systems has important externalities on whether innovation- and growth-oriented firms are started out of unemployment.

**JEL-Classifications**: L26, M13, L11, L25, D22, J21, J23, J44, J62, J64, J65
**Keywords**: entrepreneurship, unemployment insurance, self-employment, opportunity entrepreneurship, fiscal externality

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# 1 Introduction

Business creation plays an important economic role in stimulating productivity, promoting innovation and structural change, and generating income for founders and their employees (Aghion et al., 2009; Dent et al., 2016; Haltiwanger et al., 2013; Coad et al., 2014; Audretsch et al., 2020). Unemployment precedes a significant share of new firms, an empirical fact that has received too little attention.[1] Moreover, the increasing use of policy instruments to support start-up initiatives by the unemployed (e.g., with the intention of mitigating economic crises) and the expansion of new forms of employment in the digital economy (e.g., Uber drivers) are likely to further increase the importance of transitions from unemployment to self-employment in the future. Recent research recognizes the importance of incentives provided by unemployment insurance (UI) regulations and active labor market policies in stimulating entrepreneurial activity (Caliendo and Künn, 2011; Hombert et al., 2020; Caliendo et al., 2020). Importantly, this research suggests that the unemployed are a highly heterogeneous group, consisting not only of potential necessity entrepreneurs, but also of potential opportunity-driven entrepreneurs who might start innovation and growth-oriented firms (Caliendo and Kritikos, 2019; Caliendo et al., 2023). However, how UI regulations shape the potential and outcomes of firms started by the unemployed remains underexplored. Existing research has focused primarily on specific forms of government intervention through the UI system and has not yet considered the impact of the general UI rules. We examine how the potential duration of UI benefits determines whether entrepreneurs who start businesses after experiencing unemployment do so out of opportunity or necessity, and how successful they become in terms of sales and job creation. This is a crucial step, since few businesses succeed in generating stable returns for their founders and their public and private stakeholders, and the effects of potential benefit duration (PBD) on entrepreneurial success could have significant externalities for national innovation systems and public finances.[2]

The effect of longer PBD on self-employment outcomes seems unclear a priori. On the one hand, when longer PBD incentivizes longer actual unemployment, losses in financial, social, and

[1] Self-employment accounts for 10-15 percent of the labor force in most OECD countries. According to our data, in Germany, the empirical setting of this paper, about 25-30 percent of all founders between 2005–15 were unemployed immediately before starting their firms. Data from the Mannheim Enterprise Panel for Germany show an average of about 200,000 start-ups per year between 2000–2015. This total corresponds to around 50,000–60,000 startups per year that originate from unemployment (for comparison, according to Spanish administrative data, up to 50 percent of startups created between 2005–2017 were started out of unemployment (Camarero Garcia and Hansch, 2020)). A significant proportion of these startups will hire additional staff. Since startups often recruit previously unemployed workers (Coad et al., 2017), the actual importance of startups from unemployment for transitions out of unemployment is likely to be even greater. Thus, even though self-employment accounts for comparatively small share of the total workforce, new firms can be considered as (re)-employment incubators (Haltiwanger et al., 2013).

[2] Regarding our notation: In terms of labor market status, we distinguish between unemployment, (dependent) employment, and self-employment. Within the labor market status of self-employment, the term *founder* refers to the individual who starts a firm and includes both firm founders with and without employees. The term *entrepreneur* is used to focus on a founder who continues to be the owner-manager of a firm after it has been set up. The term *startup* refers to the act of starting a firm and is used as a synonym for a *new firm*.

human capital might lead to a gradual decrease in startup quality. Longer unemployment duration may reduce financial resources, increase difficulties in attracting external financial capital (due to decreasing collateral or stigmatization), or lead to loss of business contacts or depreciation of skills and knowledge (Pissarides, 1992). On the other hand, a period of unemployment might serve to better prepare for self-employment, e.g., by acquiring new skills or developing market-entry strategies. Apart from these *individual-level duration effects*, there are likely to be *composition effects* as highly motivated and capable individuals will likely exit unemployment most quickly. Thus, with longer unemployment duration, a higher number of individuals with low levels of ability and motivation could remain to found startups.

In this paper, we first identify the overall effect of PBD on startup success and, thus, the (net) result of the government's UI policy. Subsequently, we rationalize which mechanisms could explain our results, with the help of post-hoc analyses and a formalized job-search model. To identify the overall effect of unemployment benefit duration on startup success, we exploit exogenous variation through policy reforms of PBD and age-specific cutoffs in the PBD schedule of the German unemployment insurance. Our main empirical strategy is an Instrumental Variable (IV) approach in which we instrument potential (and actual) unemployment benefit duration with the interaction term between "becoming unemployed after a reform-changed maximum PBD" and "being in the relevant age cohort affected by the reform" (i.e., only those over 45 years old were affected). Two reforms of the German UI in 2006 and 2008 jointly reduced the maximum PBD by at least six months for affected cohorts. We estimate consistent results by propensity score matching (PSM) and coarsened exact matching (CEM) in robustness checks.

For our empirical analyses, we construct a comprehensive linked employer-employee dataset for founders that links a representative panel survey of German founders to administrative data on their own and their employees' labor-market histories. Due to their high level of detail, researchers have widely used German administrative labor-market data (e.g., von Wachter and Bender, 2006; Dustmann et al., 2009), which allows for good comparability of our measures with those in previous research in the context of transitions to dependent employment. Our data allow us to consider two types of outcome variables: founders' self-assessments of their motivations for starting a business (*necessity-/opportunity*-driven entrepreneurship), and their outcomes, such as sales and employment growth, during the first years of business. We focus on startup growth as an outcome, to allow for a clear attribution of the measured effects. Growth in the early years is a strong predictor of firms' long-term success (Sedláček and Sterk, 2017) and should be more directly influenced by unemployment duration than more distant outcomes.

Our results reveal a negative overall effect of longer PBD on startup success. More specifically, our estimates suggest that longer PBD increases the actual unemployment duration of

future founders, implying an UI duration elasticity of around 0.6. This estimate is higher than recent estimates in the literature that focuses on dependent re-employment (e.g., Schmieder and von Wachter, 2016). Through this channel of longer actual unemployment duration, longer PBD significantly increases the likelihood that individuals start firms out of *necessity*, compared to situations in which they start firms due to *opportunity* motives, by about 2 percent per month of PBD. Ultimately, and foremost in the non-manufacturing sectors, we find consistent evidence for a negative effect of longer PBD on actual outcomes, in terms of employment and sales growth in the first two years after starting up. Turning to the question of whether *individual-level duration effects*, *composition effects*, or a mix of both drive these overall effects of PBD, we find limited empirical evidence for *composition effects* in the observable characteristics of unemployed founders in response to UI policy changes. Rather, our findings suggest that *individual-level duration effects* are primarily driving the net effect; i.e., the ability of individuals to succeed as entrepreneurs steadily declines during spells of unemployment. For example, professional networks or access to credit may deteriorate with longer unemployment duration and thus constrain startup's growth potential.

Our study makes important contributions that are relevant to policymakers, prospective entrepreneurs, and private lenders and investors of business startups. First, we document that the PBD of unemployment insurance may affect the actual duration of unemployment of future entrepreneurs more than it does for individuals returning to wage employment. Together with our findings of a negative effect of longer unemployment duration on opportunity motivation of founders and the success of their startups, this has direct implications for public finance. Policymakers should be aware that by setting the length of PBD they affect the quality of firms started out of unemployment; therefore, changes in PBD may induce significant fiscal externalities (Lawson, 2017) that affect the cost-benefit analysis of the UI system. In this respect, our findings also have implications for the design of startup subsidies that incentivize the unemployed to start a business, especially in terms of *when* such subsidies should be offered in order to promise the highest returns. From a specific innovation policy perspective, our results illustrate how UI policies can serve as tools to maximize the share of *opportunity*-driven startups, the type of startups that typically have the highest potential for generating long-term economic value (e.g., through innovation or growth; Caliendo et al., 2023). For the unemployed who are considering self-employment, and for their creditors and investors, we facilitate an understanding of how the growth potential (success) of start-ups, in terms of job creation and sales, depends on UI policy. This understanding has direct implications for their cost-benefit analysis.

With its research focus, our paper connects several strands of the entrepreneurship, finance, and public and labor economics literatures that have so far developed in parallel. First, research on entrepreneurship has examined potential determinants of becoming a firm founder (e.g., Cagetti

and De Nardi, 2006; Berglann et al., 2011; Levine and Rubinstein, 2017). Stylized facts suggest that unemployment increases the propensity to become self-employed (e.g., Evans and Leighton, 1990*a*,*b*; Meager, 1992; Kuhn and Schuetze, 2001; Andersson and Wadensjö, 2007; von Greiff, 2009; Røed and Skogstrøm, 2014*a*,*b*), but that previously unemployed founders perform worse in entrepreneurship than those transitioning from dependent employment (e.g., Andersson and Wadensjö, 2007; Caliendo et al., 2020). While opportunity-driven entrepreneurs may have substantially higher innovation and growth potential than necessity-driven entrepreneurs (Caliendo et al., 2023), the question of whether and when unemployment precedes *necessity*- versus *opportunity*-driven entrepreneurship has mostly emerged in the context of very specific active labor market policies (e.g, in the case of start-up subsidies, Caliendo and Kritikos, 2010; Caliendo et al., 2020) but not in the broader context of the general regulations of the UI system. The results suggest that while entrepreneurs out of unemployment are less likely to start with opportunity motivation and have lower innovative capabilities on average, they are a diverse group with both individuals with necessity and opportunity motives (Caliendo and Kritikos, 2019, 2010; Caliendo et al., 2020). This is in contrast to most of the entrepreneurship literature to date, which has treated previously unemployed founders as a group and has not yet embraced the significant heterogeneity among them. We contribute to the entrepreneurship literature by providing evidence on the potential impact of UI regulations on whether firms started by unemployed individuals are motivated by opportunity or necessity, and on their subsequent growth.

Second, research in finance has investigated the relationships between financing constraints, risk, and new firm entry and success (Bianchi and Bobba, 2013; Cetorelli and Strahan, 2006; Schmalz et al., 2017; Kerr and Nanda, 2009; Rampini and Viswanathan, 2010). More recently, Hombert et al. (2020) suggest that downside insurance for business failures for founders who start a company out of unemployment, as part of the unemployment insurance system, can be an important factor in motivating entrepreneurial activity among previously unemployed founders. Importantly, they do not find evidence that downside insurance leads to a decrease in the quality of the average business foundation. By analyzing the effects of PBD on the motivation for starting up and on the success of startups created out of unemployment, we contribute to the literature by widening the view on the implications of the general UI system. This contribution is of great importance because the general UI regulations determine financing constraints and downside risks of formerly unemployed entrepreneurs and, therefore, constitute the framework for the more specific regulations analyzed so far.

Finally, this project adds to the literature on the optimal design of unemployment insurance (UI) in labor and public economics, by providing evidence for the effect of PBD on future entrepreneurs. The existing studies focus on investigating effects on subsequent employment

outcomes, predominantly re-employment wages (e.g. Le Barbanchon, 2016; Schmieder et al., 2016; Le Barbanchon et al., 2019; Nekoei and Weber, 2017), usually excluding individuals transitioning from unemployment to self-employment. Results suggest that increases in PBD lead to increases in actual unemployment duration. However, the effects of longer actual unemployment on re-employment wages remain disputed. For instance, Nekoei and Weber (2017) argue that longer PBD can either induce delays in job acceptance (and simply subsidize leisure) or improve job opportunities (through subsidizing a longer search that results in job matches of higher quality). While Nekoei and Weber (2017) find that the latter positive effect dominates in Austria, Schmieder et al. (2016) report negative effects of unemployment duration on re-employment wages in Germany.

We proceed as follows: In Section 2, we explain our dataset construction and conduct a descriptive analysis. Section 3 illustrates the institutional background and our identification strategies for deriving causal effects. In Section 4, we present our empirical estimates, which we rationalize in a stylized model in Section 5. In Section 6, we present post-hoc analyses of the mechanisms driving our results and discuss limitations, Section 7 provides our conclusion.

# 2 Data and Descriptive Analysis

## 2.1 Dataset

For this paper, we construct data that match the employer information provided in the IAB/ZEW Start-Up Panel with employee register data from the German Federal Employment Agency. In this way, we circumvent data limitations since German administrative social security employer-employee linked data normally do not contain any information on self-employed individuals, who unlike dependent employees, are not obliged to contribute to the social security system.

The IAB/ZEW Start-Up Panel is a joint research project of the Institute for Employment Research of the German Federal Employment Agency (IAB), the Leibniz Centre for European Economic Research (ZEW), and Creditreform, Germany's largest credit rating agency. The Start-Up Panel is a stratified random sample taken from the Mannheim Enterprise Panel ("MUP"), which contains basic information on almost all firms in Germany, including startups (Bersch et al., 2014).[3] It provides comprehensive data on young firms from almost all industries (the primary sector, public sector and energy sector are excluded). The sample of the IAB/ZEW Start-Up Panel is stratified by the year of firm formation and by industry sector. Stratification is controlled for by including dummy variables for the stratification cells in all regressions. Information is

[3]The underlying firm information is collected and provided by Creditreform, which maintains this data to conduct credit ratings for nearly all firms in Germany.

collected by means of a yearly telephone survey (computer-aided telephone interviews, CATI). For a thorough overview of the panel dataset's sampling design, we recommend consulting Fryges et al. (2010); Vaznyte and Andries (2019) provide an application of the survey data, including a discussion of the sample response, which they consider sufficiently robust.[4]

The linked register data are "Integrated Employment Biographies" provided by the German Federal Employment Agency. These administrative data yield information on the start and end dates of all employment and unemployment spells in the founders' (and the startup employees') employment histories and their potential unemployment benefit durations. The data are reported by the employing establishment, collected by the social insurance agencies, and processed by the employment agency. Due to their high level of detail, the data are widely used in scientific research (e.g. von Wachter and Bender, 2006; Dustmann et al., 2009; Schmieder et al., 2016). A similar combination of the IAB/ZEW Start-Up Panel and German employment register data has previously been used, for example, in Murmann et al. (2023).

We match the founders' and the startup employees' employment histories from the German Federal Employment Agency with the firm-level data from the IAB/ZEW Start-Up Panel with text search algorithm methods. Our matched dataset covers longitudinal information on approximately 18,000 startups founded between 2005-2015.[5] In the main empirical analysis, we focus on 1,291 firms whose non-team-founders were unemployed directly before starting their firms. They were between 35 and 65 years of age when entering unemployment, and became unemployed before some major reforms led to changes in the availability of startup subsidies for the unemployed in 2012 (see Appendix C.2). We concentrate on single founders because our aim is to isolate the effects of individual unemployment duration on firm outcomes. Such an effect can be hardly identified for teams of founders, as, e.g., only one of the founders might have been unemployed before starting up or all founders were unemployed but for different durations. Moreover, our dataset includes non-team founders that have and do not have employees. We impose the lower age limit to avoid bias against highly educated individuals who, for example, may

[4]Detailed information on response rates of the individual survey waves of the panel dataset, including the reasons for non-response, are provided in technical reports to each wave on `https://www.gruendungspanel.de/en/zew-start-up-panel/home`. The first survey wave was conducted in 2008 and collected data on firms founded between 2005 to 2007. In the first years of data collection efforts, the Start-Up Panel dataset was financed jointly by ZEW, Creditreform and KfW bank, Germany's state-owned development bank, which administers a large part of the federal SME support programs in Germany. Therefore, the sample of startup cohorts until the year 2012 was also stratified by whether or not support was received from KfW. As for the other stratification criteria, sector and year of foundation, we control for these stratifications with dummy variables in all regressions as well.

[5]We could match labor market histories of about 80% of the founders from the IAB/ZEW Start-Up Panel based on their names, birth dates, and additional geographical information. Given that not all founders were employed, i.e. subject to social insurance in Germany previously (e.g. as they have always been self-employed), this is a very high ratio of matched individuals. Moreover, we were able to match establishment data to about 90% of those startups that self-reported (during an interview) employees subject to registration with the German social insurance based on the establishments' names and addresses. For details on the construction of our dataset, see Appendix B.

need until their mid-30s to qualify for full unemployment benefits if they are pursuing a Ph.D.. We impose the upper age limit to avoid bias against individuals who may already be eligible for retirement benefits and who may have different aspirations for an entrepreneurial career than the average entrepreneur. We only include individuals for which all required information on control variables is available and who had collected enough contribution months to be entitled to receive benefits for the maximum PBD.[6]

## 2.2 Descriptive Analysis

Detailed summary statistics for all variables are shown in Table 1, i.e., for our regression sample of previously unemployed founders, for those founders with unemployment durations above the median, as well as for a reference group of previously employed founders. The founders are typically male (85%) and of German origin (94%). They have on average 17 years of experience in the industry in which they started firms, and most of them (85%) had never been self-employed prior to entering unemployment. The founders are, on average, 44.44 years old, and about 39% of them became unemployed when they were at least 45 years old (and hence belong to the treatment group in the subsequent causal analysis). In terms of education, 28% of founders achieved university degrees, and 13% of them held managerial positions in the five years before starting up. With, on average, a PBD of 12.32 months, their mean actual unemployment duration was 4.79 months prior to entering self-employment.

Figure 1 compares the outcomes of all entrepreneurs in our sample in terms of employment and sales per year, distinguishing those who started their business out of unemployment with those who became entrepreneurs without having been unemployed (Figure A.1 in the online appendix pools all previously employed and unemployed entrepreneurs and presents the average outcomes of all the (non-team) entrepreneurs in the relevant age range in the linked dataset).[7] The results show large differences between the two groups in terms of full-time equivalent (FTE) employment and sales. Having been unemployed before starting a firm is associated with inferior outcomes as an entrepreneur from the very beginning and cannot be compensated for over the first seven years in business. After entering self-employment out of employment,

[6]Out of 11,932 solo entrepreneurs in our linked employer-employee sample, we focus on 3,841 who were previously unemployed. Of these, we lose about 800 because we exploit policy shocks in 2006 and 2008 in our identification strategy and therefore retain in the sample only founders who became unemployed until 2011, before there were significant policy changes in the subsidies provided to founders starting out of unemployment in Germany. We exclude another 900 founders because our identification strategy requires us to compare founders with full potential unemployment benefit duration and another 800 founders because of the age restrictions, which aim to ensure that founders had the chance to claim full potential benefit duration after their training and are not yet of retirement age. We conducted robustness checks by (1) relaxing the age restriction to include younger founders from the age of 18 and (2) removing all sample restrictions. In both cases, we find qualitatively and quantitatively very similar results that do not change the conclusions of our study.

[7]As explained in Section 2.1, we focus on non-team founders that are 35 to 65 years old. All firms are included, independent of the survival length. The graphs look almost identical when we condition on firms that survive at least three or five years, providing evidence that differences in growth measures are not driven by differences in survival.

founders start with average yearly sales of about 370,000 Euro and increase their yearly sales by an average of about 100,000 Euro over the first seven years in business. In contrast, founders who were previously unemployed start with sales of about 150,000 Euro a year and despite relatively stronger, concave-shaped sales growth over the first seven years in business, never come close to catching up (average yearly sales increase from about 150,000 to 300,000 Euro over the first seven years). Similarly, while founders coming out of unemployment show stronger relative employment growth in terms of FTE employment over the first seven years, they come never close to catching up with founders who were previously not unemployed (for unemployed founders: FTE employment increases from about 0.5 to 1.5 employees; for not unemployed founders: FTE employment increases from about 1 to 2 employees). The boxplots suggest that these differences do not appear to be driven by outliers, as comparing the 25th, 50th, or 75th percentiles instead of the mean leads to very similar conclusions. In addition, the boxplots suggest that there is significant variability within the group of unemployed founders.

Zooming in on those founders entering self-employment out of unemployment, Figure 2 compares the outcomes of the previously unemployed entrepreneurs in our sample, split at the median unemployment duration. The results show large differences between the two groups from the beginning that increase further over time in terms of both FTE employment and sales per year. A longer unemployment duration before starting a firm seems to be associated with inferior outcomes as an entrepreneur that are not yet visible to their full extent in the year of foundation but develop over the first years of a firm's existence. Hence, our descriptive results indicate that a large part of the outcome differentials between previously unemployed and not unemployed founders are driven by unemployed founders with long unemployment durations.

Besides sales and employment outcomes, our dataset also allows an assessment that comes closer to the roots of individual decision making and success by providing information on the founders' motives for starting up. During the first interview, i.e., closest possible to the date of startup to prevent bias, founders were asked to categorize their *main* motivation to start up the business. Table A.1 shows how we categorize the motives for starting up into either *necessity*-driven or *opportunity*-driven.[8] We classify the motives "self-determined working", the "realization of a business idea", as well as "better earning potential" as indicators of *opportunity*-driven entrepreneurship. In contrast, we classify the motives "no suitable employment options" and "escape from unemployment" as indicators of *necessity*-driven or *pushed* entrepreneurship.[9]

[8] Figure A.2 in Appendix A shows that *necessity*-driven founders start up more often just before UI benefits expire and thus appear to be *pushed* into self-employment. Table 1 shows that one third of previously unemployed non-team founders indicate that they were *pushed* into self-employment. Note that the notion of *pushed* entrepreneurship also corresponds to its usage in Bianchi (2012). Recently, Hacamo and Kleiner (2022) use the term *forced* entrepreneur to describe founders who were pushed into entrepreneurship during high aggregate (though not own individual) unemployment. The observation of a spike just before exhausting UI benefits has been studied by Card et al. (2007) and recently been documented for Germany by DellaVigna et al. (2020).

[9] Since the item "better earning potential" could be alternatively interpreted as pointing to a *necessity* motive,

Figure 3 compares the sales and employment outcomes among the previously unemployed founders in our main regression sample, split by their self-reported startup motivations (i.e., whether they classify as *opportunity*- or *necessity*-driven/*pushed* founders; we present similar graphs for the outcomes of all non-team founders in our dataset, i.e., those with and those without a history of unemployment, in Figure A.3 in the online appendix). The graphs reveal that founders who report an *opportunity*-driven motivation for starting their business experience faster growth in sales and FTE employment, suggesting that the motive for starting up is already a good predictor of subsequent startup success and that defining groups of entrepreneurs along the lines of their motivation seems adequate for describing observable differences in longer-term growth potential.

OLS regressions of being classified as *necessity*-driven (*pushed*) entrepreneur, of sales and of FTE employment (one and two years after having started the business) on the actual benefit duration (and numerous covariates) suggest that the graphically observed correlations are quite robust (see Table 2). The relationships revealed in the descriptive analysis (as discussed in the figures above) remain significant in the OLS models even after controlling for individual labor market experience, education, gender, nationality, and year as well as industry fixed effects (see Table A.2 for details on the industry classification).[10] The simple regression analysis suggests that one additional month of actual unemployment duration is associated with a 1.7 percentage point increase in the likelihood of being *pushed* into entrepreneurship (see Table 2: five percent in relative terms, given an original basis of about 35% *necessity*-driven entrepreneurs). Moreover, one month of actual benefit duration is significantly correlated with a decrease in sales and FTE employment. These results are reconfirmed when focusing on startups in non-manufacturing sectors (75% of our sample, see Table 3). Non-manufacturing sectors offer less restricted market entry due to lower initial investment requirements; thus, they are the most relevant for the entry of founders transitioning from unemployment to self-employment.

We conclude from our descriptive analyses that there is a statistically significant relationship between actual unemployment duration and subsequent self-employment outcomes in our data. In particular, starting a business out of unemployment is associated with poorer outcomes in terms of sales and employment when compared to businesses started by founders who have not been previously unemployed. Moreover, given a previous unemployment history, a longer duration of unemployment correlates with a *necessity*-driven motivation for starting up (or *pushed* entrepreneurship) and subsequently comes with poorer firm outcomes.

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we double-checked all results by excluding founders who self-reported this motivation category. All results remain robust. Note that the surveyed persons could only select one answer category as their main motive for starting up.

[10] We find fully consistent results when we add a linear term for the age of the founder at the time of entry into unemployment as a control variable.

# 3 Institutions and Empirical Strategy

This paper focuses on finding out whether PBD drives the actual unemployment duration for founders who start up out of unemployment and whether, in consequence, actual unemployment duration drives the motivation for starting a business as well as startup success. The main identification challenges consist of endogeneity concerns because an individual's potential and actual unemployment duration are likely non-randomly distributed. For instance, PBD (or actual unemployment duration) might be correlated with characteristics of unemployed people (e.g., previous working experience) that in fact explain the observed outcome. To solve these identification issues, we exploit policy reform- and an age-cutoff-based exogenous variation in the PBD schedule within the German UI system.

We use an instrumental variables (IV) approach as our main estimation strategy. Our strategy allows us to derive the net effect of PBD on the actual UI duration elasticity of founders, the motivation to become self-employed, and measures of startup success. Therefore, we identify the overall effect of a change in the policy variable, PBD, on entrepreneurial outcomes.[11] Since PBD might affect entrepreneurial outcomes through either *composition effects* in the pool of unemployed individuals or *individual-level duration effects*, we try to disentangle both channels in post-hoc analyses. As a start, we explain the main institutional features the identification strategies rely upon.

## 3.1 Institutional Background: German UI System and Reforms

In general, individuals in Germany who lose a job through no fault of their own are entitled to UI benefits ("Arbeitlosengeld I") if they satisfy certain *eligibility constraints*. These *eligibility constraints* require UI benefit claimants to have made social insurance contributions for at least 12 months within the two years (three years before February 2006) prior to becoming unemployed. The replacement rate is 60 percent of previous after-tax (net) earnings (67 percent if a person has dependent children) and has not changed since 1995. After exhausting UI benefits, an individual can obtain social security benefits tied to the existential minimum ("Arbeitslosengeld II"), which is subject to annual means testing.[12]

The PBD depends, first, on an individual's age at the start of the unemployment spell, and, second, on the number of months worked in jobs subject to social insurance contributions (*contribution months*) within a defined time period before claiming UI benefits (the *coverage constraint* was seven years prior to February 2006 and five years afterwards). For all workers

[11] The interpretation of the measured effects as local average treatment effects is discussed below.

[12] In line with our data analysis focusing on the years 2005-2015, we describe the German UI system as it has existed since 2005 in the main text. Appendix C.1 provides more details on the most important labor market reforms that took place in Germany during the early 2000s.

satisfying the *eligibility constraints*, the PBD consists of a minimum of six months collected through at least the 12 *contribution months* in the time period just before the UI spell starts (Table A.3). For each four additional *contribution months* before starting an UI spell, the PBD increases by two months. However, workers younger than 45 years are restricted to a maximum PBD of 12 months, which corresponds to 24 months of contributions, i.e., they cannot get more than 12 months of PBD if they have collected more than 24 *contribution months*. This maximum PBD cutoff increases with the age. For instance, before February 2006, for workers 45 and older at the start of their UI spell, 30 months of contribution led to 15 months of PBD (Table A.3). Workers 57 and older could reach the maximum PBD of 32 months with 64 months of contributions. Hence, they could acquire 20 more months of PBD compared to a worker younger than 45 years who had also contributed 64 months before entering UI in the same month.

While the PBD schedule has remained stable for workers that enter UI at ages younger than 45, the maximum PBD cutoffs changed for individuals over 45 years in age in February 2006 and a second time in January 2008. Each reform affected those individuals entering UI after its implementation, whereas already unemployed individuals were still treated according to the rules in place in the month in which they entered UI. Table A.4 summarizes the eligibility criteria and changes resulting from the different reforms.[13] The reform of 2006 led to a considerable reduction in the maximum PBD for those 45 years and older. The reform of 2008 led to a comparatively small (readjustment) increase in the maximum PBD for some age cohorts over 50 years. In total, the net reform effect when comparing the time period before February 2006 to that after January 2008 can be characterized by a reduction of at least six months in the maximum PBD for all age cohorts entering the UI system at 45 years and older (Table A.4).

## 3.2 Empirical Strategy

The identifying variation that we exploit in our three empirical estimation models stems from the age-dependent discontinuities in PBD (Table A.3) and from the two reforms regarding the maximum PBD schedule which took place in 2006 and 2008 (Table A.4).[14] Our main empirical models follow the instrumental variable (IV) approach used in Le Barbanchon et al. (2019). The idea is to exploit the fact that the PBD in the German UI system depends on age-cut offs and that there have been reforms that changed the PBD but no other parameters, such as the

[13] For an overview of the reforms of the German UI benefit system before the time period studied in this paper, see Schmieder et al. (2012). For the time period studied in this paper, see Price (2019) and Appendix C.1.

[14] To the best of our knowledge, no startup subsidies in Germany depend on a founder's age. While there was a change in the scheme for startup subsidies in 2006, first, we also use the 2008 reform for identification when relying on reform-based variations in PBD, and second, the age-dependent discontinuities that we exploit for identification are independent of subsidy reforms. Thus, we are confident that our source of variation is not correlated to any changes occurring in startup subsidies for the unemployed (compare Appendix C.2). Moreover, we control for participation in subsidy schemes that are either governed by the German Federal Employment Agency or the KfW bank in all regressions and therefore account for all major startup subsidies in Germany.

UI benefit levels. Therefore, instrumenting PBD (or actual unemployment benefit duration) by an interaction between the reform and the age cutoff constitutes a valid instrument. It should introduce variation in benefit duration and satisfy the exclusion restriction because the differences in outcomes among individuals are unlikely to be explained by just small differentials in age (under or over the age cutoff) and the time at which individuals became unemployed (before or after the reform). We estimate IV models of the form:

$$y_{it} = \alpha + \beta * Treated_{it} + \gamma * PBD_{it} + \delta * X_{it} + year_t + \varepsilon_{it} \quad (1)$$

$$y_{it} = \alpha + \beta * Treated_{it} + \gamma * AUD_{it} + \delta * X_{it} + year_t + \varepsilon_{it} \quad (2)$$

where, for each founder $i$ in month $t$, $y$ is the outcome variable which can be the motivation for starting a firm, logarithmized yearly sales in Euro in the first and in the second year after foundation, or the logarithmized FTE number of employees one year and two years after foundation. Moreover, $\alpha$ is a constant, and $X$ is a vector of firm- and founder-specific control variables (education, managerial experience, self-employment experience, industry experience, gender, being subsidized, industry-fixed effects). Finally, we control for macroeconomic conditions and trends in the unemployment or self-employment rate by taking into account year-fixed effects.[15]

Depending on the model , the potential benefit duration ($PBD_{it}$) and the actual unemployment duration ($AUD_{it}$) are instrumented by the instrumental variables:

- *IV06=After(02/2006)*Treated(age≥45)* which reflects the effect of a decrease in PBD by at least 6 months and/or
- *IV08=After(01/2008)*Treated(50≤age≤54)* which reflects the effect of an increase in PBD by at least 3 months.

This set-up leads to the first-stage of the instrumental variable (IV) models:

$$PBD_{it} = \alpha + \beta * Treated_{it} + \gamma * IV06\ (+\gamma * IV08) + \delta * X_{it} + year_t + \varepsilon_{it} \quad (3)$$

$$AUD_{it} = \alpha + \beta * Treated_{it} + \gamma * IV06\ (+\gamma * IV08) + \delta * X_{it} + year_t + \varepsilon_{it} \quad (4)$$

The first-stage models can be regarded as tests of the strength of our instrumental variables. F-statistics from our first-stage models for PBD generally suggest that our instruments are very strong predictors of $PBD_{it}$, with Equation (3) yielding high F-statistics for the instruments, i.e., most F-statistic values are above 100 and never less than 10 in any specification (see Tables 6 and 7 for first-stage estimates of our main IV models). Moreover, one would expect the corresponding first-stage F-statistics to be smaller when instrumenting the actual employment duration ($AUD_{it}$ in Equation (4)). The IV should have a first-order correlation with the policy

[15] We tested taking out observations from January 2006 so that the year effects fully capture the after-reform dummy. Following this approach does not alter our results.

variable that changed due to the reforms (PBD) and only a second-order correlation with the actual unemployment duration. Consequently, when we use our IVs to instrument the actual unemployment duration—in order to understand how changes in PBD affect subsequent outcomes of unemployed individuals in self-employment through changes in actual unemployment duration—the F-statistics are clearly smaller. However, they always remain above 10, which is the commonly used rule of thumb for F-statistics to identify weak instruments.

Our IV estimator exploits both reform- and age-cutoff-based exogenous variation in order to estimate the effect of PBD on actual unemployment duration, the motivation for starting a business, and the success of entrepreneurs starting from unemployment. It is best interpreted as the local average treatment effect of PBD (or, depending on the model specification, actual unemployment duration) on our outcomes. This interpretation is similar to the interpretation of the IV approach used in Schmieder et al. (2016) for estimating the wage effect for unemployed individuals becoming re-employed as dependent employees. While our OLS results can be interpreted as average treatment effects across our estimation sample of previously unemployed entrepreneurs, the identifying variation exploited in the IV estimates is based on variation among individuals aged 45 and over who were affected by the policy reforms.

# 4 Results

We begin by presenting OLS baseline estimates of the relationship between our main explanatory variable, potential benefit duration (PBD), and the actual unemployment duration, the motivation for starting a business, and subsequent firm outcomes (see Table 4). In all regressions, we control for education, previous labor market experience, individual characteristics (gender, nationality), industry, and year-fixed effects. We also include dummy variables indicating whether founders received subsidies from the Federal Employment Agency and/or the KfW bank to control for any unobserved heterogeneity related to startup subsidies (see also Appendix C.2).[16] The OLS results indicate that a one month increase in PBD comes with an increase in actual unemployment duration of 0.47 months. Hence, we estimate a duration elasticity of about 0.5. Moreover, one month of additional PBD is associated with an increase in the probability of starting a business out of necessity by about two percentage points. Concerning firm outcomes, more PBD comes with fewer sales and FTE employment in the first two years after starting up. Turning to the coefficients of the control variables, more highly educated individuals tend to be less likely to start a business out of self-reported *necessity*. Previous managerial experience contributes to better performance in terms of sales and employment growth. Being female or a foreigner does

[16] Again, we find fully consistent results when we add a linear term for the age of the founder at the time of entry into unemployment as a control variable.

not have any differential effect concerning actual unemployment duration or the motivation for starting a business. If at all, these two characteristics may be associated with lower sales growth.

We generally present results for all sectors, as well as results for just non-manufacturing sectors in this section (e.g., OLS baseline estimates for non-manufacturing firms are shown in Table 5). We do so because non-manufacturing sectors are particularly relevant for the entry of the unemployed, as entry into these sectors is usually possible at a comparatively smaller minimum efficient scale of operation, which may require lower initial investment and growth ambitions (Mata and Machado, 1996; Audretsch et al., 2004).

## 4.1 Main Results: Instrumental Variable (IV) Approach

We present the results from our main IV models in Tables 6 and 7. For these main results, we use "being treated by the policy reform of 2006" as an instrument for longer PBD and longer actual unemployment duration.

The IV estimates suggest that longer PBD increases actual unemployment duration before individuals transfer from unemployment to self-employment. Prior research has confirmed this result only with respect to dependent re-employment. Via longer actual unemployment duration, longer PBD increases the probability that individuals start a company out of *necessity* (and not because they see a business *opportunity*). Subsequently, longer PBD leads to a decrease in firm performance in terms of employment and sales over the initial years in business. Turning to the effect sizes, according to our IV estimates, a one month increase in the PBD leads to a 0.66 month increase in the actual unemployment duration before starting up (column two of Table 6). Moreover, one additional month of PBD leads to a 1.5 percentage points higher probability of starting a firm out of *necessity*. Given that the average probability of starting a firm out of *necessity* is around 35 percent, this increase corresponds to a relative increase of four percent per month, which is economically significant (column three of Table 6). Concerning the effects on more objective outcomes, we find that only the effect on sales after two years remains statistically significant in the full sample in the IV setting. A one-month increase in the PBD leads to 7.2 percent lower sales in the second year. The effect of longer PBD on employment after two years is negative, as it was in the OLS models, but it is less precisely measured here. When focusing on the non-manufacturing sectors in Table 7, the effect of longer PBD on the motivation to start a business becomes insignificant, while the effects on outcomes become larger and more precisely estimated, suggesting statistically significant negative effects of longer PBD on sales and FTE employment after the second year. These results are consistent with the logic that focusing on non-manufacturing sectors may mean focusing on a pre-selection of unemployed individuals with fewer resources and ambitions, and may allow a more direct measurement of the effects

of prolonged unemployment on the ability of entrepreneurs to run successful firms, given their situation at market entry. In general, the first-stage F-statistics are well above 150 in all versions of the IV models and indicate the very good predictive power of the instrument (Section 3.2).

Our results are reconfirmed when using both IVs, $IV06$ for the 2006 reform, which decreased the PBD by at least six months, and $IV08$ for the 2008 reform, which increased the PBD by three months. The results of changes in PBD on our outcomes of interest (Tables A.5 and A.6) remain very similar to those based on just the single instrument $IV06$. However, the quality of the first-stage model in terms of the F-statistic decreases once including the additional instrument. Therefore, we present estimates with only one instrument ($IV06$) as main results. In summary, our IV results confirm the initial OLS results but are less precisely measured.

Finally, we repeat the IV estimation instrumenting actual unemployment duration (AUD) to establish a clear causal channel from PBD via AUD to firm outcomes. The findings are shown in Tables A.7 and A.8 when using only *IV06* as well as Tables A.9 and A.10 when using *IV06* and *IV08* combined. While, as expected, the predictive quality of the first-stage models is lower than when instrumenting PBD, the results are fully in line with the previously described results for PBD and suggest that longer PBD affects startup motivation and outcomes via incentivizing longer AUD.

# 5 Stylized Theoretical Model

In this section, we present a stylized model to rationalize the empirical findings that we observed Section 4 and disentangle the potential mechanisms driving the results. We conclude the section by discussing the model's implications for policy makers and startup stakeholders.

## 5.1 Model Framework

We consider workers who become unemployed in period $t = 0$, provided they remain unemployed and receive UI benefits for duration $d$.[17] In each time period (month), they receive unemployment benefits $b_t$ until the maximal potential unemployment benefit duration *PBD* is reached (cf. Section 3.1). Focusing on the case of a two-layer UI system, benefits can be defined as $b_t = \bar{b}$ for $t \leq PBD$, where $\bar{b}$ is the constant UI benefit level which the unemployed individual receives for the entire UI spell (until exhausting benefits at the PBD). The UI benefits received depend on the previous wage, i.e., they constitute the replacement rate fraction of the average monthly wage income over the six months before becoming unemployed. Next, $b_t = \tilde{b} < \bar{b}$ for $t > PBD$,

[17] The model is in continuous time, and the horizon for each worker lasts until retirement time $T$. Moreover, we consider them to be risk-neutral.

where $\tilde{b}$ can be interpreted as Germany's existential minimum assistance "Arbeitslosengeld II", which is independent of previous contribution months and lower than the wage-dependent UI benefits ($\bar{b}$). Without loss of generality, this amount is the same for all eligible claimants.[18] We assume that each individual has a latent ability (including entrepreneurial ability) $\theta \sim G(\theta)$, where $G()$ is a normal density function. In each time period, an unemployed individual has to decide whether to search for employment or to start a firm, i.e., to become self-employed. Let $V_u^e$ be the value function of an unemployed individual searching for employment and $V_u^{se}$ be the value function of an unemployed individual starting a business. Then the decision of an unemployed individual is characterized by the value function:

$$V_t^u = max\{V_{u,t}^e, V_{u,t}^{se}\} \tag{5}$$

**Value of Searching for Employment out of Unemployment** Ignoring savings (workers live hand-to-mouth), the value of searching for employment when an individual is unemployed can be characterized by:

$$V_{u,t}^e = b_t - \psi_t(s_t) + \beta\left\{p_t[1-F(\phi_t)]\int_{\phi_t}^{\infty} V_{t+1}^e(w_{t+1})dF(w_{t+1}) + [p_t F(\phi_t) + (1-p_t)]V_{t+1}^u\right\} \tag{6}$$

An unemployed individual receives consumption flow utility from benefits $c_{u,t} = b_t$[19] but faces search costs $\psi_t$, which, in line with the literature (e.g., Schmieder and von Wachter, 2016), are assumed to be a differentiable, increasing, and convex function of search effort $s_t$. With probability $p_t = p(s_t, \theta)$, which depends on search efforts and ability, the unemployed worker receives a job offer for period $t+1$. Note that in this setting, the individual's optimal behavior is characterized by a reservation wage $\phi_t$, above which any wage offer $w_t \geq \phi_t$ is accepted.[20]

Thus, with probability $1 - F(\phi_t)$, the offer is accepted and the individual becomes re-employed, receiving the corresponding expected value of being employed, i.e., $V_{t+1}^e$ (see Equation (7)). However, with probability $F(\phi_t)$, the offer is too low and is rejected. In this case and if the worker receives no other offer (with probability $1 - p_t$), s/he remains unemployed in the next month and receives the next period value of being in unemployment, i.e., $V_{t+1}^u$ (Equation (5)).

[18] Note that the replacement rate for UI benefits ($\bar{b}$) is 60% for single individuals and 67% for individuals with dependent children. When receiving the existential minimum ($\tilde{b}$), the additional amount received per child on top of the basic minimum corresponds approximately to the general child allowances every parent receives from the German federal state ("Kindergeld"). Thus, the relative drop in income when exhausting UI benefits does not vary much per person independent of the family structure, and we abstract from this issue for the purpose of this chapter.

[19] Note that $c_{u,t} = b_t + y_u$, where $y_u$ could be income from other sources that, if assumed to remain constant over the UI spell and exogenously given, would not alter our qualitative conclusions (e.g., support from family members).

[20] Note that the cumulative distribution function $F()$ may depend on the duration of unemployment, for instance, due to depreciation in human capital, (statistical) discrimination, or stigma effects, as explained in Jarosch and Pilossoph (2019) and suggested by the experimental evidence in Oberholzer-Gee (2008).

As usual, $\beta$ is the discount factor for future period returns.[21] The two-layer UI system implies through the parameter $b_t$ that if an individual stays unemployed, surpassing the PBD, the outside option will decline to the existential minimum (from $b_t = \bar{b}$ to $b_t = \tilde{b} < \bar{b}$). Thus, a drop in the value function ($V^e_{u,t}$) is to be expected in the month when the maximum *PBD* is reached.

**The Value of Being in Employment** is then characterized by:

$$V^e_t = (w_t - \tau) + \beta\{\lambda_t V^u_{t+1} + (1-\lambda_t)V^e_{t+1}\} \tag{7}$$

An employed worker receives consumption flow utility $c_{e,t} = w_t - \tau$, i.e. consumption is based on the net wage.[22] Variable $\lambda_t$ is an exogenous separation rate that may vary depending on macroeconomic conditions over time. Thus, with probability $\lambda_t$, the worker may lose his/her job and become unemployed again, but, with probability $1-\lambda_t$, the worker remains employed. As a simplifying restriction, we ignore the option of moving from employment to self-employment but focus on flows from unemployment to self-employment, as this resembles our available empirical setting and is the relevant labor market flow we study.

**Value of Entering Self-Employment out of Unemployment** The value for an unemployed individual becoming self-employed out of unemployment is characterized by:

$$V^{se}_{u,t} = b_t - \psi^{se}_t(s_t,\theta) + \beta\Big\{p_t[1-F(\phi_t)]\int_{\phi_t}^{\infty} V^{se}_{t+1}(\pi_{t+1})dF(\pi_{t+1}) + [p_t F(\phi_t) + (1-p_t)]\,V^u_{t+1}\Big\} \tag{8}$$

An unemployed individual evaluating whether to become self-employed faces a value function similar to that of an individual searching for employment in Equation (6). Again, the individual has a consumption flow utility in the form of unemployment benefits $b_t$ and faces search costs $\psi^{se}_t(s_t\theta)$. We expect these search costs to be different from, and more dependent on individual ability, than those costs incurred when searching for employment since an individual has to develop an idea, do market research, and find capital instead of writing applications during the more standardized process of looking for paid employment. In other words, becoming self-employed depends more on an individual's skills $\theta$. The higher the ability, the smaller are market-entry search costs. The unemployed individual still faces a reservation wage $\phi_t$, above which potential profits from self-employment would be accepted. However, if the potential profit is too low, the individual may remain unemployed and continue to look for employment. Otherwise, if self-employment profits are higher than the reservation wage $\pi_t \geq \phi_t$, the individual will prefer to form a startup.

[21] One could introduce myopic behavior on the part of agents by changing the discount factor. We abstract from this complication, as we have no empirical evidence that irrational behavior is driving our results.

[22] Taxes could be also designed to be proportional taxes $(1-t)$ without changing the qualitative results.

**Value of Being in Self-Employment** The value of being in self-employment can be characterized by the following value function:

$$V_{ut}^{se} = \pi_t(\theta) + sub_t + \beta\{\gamma(\theta)V_{t+1}^{u} + (1-\gamma(\theta))V_{t+1}^{se}\} \tag{9}$$

A self-employed person earns profits $\pi_t(\theta)$ (net of the startup costs and taxes in the case of positive profits) and may receive a subsidy $sub_t$. Therefore, the returns $\pi_t(\theta)$ are assumed to increase with entrepreneurial skills ($\frac{\partial \pi_t()}{\partial \theta} > 0$), reflecting, e.g., that the quality of successful business ideas may increase with $\theta$. Similarly, the probability that the startup fails, $\gamma(\theta)$, is assumed to decrease as ability increases, $\frac{\partial \gamma()}{\partial \theta} < 0$, reflecting, e.g., that better business ideas are less likely to result in failure. Thus, with probability $(1-\gamma(\theta))$, the startup will survive. With probability $\gamma(\theta)$, the founder has to return to unemployment.

**The Effect of Unemployment Duration on Value Functions** The unemployed worker's decision problem in Equation (5) involves maximizing the expected utility between the value of moving from unemployment to employment and the value of becoming self-employed out of unemployment (see Appendix D.1 for the derivation of the results).

First, the **value function for moving from unemployment to employment** can be characterized by Equation (6), where $V_{t+1}^{e}$ is characterized by Equation (7). It is important to note that given a fixed level of (entrepreneurial) ability $\theta$, the value function $V_{u,t}^{e}$ features negative **duration dependence** $\frac{\partial V_{ut}^{e}}{\partial d}|\theta < 0$. There are two main sources of UI *duration dependence*: the search effort may vary over the unemployment duration, and, over time, benefit levels decrease (at least once, when reaching PBD, with the drop to the existential minimum).[23] The accepted job offer's value depends on both the search effort, which determines the job offer arrival rate $p(s_t, \theta)$, and the re-employment wage.

We derive the optimal search intensity and reservation wage paths in order to observe how these variables react to an increase in $d = PBD$. We find that the reservation wage is positively correlated with the potential unemployment benefit duration, i.e. $\frac{\partial \phi_t}{\partial d} > 0$. The search intensity reacts negatively to an increase in PBD, i.e. $\frac{\partial s_t}{\partial d} < 0$. Hence, an individual will prefer to stay unemployed longer when the PBD is increased. This effect of PBD on actual unemployment duration, which can be rationalized by negative duration dependence $\left(\frac{\partial V_{ut}^{e}}{\partial d}|\theta < 0\right)$, has been shown to be an empirically robust finding, even if there is not yet a consensus concerning

[23] Nekoei and Weber (2017) show that a directed search model incorporates these two sources of *duration dependence* and includes the random search McCall-style model that we present as a special case. Moreover, they reveal that selectivity may be positively, and *duration dependence* negatively, affecting re-employment wages. Burdett et al. (2020) build a structural model that reproduces negative wage effects following a job loss and suggest that foregone human capital accumulation is the main source of their persistent drain on post-unemployment earnings.

the welfare implications regarding post-unemployment wages (e.g. Schmieder et al., 2016; Schmieder and von Wachter, 2016; Nekoei and Weber, 2017).[24]

Second, the **value function of moving from unemployment to self-employment** can be characterized by Equation (8), where $V^{se}_{t+1}$ is characterized by Equation (9). Holding (entrepreneurial) ability fixed, this value function is also dependent on unemployment duration $d$, i.e. $\frac{\partial V^{se}_{ut}}{\partial d}|\theta < 0$. However, in absolute terms, it is smaller than $\frac{\partial V^{e}_{ut}}{\partial d}$, i.e., $\frac{\partial V^{e}_{ut}}{\partial d}|\theta < \frac{\partial V^{se}_{ut}}{\partial d}|\theta < 0$. We derive this fact by exploiting the definitions of $V^{e}_{u,t}$ and $V^{se}_{u,t}$. By assuming that the value of leaving unemployment in the next period depends, on average, on the present value of the reservation wage, we can write $V^{e}_{u,t+1} = \frac{1}{\rho}\phi_t$. In the case of self-employment, the latter definition has to be extended to $V^{se}_{t+1} = \frac{1-\gamma(\theta)}{\rho}\ \phi_t$ because self-employment can only be realized with probability $[1-\gamma(\theta)]$.

Having derived the optimal reservation wage and search intensity paths, we document that the optimal search intensity for business opportunities is less dependent on unemployment duration $d$ than is the optimal search intensity for regular employment. Thus, the negative unemployment *duration dependence* for becoming self-employed is smaller than that of searching for employment, reflecting the idea that self-employment can be interpreted as an alternative professional activity that is more dependent on an individual's skills than on the labor market conditions and thus less dependent on unemployment duration. This is consistent with the empirically detected higher UI duration elasticity for founders compared to dependent employees (compare Appendix D.1). Intuitively, if self-employment seems a viable path, the time pressure to leave unemployment becomes smaller, and the UI duration elasticity becomes larger. Moreover, the search process for self-employment differs from the search process for regular employment.

## 5.2 Model Implications

**Model implications** Now, it is possible to rationalize our empirical results by analyzing qualitatively how the value functions for becoming employed $V^{e}_{ut}$ (Equation (6)) and self-employed $V^{se}_{ut}$ (Equation (8)) evolve with unemployment duration $d$ and how these evolutions influence an unemployed individual's decision, given his/her (entrepreneurial) ability. Figure 4 illustrates that the unemployed individual will prefer to find a job when the value function for searching for employment $V^{e}_{ut}$ is above the value function for becoming self-employed $V^{se}_{ut}$. Whereas, the individual will prefer to start a business when $V^{se}_{ut} > V^{e}_{ut}|\theta$. The grey line depicts $\frac{\partial V^{e}_{ut}}{\partial d}|\theta < 0$. The

[24] Note that there have been different theories proposed to explain this finding. These theories include human capital or job-specific skills decaying over unemployment spells and statistical discrimination, which assumes that individuals who are less capable remain unemployed for longer periods. Additionally, stock-flow matching could also explain *duration dependence*, as it implies that those entering unemployment and not finding a job match quickly become increasingly dependent on the inflow of newly posted vacancies (note that flow variables are quantitatively smaller than stock variables).

black line shows $\frac{\partial V_{ut}^{e}}{\partial d}|\theta < \frac{\partial V_{ut}^{se}}{\partial d}|\theta < 0$. Moreover, the vertical dotted black line marks the PBD; at this point in the unemployment duration, the grey line drops by $x = \bar{b} - \tilde{b}$ because UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (cf. Appendix C). Thus, by rationalizing the behavior of unemployed individuals, the stylized model suggests, as a first takeaway, that PBD can determine the composition of the group of self-employed transitioning from unemployment. Figure 4 is also helpful to rationalize that, holding all else fixed as (entrepreneurial) ability changes, some high-ability individuals may always decide to become self-employed once unemployed, i.e., once they must search for a new post-unemployment labor market status (see also Figure A.4). Correspondingly, certain low-skilled unemployed individuals would never decide to become self-employed but rather would continue to search for employment (see also Figure A.5). Note that these individuals have been employees and, after becoming unemployed, start to consider self-employment as an alternative to re-employment. Thus, they may only start to think about their entrepreneurial abilities once they become unemployed.

In the following, we use further graphical representations of our model results to discuss implications for individuals' decisions to become entrepreneurs as well as the resulting implications for startup stakeholders and policy makers. As Figure 5 illustrates, our model explains how the government can influence the composition of the group of unemployed individuals who decide to become self-employed out of unemployment via setting the PBD. Note that a minimum PBD is needed for even highly entrepreneurial types to have enough time to prepare for the transition from unemployment to self-employment. Beyond that, however, the longer an individual is unemployed before moving to self-employment, the lower their $V_{ut}^{se}$ and thus the lower their subsequent firm's performance appears to be.[25] Figure 6 sums up how changing the PBD affects startup success. I.e., it demonstrates that longer PBD may induce more individuals with low (entrepreneurial) ability to transition from unemployment to self-employment and that, for a given (entrepreneurial) ability, it may induce a transition to entrepreneurship at too late a point in time when the individual's ability to succeed as an entrepreneur has already diminished. In summary, the model rationalizes how *composition* effects and *decreasing individual ability over time* or a mixture of both can explain our empirical evidence that PBD positively affects actual benefit duration and, through the latter, negatively affects opportunity motivation as well as subsequent start-up success of founders from unemployment.

Finally, we use the model to derive implications for two very common policy measures, retraining for employment and subsidies for self-employment. Figure 7 shows that, given the same maximal PBD, *early* retraining can reduce the rate at which $V_{u}^{e}$ declines with actual

[25] As Figure A.6 shows, our model can also rationalize our results for the case in which unemployment duration would not also harm potential self-employment outcomes, i.e. in the case of zero UI *duration dependence* for self-employment outcomes. Then, the empirical result of the subsequent startup success declining as the unemployment duration of a founder increases can also be rationalized with a horizontal value function $V_{u}^{se}$ that is independent of $d$.

unemployment duration. Thus, for a fixed PBD, retraining may improve welfare, thus maintaining consumption smoothing and general matching considerations for unemployment-to-employment transitions. This could reduce the number of *necessity* founders via slowing the negative UI *duration dependence* in $V_u^e$ that is itself causally influenced by PBD. As Figure 8 illustrates, subsidies targeted at unemployed workers who may have revealed some entrepreneurial skills, perhaps via a business plan, would increase $V_u^s$ and thus the post-unemployment startup success probability. Hence, subsidies could make it easier for unemployed individuals with promising ideas to stop searching for employment and focus on preparing their startup, consequently reducing their time in unemployment (and hence, the fiscal externality; see the next paragraph).[26]

**Implications for Fiscal Externality** When thinking about optimal UI benefit duration in terms of its implications for public finance, the social costs of changing the PBD must be taken into account: the "fiscal externality" it creates (Lawson, 2017). That is, in the spirit of the Baily–Chetty framework (e.g. Chetty, 2009; Kroft and Notowidigdo, 2016), the optimal UI benefit duration should balance the welfare benefits created by additional insurance, which help to smooth overall consumption, with the social costs of extending PBD. Those costs are captured by the fiscal externality (i.e., the effect on the government's budget).

To illustrate the role of taking self-employment out of unemployment into account, let us consider an example. In a worker's last pre-unemployment job, s/he earned wage $w$ and paid taxes $\tau$.[27] The worker enters unemployment in time period $T_0$. In line with our results, extending the PBD would induce longer actual unemployment of $(T - T_0)$ periods. In time period $T$, the unemployed individual becomes self-employed. Especially, if the individual becomes a *necessity* entrepreneur who actually does not want to become self-employed but only starts a firm to escape unemployment, their profits $\pi_s$ might be lower than their pre-unemployment wage $w$ (as a proxy for the hypothetical re-employment wage) during their self-employment spell (lasting from period $T+1$ until time period $S$). If, in addition, the (*necessity*) entrepreneur fails at time $S$ and drops back into unemployment from time $S+1$ onward, there would be forgone tax revenues $(\tau\pi_s)$ and the benefits paid during unemployment $(b)$ to consider. Formalizing the example, we arrive at a formula for fiscal externality:

$$FiscalExternality = (\tau w + b)(T - T_0) + \sum_{s=T+1}^{S} \tau(w - \pi_s) + \sum_{s=S+1} (\tau\pi_s + b)D_s \qquad (10)$$

The first term is the standard duration effect, which imposes a negative fiscal externality in the case of limited UI duration. In fact, longer unemployment duration implies that the

[26] Early training for self-employment (relaxing the assumption of entrepreneurial types such that some skills can be developed through external support) could increase $V_u^s$. Thus, the post-unemployment startup success probability could be increased, e.g. by coaching founders in creating better business plans.

[27] Without loss of generality, we just consider proportional taxes and follow Lawson (2017) in assuming that the fiscal externality of social security programs works through labor income taxes.

government forgoes potential tax revenue ($\tau w$) and also has to pay for the unemployment insurance expenditures $b$ over the course of the worker's unemployment spell. By increasing PBD, the negative fiscal externality would increase, not only for those who then become employed (Schmieder et al., 2016) but also for those who start a business out of unemployment, as shown earlier, because, in both cases, the PBD is positively linked to actual unemployment duration. The second term takes into account the effect of unemployment insurance on self-employment performance in terms of the government's budget. In the given example, when the profits from self-employed are below pre-unemployment wages ($\pi_s < w$) [as a proxy for the hypothetical re-employment wage], the negative fiscal externality would increase.[28] However, in theory, this term could also decrease the fiscal externality if $\pi_s > w$, which might most likely be the case for *opportunity* entrepreneurs who have good business plans and might be better off than they were with pre-unemployment wages or would be under other re-employment options.[29] The last term expresses the extra cost incurred if the self-employed fails and the individual subsequently (for a period $D_s$) returns to unemployment. In that case, a second-order duration effect consisting of forgone tax revenue and potential benefit payments could further increase the fiscal externality.

In summary, our results have implications for the design of an optimal UI policy because longer PBD may increase the fiscal externality through its effect on self-employment performance. The literature and politics have neglected this effect by omitting the possibility that unemployed individuals can also choose to enter self-employment instead of dependent employment. Too much selection into self-employment due to *necessity* after a long unemployment duration may, however, imply high social costs (i.e., ignoring the option that unemployed individuals become self-employed implies that only the first standard duration term in Equation (10) is taken into account). Thus, the UI system should design optimal PBD in such a way that considers both transitions to dependent employment and self-employment, as well as their outcomes. Moreover, our findings can improve insights into the value of non-employment, which is important for the results of many wage-bargaining models (Jäger et al., 2020).

# 6 Post-hoc Analysis of Mechanisms and Limitations

As rationalized in our theoretical model, the estimated effects of longer PBD on startup motivation and success can be driven by different mechanisms. On the one hand, longer PBD can be expected to change the behavior of unemployed individuals, thereby leading to a different composition of founders who decide to start a firm out of unemployment (*composition effect*). On

[28] Note that this case is plausible even at low income levels. Regular wages are usually bound by minimum wages, whereas the corresponding earnings from self-employment have no lower bound.

[29] In fact, if these positive effects were to dominate, this situation would correspond to the positive UI wage effect, as suggested by Nekoei and Weber (2017), for those who start a business instead of finding re-employment.

the other hand, by incentivizing longer actual unemployment duration, longer PBD could alter the success potential at the individual level. Such *individual-level duration effects* can constrain the growth potential of firms started out of unemployment through, for instance, stigmatization, a loss of professional networks, depreciation of skills and knowledge, or reductions in financial assets during an unemployment spell.

We attempt to explore the potential influence of both mechanisms by analyzing changes in the composition of our sample of previously unemployed founders over time and comparing them to changes in the composition of a reference group of previously *not* unemployed founders. We focus on comparing the two groups across two points in time, namely, before and after the UI reform of 2006 (our main source of exogenous variation in PBD). In Table A.11, we provide before/after reform comparisons of our main explanatory variables and an additional broader indicator of founder quality: the average daily employment wage within five years before starting up (capped at the social security contribution ceiling). We add this measure to assess the potential influence of unobserved factors that we do not control for in our models.

Looking at all unemployed founders in our regression sample in the age-based treatment group (two left panels), we observe few meaningful changes in composition before or after the reform. Consistent with the reform and our estimation results, the average actual unemployment duration of treated founders increases remarkably. Moreover, visibly more founders receive subsidies from the Federal Employment Agency in the period after the reform (we control for these subsidies in our regressions). Notably, the relatively strong increase in the average pre-unemployment wage for founders after the reform is in line with a composition mechanism of "better" founders due to lower PBD. In addition, the fact that we also find smaller effect sizes for the reference group of founders who were not previously unemployed (right panels in Table A.11) points towards the possibility that *composition effects* are induced by the reform. Overall, given the modest observable differences in composition, *composition effects* seem to partially explain our results but are unlikely to be their main driver.

Further checks support this assessment. First, we re-estimate our main OLS and IV models without any control variables (see Tables A.12 and A.13 as well as Tables A.14 and A.15), which allows us to assess whether including covariates, which should substantially reduce the impact of the *composition effects*, affect our point estimates for changes in PBD. When estimated without control variables, all point estimates for changes in PBD or actual unemployment duration remain very similar. Hence, the test does not suggest that substantial reform-induced composition changes in the group of unemployed founders are driving our results. This interpretation is also in line with the reduction in, but not loss of, statistical significance when moving from OLS to IV estimation. Second, our assessment is supported by the sample/reference group summary

statistics in Table 1. Differences in human capital between unemployed founders and the reference group of previously employed founders seem more sizeable than the small differences between all unemployed founders and unemployed founders with unemployment durations above the median. Thus, it seems unlikely that compositional changes over unemployment duration primarily explain our regression results. Third, as a more formal statistical check for the influence of composition effects and as a robustness check of our IV strategy, we re-estimate the baseline models for the relationships between actual and potential benefit duration, motivations, and outcomes using propensity score matching (PSM) (Tables A.16 and A.17). In PSM, we match samples of entrepreneurs below (or equal to) and above the median of actual or potential benefit duration across all explanatory variables in our models and estimate the average treatment effect of having an actual or potential benefit duration above the median.[30] All results remain very similar to the OLS results and appear more pronounced than the IV results. We find this reassuring for our interpretation that compositional changes over unemployment spells are unlikely to be the main drivers of our regression results and content that our IV estimates are reasonably conservative.

In summary, our data indicate the existence of both *composition* and *individual-level duration* effects that are induced by the UI policy reforms. Of the two, our results suggest that reform-induced *individual-level duration effects* could be the main mechanism behind the estimated effects of longer PBD on startup success. Despite detailed empirical analyses and robustness checks, our study is not without limitations. First, future research should investigate the mechanisms leading to our results in more detail and quantify the relative importance of *composition* versus *individual-level duration* effects. Second, while our data allow us to understand self-employment out of unemployment in unprecedented detail, it is beyond the scope of the present paper to directly compare post-unemployment outcomes in self-employment and dependent employment under different UI benefit duration regimes. Future research is needed to develop databases and measures that allow direct comparisons of self-employment and wage employment outcomes, particularly with respect to the treatment of accumulated business value in comparing returns. Third, as with other studies using IV strategies, our IV results are best interpreted as local average treatment effects for the treated (and treatment-compliant) individuals, which limits, for example, the generalizability of the causal estimates to age groups unaffected by the UI policy reforms. However, since estimates from different methods are qualitatively and quantitatively very close, we consider the potential bias to be comparatively small. Finally, another limitation may arise from the fact that founders of non-German nationality appear to be underrepresented

[30] We use PSM with nearest neighbor matching. Again, we find fully consistent results when we add a linear term for the age of the founder at the time of entry into unemployment as a control variable. We also estimated effects using coarsened exact matching (CEM), where we matched exactly on all binary explanatory variables and on bins of continuous explanatory variables, and found very similar results.

in our sample, which is likely because the survey is conducted in German and we only observe founders who are eligible for German UI benefits, which may exclude recent immigrants. We performed robustness checks by reweighting the observations of non-German founders to mimic their German population average during our sample period and found our results to be fully robust. However, the immigrant founders surveyed may not be representative of immigrant founders in Germany, and future research is needed to fully understand the potentially different responses of immigrant founders to UI regulations.

# 7 Concluding Discussion

This paper addresses the question of how potential unemployment insurance (UI) benefit duration (PBD) affects the outcomes of firm founders out of unemployment, via their actual unemployment duration before becoming self-employed and their motivations for starting up. Only a small fraction of startups ultimately succeed in providing stable returns to stakeholders, and active labor market policies, which mainly incentivize the long-term unemployed to become self-employed, are commonly used as policy measures to combat unemployment. Therefore, understanding the effects of the design of UI policies on the success of start-ups seems highly relevant. Yet, the existing literature mostly addresses specific policies when it comes to startups from unemployment and tends to neglect entrepreneurs when analyzing how general UI policies affect the unemployment duration and re-employment outcomes of individuals. We are the first to examine the effect of the PBD in the UI system in the context of transitions to self-employment by creating a comprehensive dataset of founders in Germany.

Using instrumental variables methods, we estimate the effects of PBD on entrepreneurial outcomes by exploiting reform- and age-related exogenous variations in PBD within the German UI system. Our empirical results, based on a sample of previously unemployed founders, suggest a number of conclusions. First, longer PBD increases the actual UI duration for those unemployed individuals who exit unemployment by starting a firm. Thus, our results document that what prior literature has found for individuals transitioning from unemployment to dependent employment (e.g., Schmieder and von Wachter, 2016) also holds for individuals transitioning from unemployment to self-employment. In terms of magnitude, our estimated duration elasticity is about 0.6, which is somewhat higher than what recent estimates focusing on transitions from unemployment to employment suggest.[31]

[31]For the OLS regression, we find a duration elasticity of about 0.5; for the IV strategy, we obtain a duration elasticity of about 0.6 to 0.7. Focusing on transitions from unemployment to paid employment, Le Barbanchon et al. (2019) find a duration elasticity of 0.3 for France, Nekoei and Weber (2017) find a duration elasticity of 0.016 for Austria, and Schmieder et al. (2016) find a duration elasticity of 0.15 for Germany (in the period before 2004). While these studies analyze increases in PBD, in a setting like ours where UI generosity decreases, Doris et al.

Second, longer PBD (via longer actual duration of unemployment) increases the proportion of *pushed* entrepreneurs: More unemployed individuals appear to escape unemployment by becoming self-employed out of self-reported *necessity* rather than *opportunity*-driven motivation. Finally, we find overall consistent, but not always precisely measured, evidence that longer PBD and longer actual unemployment duration reduce the subsequent success of firms started out of unemployment (in terms of sales and employment growth).

The reason for this negative overall relationship may be a mixture of both a *effect on the composition* of startups out of unemployment and a *individual-level duration effect* on the founders over the UI spell. In a stylized formal model, we illustrate how both mechanisms explain why a government policy change in PBD can generate our results. By exploring the contributions of both mechanisms empirically, extensions of our analyses reveal limited changes in the composition of the group of unemployed founders under different UI policy regimes. Thus, our analyses suggest that the effect of UI duration policies on individual-level entrepreneurial potential is the primary driver of our results. A consistent explanation for this finding is that individuals' financial, social, and human capital depreciate during unemployment.

For startup founders and their creditors and investors, our results suggest that the option of escaping unemployment through self-employment is better explored sooner rather than later after entering unemployment—for example, before entrepreneurs' social capital depreciates and their ability to invest in their firm or provide collateral diminishes. For policymakers whose goal of investing in entrepreneurship is to promote innovation-oriented firm creation (Audretsch et al., 2020), our results suggest that the length of potential benefit duration in unemployment may be an important lever to maximize the share of opportunity-driven new firm creation out of unemployment, i.e., those firms with the highest potential for innovation and growth (Caliendo et al., 2023). Our results highlight that entrepreneurs out of unemployment are a diverse group, including individuals with necessity and opportunity motivations (Caliendo and Kritikos, 2019), and show that the time spent in unemployment is crucial for motivation and success. This also suggests that the motivation to start a business is a good predictor of the success of startups created out of unemployment. Thus, improving timely support for previously unemployed founders who are opportunity-driven and have a good business idea may be a good strategy from the public and investor perspective. As a corollary, our results imply that all startup stakeholders should closely monitor UI policy regulations because they affect the composition and prospects of founders seeking financing.

(2018) find larger effects. Moreover, Doris et al. (2018) provide an overview of more than 18 studies that estimate the UI duration elasticity with respect to transitions to paid employment, and report a median duration elasticity of 0.53 (cf. Appendix, Table 2 in Doris et al., 2018). Thus, our estimate of a duration elasticity of 0.6 for those transitioning from unemployment to self-employment seems to be in a reasonable range and somewhat higher than what has been found for those transitioning to paid employment. In addition, our results may suggest that the translation from potential to actual unemployment duration may be stronger for reductions than for increases in the PBD.

Given the current lack of evidence on the role of the general design of the UI system on startup success, our results are also highly relevant from a public policy perspective. For researchers and policy makers, our results highlight the importance of considering self-employment as a post-unemployment outcome in typical optimal UI models (usually based on the sufficient statistics approach, following the Baily–Chetty model (Chetty, 2009; Landais et al., 2018)). Ignoring entrepreneurship out of unemployment is likely to lead to an underestimation of fiscal externalities and thus to a loss of social welfare. For example, a UI policy may induce firm creation by low-performing *necessity* entrepreneurs whose taxable income will be comparatively low or who may generate additional costs to society by returning to unemployment. The results of our paper may also be relevant for the evaluation of active labor market policies, since such policies can be interpreted as measures that usually involve the extension of PBD and the provision of subsidies equivalent to UI benefits. These active labor market policies are often targeted at the long-term unemployed. In light of our results, questions should be raised about the desirability of current policies for the long-term unemployed. Our results suggest that interventions should not be measures of last resort, but should target unemployed individuals early in their unemployment spells. In general, investments in early retraining and well-targeted start-up subsidies for unemployed individuals with viable business ideas could increase the share of founders with a high potential for success. Our results are particularly relevant for all countries with generous UI benefit durations and those that provide extended UI benefits to founders starting from unemployment. Because of its relatively low unemployment and self-employment rates, our results for Germany can be considered lower bound estimates for use by other countries.[32]

[32]For example, Camarero Garcia and Hansch (2020) examine the role of UI benefit levels on self-employment in Spain. They complement the present study by showing that the effects of PBD and UI benefits together constitute the total effect of UI on the transition channel from unemployment to self-employment.

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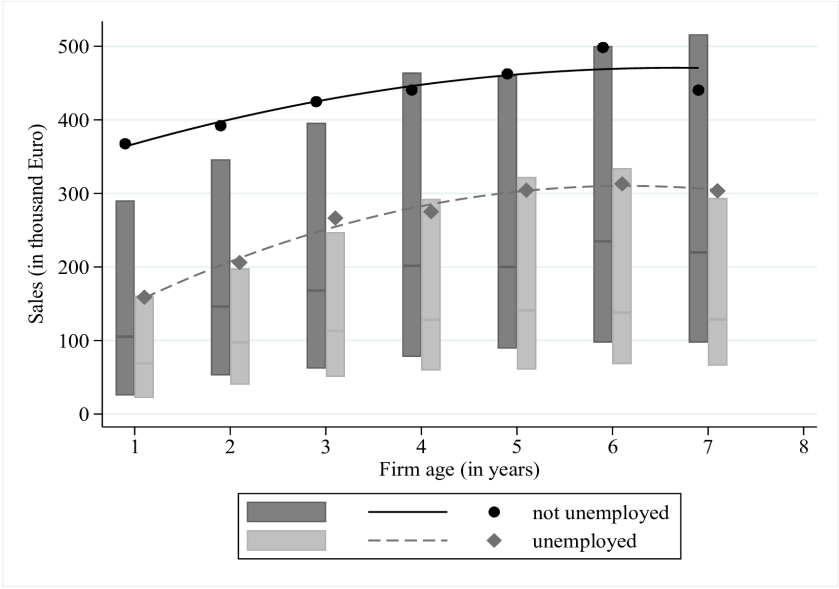
# List of Abbreviations

| | |
|---|---|
| AUD | actual unemployment duration. |
| CEM | coarsened exact matching. |
| FTE | full-time equivalent. |
| IAB | Institute for Employment Research of the German Federal Employment Agency. |
| IV | Instrumental Variable. |
| PBD | potential benefit duration. |
| PSM | propensity score matching. |
| SE | self-employed. |
| UI | unemployment insurance. |
| ZEW | Leibniz Centre for European Economic Research. |

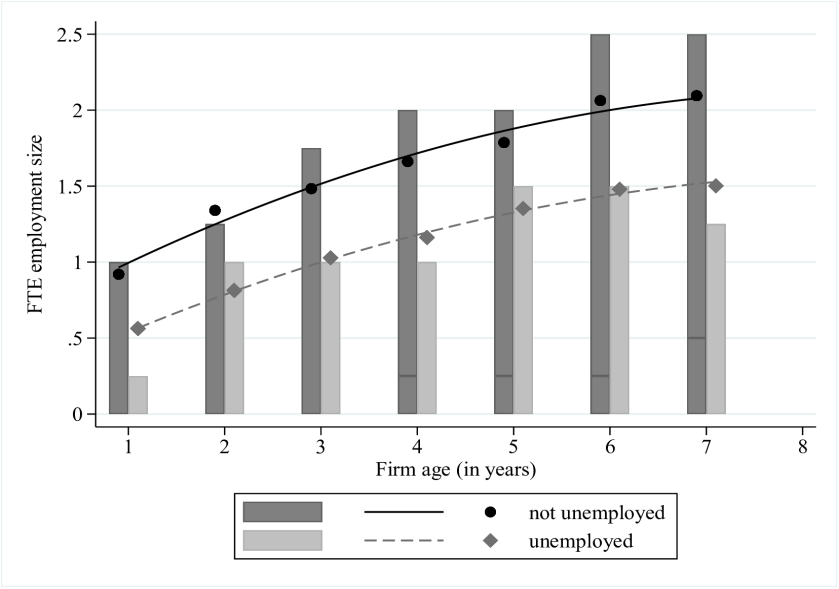
# Figures & Tables

**Figure 1:** Firm Outcomes in Years after Foundation by Previous Employment Status

**(a)** Sales in EUR



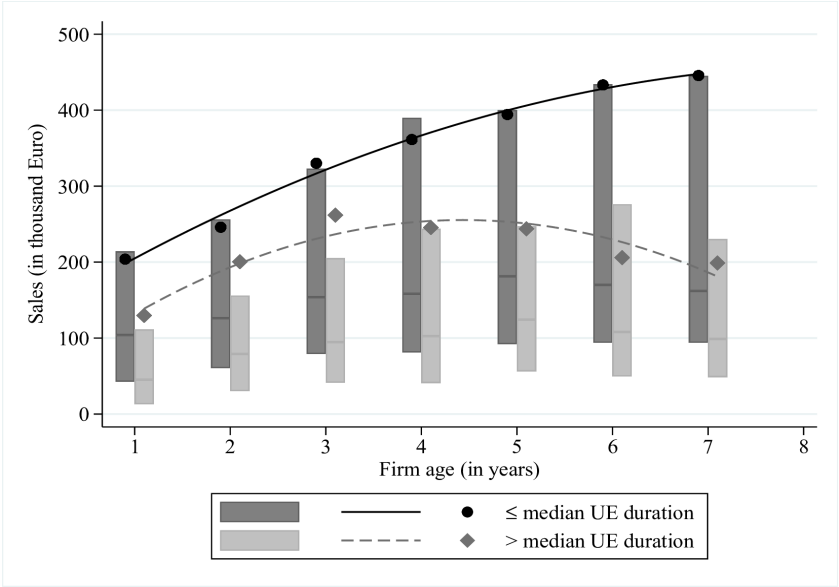

**(b)** Full-Time Equivalent Employment



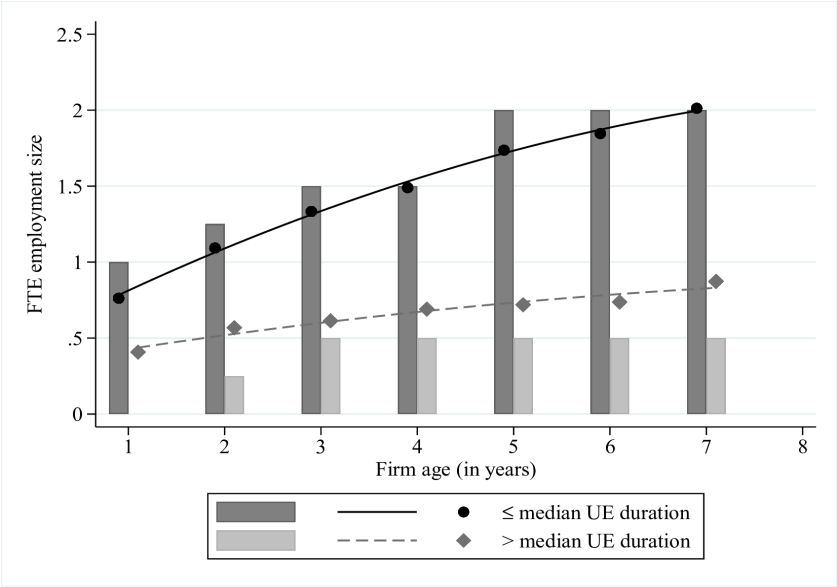

*Notes*: The Figure shows firm outcomes of non-team founders aged 35-65 (see the definition of our main estimation sample in Table 1) in years after foundation, split by the previous labor market status of the founder (not unemployed or unemployed). We cover startups established between 2005 and 2011 from our linked dataset as described in Section 2. Binned for each year of firm age, the black dots show means for firms with previously not unemployed founders; the black lines show their fitted trends using a quadratic fit. The dark grey boxes show corresponding box plots with bars for the 25th, 50th, and 75th percentiles of the distribution. Similarly, the dark grey diamonds show the means for firms with previously unemployed founders; the dashed dark grey lines show their fitted (quadratic) trends. The light grey boxes show the corresponding box plots. The figure shows that firms with previously not unemployed founders have consistently higher sales (top panel) and employment (bottom panel) than firms with previously unemployed founders, both when comparing means and percentiles of the distribution. While this performance gap does not decrease with firm age, the box plots also show significant heterogeneity among previously unemployed founders.

**Figure 2:** Firm Outcomes in Years after Foundation split by Median Unemployment Duration

**(a)** Sales in EUR



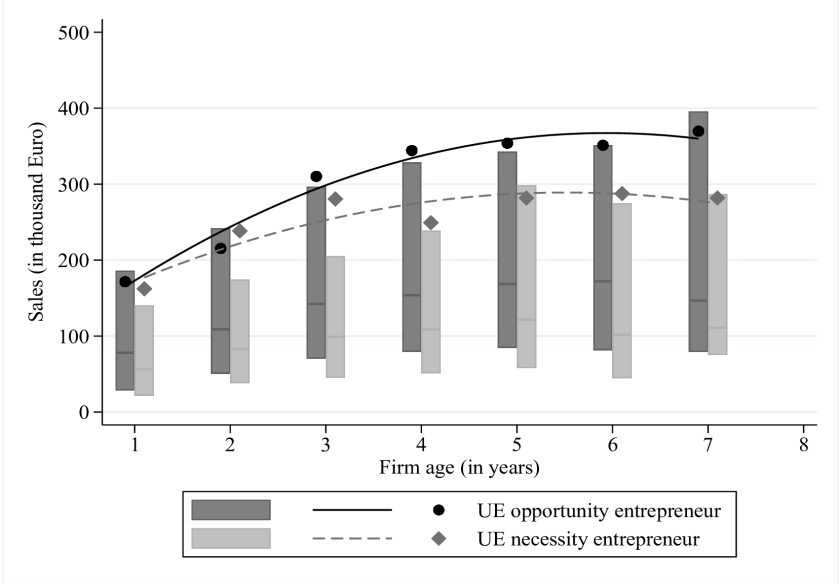

**(b)** Full-Time Equivalent Employment



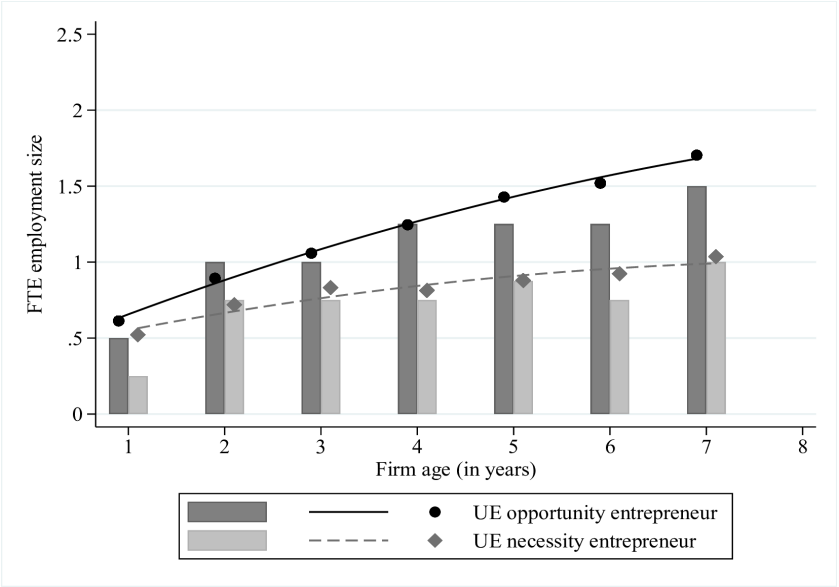

*Notes*: The Figure shows firm outcomes of previously unemployed non-team founders aged 35-65 (see the definition of our main estimation sample in Table 1) in years after foundation, split at the medium (actual) unemployment duration. We cover startups established between 2005 and 2011 from our linked dataset as described in Section 2. Binned for each year of firm age, the black dots show means for firms with previously unemployed founders with below median or median unemployment duration; the black lines show their fitted trends using a quadratic fit. The dark grey boxes show corresponding box plots with bars for the 25th, 50th, and 75th percentiles of the distribution. Similarly, the dark grey diamonds show the means for firms with previously unemployed founders with above the median unemployment duration; the dashed dark grey lines show their fitted (quadratic) trends. The light grey boxes show the corresponding box plots. The figure shows that firms with previously unemployed founders are heterogeneous, and founders with shorter unemployment durations consistently have higher sales (top panel) and employment (bottom panel) than firms with founders with longer unemployment durations when comparing the means and percentiles of the distribution. Firms founded by founders with a shorter duration of unemployment also show stronger growth in both sales and employment and, overall, only small differences compared to founders with no previous unemployment (cf. Figure 1).

**Figure 3:** Firm Outcomes in Years after Foundation by Motivation for Starting Up out of Unemployment

**(a)** Sales in EUR

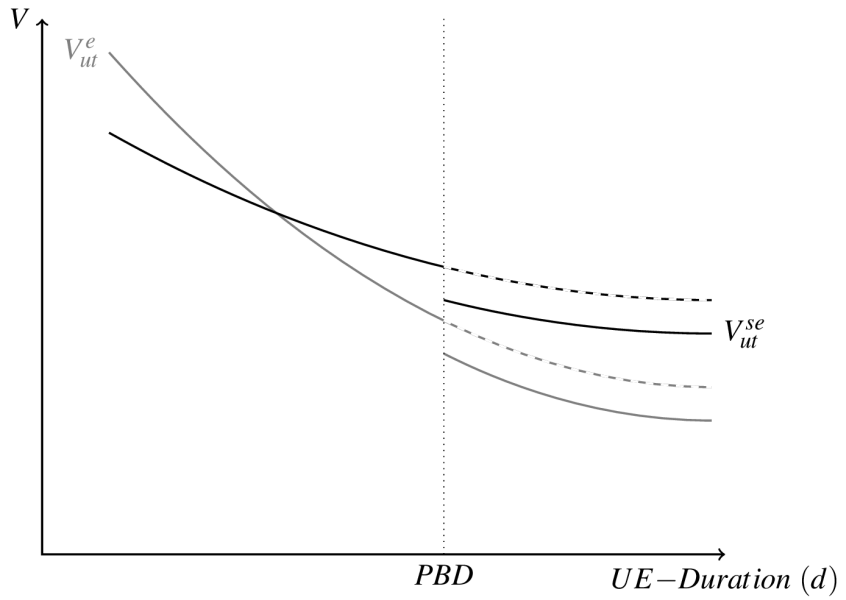



**(b)** Full-Time Equivalent Employment



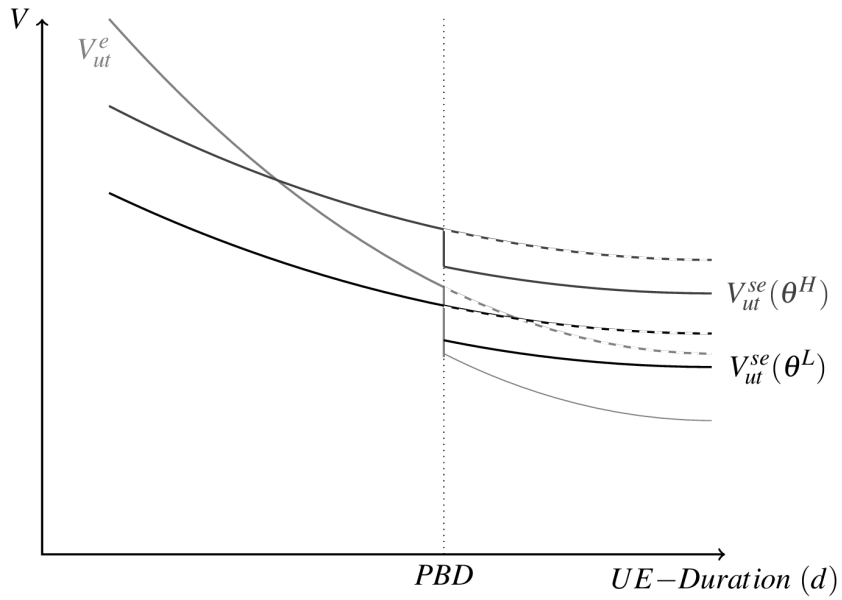

*Notes*: The Figure shows firm outcomes of previously unemployed non-team founders aged 35-65 (see the definition of our main estimation sample in Table 1) in years after foundation, split by self-reported motivation, i.e., *opportunity* vs. *pushed/necessity*-driven entrepreneurship. We cover startups established between 2005 and 2011 from our linked dataset as described in Section 2. Binned for each year of firm age, the black dots show means for firms with previously unemployed founders classified as opportunity-driven; the black lines show their fitted trends using a quadratic fit. The dark grey boxes show corresponding box plots with bars for the 25th, 50th, and 75th percentiles of the distribution. Similarly, the dark grey diamonds show the means for firms with previously unemployed founders classified as necessity-driven; the dashed dark grey lines show their fitted (quadratic) trends. The light grey boxes show the corresponding box plots. The figure shows that firms with previously unemployed founders develop heterogeneously. While both groups start from a similar level, on average, opportunity-driven, previously unemployed founders have higher sales (top panel) and employment (bottom panel) growth than firms with necessity-driven, previously unemployed founders when comparing the means and percentiles of the distribution. Firms founded by opportunity-driven previously unemployed founders thus move closer to founders with no prior unemployment than to necessity-driven previously unemployed founders (cf. Figure 1).

**Figure 4:** Selection into Self-Employment



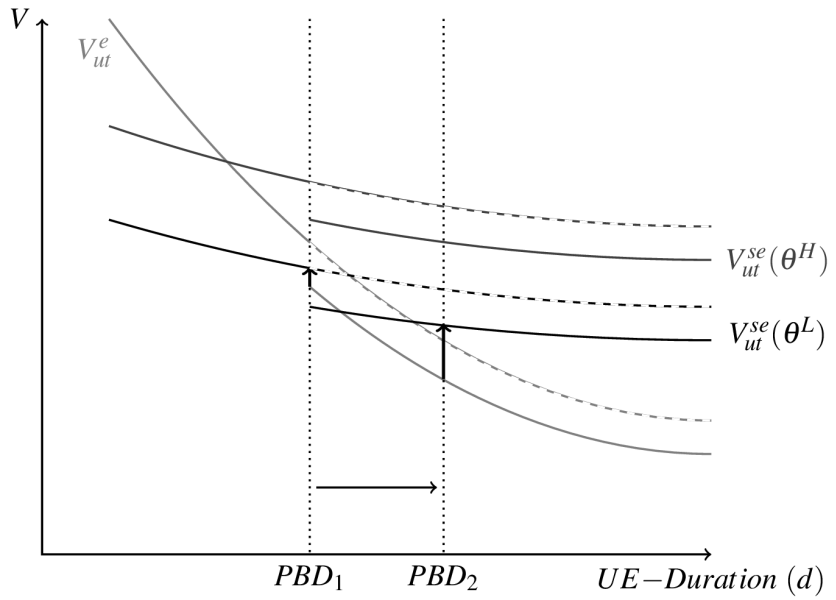

*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with actual unemployment duration (AUD) $d$ according to the stylized model as explained in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration (PBD). At this point of unemployment duration the grey/black line drop by $x = \bar{b} - \tilde{b}$ because UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (compare Equation (6) and Equation (8)). In this example, the unemployed individual would first prefer to search for employment. But once the grey line crosses the black one: from this unemployment duration (d) onward, the unemployed individual would prefer starting a business. Note that these results hold as long as depreciation in entrepreneurial skills is smaller in absolute terms than depreciation in employment skills and thus as long as the black line has a less negative slope than the grey line. If the value of becoming self-employed out of unemployment was independent of unemployment duration $d$, the black line would be a horizontal line, and the associated pure selection channel (composition effect) could also explain our main results, i.e. that longer PBD leads to longer actual unemployment duration and more *pushed* startups.

**Figure 5:** PBD Rules can influence the Composition of Startups out of Unemployment



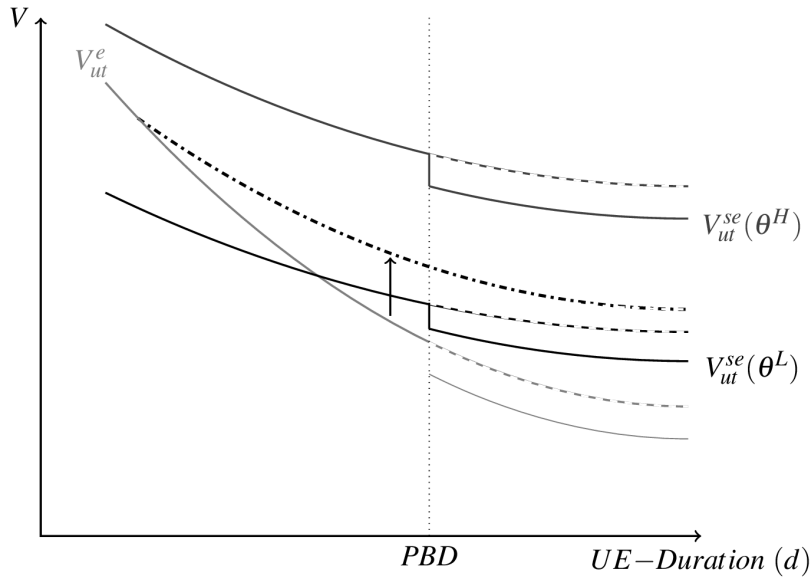

*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration (AUD) $d$ according to the stylized model in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The light black/black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration (PBD): at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6) and Equation (8)). In this example, the unemployed individual with high ability $\theta_H$ would decide to become self-employed after a short UI duration (light black line on top), whereas the other unemployed individual $\theta_L$ would intensify search for employment before reaching PBD (grey line to the left of PBD), when $V^e_{ut}$ suddenly drops below $V^{se}_{ut}$ (black line to the right of PBD). Here, the government could induce type $H$ to become self-employed and $L$ to search for employment or also to become self-employed depending on how big the reduction of the value at PBD is.

**Figure 6:** PBD Rules can influence the Composition of Startups out of Unemployment (Increase in PBD)



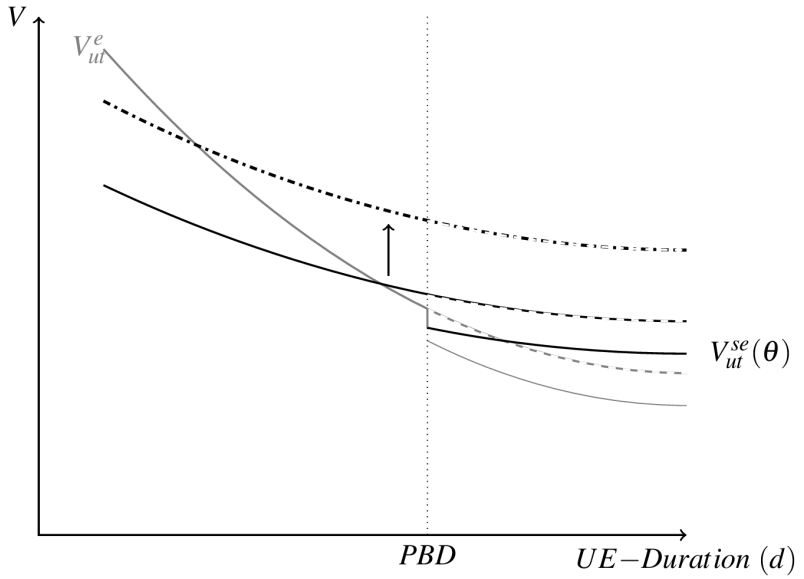

*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration (AUD) $d$ according to the stylized model in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The light black/black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration (PBD): at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6) and Equation (8)). In this example, the government increases PBD (*PBD* moves to the right). $PBD_1$ represents the initial potential benefit duration. $PBD_2$ the extended one. At the initial $PBD_1$, the unemployed individual with high ability ($\theta_H$) would decide to become self-employed after a short UI duration (light black line), whereas the other unemployed individual ($\theta_L$) would rather accept the next job when reaching $PBD_1$ (grey curve is above dark black curve at $PBD_1$). This illustrates, that in theory, increasing the potential benefit duration to $PBD_2$ can change the composition among the unemployed individuals start up. Now, the value for becoming self-employed would be higher for both high individuals with $\theta_H$ (*opportunity* entrepreneurs) and for individuals with $\theta_L$ (*necessity* entrepreneurs) compared to the value for transitioning from unemployment to wage employment (at $PBD_2$ the dark black curve is now above the grey curve). This illustrates how PBD can change the composition of startups created out of unemployment.

**Figure 7:** Early Retraining for Wage-Employment




*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration $d$ according to the stylized model in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The light black/black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration (PBD): at this point of $d$ the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6), Equation (8)). By early retraining, the value function of searching for employment $V^e_{ut}$ could be increased, as the black dashdotted line indicates.

**Figure 8:** Targeted Subsidies for Self-Employment




*Notes*: The figure shows how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration $d$ according to the stylized model in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration (PBD): at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6) and Equation (8)). By providing startup subsidies or special training for future self-employed, the government could increase $V^{se}_{ut}$, as shown by the black dashdotted line.

**Table 1: Summary Statistics**: Regression Sample - for previously Unemployed (above median unemployment duration) or Employed Founders

| | Regression sample of unemployed founders | | | | | Founders with > median AUD | | | | | Previously not unemployed founders | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | N | Mean | SD | Min | Max | N | Mean | SD | Min | Max | N | Mean | SD | Min | Max |
| Actual unemployment duration (AUD) (in months) | 1291 | 4.79 | 4.56 | 0.03 | 36.17 | 641 | 8.02 | 4.52 | 3.12 | 36.17 | 0 | | | | |
| Potential benefit duration (PBD) (in months) | 1291 | 12.32 | 4.25 | 0.59 | 37.42 | 641 | 13.31 | 4.62 | 3.52 | 37.42 | 0 | | | | |
| Tertiary degree (=1) | 1291 | 0.28 | 0.45 | 0 | 1 | 641 | 0.30 | 0.46 | 0 | 1 | 1610 | 0.35 | 0.48 | 0 | 1 |
| Founder was self-employed (SE) before (=1) | 1291 | 0.15 | 0.36 | 0 | 1 | 641 | 0.16 | 0.37 | 0 | 1 | 1610 | 0.23 | 0.42 | 0 | 1 |
| Managerial experience as employee (=1) | 1291 | 0.13 | 0.33 | 0 | 1 | 641 | 0.14 | 0.34 | 0 | 1 | 1610 | 0.15 | 0.36 | 0 | 1 |
| Female founder (=1) | 1291 | 0.15 | 0.35 | 0 | 1 | 641 | 0.15 | 0.35 | 0 | 1 | 1610 | 0.13 | 0.34 | 0 | 1 |
| Founder of non-German origin (=1) | 1291 | 0.06 | 0.23 | 0 | 1 | 641 | 0.07 | 0.25 | 0 | 1 | 1610 | 0.05 | 0.21 | 0 | 1 |
| SE Subsidy by Employment Agency (=1) | 1291 | 0.75 | 0.43 | 0 | 1 | 641 | 0.73 | 0.44 | 0 | 1 | 1610 | 0.38 | 0.49 | 0 | 1 |
| Industry Experience (in years) | 1291 | 17.22 | 9.52 | 1.00 | 50.00 | 641 | 17.00 | 10.33 | 1.00 | 50.00 | 1610 | 16.56 | 9.15 | 1 | 54.00 |
| Age of Founder (in years) | 1291 | 44.44 | 5.93 | 35.09 | 65.11 | 641 | 45.28 | 6.20 | 35.34 | 65.11 | 1610 | 43.93 | 6.01 | 35 | 63.85 |
| Sales in Year 1 | 1039 | 173,661 | 461,647 | 0 | 8,123,565 | 507 | 134,149 | 451,385 | 0 | 8,123,565 | 1309 | 399,872 | 2,467,627 | 0 | 84,370,000 |
| Sales in Year 2 | 851 | 231,293 | 665,161 | 0 | 13,640,000 | 409 | 212,599 | 830,844 | 0 | 13,640,000 | 1067 | 400,055 | 1,121,272 | 0 | 24,180,000 |
| FTE Employment after Year 1 | 1291 | 0.61 | 1.60 | 0 | 16.50 | 641 | 0.39 | 1.26 | 0 | 13.00 | 1610 | 1.02 | 3.28 | 0 | 74.50 |
| FTE Employment after Year 2 | 1272 | 0.85 | 2.08 | 0 | 28.25 | 628 | 0.54 | 1.44 | 0 | 12.50 | 1597 | 1.45 | 4.26 | 0 | 95.75 |
| Pushed/Necessity motive (=1) | 1256 | 0.35 | 0.48 | 0 | 1 | 631 | 0.39 | 0.49 | 0 | 1 | 1531 | 0.21 | 0.41 | 0 | 1 |
| Technology-intensive services | 1291 | 0.19 | 0.39 | 0 | 1 | 641 | 0.20 | 0.40 | 0 | 1 | 1610 | 0.23 | 0.42 | 0 | 1 |
| High-technology manufacturing | 1291 | 0.09 | 0.28 | 0 | 1 | 641 | 0.08 | 0.28 | 0 | 1 | 1610 | 0.12 | 0.33 | 0 | 1 |
| Skill-intensive services | 1291 | 0.05 | 0.21 | 0 | 1 | 641 | 0.05 | 0.22 | 0 | 1 | 1610 | 0.08 | 0.27 | 0 | 1 |
| Software supply and consultancy | 1291 | 0.03 | 0.18 | 0 | 1 | 641 | 0.03 | 0.18 | 0 | 1 | 1610 | 0.06 | 0.23 | 0 | 1 |
| Non-high-tech manufacturing | 1291 | 0.12 | 0.33 | 0 | 1 | 641 | 0.11 | 0.31 | 0 | 1 | 1610 | 0.12 | 0.33 | 0 | 1 |
| Other business-oriented services | 1291 | 0.07 | 0.25 | 0 | 1 | 641 | 0.07 | 0.25 | 0 | 1 | 1610 | 0.05 | 0.22 | 0 | 1 |
| Cons.-or. services in creative sect. | 1291 | 0.02 | 0.15 | 0 | 1 | 641 | 0.02 | 0.15 | 0 | 1 | 1610 | 0.03 | 0.16 | 0 | 1 |
| Consumer-oriented services | 1291 | 0.10 | 0.30 | 0 | 1 | 641 | 0.10 | 0.30 | 0 | 1 | 1610 | 0.07 | 0.25 | 0 | 1 |
| Construction | 1291 | 0.16 | 0.36 | 0 | 1 | 641 | 0.15 | 0.35 | 0 | 1 | 1610 | 0.11 | 0.31 | 0 | 1 |
| Retail & wholesale | 1291 | 0.18 | 0.38 | 0 | 1 | 641 | 0.19 | 0.39 | 0 | 1 | 1610 | 0.14 | 0.35 | 0 | 1 |

*Notes:* This table shows summary statistics for non-team founders that have started their business out of unemployment (first panel). In the second panel, our table shows the same statistics for the sub-sample of these non-team founders that had equal or greater than median actual unemployment duration (AUD) before starting up. The table only includes those individuals that have maximum potential benefit duration (PBD) at the beginning of the unemployment spell, since the empirical strategies require that our main regression sample consists of non-team founders that have achieved these criteria. Note that out of the around 4,000 non-team founders having unemployment experience before starting up in our data, approximately 1,300 satisfy the criteria to be included in our main regression sample: they became unemployed between 2003 and 2011, were between 35 and 65 years old when becoming unemployed, are eligible to maximum potential benefit duration, and have information on all included control variables available. Finally, the right-hand panel of this table shows the same summary statistics for a reference group of founders who have started their business out of employment, i.e. they have not been previously unemployed.

**Table 2: OLS Results**: **Actual Unemployment Duration (AUD)** on Motivation of Founder and Firm Outcomes

| | (1) Necessity Motive (=1) | (2) Sales Year 1 (log) | (3) Sales Year 2 (log) | (4) FTE Employment Year 1 (log) | (5) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | **0.017***** | **-0.139***** | **-0.096***** | **-0.016***** | **-0.023***** |
| | (0.003) | (0.027) | (0.018) | (0.003) | (0.003) |
| Tertiary degree (=1) | -0.050 | -0.663** | -0.029 | 0.076** | 0.074* |
| | (0.032) | (0.283) | (0.168) | (0.034) | (0.039) |
| Founder was self-employed before (=1) | -0.009 | 0.031 | -0.125 | -0.006 | -0.018 |
| | (0.037) | (0.336) | (0.211) | (0.040) | (0.045) |
| Managerial experience as employee (=1) | -0.059 | 0.169 | 0.618*** | 0.135*** | 0.173*** |
| | (0.038) | (0.350) | (0.164) | (0.049) | (0.056) |
| Industry experience (in years) | 0.003* | 0.034** | 0.003 | 0.001 | 0.001 |
| | (0.001) | (0.014) | (0.009) | (0.001) | (0.002) |
| Female founder (=1) | 0.013 | -0.993** | -0.361* | 0.069 | 0.104** |
| | (0.039) | (0.404) | (0.210) | (0.046) | (0.052) |
| Founder of non-German origin (=1) | 0.033 | -1.758*** | -0.509 | -0.015 | -0.048 |
| | (0.060) | (0.673) | (0.418) | (0.055) | (0.054) |
| SE Subsidy by Federal Employment Agency (=1) | 0.073** | -0.413 | -0.289* | -0.056* | -0.086** |
| | (0.032) | (0.280) | (0.168) | (0.033) | (0.037) |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| N | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.063 | 0.122 | 0.126 | 0.150 | 0.158 |
| Mean of dependent variable | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value for log-terms) | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the OLS regression of our main outcome variables (motivation for starting up; sales and employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up. We control for the founders' education, their previous work experience, and individual characteristics. Moreover, we include year and industry (of the startup, see Table A.2)fixed effects. We also include dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW bank (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, who were 35 to 65 years old when becoming unemployed, and for whom information on all included control variables is available.

**Table 3: OLS Results**: **Actual Unemployment Duration (AUD)** on Motivation of Founder and Firm Outcomes **focusing on Non-Manufacturing Sector**

| | (1) Necessity Motive (=1) | (2) Sales Year 1 (log) | (3) Sales Year 2 (log) | (4) FTE Employment Year 1 (log) | (5) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | **0.018**$^{***}$ | **-0.128**$^{***}$ | **-0.102**$^{***}$ | **-0.016**$^{***}$ | **-0.024**$^{***}$ |
| | (0.003) | (0.029) | (0.021) | (0.003) | (0.003) |
| Tertiary degree (=1) | -0.069$^{*}$ | -0.392 | 0.143 | 0.059$^{*}$ | 0.057 |
| | (0.036) | (0.290) | (0.168) | (0.035) | (0.041) |
| Founder was self-employed before (=1) | 0.009 | 0.119 | -0.262 | 0.015 | 0.031 |
| | (0.042) | (0.343) | (0.230) | (0.045) | (0.051) |
| Managerial experience as employee (=1) | -0.096$^{**}$ | 0.022 | 0.457$^{**}$ | 0.130$^{**}$ | 0.178$^{***}$ |
| | (0.042) | (0.381) | (0.184) | (0.053) | (0.060) |
| Industry experience (in years) | 0.002 | 0.021 | 0.001 | 0.002 | 0.002 |
| | (0.002) | (0.015) | (0.011) | (0.002) | (0.002) |
| Female founder (=1) | 0.006 | -0.693$^{*}$ | -0.512$^{**}$ | 0.077 | 0.096$^{*}$ |
| | (0.043) | (0.413) | (0.232) | (0.051) | (0.056) |
| Founder of non-German origin (=1) | -0.047 | -1.820$^{**}$ | -0.843$^{*}$ | -0.076 | -0.080$^{*}$ |
| | (0.064) | (0.724) | (0.496) | (0.047) | (0.047) |
| SE Subsidy by Federal Employment Agency (=1) | 0.070$^{*}$ | -0.629$^{**}$ | -0.277 | -0.054 | -0.069$^{*}$ |
| | (0.036) | (0.309) | (0.202) | (0.035) | (0.040) |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes |
| N | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.076 | 0.103 | 0.145 | 0.167 | 0.168 |
| Mean of dependent variable | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | 179,344 | 237,112 | 0.549 | 0.76 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the OLS regression of our main outcome variables (motivation for starting up; sales and employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up in the non-manufacturing sector (75% of our sample). We control for the founders' education, their previous work experience, and individual characteristics. Moreover, we include year and industry (of the startup, see Table A.2) fixed effects. We also include dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW bank (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, who were 35 to 65 years old when becoming unemployed, and for whom information on all included control variables is available.

**Table 4: OLS Results**: **Potential Benefit Duration (PBD)** on Actual Unemployment Duration (AUD), Motivation of Founder, and Firm Outcomes

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | **0.471**$^{***}$ | **0.023**$^{***}$ | **-0.036** | **-0.049**$^{**}$ | **-0.004** | **-0.009**$^{**}$ |
| | (0.048) | (0.003) | (0.024) | (0.022) | (0.004) | (0.004) |
| Tertiary degree (=1) | -0.386 | -0.073$^{**}$ | -0.636$^{**}$ | 0.027 | 0.079$^{**}$ | 0.081$^{**}$ |
| | (0.291) | (0.032) | (0.289) | (0.173) | (0.034) | (0.040) |
| Founder was self-employed before (=1) | 0.116 | -0.014 | -0.001 | -0.095 | -0.009 | -0.019 |
| | (0.338) | (0.037) | (0.341) | (0.213) | (0.040) | (0.045) |
| Managerial experience as employee (=1) | -0.004 | -0.069$^{*}$ | 0.160 | 0.609$^{***}$ | 0.134$^{***}$ | 0.173$^{***}$ |
| | (0.346) | (0.038) | (0.356) | (0.168) | (0.050) | (0.057) |
| Industry experience (in years) | -0.013 | 0.001 | 0.036$^{**}$ | 0.007 | 0.001 | 0.002 |
| | (0.015) | (0.001) | (0.014) | (0.009) | (0.002) | (0.002) |
| Female founder (=1) | 0.176 | 0.013 | -1.075$^{***}$ | -0.369$^{*}$ | 0.065 | 0.100$^{*}$ |
| | (0.326) | (0.039) | (0.405) | (0.221) | (0.047) | (0.053) |
| Founder of non-German origin (=1) | 0.299 | 0.034 | -1.853$^{***}$ | -0.553 | -0.021 | -0.056 |
| | (0.500) | (0.059) | (0.674) | (0.446) | (0.056) | (0.057) |
| SE Subsidy by Federal Employment Agency (=1) | -0.301 | 0.061$^{*}$ | -0.401 | -0.277 | -0.053 | -0.080$^{**}$ |
| | (0.292) | (0.031) | (0.281) | (0.171) | (0.034) | (0.038) |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1291 | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.256 | 0.077 | 0.099 | 0.096 | 0.133 | 0.134 |
| Mean of dependent variable | 4.785 | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value for log-terms) | | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the OLS regression of our main outcome variables (actual unemployment duration (AUD), motivation for starting up; sales and employment growth after year 1, 2) on the founders' potential benefit duration (PBD) before starting up. We control for the founders' education, their previous work experience, and individual characteristics. Moreover, we include year and industry (of the startup, see Table A.2) fixed effects. We also include dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW bank (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, who were 35 to 65 years old when becoming unemployed, and for whom information on all included control variables is available.

**Table 5: OLS Results**: **Potential Benefit Duration** on Actual Unemployment Duration, Motivation of Founder, and Firm Outcomes **for Non-Manufacturing Sector**

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | **0.484***** | **0.022***** | **-0.067***** | **-0.070***** | **-0.010***** | **-0.015***** |
| | (0.053) | (0.004) | (0.026) | (0.026) | (0.003) | (0.004) |
| Tertiary degree (=1) | -0.462 | -0.092*** | -0.324 | 0.225 | 0.069* | 0.072* |
| | (0.335) | (0.036) | (0.295) | (0.168) | (0.036) | (0.041) |
| Founder was self-employed before (=1) | 0.443 | 0.015 | 0.065 | -0.250 | 0.008 | 0.023 |
| | (0.369) | (0.042) | (0.351) | (0.235) | (0.046) | (0.052) |
| Managerial experience as employee (=1) | 0.052 | -0.098** | 0.005 | 0.430** | 0.130** | 0.178*** |
| | (0.387) | (0.043) | (0.383) | (0.188) | (0.053) | (0.061) |
| Industry experience (in years) | 0.001 | 0.001 | 0.022 | 0.005 | 0.002 | 0.003 |
| | (0.016) | (0.002) | (0.015) | (0.011) | (0.002) | (0.002) |
| Female founder (=1) | 0.329 | 0.007 | -0.787* | -0.539** | 0.072 | 0.090 |
| | (0.370) | (0.043) | (0.415) | (0.244) | (0.052) | (0.057) |
| Founder of non-German origin (=1) | 0.303 | -0.040 | -1.882*** | -0.876 | -0.081* | -0.088* |
| | (0.546) | (0.065) | (0.723) | (0.533) | (0.047) | (0.049) |
| SE Subsidy by Federal Employment Agency (=1) | -0.287 | 0.062* | -0.597* | -0.252 | -0.049 | -0.060 |
| | (0.342) | (0.036) | (0.310) | (0.202) | (0.036) | (0.041) |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| N | 1022 | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.266 | 0.082 | 0.085 | 0.116 | 0.153 | 0.145 |
| Mean of dependent variable | 4.895 | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | | 179,344 | 237,112 | 0.549 | 0.76 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the OLS regression of our main outcome variables (actual unemployment duration (AUD), motivation for starting up; sales and employment growth after year 1, 2) on the founders' potential benefit duration (PBD) before starting up in the non-manufacturing sector (75% of our sample). We control for the founders' education, their previous work experience, and individual characteristics. Moreover, we include year and industry (of the startup, see Table A.2) fixed effects. We also include dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW bank (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, who were 35 to 65 years old when becoming unemployed, and for whom information on all included control variables is available.

**Table 6: IV Results** for Reform 2006: **Potential Benefit Duration (PBD)** on Actual Unemployment Duration (AUD), Motivation of Founder, and Firm Outcomes

| | (1) PBD (in months) | (2) AUD (in months) | (3) Necessity Motive (=1) | (4) Sales Year 1 (log) | (5) Sales Year 2 (log) | (6) FTE Employment Year 1 (log) | (7) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | | **0.661**$^{***}$ | **0.015**$^{**}$ | **0.034** | **-0.072**$^{*}$ | **0.003** | **-0.006** |
| | | (0.094) | (0.007) | (0.052) | (0.039) | (0.007) | (0.008) |
| Tertiary degree (=1) | 0.313 | -0.513$^{*}$ | -0.075$^{**}$ | -0.689$^{**}$ | 0.048 | 0.071$^{**}$ | 0.078$^{**}$ |
| | (0.221) | (0.289) | (0.032) | (0.289) | (0.169) | (0.034) | (0.039) |
| Founder was self-employed before (=1) | -0.025 | 0.121 | -0.022 | -0.014 | -0.093 | -0.012 | -0.020 |
| | (0.278) | (0.345) | (0.037) | (0.339) | (0.210) | (0.039) | (0.045) |
| Managerial experience as employee (=1) | 0.301 | -0.023 | -0.077$^{**}$ | 0.144 | 0.613$^{***}$ | 0.130$^{***}$ | 0.171$^{***}$ |
| | (0.305) | (0.348) | (0.038) | (0.353) | (0.165) | (0.050) | (0.057) |
| Industry experience (in years) | 0.014 | -0.017 | 0.001 | 0.033$^{**}$ | 0.009 | 0.001 | 0.001 |
| | (0.011) | (0.014) | (0.001) | (0.015) | (0.010) | (0.002) | (0.002) |
| Female founder (=1) | 0.002 | 0.198 | 0.004 | -1.088$^{***}$ | -0.366$^{*}$ | 0.063 | 0.099$^{*}$ |
| | (0.274) | (0.325) | (0.038) | (0.402) | (0.216) | (0.046) | (0.052) |
| Founder of non-German origin (=1) | 0.021 | 0.207 | 0.042 | -1.897$^{***}$ | -0.530 | -0.023 | -0.057 |
| | (0.372) | (0.505) | (0.058) | (0.666) | (0.427) | (0.055) | (0.056) |
| SE Subsidy by Federal Employment Agency (=1) | 0.398$^{*}$ | -0.406 | 0.067$^{**}$ | -0.437 | -0.269 | -0.056$^{*}$ | -0.081$^{**}$ |
| | (0.214) | (0.294) | (0.031) | (0.279) | (0.167) | (0.033) | (0.038) |
| **IV_06** | **-8.743**$^{***}$ | | | | | | |
| | (0.505) | | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 299.421 | 286.66 | 223.603 | 220.761 | 299.421 | 296.11 |
| N | 1291 | 1291 | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.470 | 0.234 | 0.083 | 0.094 | 0.094 | 0.130 | 0.134 |
| Mean of dependent variable | 12.324 | 4.785 | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value for log-terms) | | | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (AUD, motivation for starting up; sales/employment growth after year 1, 2) on the founders' PBD before starting up that is instrumented by *IV06* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table 7: IV Results** for Reform 2006: **PBD** on Actual Unemployment Duration, Motivation of Founder, Firm Outcomes **for Non-Manufacturing Sector**

| | (1) PBD (in months) | (2) AUD (in months) | (3) Necessity Motive (=1) | (4) Sales Year 1 (log) | (5) Sales Year 2 (log) | (6) FTE Employment Year 1 (log) | (7) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | | **0.722**$^{***}$ | **0.010** | **0.004** | **-0.115**$^{**}$ | **-0.008** | **-0.018**$^{**}$ |
| | | (0.109) | (0.008) | (0.056) | (0.051) | (0.006) | (0.008) |
| Tertiary degree (=1) | 0.434$^{*}$ | -0.641$^{*}$ | -0.089$^{**}$ | -0.390 | 0.269 | 0.064$^{*}$ | 0.071$^{*}$ |
| | (0.248) | (0.331) | (0.036) | (0.296) | (0.167) | (0.036) | (0.041) |
| Founder was self-employed before (=1) | -0.296 | 0.517 | 0.006 | 0.078 | -0.270 | 0.005 | 0.019 |
| | (0.312) | (0.385) | (0.042) | (0.350) | (0.234) | (0.044) | (0.051) |
| Managerial experience as employee (=1) | 0.137 | 0.068 | -0.105$^{**}$ | -0.000 | 0.423$^{**}$ | 0.127$^{**}$ | 0.176$^{***}$ |
| | (0.350) | (0.387) | (0.042) | (0.377) | (0.186) | (0.053) | (0.060) |
| Industry experience (in years) | 0.011 | -0.006 | 0.001 | 0.019 | 0.008 | 0.002 | 0.002 |
| | (0.013) | (0.016) | (0.002) | (0.016) | (0.012) | (0.002) | (0.002) |
| Female founder (=1) | 0.086 | 0.312 | 0.001 | -0.818$^{**}$ | -0.533$^{**}$ | 0.069 | 0.088 |
| | (0.313) | (0.368) | (0.042) | (0.412) | (0.238) | (0.051) | (0.056) |
| Founder of non-German origin (=1) | -0.101 | 0.252 | -0.032 | -1.922$^{***}$ | -0.828 | -0.079$^{*}$ | -0.085$^{*}$ |
| | (0.395) | (0.554) | (0.063) | (0.708) | (0.508) | (0.046) | (0.048) |
| SE Subsidy by Federal Employment Agency (=1) | 0.333 | -0.389 | 0.071$^{**}$ | -0.633$^{**}$ | -0.236 | -0.049 | -0.058 |
| | (0.234) | (0.341) | (0.036) | (0.307) | (0.198) | (0.035) | (0.040) |
| **IV_06** | **-8.401**$^{***}$ | | | | | | |
| | (0.569) | | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 217.975 | 209.815 | 155.049 | 153.108 | 217.975 | 216.04 |
| N | 1022 | 1022 | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.477 | 0.232 | 0.083 | 0.079 | 0.110 | 0.153 | 0.145 |
| Mean of dependent variable | 12.327 | 4.895 | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | | | 179,344 | 237,112 | 0.549 | 0.76 |

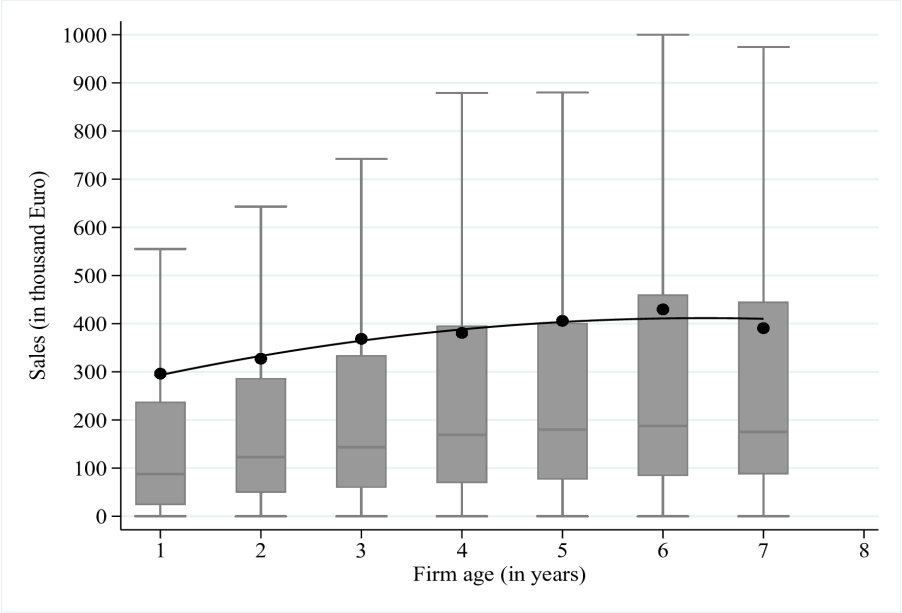
*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (AUD, motivation for starting up; sales/employment growth after year 1, 2) on the founders' PBD before starting up in the non-manufacturing sector (75% of the sample) that is instrumented by *IV06* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

# – Internet Appendices –

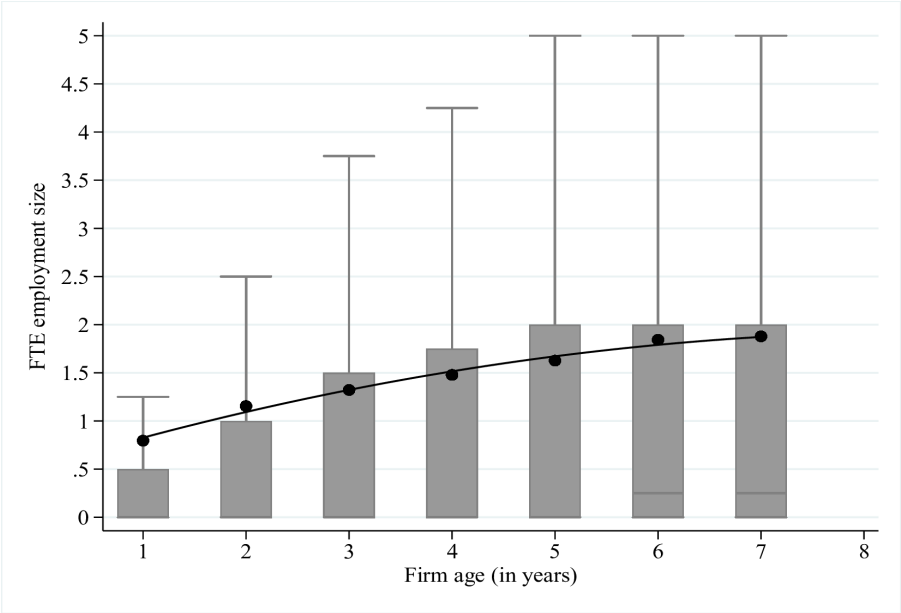
# A Appendix: Tables & Figures

**Figure A.1:** Firm Outcomes in Years after Foundation for All Founders

**(a)** Sales in EUR

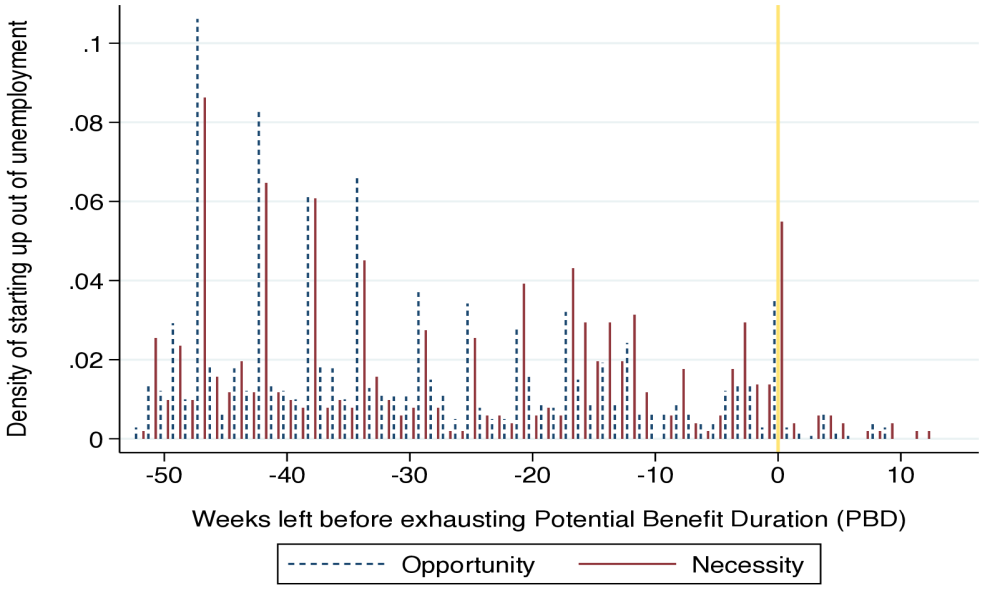



**(b)** Full-Time Equivalent Employment




*Notes*: The Figure shows pooled firm outcomes of previously unemployed and not unemployed non-team founders aged 35-65 (analogous to the definition of our main estimation sample) in years after foundation. We see the outcomes of startups in terms of sales per year (upper panel) and full-time equivalent employment (lower panel) based on 5,250 (sales) and 5,850 (employment) startups established between 2005 and 2011 from our linked dataset (see Section 2). Firms usually stay in the panel for seven years but can drop out if they fail or refuse to take part in more than two consecutive years. Thus, less firms are observed in year seven compared to year one after starting up. Binned for each year of firm age, the black dots show means and the black lines show fitted trends using a quadratic fit. The grey boxes show corresponding box plots with bars for the 25th, 50th, and 75th percentiles of the distribution; the whiskers display 1.5 times the interquartile range.

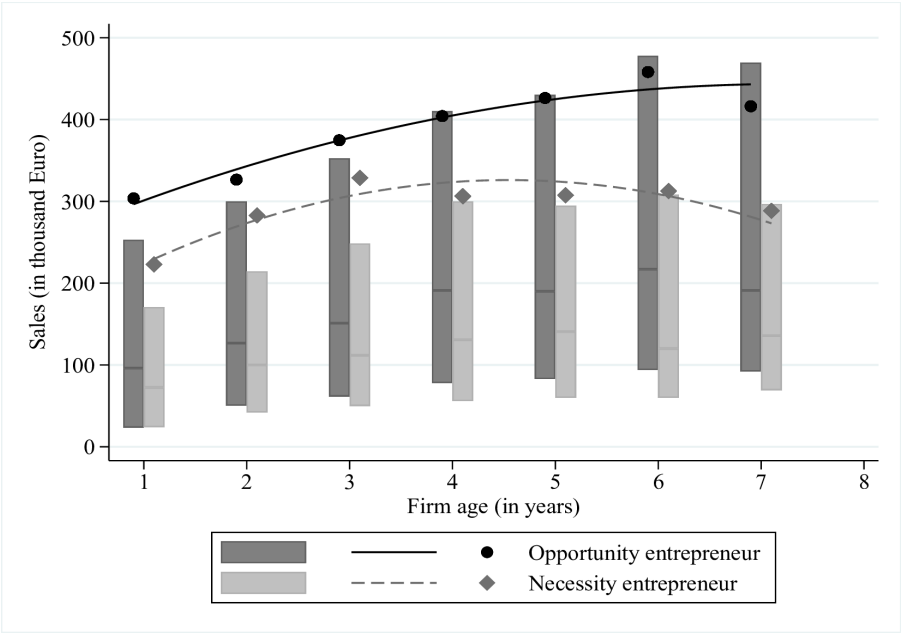
**Figure A.2: Spikes at exhausting Potential Benefit Duration:** Necessity/Pushed Founders



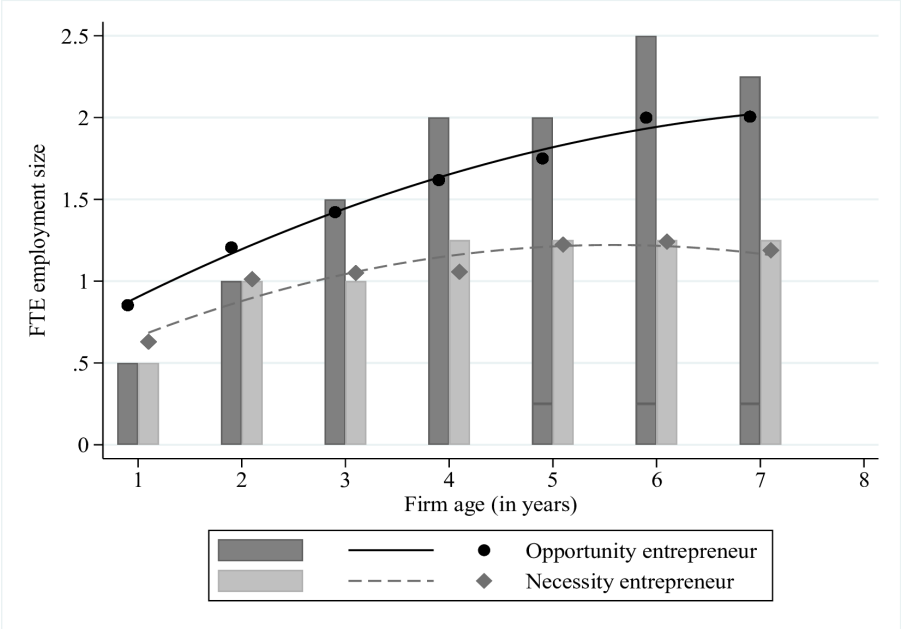

*Notes:* This Figure shows the difference between actual and potential unemployment duration, i.e. when the unemployed individual starts a firm given his/her remaining PBD. The Figure shows that when UI benefits run out (remaining PBD is close to 0) the spike in the exit rate from unemployment to self-employment is significantly higher for those indicating to start a firm due to *necessity* motives (red lines) compared to those indicating an *opportunity* motive (blue dashed spikes). Thus, it is plausible to use the term *pushed* for *necessity*-driven founders (cf. Section 2). For a review of the literature on UI spikes, see also Card et al. (2007).

**Figure A.3:** Firm Outcomes in Years after Foundation split by Motivation for Starting Up

**(a)** Sales in EUR

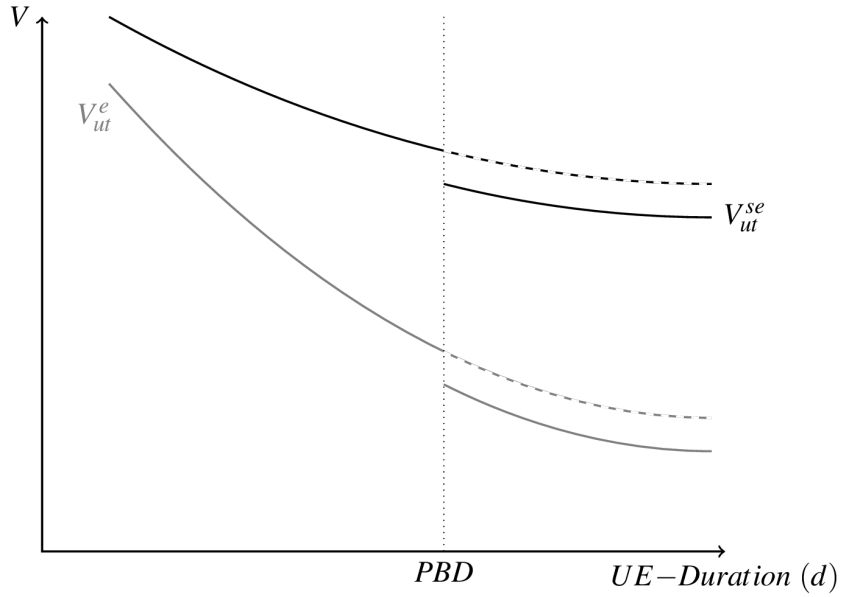



**(b)** Full-Time Equivalent Employment



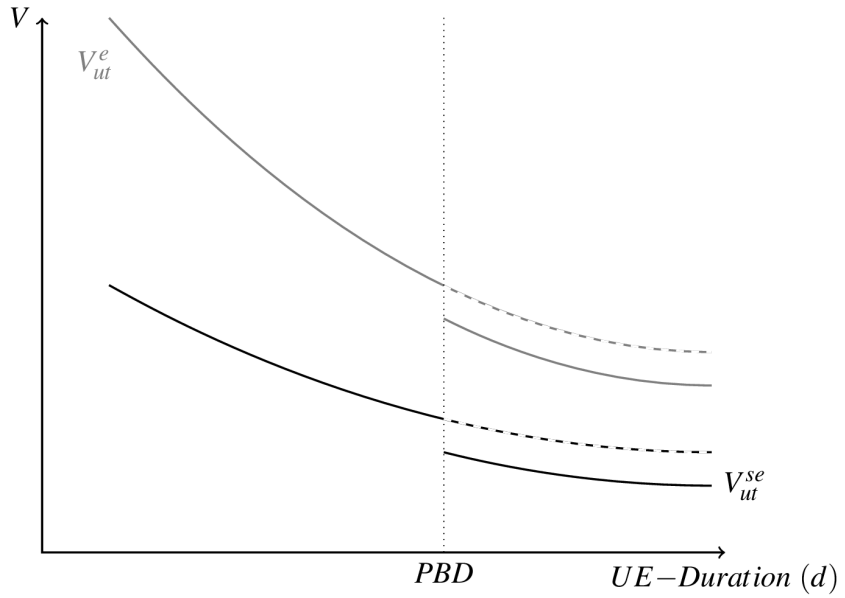

*Notes*: The Figure shows pooled firm outcomes of previously unemployed and not unemployed non-team founders aged 35-65 (analogous to the definition of our main estimation sample) in years after foundation split by self-reported motivation, i.e. *opportunity* vs. *pushed/necessity* driven entrepreneurship. We cover approximately 5,050 (sales) and 5,600 (employment) startups established between 2005 and 2011 from our linked dataset as described in Section 2. The notion of using, instead of *necessity*-driven founder, the term *pushed* entrepreneur is best understood by checking the spikes of the exit rate from unemployment into self-employment split by the motivation to start up which is shown in Figure A.2. Binned for each year of firm age, the black dots show means for firms with founders classified as opportunity-driven; the black lines show their fitted trends using a quadratic fit. The dark grey boxes show corresponding box plots with bars for the 25th, 50th, and 75th percentiles of the distribution. Similarly, the dark grey diamonds show the means for firms with founders classified as necessity-driven; the dashed dark grey lines show their fitted (quadratic) trends. The light grey boxes show the corresponding box plots. On average, opportunity-driven founders have higher sales (top panel) and employment (bottom panel) growth than firms with necessity-driven founders when comparing the means and percentiles of the distribution.

**Figure A.4:** Selection into Self-Employment: High Entrepreneurial Ability



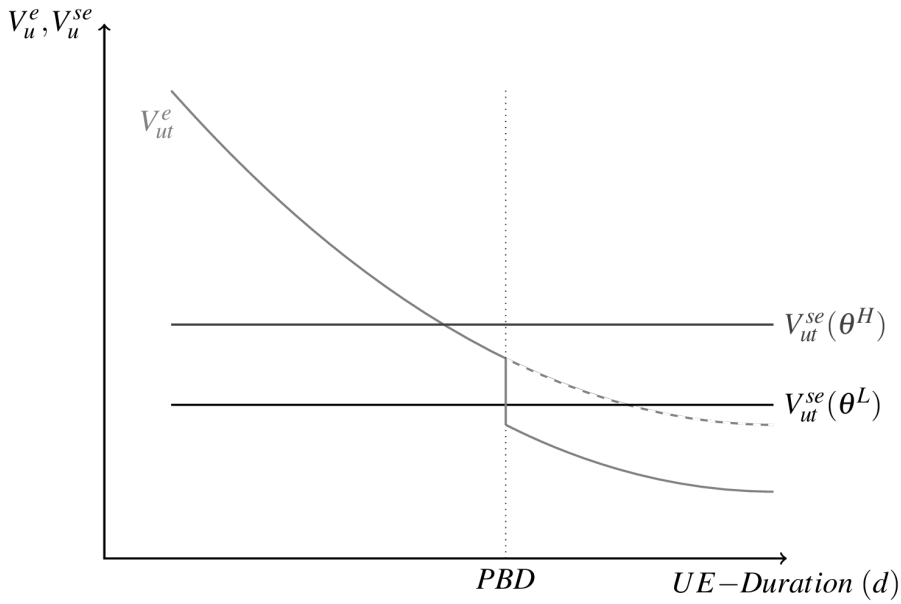

*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration (AUD) $d$ according to the stylized model as explained in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration: at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6) and Equation (8)). The unemployed individual learns to have such high (entrepreneurial) ability that she starts a business.

**Figure A.5:** Selection into Employment: Low Entrepreneurial Ability




*Notes*: The figure illustrates how the value functions for becoming employed $V^e_{ut}$ and self-employed $V^{se}_{ut}$ evolve with unemployment duration (AUD) $d$ according to the stylized model as explained in Section 5. The grey line depicts $\frac{\partial V^e_{ut}}{\partial d}|\theta < 0$. The black line depicts $\frac{\partial V^{se}_{ut}}{\partial d}|\theta$ for which it holds that: $0 > \frac{\partial V^{se}_{ut}}{\partial d}|\theta > \frac{\partial V^e_{ut}}{\partial d}|\theta$. The vertical dotted black line marks the potential benefit duration: at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ (Equation (6) and Equation (8)). The unemployed individual learns to have such low (entrepreneurial) ability that she prefers employment.

**Figure A.6:** If there was No Negative UI Duration Dependence concerning potential SE Outcomes




*Notes*: The figure illustrates how the value functions for becoming employed $V_{ut}^e$ and self-employed $V_{ut}^{se}$ evolve with unemployment duration $d$ according to the stylized model as explained in Section 5. The grey line depicts $\frac{\partial V_{ut}^e}{\partial d}|\theta < 0$. The black line depicts $\frac{\partial V_{ut}^{se}}{\partial d}|\theta = 0$ for both $H$ and $L$ type. The vertical dotted dashdotted black line marks PBD: at this point of unemployment duration the grey/black line drops by $x = \bar{b} - \tilde{b}$, as UI benefits $\bar{b}$ drop to the existential minimum $\tilde{b}$ ( Equation (6) and Equation (8)). The government could induce the $H$ type to become self-employed, but would make the $L$ type to become self-employed if $V_{ut}^{se}(\theta^L) > V_{ut}^e(\theta^L)$ after *PBD*.

**Table A.1: Definition** of **Necessity/Pushed** vs. **Opportunity** Founders for Regression Sample

| Motive to become entrepreneur | Opportunity entrepreneur | Pushed entrepreneur |
|---|---|---|
| Self-determined working | 527 | 0 |
| Realisation of business idea | 255 | 0 |
| Better earning potential | 32 | 0 |
| Tax incentives | 3 | 0 |
| No suitable employment options | 0 | 169 |
| Escape from unemployment | 0 | 260 |
| Forced by former employer | 0 | 10 |
| Total | 817 | 439 |

*Notes:* This table is based on information from the IAB/ZEW Start-Up Panel and shows only our main regression sample. 1,300 non-team founders with maximal UI potential benefit duration that have been previously unemployed are considered in this table (see the definition of our main estimation sample in Table 1). Founders are asked about their motivation for starting a firm during the survey interview that is conducted when they enter the panel for the first time. Note that the intuition behind using the term *pushed* entrepreneur can be well understood by checking the spikes of the exit rate from unemployment into self-employment split by the motivation to start up, which is shown in Figure A.2. This is corroborated when looking at Table 1: Previously employed founders are much less likely to feel pushed into entrepreneurship (21% vs. 35% for previously unemployed founders).

**Table A.2: Examples of Startups** included **in** the **Industry Classification**

| Industry Classification | Examples |
|---|---|
| **Technology-intensive services** | Computer facility management, web hosting; architecture and engineering consulting; technical testing/analysis |
| **High-technology manufacturing** | Manufacturing of glass, optical instruments, photographic equipment, manufacturing of electric lighting/electrical equipment, manufacturing of other pumps/compressors/metal forming machinery |
| **Skill-intensive services** | Tax consulting, bookkeeping; consulting; market/opinion polling |
| **Software supply and consultancy** | Programmers |
| **Non-high-tech manufacturing** | Breweries, textile companies, manufacturing of shoe-ware; copy-shops, printing; furniture, jewellery; installation of machinery |
| **Other business-oriented services** | Warehouses; postal/courier activities; renting vehicles; translators, human resources; landscape services |
| **Cons.-or. services in creative sect.** | Publishers, photographers, driving schools |
| **Consumer-oriented services** | Taxis; restaurants/mobile food service; repair services (computer); hairdressers; gambling and betting activities, insurance vendors |
| **Construction** | Electrical installations, floor and wall covering, painting and glazing |
| **Retail & wholesale** | Sales of cars, wholesale (flowers, fruit, bicycle), retail sales |

*Notes:* This table provides examples for the type of firms that are included in the ten industry classification codes for which we control in all our main regressions (compare Table 1). It illustrates that we cover a very broad set of startups and that we indeed have a comprehensive dataset of foundations in Germany.

**Table A.3:** Potential UI Benefit Duration (in months) based on Contributions/Age

| (1) Contribution Months | (2) before 02/2006 | (3) Age Rules | (4) from 02/2006 until 12/2007 | (5) Age Rules | (6) since 01/2008 | (7) Age Rules |
|---|---|---|---|---|---|---|
| 12 | 6 | | 6 | | 6 | |
| 18 | 9 | | 9 | | 9 | |
| 24 | 12 | | 12 | | 12 | |
| 30 | 15 | $\geq 45$ | 15 | $\geq 55$ | 15 | $\geq 50$ |
| 36 | 18 | | 18 | $\geq 55$ | 18 | $\geq 55$ |
| 44 | 22 | $\geq 47$ | 18 | $\geq 55$ | 22 | $\geq 58$ |
| 48 | 24 | | 18 | $\geq 55$ | 24 | $\geq 58$ |
| 52 | 26 | $\geq 52$ | 18 | $\geq 55$ | 24 | $\geq 58$ |
| 64 | 32 | $\geq 57$ | 18 | $\geq 55$ | 24 | $\geq 58$ |

*Notes:* The table shows how potential unemployment insurance (UI) benefit duration (PBD) varies with the number of contribution months (column 1), i.e. the number of months a worker paid UI contributions that are mandatory for jobs covered by the social security. The rules state that after having satisfied the minimum eligibility requirement (e.g. at least 12 contributions within last 24 months) half of the number of contribution months translate into PBD. However, at some point a maximum PBD is reached and additional contribution months can no longer increase PBD. This table presents the age rules for maximum PBD, i.e. for which age groups the indicated PBD is available, since only with increasing age does the maximum PBD increase. Maximum PBD by age group is also shown in Table A.4. Columns (2) and (3) show the PBD regime before February 2006, columns (4) and (5) between February 2006 and December 2007 and columns (6) and (7) since January 2008.

**Table A.4:** Maximum Potential UI Benefit Duration (in months) in Germany

| (1) Age | (2) before 02/2006 | (3) Reduction in months | (4) from 02/2006 until 12/2007 | (5) Extension in months | (6) since 01/2008 | (7) Net-Effect in months |
|---|---|---|---|---|---|---|
| <45 | 12 | 0 | 12 | 0 | 12 | 0 |
| 45-46 | 18 | -6 | 12 | 0 | 12 | -6 |
| 47-49 | 22 | -10 | 12 | 0 | 12 | -10 |
| 50-51 | 22 | -10 | 12 | +3 | 15 | -7 |
| 52-54 | 26 | -14 | 12 | +3 | 15 | -11 |
| 55-56 | 26 | -8 | 18 | 0 | 18 | -8 |
| 57 | 32 | -14 | 18 | 0 | 18 | -14 |
| >58 | 32 | -14 | 18 | +6 | 24 | -8 |

*Notes:* The table shows how potential unemployment insurance (UI) benefit duration (PBD) varies by age group and over time for unemployed individuals who had worked for at least the number of contribution months within the last five years (seven years before 02/2006) necessary to get the maximum PBD of their age group according to Table A.3 without intermittent UI spell. This table shows that the reform of February 2006 represents a considerable decline in PBD for workers aged above 45 years. In contrast, the reform of January 2008 partially increased PBD again. However, in total the net effect across both reforms demonstrates that all age groups beyond 45 years suffered a considerable decline in PBD (cf. Section 3).

**Table A.5: IV Results** for **Reforms 2006 & 2008**: **Potential Benefit Duration (PBD)** on Actual Unemployment Duration, Motivation of Founder, and Firm Outcomes

| | (1) PBD (in months) | (2) AUD (in months) | (3) Necessity Motive (=1) | (4) Sales Year 1 (log) | (5) Sales Year 2 (log) | (6) FTE Employment Year 1 (log) | (7) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | | **0.649**$^{***}$ | **0.015**$^{**}$ | **0.030** | **-0.074**$^{**}$ | **0.004** | **-0.006** |
| | | (0.093) | (0.007) | (0.049) | (0.038) | (0.007) | (0.008) |
| Tertiary degree (=1) | 0.247 | -0.467 | -0.076$^{**}$ | -0.671$^{**}$ | 0.057 | 0.075$^{**}$ | 0.080$^{**}$ |
| | (0.217) | (0.286) | (0.032) | (0.288) | (0.168) | (0.034) | (0.040) |
| Founder was self-employed before (=1) | -0.157 | 0.185 | -0.025 | 0.012 | -0.082 | -0.006 | -0.018 |
| | (0.268) | (0.342) | (0.037) | (0.338) | (0.207) | (0.039) | (0.045) |
| Managerial experience as employee (=1) | 0.291 | -0.006 | -0.077$^{**}$ | 0.150 | 0.615$^{***}$ | 0.131$^{***}$ | 0.172$^{***}$ |
| | (0.302) | (0.346) | (0.038) | (0.353) | (0.165) | (0.050) | (0.057) |
| Industry experience (in years) | 0.008 | -0.014 | 0.000 | 0.034$^{**}$ | 0.009 | 0.001 | 0.001 |
| | (0.011) | (0.014) | (0.001) | (0.015) | (0.010) | (0.002) | (0.002) |
| Female founder (=1) | -0.015 | 0.186 | 0.005 | -1.100$^{***}$ | -0.368$^{*}$ | 0.062 | 0.099$^{*}$ |
| | (0.273) | (0.321) | (0.038) | (0.401) | (0.216) | (0.047) | (0.052) |
| Founder of non-German origin (=1) | 0.134 | 0.219 | 0.042 | -1.899$^{***}$ | -0.535 | -0.022 | -0.057 |
| | (0.364) | (0.504) | (0.058) | (0.666) | (0.427) | (0.054) | (0.056) |
| SE Subsidy by Federal Employment Agency (=1) | 0.446$^{**}$ | -0.411 | 0.067$^{**}$ | -0.446 | -0.272 | -0.058$^{*}$ | -0.081$^{**}$ |
| | (0.210) | (0.295) | (0.031) | (0.280) | (0.167) | (0.033) | (0.038) |
| **IV_06** | **-9.316**$^{***}$ | | | | | | |
| | (0.514) | | | | | | |
| **IV_08** | **2.356**$^{***}$ | | | | | | |
| | (0.353) | | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 41.07 | 147.61 | 115.608 | 119.869 | 154.434 | 152.383 |
| N | 1291 | 1291 | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.487 | 0.242 | 0.084 | 0.096 | 0.094 | 0.133 | 0.135 |
| Mean of dependent variable | 12.324 | 4.785 | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value for log-terms) | | | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (actual unemployment duration (AUD), motivation for starting up; sales/employment growth after year 1, 2) on the founders' PBD before starting up that is instrumented by *IV06* and *IV08* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom all control variables are available.

**Table A.6: IV Results** for **Reforms 2006 & 2008**: **PBD** on Actual Unemployment Duration, Motiv. of Founder, Firm Outcomes **for Non-Manufacturing Sector**

| | (1) PBD (in months) | (2) AUD (in months) | (3) Necessity Motive (=1) | (4) Sales Year 1 (log) | (5) Sales Year 2 (log) | (6) FTE Employment Year 1 (log) | (7) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD) (in months)** | | **0.721**$^{***}$ | **0.010** | **-0.002** | **-0.115**$^{**}$ | **-0.007** | **-0.017**$^{**}$ |
| | | (0.108) | (0.008) | (0.055) | (0.050) | (0.007) | (0.008) |
| Tertiary degree (=1) | 0.391 | -0.585$^{*}$ | -0.091$^{**}$ | -0.371 | 0.266 | 0.066$^{*}$ | 0.072$^{*}$ |
| | (0.244) | (0.327) | (0.036) | (0.295) | (0.166) | (0.036) | (0.041) |
| Founder was self-employed before (=1) | -0.396 | 0.595 | 0.003 | 0.097 | -0.275 | 0.009 | 0.021 |
| | (0.304) | (0.380) | (0.042) | (0.352) | (0.233) | (0.044) | (0.051) |
| Managerial experience as employee (=1) | 0.112 | 0.096 | -0.106$^{**}$ | 0.006 | 0.422$^{**}$ | 0.128$^{**}$ | 0.177$^{***}$ |
| | (0.348) | (0.381) | (0.043) | (0.378) | (0.185) | (0.053) | (0.060) |
| Industry experience (in years) | 0.006 | -0.003 | 0.001 | 0.020 | 0.008 | 0.002 | 0.002 |
| | (0.012) | (0.016) | (0.002) | (0.016) | (0.012) | (0.002) | (0.002) |
| Female founder (=1) | 0.065 | 0.298 | 0.002 | -0.825$^{**}$ | -0.533$^{**}$ | 0.068 | 0.088 |
| | (0.312) | (0.362) | (0.042) | (0.411) | (0.238) | (0.051) | (0.056) |
| Founder of non-German origin (=1) | 0.031 | 0.214 | -0.030 | -1.928$^{***}$ | -0.824 | -0.081$^{*}$ | -0.086$^{*}$ |
| | (0.386) | (0.558) | (0.063) | (0.710) | (0.510) | (0.046) | (0.048) |
| SE Subsidy by Federal Employment Agency (=1) | 0.378 | -0.409 | 0.071$^{**}$ | -0.636$^{**}$ | -0.234 | -0.050 | -0.058 |
| | (0.231) | (0.342) | (0.036) | (0.306) | (0.197) | (0.035) | (0.040) |
| **IV_06** | **-8.955**$^{***}$ | | | | | | |
| | (0.579) | | | | | | |
| **IV_08** | **2.115**$^{***}$ | | | | | | |
| | (0.385) | | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 34.852 | 107.841 | 78.456 | 84.474 | 112.178 | 110.896 |
| N | 1022 | 1022 | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.493 | 0.241 | 0.084 | 0.080 | 0.110 | 0.155 | 0.146 |
| Mean of dependent variable | 12.327 | 4.895 | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | | | 179,344 | 237,112 | 0.549 | 0.76 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (AUD, motivation for starting up; sales/employment growth after year 1, 2) on the founders' PBD before starting up in the non-manufacturing sector (75% of the sample) that is instrumented by *IV06* and *IV08* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table A.7: IV Results** for Reform 2006: **Actual Unemployment Duration (AUD)** on Motivation of Founder and Firm Outcomes

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | | **0.022**** | **0.060** | **-0.118*** | **0.005** | **-0.010** |
| | | (0.010) | (0.095) | (0.063) | (0.011) | (0.012) |
| Tertiary degree (=1) | -0.313 | -0.063** | -0.662** | -0.030 | 0.074** | 0.073* |
| | (0.311) | (0.031) | (0.287) | (0.164) | (0.034) | (0.039) |
| Founder was self-employed before (=1) | 0.067 | -0.024 | -0.023 | -0.129 | -0.013 | -0.020 |
| | (0.357) | (0.037) | (0.343) | (0.208) | (0.040) | (0.045) |
| Managerial experience as employee (=1) | 0.144 | -0.076** | 0.146 | 0.624*** | 0.130*** | 0.171*** |
| | (0.380) | (0.038) | (0.358) | (0.162) | (0.050) | (0.057) |
| Industry experience (in years) | -0.008 | 0.001 | 0.035** | 0.003 | 0.001 | 0.001 |
| | (0.015) | (0.001) | (0.015) | (0.010) | (0.002) | (0.002) |
| Female founder (=1) | 0.240 | -0.001 | -1.118*** | -0.357* | 0.062 | 0.101* |
| | (0.361) | (0.038) | (0.408) | (0.205) | (0.047) | (0.052) |
| Founder of non-German origin (=1) | 0.226 | 0.037 | -1.928*** | -0.489 | -0.024 | -0.054 |
| | (0.505) | (0.059) | (0.670) | (0.400) | (0.055) | (0.054) |
| SE Subsidy by Federal Employment Agency (=1) | -0.086 | 0.075** | -0.423 | -0.288* | -0.054 | -0.085** |
| | (0.311) | (0.031) | (0.281) | (0.166) | (0.034) | (0.037) |
| **IV_06** | **-5.815***** | | | | | |
| | (0.921) | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 39.831 | 23.487 | 24.016 | 40.992 | 41.07 |
| N | 1256 | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.189 | 0.075 | 0.072 | 0.124 | 0.120 | 0.149 |
| Mean of dependent variable | 4.828 | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value for log-terms) | | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up that is instrumented by *IV06* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table A.8: IV Results** for Reform 2006: **Actual Unemployment Duration (AUD)** on Motivation of Founder and Firm Outcomes **for Non-Manufacturing Sector**

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | | **0.014** | **0.007** | **-0.171**** | **-0.011** | **-0.025**** |
| | | (0.011) | (0.092) | (0.077) | (0.009) | (0.011) |
| Tertiary degree (=1) | -0.305 | -0.081** | -0.387 | 0.145 | 0.057 | 0.056 |
| | (0.357) | (0.035) | (0.289) | (0.163) | (0.035) | (0.040) |
| Founder was self-employed before (=1) | 0.243 | -0.001 | 0.074 | -0.283 | 0.011 | 0.030 |
| | (0.374) | (0.042) | (0.346) | (0.228) | (0.044) | (0.050) |
| Managerial experience as employee (=1) | 0.158 | -0.105** | -0.001 | 0.475*** | 0.128** | 0.177*** |
| | (0.434) | (0.042) | (0.380) | (0.183) | (0.053) | (0.060) |
| Industry experience (in years) | 0.002 | 0.001 | 0.019 | 0.002 | 0.001 | 0.002 |
| | (0.017) | (0.002) | (0.016) | (0.012) | (0.002) | (0.002) |
| Female founder (=1) | 0.356 | -0.003 | -0.823** | -0.485** | 0.072 | 0.095* |
| | (0.407) | (0.042) | (0.419) | (0.227) | (0.051) | (0.055) |
| Founder of non-German origin (=1) | 0.198 | -0.035 | -1.925*** | -0.781* | -0.076* | -0.078* |
| | (0.551) | (0.063) | (0.709) | (0.464) | (0.046) | (0.047) |
| SE Subsidy by Federal Employment Agency (=1) | -0.084 | 0.075** | -0.631** | -0.280 | -0.053 | -0.068* |
| | (0.367) | (0.035) | (0.306) | (0.201) | (0.035) | (0.039) |
| **IV_06** | **-5.987***** | | | | | |
| | (1.047) | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 32.673 | 19.62 | 19.994 | 34.939 | 34.852 |
| N | 999 | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.209 | 0.089 | 0.077 | 0.124 | 0.165 | 0.168 |
| Mean of dependent variable | 4.926 | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | | 179,344 | 237,112 | 0.549 | 0.76 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up in the non-manufacturing sector (75% of the sample) that is instrumented by *IV06* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table A.9: IV Results** for **Reforms 2006 & 2008**: **Actual Unemployment Duration (AUD)** on Motivation of Founder and Firm Outcomes

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | | **0.023**** | **0.058** | **-0.121*** | **0.004** | **-0.010** |
| | | (0.010) | (0.095) | (0.063) | (0.011) | (0.012) |
| Tertiary degree (=1) | -0.314 | -0.065** | -0.649** | -0.019 | 0.077** | 0.075* |
| | (0.311) | (0.031) | (0.287) | (0.163) | (0.034) | (0.039) |
| Founder was self-employed before (=1) | 0.065 | -0.029 | -0.002 | -0.111 | -0.007 | -0.016 |
| | (0.358) | (0.037) | (0.342) | (0.205) | (0.040) | (0.045) |
| Managerial experience as employee (=1) | 0.143 | -0.077** | 0.150 | 0.627*** | 0.131*** | 0.172*** |
| | (0.381) | (0.038) | (0.358) | (0.161) | (0.050) | (0.056) |
| Industry experience (in years) | -0.008 | 0.001 | 0.036** | 0.004 | 0.001 | 0.001 |
| | (0.015) | (0.001) | (0.015) | (0.010) | (0.002) | (0.002) |
| Female founder (=1) | 0.242 | -0.001 | -1.126*** | -0.361* | 0.061 | 0.100* |
| | (0.361) | (0.038) | (0.407) | (0.204) | (0.047) | (0.052) |
| Founder of non-German origin (=1) | 0.222 | 0.036 | -1.930*** | -0.497 | -0.023 | -0.053 |
| | (0.505) | (0.058) | (0.670) | (0.397) | (0.055) | (0.054) |
| SE Subsidy by Federal Employment Agency (=1) | -0.087 | 0.075** | -0.431 | -0.295* | -0.056* | -0.085** |
| | (0.312) | (0.031) | (0.282) | (0.166) | (0.034) | (0.037) |
| **IV_06** | **-5.798***** | | | | | |
| | (0.961) | | | | | |
| **IV_08** | **-0.075** | | | | | |
| | (0.900) | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 152.383 | 11.84 | 12.17 | 20.8 | 20.98 |
| N | 1256 | 1256 | 1039 | 851 | 1291 | 1272 |
| R-sq. | 0.189 | 0.077 | 0.073 | 0.125 | 0.124 | 0.151 |
| Mean of dependent variable | 4.828 | 0.35 | 10.074 | 11.271 | 0.271 | 0.361 |
| (abs. value) | | | 173,661 | 231,293 | 0.605 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up that is instrumented by *IV06* and *IV08* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table A.10: IV Results** for **Reforms 2006 & 2008**: **Actual Unemployment Duration** on Motivation of Founder and Firm Outcomes **for Non-Manufacturing Sector**

| | (1) AUD (in months) | (2) Necessity Motive (=1) | (3) Sales Year 1 (log) | (4) Sales Year 2 (log) | (5) FTE Employment Year 1 (log) | (6) FTE Employment Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD) (in months)** | | **0.014** | **0.005** | **-0.166**** | **-0.011** | **-0.025**** |
| | | (0.011) | (0.091) | (0.075) | (0.009) | (0.011) |
| Tertiary degree (=1) | -0.300 | -0.083** | -0.372 | 0.153 | 0.060* | 0.059 |
| | (0.356) | (0.035) | (0.290) | (0.161) | (0.035) | (0.041) |
| Founder was self-employed before (=1) | 0.252 | -0.005 | 0.096 | -0.271 | 0.015 | 0.034 |
| | (0.376) | (0.042) | (0.346) | (0.225) | (0.044) | (0.050) |
| Managerial experience as employee (=1) | 0.160 | -0.107** | 0.005 | 0.475*** | 0.129** | 0.178*** |
| | (0.435) | (0.042) | (0.381) | (0.182) | (0.053) | (0.060) |
| Industry experience (in years) | 0.003 | 0.001 | 0.020 | 0.002 | 0.002 | 0.002 |
| | (0.017) | (0.002) | (0.016) | (0.012) | (0.002) | (0.002) |
| Female founder (=1) | 0.355 | -0.002 | -0.830** | -0.488** | 0.071 | 0.095* |
| | (0.406) | (0.042) | (0.418) | (0.226) | (0.051) | (0.055) |
| Founder of non-German origin (=1) | 0.189 | -0.033 | -1.934*** | -0.793* | -0.079* | -0.079* |
| | (0.552) | (0.063) | (0.710) | (0.464) | (0.046) | (0.047) |
| SE Subsidy by Federal Employment Agency (=1) | -0.086 | 0.075** | -0.637** | -0.283 | -0.054 | -0.069* |
| | (0.368) | (0.035) | (0.306) | (0.200) | (0.035) | (0.039) |
| **IV_06** | **-5.962***** | | | | | |
| | (1.111) | | | | | |
| **IV_08** | **-0.103** | | | | | |
| | (1.085) | | | | | |
| Industry/Year Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes |
| First-stage F-statistic | | 110.896 | 10.01 | 10.13 | 17.61 | 17.7 |
| N | 999 | 999 | 815 | 661 | 1022 | 1009 |
| R-sq. | 0.209 | 0.090 | 0.078 | 0.128 | 0.168 | 0.169 |
| Mean of dependent variable | 4.926 | 0.352 | 10.21 | 11.251 | 0.25 | 0.329 |
| (abs. value for log-terms) | | | 179,344 | 237,112 | 0.549 | 0.76 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the IV regression of our outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual unemployment duration (AUD) before starting up in the non-manufacturing sector (75% of the sample) that is instrumented by *IV06* and *IV08* (Section 3.2). Column 1 shows the first-stage regression of the IV model in column 2. We control for the founders' education, previous work experience, and individual characteristics. We include year and industry (of the startup, see Table A.2) fixed effects, and dummies to control for the receipt of self-employment (SE) related subsidies from the Federal Employment Agency and for funding by the KfW (Appendix C.2). Our regression sample consists of non-team founders who became unemployed between 2003 and 2011, were 35 to 65 years old when becoming unemployed, and for whom information on all control variables is available.

**Table A.11:** Composition or Individual-Level Duration Effects as Mechanism: Exploration of (Observable) Composition Changes

| | Treated unemployed from main sample | | | All unemployed from main sample | | | "Treated" non-unemployed from comparison group | | | All non-unemployed from comparison group | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean (before) N=106 | Mean (after) N=397 | After -before | Mean (before) N=259 | Mean (after) N=1032 | After -before | Mean (before) N=94 | Mean (after) N=509 | After -before | Mean (before) N=256 | Mean (after) N=1354 | After -before |
| **Actual unemployment duration (AUD) (in months)** | **11.171** | **4.873** | **-6.299*** ** | **7.943** | **4.193** | **-3.75*** ** | | | | | | |
| Tertiary degree (=1) | 0.33 | 0.28 | -0.05 | 0.20 | 0.23 | 0.03 | 0.32 | 0.30 | -0.03 | 0.35 | 0.25 | -0.10* |
| Founder was self-employed before (=1) | 0.17 | 0.19 | 0.02 | 0.15 | 0.18 | 0.03 | 0.26 | 0.32 | 0.05 | 0.25 | 0.27 | 0.01 |
| Managerial experience as employee (=1) | 0.17 | 0.15 | -0.02 | 0.13 | 0.13 | 0.00 | 0.16 | 0.19 | 0.03 | 0.14 | 0.16 | 0.02 |
| Industry experience (in years) | 20.02 | 18.81 | -1.22 | 16.10 | 16.31 | 0.21 | 22.71 | 17.27 | -5.44*** | 17.15 | 15.38 | -1.77 |
| Female founder (=1) | 0.17 | 0.25 | 0.08 | 0.13 | 0.20 | 0.07 | 0.18 | 0.23 | 0.05 | 0.14 | 0.20 | 0.06 |
| Founder of non-German origin (=1) | 0.08 | 0.04 | -0.03 | 0.04 | 0.07 | 0.03 | 0.08 | 0.05 | -0.02 | 0.06 | 0.07 | 0.01 |
| SE Subsidy by Federal Employment Agency (=1) | 0.65 | 0.80 | 0.15* | 0.65 | 0.80 | 0.15*** | 0.27 | 0.34 | 0.07 | 0.30 | 0.36 | 0.06 |
| Technology-intensive services | 0.05 | 0.06 | 0.01 | 0.05 | 0.05 | 0.00 | 0.05 | 0.06 | 0.01 | 0.06 | 0.06 | 0.00 |
| High-technology manufacturing | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 0.01*** | 0.01 | 0.02 | 0.01 | 0.01 | 0.01 | 0.00 |
| Skill-intensive services | 0.06 | 0.08 | 0.02 | 0.03 | 0.05 | 0.02 | 0.08 | 0.08 | 0.00 | 0.09 | 0.07 | -0.02 |
| Software supply and consultancy | 0.00 | 0.01 | 0.00 | 0.00 | 0.01 | 0.00* | 0.01 | 0.01 | 0.00 | 0.01 | 0.01 | 0.00 |
| Non-high-tech manufacturing | 0.03 | 0.04 | 0.01 | 0.04 | 0.05 | 0.01 | 0.03 | 0.05 | 0.02 | 0.03 | 0.05 | 0.02*** |
| Other business-oriented services | 0.07 | 0.11 | 0.04 | 0.10 | 0.14 | 0.03 | 0.04 | 0.12 | 0.08* | 0.12 | 0.12 | -0.01 |
| Cons.-or. services in creative sect. | 0.08 | 0.02 | -0.06 | 0.10 | 0.05 | -0.05 | 0.24 | 0.11 | -0.13 | 0.15 | 0.09 | -0.06 |
| Consumer-oriented services | 0.30 | 0.31 | 0.01 | 0.26 | 0.26 | 0.00 | 0.15 | 0.24 | 0.09 | 0.14 | 0.23 | 0.10* |
| Construction | 0.11 | 0.20 | 0.09* | 0.19 | 0.20 | 0.01 | 0.12 | 0.10 | -0.02 | 0.16 | 0.14 | -0.02 |
| Retail & wholesale | 0.29 | 0.17 | -0.12 | 0.21 | 0.18 | -0.03 | 0.28 | 0.21 | -0.07 | 0.24 | 0.22 | -0.02 |
| Average daily wage in 5 years before founding | 107.87 | 124.75 | 16.88 | 96.87 | 106.56 | 9.69 | 129.17 | 125.10 | -4.06 | 127.03 | 119.66 | -7.37 |

*Notes:* Significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows weighted t-test comparisons of observable characteristic of different subgroups accounting for the startification of the IAB/ZEW Start-up Panel. In the first panel, we compare those unemployed individuals that are affected by 2006 reform. In the second panel, we compare all unemployed individuals before and after the 2006 reform. In the third panel, we compare the potentially treated non-unemployed and in the fourth panel, we do so for all non-unemployed individuals. Results suggest that composition and individual-level duration effects play a role in explaining the overall effects but that the size of (observable) compositions effects is limited.)

**Table A.12: OLS - Actual Unemployment Duration (AUD)** - Controlled vs. Uncontrolled

| | (1) Necessity Motive (=1) | | (2) Sales Year 1 (log) | | (3) Sales Year 2 (log) | | (4) FTE Employment Year 1 (log) | | (5) FTE Employment Year 2 (log) | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD)** (in months) | **0.017***** (0.003) | **0.017***** (0.003) | **-0.139***** (0.027) | **-0.141***** (0.028) | **-0.096***** (0.018) | **-0.104***** (0.021) | **-0.016***** (0.003) | **-0.018***** (0.003) | **-0.023***** (0.003) | **-0.024***** (0.003) |
| **CONTROLS** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| N | 1256 | 1256 | 1039 | 1039 | 851 | 851 | 1291 | 1291 | 1272 | 1272 |
| R-sq. | 0.063 | 0.026 | 0.122 | 0.028 | 0.126 | 0.049 | 0.150 | 0.023 | 0.158 | 0.034 |
| Mean of dependent variable | 0.35 | 0.35 | 10.074 | 10.074 | 11.271 | 11.271 | 0.271 | 0.271 | 0.361 | 0.361 |
| (abs. value for log-terms) | | | 173,661 | 173,661 | 231,293 | 231,293 | 0.605 | 0.605 | 0.847 | 0.847 |

**Table A.13: OLS - Potential Benefit Duration (PBD)** - Controlled vs. Uncontrolled

| | (1) AUD (in months) | | (2) Necessity Motive (=1) | | (3) Sales Year 1 (log) | | (4) Sales Year 2 (log) | | (5) FTE Employment Year 1 (log) | | (6) FTE Employment Year 2 (log) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD)** (in months) | **0.471***** (0.048) | **0.498***** (0.048) | **0.023***** (0.003) | **0.023***** (0.003) | **-0.036** (0.024) | **-0.045*** (0.024) | **-0.049**** (0.022) | **-0.053**** (0.022) | **-0.004** (0.004) | **-0.008**** (0.004) | **-0.009**** (0.004) | **-0.013***** (0.004) |
| **CONTROLS** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| N | 1291 | 1291 | 1256 | 1256 | 1039 | 1039 | 851 | 851 | 1291 | 1291 | 1272 | 1272 |
| R-sq. | 0.256 | 0.215 | 0.077 | 0.044 | 0.099 | 0.003 | 0.096 | 0.012 | 0.133 | 0.004 | 0.134 | 0.008 |
| Mean of dependent variable | 4.785 | 4.785 | 0.35 | 0.35 | 10.074 | 10.074 | 11.271 | 11.271 | 0.271 | 0.271 | 0.361 | 0.361 |
| (abs. value for log-terms) | | | | | 173,661 | 173,661 | 231,293 | 231,293 | 0.605 | 0.605 | 0.847 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. These tables show the OLS regression of our main outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual and potential benefit duration (AUD and PBD) before starting up. We analyze to which extent controls for founders' education, previous work experience and individual characteristics affect results compared to the standard case without controls. The fact that there are no remarkable differences shows that *composition effects* are limited.

**Table A.14: IV - Actual Unemployment Duration (AUD)** - Controlled vs. Uncontrolled

| | (1) AUD (in months) | | (2) Necessity Motive (=1) | | (3) Sales Year 1 (log) | | (4) Sales Year 2 (log) | | (5) FTE Employment Year 1 (log) | | (6) FTE Employment Year 2 (log) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD)** (in months) | | | **0.022**** (0.010) | **0.030***** (0.010) | **0.060** (0.095) | **0.145** (0.092) | **-0.118*** (0.063) | **-0.115*** (0.066) | **0.005** (0.011) | **-0.008** (0.010) | **-0.010** (0.012) | **-0.017** (0.011) |
| **IV_06** | **-5.815***** (0.921) | **-5.695***** (0.846) | | | | | | | | | | |
| **CONTROLS** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| First-stage F-statistic | | | 39.831 | 45.318 | 23.487 | 26.687 | 24.016 | 23.626 | 40.992 | 45.866 | 41.07 | 45.886 |
| N | 1256 | 1256 | 1256 | 1256 | 1039 | 1039 | 851 | 851 | 1291 | 1291 | 1272 | 1272 |
| R-sq. | 0.189 | 0.135 | 0.075 | 0.021 | 0.072 | . | 0.124 | 0.048 | 0.120 | 0.016 | 0.149 | 0.032 |
| Mean of dependent variable | 4.828 | 4.828 | 0.35 | 0.35 | 10.074 | 10.074 | 11.271 | 11.271 | 0.271 | 0.271 | 0.361 | 0.361 |
| (abs. value for log-terms) | | | | | 173,661 | 173,661 | 231,293 | 231,293 | 0.605 | 0.605 | 0.847 | 0.847 |

**Table A.15: IV - Potential Benefit Duration (PBD)** - Controlled vs. Uncontrolled

| | (1) PBD (in months) | | (2) AUD (in months) | | (3) Necessity Motive (=1) | | (4) Sales Year 1 (log) | | (5) Sales Year 2 (log) | | (6) FTE Employment Year 1 (log) | | (7) FTE Employment Year 2 (log) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Potential benefit duration (PBD)** (in months) | | | **0.661***** (0.094) | **0.677***** (0.094) | **0.015**** (0.007) | **0.020***** (0.006) | **0.034** (0.052) | **0.084*** (0.048) | **-0.072*** (0.039) | **-0.068*** (0.040) | **0.003** (0.007) | **-0.005** (0.007) | **-0.006** (0.008) | **-0.012** (0.007) |
| **IV_06** | **-8.743***** (0.505) | **-8.322***** (0.459) | | | | | | | | | | | | |
| **CONTROLS** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** | **Yes** | **No** |
| First-stage F-statistic | | | 299.421 | 328.397 | 286.66 | 319.312 | 223.603 | 242.271 | 220.761 | 219.543 | 299.421 | 328.397 | 296.11 | 325.42 |
| N | 1291 | 1291 | 1291 | 1291 | 1256 | 1256 | 1039 | 1039 | 851 | 851 | 1291 | 1291 | 1272 | 1272 |
| R-sq. | 0.470 | 0.434 | 0.234 | 0.194 | 0.083 | 0.049 | 0.094 | . | 0.094 | 0.011 | 0.130 | 0.004 | 0.134 | 0.009 |
| Mean of dependent variable | 12.324 | 12.324 | 4.785 | 4.785 | 0.35 | 0.35 | 10.074 | 10.074 | 11.271 | 11.271 | 0.271 | 0.271 | 0.361 | 0.361 |
| (abs. value for log-terms) | | | | | | | 173,661 | 173,661 | 231,293 | 231,293 | 0.605 | 0.605 | 0.847 | 0.847 |

*Notes:* Standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. These tables show the IV regression of our outcome variables (motivation for starting up; sales/employment growth after year 1, 2) on the founders' actual and potential benefit duration (AUD and PBD) before starting up that are instrumented by *IV06* (Section 3.2). We analyze to which extent controls for founders' education, previous work experience and individual characteristics affect results compared to the standard case without controls. The fact that there are no remarkable differences shows that *composition effects* are limited.

**Table A.16: PSM Results**: Average Treatment Effect of **Actual and Potential Benefit Duration** on Startup Motivation and Firm Outcomes

| | (1) AUD (in mon.) | (2) Necessity Motive | (3) Sales year 1 (log) | (4) Sales year 2 (log) | (5) FTE Employm. Year 1 (log) | (6) FTE Employm. Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD)** | | 0.091*** | -1.246*** | -0.768*** | -0.176*** | -0.253*** |
| (> Median) | | (0.031) | (0.271) | (0.189) | (0.034) | (0.039) |
| **Potential benefit duration (PBD)** | 4.023*** | 0.114*** | -0.840*** | -0.417*** | -0.115*** | -0.083** |
| (> Median) | (0.271) | (0.031) | (0.262) | (0.150) | (0.032) | (0.038) |
| Observations | 1291 | 1256 | 1039 | 851 | 1291 | 1272 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the PSM results of our main outcome variables (actual unemployment duration, motivation for starting up, sales and employment growth after year 1, 2) on whether the founder exceeded the median actual unemployment duration and the median potential benefit duration before starting up.

**Table A.17: PSM Results**: Average Treatment Effect of **Actual and Potential Benefit Duration** on Startup Motivation and Firm Outcomes **(Non-Manufacturing)**

| | (1) AUD (in mon.) | (2) Necessity Motive | (3) Sales year 1 (log) | (4) Sales year 2 (log) | (5) FTE Employm. Year 1 (log) | (6) FTE Employm. Year 2 (log) |
|---|---|---|---|---|---|---|
| **Actual unemployment duration (AUD)** | | 0.075** | -1.024*** | -0.524*** | -0.132*** | -0.240*** |
| (> Median) | | (0.033) | (0.286) | (0.160) | (0.035) | (0.038) |
| **Potential benefit duration (PBD)** | 3.963*** | 0.126*** | -1.027*** | -0.711*** | -0.108*** | -0.144*** |
| (> Median) | (0.283) | (0.035) | (0.278) | (0.193) | (0.036) | (0.037) |
| Observations | 1022 | 999 | 815 | 661 | 1022 | 1009 |

*Notes:* Robust standard errors are shown in parentheses and significance levels are indicated by: *** 1%, ** 5%, * 10%. This table shows the PSM results of our main outcome variables (actual unemployment duration, motivation for starting up, sales and employment growth after year 1, 2) on whether the founder exceeded the median actual unemployment duration and the median potential benefit duration before starting up in the non-manufacturing sectors (75% of our sample).

# B Appendix: Technical Details of Data Construction

## B.1 Details on the created linked dataset and the matching procedure

The IAB/ZEW Start-Up Panel is a random sample drawn from the "universe" of the Mannheim Enterprise Panel ("MUP"). The MUP is collected by Creditreform (Germany's largest credit rating agency) and processed by ZEW. It covers basic information (addresses, phone numbers, industry, incorporation status, survival) about all "economically active" firms in Germany. This is guaranteed by automated synchronization of data with official commercial registers and the Chambers of Industry and Commerce (IHKs), as well as by active search for new firms by local Creditreform offices, which usually also receive a request for conducting a credit rating when new firms enter the market.

Only independent new firms are sampled for the Start-Up Panel survey, which means that all startups are included, except: subsidiaries or new establishments of existing firms and business succession (also in case of insolvency) are excluded. In contrast, joint ventures and franchise are included. Moreover, a maximum of 75% of a firm's shares may be held by other firms. In conclusion, the interviewee entering into the Start-Up Panel is financially engaged in the firm and usually the single founder or one member of a founding team. The Start-Up Panel is a stratified random sample. Stratification is based on KfW funding (until 2011), founding year, and industry. A detailed first interview is supposed to take place within one year after the firm has been started. Only a small proportion of firms is first sampled up to three years after foundation to balance small stratification cells (they can be excluded). Shorter follow-up surveys are then conducted in subsequent years. Each startup stays in the sample for up to seven interviews or until they drop out by missing two subsequent interviews. All information is retrieved by computer-assisted telephone interviews.

This firm-level survey data is matched to person-specific employment register data on the startups' founders and employees. The employment register data contain information on all employees who are subject to social security contributions in Germany. This includes apprentices, interns, and employees in marginal part-time employment. All notifications on an individual's employment or unemployment spell can be linked via a unique person-specific identifier to construct the employment history for each employee. Another identifier allows matching the employees to establishments. However, there is no unique identifier to match establishments to firms. Therefore, we matched establishments to firms in the IAB/ZEW Start-Up Panel using a text search algorithm via firm/establishment names and addresses. The text search algorithm is described in detail in Appendix B of Czarnitzki et al. (2015) and has proved to deliver very reliable results in various settings. In the matching procedure we were able to find about 90% of the firms in the IAB/ZEW Start-Up Panel which reported having employees in the yearly telephone surveys. We removed firms from the sample which reported that they had employees but which we were unable to detect during the matching procedure. In addition, to safeguard against false matches, all matches were double-checked manually and we excluded matches in the $1^{st}$ and $100^{th}$ percentile of the difference between self-reported and process-generated firm sizes from the sample. The correlation coefficient between self-reported and process-generated firm sizes in the final firm-year panel dataset is slightly above 0.95.

Since founders are usually not subject to social insurance contributions in their own companies, they are not reported as employees of their ventures in the register data. Therefore, we matched labor market histories of all founders from the IAB/ZEW Start-up Panel based on their names, birth dates, and additional geographical information. We were able to find matching employment register data for about 80% of the founders. Given that not all founders were necessarily employed, i.e. subject to social insurance in Germany previously (e.g. as they have always been self-employed), this is a very high ratio of matched individuals. Importantly, any bias due to unmatched individuals that might still arise should be particularly small for unemployed founders, who are in the focus of this study. To qualify for UI benefits, individuals need to have been previously employed subject to social insurance (cf. Section 3.1). In addition, all spells with UI benefit receipts are observable in the register data.

# C Appendix: Institutional Details

## C.1 Labour Market Reforms in Germany

In this paper, we exploit parts of the big labor market reforms enacted in Germany between 2003 and 2005 that are known as *Hartz reforms* (see e.g. Hartung et al. (2018), Petrunyk and Pfeifer (2023), or Price (2019), who evaluate theses reforms).

- In 2003, the first two parts of the labor market reform were passed: the first measure (*Hartz I*) liberalized temporary work, allowing firms to hire workers from temporary work agencies for short-term periods. The second measure package (*Hartz II*) reduced the regulations on marginal employment and introduced an additional form of social security tax-favored employment (*midi-jobs*). Moreover, it created new subsidies for unemployed workers starting their own businesses (*Ich-AGs*). The latter program ended in 2006 and was replaced by a new startup subsidy scheme (*Gründungszuschuss*, see Appendix C.2).
- In 2004, the third reform package (*Hartz III*) renewed the structure and role of the German Federal Employment Agency. Most importantly, the original placement agencies (*Arbeitsämter*) and social security offices (*Sozialämter*) were merged into single institutions (*Arbeitsagenturen*). Moreover, additional *job centers* were set up in many municipalities. Finally, case managers were introduced to have one person in charge of assisting unemployed workers over the entire job search process.
- In 2005, the last reform package (*Hartz IV*) transformed the three-tier system of unemployment benefits, unemployment assistance, and subsistence benefits into a two-tier system of unemployment benefits and subsistence benefits.
    - Concerning the benefit level, the reform involved abolishing unemployment assistance benefits (Arbeitslosenhilfe). The unemployment assistance depended on some previous work history and could be received for several years after unemployment insurance (UI) benefits expired. The net replacement rates were at 53% for a single person and could reach 57% for persons with dependent children. In addition, those who were not eligible for unemployment assistance were still eligible to receive a minimum subsistence benefit (Sozialhilfe) that included rent payments and was not dependent on previous wages. The reform of 2005 removed wage-dependent benefits for long-term unemployed, and merged unemployment assistance and subsistence benefits to create a new minimum benefit scheme (Arbeitslosengeld II) that is independent of previous wages and only intended to provide recipients with the minimum benefits necessary to survive. It is subject to a tight means testing procedure. In contrast, the unemployment insurance (UI) benefits (Arbeitslosengeld I) remained unchanged at a net replacement rate of 60% for single persons and 67% for those with dependent children. Note that we only focus on individuals who enter unemployment and receive UI benefits, thus, they were not affected by these benefit level changes targeted at those having exhausted UI benefits.
    - Moreover, the fourth reform package involved changing the duration of unemployment benefits (see Table A.4). These changes only came in effect for individuals claiming UI benefits after February 1, 2006 and brought significant cuts in UI benefit durations for individuals entering UI at an age above 45. Via our identification strategy, we exploit this reform along with a later reform in 2008 that partially increased the UI benefit duration for some older age groups of benefit claimants again (Lichter and Schiprowski, 2021).

Over the course of the labor market reforms, the German government also introduced two new forms of government-funded/tax-subsidized private pension schemes. The so-called *Riester Rente* became effective on the 1st of January 2002 and is mainly attractive for wage workers and public servants with low to medium income. The so-called *Rürup* or *Basis Rente* became effective on the 1st of January 2005 is attractive mainly for wage workers with high income and self-employed individuals. Since we only analyse firm foundations from 2005 onwards, the availability of both schemes was similar for all founders in our sample. In addition, eligibility for both pension plans is independent of age and previous unemployment (duration) and hence should not interfere with our identification strategy (see Section 3).

## C.2 Startup Subsidies

This section provides an overview of startup subsidies in Germany. Importantly, with respect to our identification strategy, all startup subsidies schemes were (and are) independent of the age of claimants and were not subject to changes at the same time when the reforms of potential unemployment insurance (UI) benefit duration (PBD) were introduced. Thus, the available startup subsidy schemes should not interfere with our identification strategy that exploits policy changes in PBD (as explained in Section 3). Moreover, we control for any funding provided by the German Federal Employment Agency (Bundesagentur für Arbeit) and/or the state-owned KfW bank (the development bank Kreditanstalt für Wiederaufbau, which was originally formed in 1948 to fund the reconstruction of Germany after World War II). By controlling for funding by the Federal Employment Agency, we effectively control for any startup subsidies targeted at founders starting a business out of unemployment. Funding via the KfW is the most important channel through which startups in Germany are subsidized in general (i.e. by subsidized credits that are administered and secured by KfW bank).

1. Bridging Allowance (BA) - "Überbrückungsgeld" (1986-07/2006)
    - Eligibility: it covered individuals who were eligible for UI benefits, and presented an externally approved business plan (issued by the regional chamber of commerce). It was not possible to quit a job and directly apply for this bridging allowance.
    - Amount: financial support was based on UI benefits plus social security contributions and it could be provided for up to six months.
    - Until 2002, individuals had to stay unemployed for a minimum of one month to apply for BA. From 2002, one could apply for BA from the first unemployment day onward.
2. Existenzgründerzuschuss (Ich-AG) (startup subsidies (SUS)) (01/2003-06/2006)
    - Eligibility: it covered individuals who were eligible for UI benefits, but also those with means-tested social assistance or limited labor market experience (hence it was open to more people than BA).
    - Amount: it involved a monthly lump-sum payment for up to three years with 600 Euro per month in the first year, 360 Euro per month in the second year, 240 Euro per month in the third year. In contrast to BA, these startup subsidies were approved yearly if self-employment income did not exceed 25,000 Euro per year.
    - There was no need of business plans for approval, but parallel receipts of BA and SUS were excluded.

3. New SUS: new startup subsidy program ("Gründungszuschuss") (08/2006-12/2011)

    - Eligibility: it covered individuals that were unemployed for at least one day, eligible to receive UI (Arbeitslosengeld I) and that still had at least 90 days of potential UI benefit duration (PBD) left when making the transition from unemployment to self-employment. Thus, it was not possible to get this startup subsidy when an unemployed worker just exhausted her UI benefits.
    - Amount: it involved UI benefits plus 300 Euro (for social security contributions) for nine months. It was possible to get an extension of six months by proving that the business is economically active. The amount of startup subsidies after the first nine months was reduced to just 300 Euro for the remaining six months. In total the startup subsidies could be taken for a maximum of 15 months.
    - The first period of SUS could be legally claimed by all persons who fulfilled the legal eligibility requirements. The second period was entirely subject to an assessment.
    - In case of returning from self-employment to unemployment, the PBD would be reduced by the number of months the person received SUS up to a minimum of zero PBD months.

4. New SUS adjusted: startup subsidy program ("Gründungszuschuss") adjusted (01/2012-today)

    - Eligibility: it covers individuals that are unemployed for at least one day, eligible to receive UI (Arbeitslosengeld I) and that still have at least 150 days (instead of previously 90 days) of potential UI benefit duration (PBD) left when making the transition from unemployment to self-employment. Thus, it is not possible to get this startup subsidy when an unemployed worker just exhausts her UI benefits.
    - Amount: it involves unemployment insurance benefits plus 300 Euro (for social security contributions) for six (instead of previously nine) months. It is possible to get an extension of nine (instead of six) months by proving that the business is economically active. The amount of startup subsidies after the first nine months is reduced to just 300 Euro for the remaining six months. In total, the startup subsidies can be taken for a maximum of 15 months.
    - The assessment for receiving startup subsidies has been extended to the first period. The previous legal right to claim this subsidy has been abolished by December 2011 and is now a subsidy that is available upon assessment of the caseworker at the federal employment agency.
    - Background: as part of public spending cuts, the intention was to reduce money allocated for such active labor market policies.

# D Appendix: Model Extension

## D.1 Model: Derivations and Details

**The Effect of Unemployment Duration on the Value of Searching for Employment** Starting from the modeling framework as discussed in Section 5.1 with the value function of an unemployed individual searching for employment (Equation (6)), we have:

$$V^e_{u,t} = b_t - \psi_t(s_t) + \beta\Big\{p_t[1-F(\phi_t)]\int_{\phi_t}^{\infty} V^e_{t+1}(w_{t+1})dF(w_{t+1}) + [p_t F(\phi_t) + (1-p_t)]\,V^u_{t+1}\Big\} \quad (11)$$

This value function is increasing in the next period's wage $w_{t+1}$, such that the reservation wage plays an important role in the optimal search behavior. Every wage that is larger than the reservation wage, i.e. $w_{t+1} \geq \phi_t$, will be accepted. Therefore, we can write Equation (11) in terms of the following Bellman equation as:

$$V^e_{u,t} = b_t - \psi_t(s_t) + \beta\Big\{V^u_{t+1} + p_t[1-F(\phi_t)]\int_{\phi_t}^{\infty}\left[V^e_{t+1}(w_{t+1}) - V^u_{t+1}\right]dF(w_{t+1})\Big\} \quad (12)$$

As mentioned in Section 5.1, $p_t = p(s_t, \theta)$. The case of leaving unemployment to employment is dependent on the search intensity and an unemployed individual's skill. Holding the level of ability $\theta$ fix, $p_t$ is directly dependent on the search intensity $s_t$, and can be substituted accordingly.

Further, defining the discount factor $\beta$ as $\frac{1}{1+\rho}$, with $\rho$ being the discount rate (see Schmieder and von Wachter, 2016), one can rewrite Equation (12) to:

$$V^e_{u,t} = b_t - \psi_t(s_t) + \frac{1}{1+\rho}\Big\{V^u_{t+1} + s_t[1-F(\phi_t)]\int_{\phi_t}^{\infty}\left[V^e_{t+1}(w_{t+1}) - V^u_{t+1}\right]dF(w_{t+1})\Big\} \quad (13)$$

Assuming that the value of unemployment is in equilibrium equal to the discounted reservation wage, we define $V^u_{t+1} = \frac{1}{\rho}\phi_t$. Analogously, the value of leaving unemployment in the next period depends on the present value of the reservation wage $V^e_{u,t+1} = \frac{1}{\rho}\phi_t$ , or in this case $V^e_{u,t} = \frac{1}{\rho}\phi_{t-1}$.

Note that the individual is indifferent between leaving unemployment or staying unemployed at the exact level of the reservation wage when $V^e_{u,t+1} = V^u_{t+1}$. Knowing the reservation wage $\phi_t$ and the optimal search intensity $s_t$ in period $t$ will enable us to detect the reservation wage in period $t-1$. Therefore, plugging in $V^u_{t+1} = \frac{1}{\rho}\phi_t$, $V^u_t = \frac{1}{\rho}\phi_{t-1}$ into Equation (13), we get:

$$\frac{1}{\rho}\phi_{t-1} = b_{t-1} - \psi_t(s_t) + \frac{1}{1+\rho}\Big\{\frac{1}{\rho}\phi_t + s_t[1-F(\phi_t)]\int_{\phi_t}^{\infty}\left[V^e_{t+1}(w_{t+1}) - \frac{1}{\rho}\phi_t\right]dF(w_{t+1})\Big\} \quad (14)$$

Multiplying Equation (14) by $\rho(1+\rho)$, we get:

$$(1+\rho)\phi_{t-1} = (1+\rho)\rho(b_{t-1} - \psi_t(s_t)) + \phi_t + s_t[1-F(\phi_t)]\int_{\phi_t}^{\infty}\left[\rho V^e_{t+1}(w_{t+1}) - \phi_t\right]dF(w_{t+1}) \quad (15)$$

To find the optimal reservation wage, we need to derive the first-order conditions. With the optimal reservation wage implying indifference between the value functions for searching employment and for remaining unemployed (when $V^e_{u,t+1} = V^u_{t+1}$), we can further solve for the optimal search intensity (taking the derivative of Equation (15) for $s_t$ at the reservation wage $\phi_{t-1}$):

$$(1+\rho)\rho\psi'_t(s_{t-1}) - [1-F(\phi_{t-1})]\int_{\phi_{t-1}}^{\infty}[\rho V^e_t(w_t) - \phi_{t-1}]\,dF(w_t) = 0 \tag{16}$$

As mentioned in the main text, an unemployed individual receives a constant benefit $b_t$ for a duration $d$. When $t \geq d = PBD$, the benefit drops to a lower and constant level. This illustrates the importance of duration $d$. Since the reservation wage and the optimal search intensity are two choice variables that directly influence the value for employment, we are interested in their behavior over the unemployment duration spell $d$.

Exploiting the fact $V^u_{t+1} = \frac{1}{\rho}\phi_t$, the first order condition for the optimal reservation path is given by:

$$\frac{\partial \phi_t}{\partial d} = \frac{\partial V^u_{t+1}}{\partial d}\rho \tag{17}$$

Taking the total derivative of Equation (16) with respect to $d$, we get for the optimal search intensity path at period $t$:

$$\frac{\partial s_t}{\partial d} = -\frac{\partial \phi_t}{\partial d}\frac{[1-F(\phi_t)]^2 + f(\phi_t)\int_{\phi_t}^{\infty}[\rho V^e_t(w_t) - \phi_t]\,dF(w_t)}{(1+\rho)\rho\psi''_t(s_t)} \tag{18}$$

If there exists at least the slightest chance someone cannot find a job by the time unemployment benefits expire i.e. $t = d = PBD$, then a longer benefit duration in general increases the value for unemployment i.e. $\frac{\delta V^u_{t+1}}{\delta d} > 0$. Equations (17) and (18) show that a longer $d$ will lead to a higher reservation wage $\phi_t$ and a lower search intensity $s_t$.

This means that given the hazard of leaving unemployment is given as $h_t = s_t(1-F(\phi_t))$, an extension of *PBD* would lower the probability of leaving unemployment in that period, thus increasing actual unemployment duration (compare also Schmieder and von Wachter, 2016). Moreover, this implies that the effect of unemployment duration on the value of searching for employment should be negative

$$\frac{\partial V^e_{ut}}{\partial d}|\theta < 0 \tag{19}$$

In other words, this model implies negative duration dependence which leads to the implications as described in the main text in Section 5.

**The Effect of Unemployment Duration on the Value of Searching for Self-Employment** Starting from the modeling framework as discussed in Section 5.1 with the value function of an unemployed individual searching for employment (Equation (8)), we have:

$$V_{u,t}^{se} = b_t - \psi_t^{se}(s_t, \theta) + \beta \left\{ p_t[1 - F(\phi_t)] \int_{\phi_t}^{\infty} V_{t+1}^{se}(\pi_{t+1}) dF(\pi_{t+1}) + [p_t F(\phi_t) + (1 - p_t)] V_{t+1}^{u} \right\} \quad (20)$$

Giving the same importance to the reservation wage and using the same definition for $\beta$ as in the case before, holding $\theta$ fixed we can rewrite the above equation in terms of the following Bellman equation as:

$$V_{u,t}^{se} = b_t - \psi_t^{se}(s_t) + \beta \left\{ V_{t+1}^{u} + p_t^{se}[1 - F(\phi_t)] \int_{\phi_t}^{\infty} \left[ V_{t+1}^{se}(\pi_{t+1}) - V_{t+1}^{u} \right] dF(\pi_{t+1}) \right\} \quad (21)$$

This value function is again increasing in the next period's profits as income when being self-employed $\pi_{t+1}$. Every potential profit as self-employed that is larger than the reservation wage, i.e. $\pi_{t+1} \geq \phi_t$, will be accepted. Note that the search costs have a different interpretation in this case. $\psi^{se}$ reflects costs related to developing a startup idea, doing the required research on it or finding capital.

Furthermore, defining the discount factor $\beta$ as $\frac{1}{1+\rho}$, with $\rho$ being the discount rate, one can rewrite Equation (21) to:

$$V_{u,t}^{se} = b_t - \psi_t^{se}(s_t) + \frac{1}{1+\rho} \left\{ V_{t+1}^{u} + p_t^{se}[1 - F(\phi_t)] \int_{\phi_t}^{\infty} \left[ V_{t+1}^{se}(\pi_{t+1}) - V_{t+1}^{u} \right] dF(\pi_{t+1}) \right\} \quad (22)$$

For the case of moving from unemployment to self-employment, we define $V_{u,t+1}^{se} = \frac{1-\gamma(\bar{\theta})}{\rho}\phi_t$: i.e. it depends also on the probability of startup success (survival), here for the average type at $\bar{\theta}$.

Note, that the individual is indifferent between leaving unemployment or staying unemployed at the exact level of the reservation wage when $V_{u,t+1}^{se} = V_{t+1}^{u}$. Knowing the reservation wage $\phi_t$ and the optimal search intensity $s_t$ in period $t$ will enable us to detect the reservation wage in period $t-1$. Plugging in $V_{t+1}^{u} = \frac{1-\gamma(\bar{\theta})}{\rho}\phi_t$, $V_t^{u} = \frac{1-\gamma(\bar{\theta})}{\rho}\phi_{t-1}$ into Equation (22), we get:

$$\frac{1-\gamma(\bar{\theta})}{\rho}\phi_{t-1} = b_{t-1} - \psi_t^{se}(s_t) + \frac{1}{1+\rho} \left\{ \frac{1-\gamma(\bar{\theta})}{\rho}\phi_t + s_t^{se}[1 - F(\phi_t)] \int_{\phi_t}^{\infty} \left[ V_{t+1}^{se}(\pi_{t+1}) - \frac{1-\gamma(\bar{\theta})}{\rho}\phi_t \right] dF(\pi_{t+1}) \right\} \quad (23)$$

After some rearranging we get:

$$[1 - \gamma(\bar{\theta})](1+\rho)\phi_{t-1} = (1+\rho)\rho(b_{t-1} - \psi_t^{se}(s_t)) + (1 - \gamma(\bar{\theta}))\phi_t + s_t^{se}[1 - F(\phi_t)] \int_{\phi_t}^{\infty} \left[ \rho V_t^{se}(\pi_{t+1}) - (1 - \gamma(\bar{\theta}))\phi_t \right] dF(\pi_{t+1}) \quad (24)$$

To find the optimal reservation wage, we again need to derive the first-order conditions. With the optimal reservation wage implying indifference between the value functions for becoming self-employed and for remaining unemployed (when $V^{se}_{u,t+1} = V^{u}_{t+1}$), we can further solve for the optimal search intensity (taking the derivative of Equation (24) for $s_t$ at the reservation wage $\phi_{t-1}$):

$$(1+\rho)\rho\,\psi^{se'}_{t-1}(s_{t-1}) - [1-F(\phi_{t-1})]\int_{\phi_{t-1}}^{\infty}\left[\rho V^{se}_{t}(\pi_t) - (1-\gamma(\bar{\theta}))\phi_{t-1}\right]dF(\pi_t) = 0 \tag{25}$$

As mentioned in the main text, an unemployed individual receives a constant benefit $b_t$ for a duration $d$. When $t \geq d = PBD$, the benefit drops to a lower and constant level. This illustrates the importance of duration $d$. Since the reservation wage and the optimal search intensity are two choice variables that directly influence the value for employment, we are interested in their behavior over the unemployment duration spell $d$.

Exploiting the fact $V^{u}_{t+1} = \frac{(1-\gamma(\bar{\theta}))}{\rho}\phi_t$ , the first order condition for the optimal reservation path is given by:

$$\frac{\partial \phi_t}{\partial d} = \frac{\partial V^{u}_{t+1}}{\partial d}\frac{\rho}{(1-\gamma(\bar{\theta}))} \tag{26}$$

Taking the total derivative of Equation (25) with respect to $d$, we get for the optimal search intensity path:

$$\frac{\partial s_t}{\partial d} = -\frac{\partial \phi_t}{\partial d}\frac{[1-F(\phi_t)]^2 + f(\phi_t)\int_{\phi_t}^{\infty}\left[\rho V^{se}_{t}(\pi_t) - (1-\gamma(\bar{\theta}))\phi_t\right]dF(\pi_t)}{(1+\rho)\rho\,\psi''_t(s_t)} \tag{27}$$

Again when unemployment benefit duration increases and there is chance of not finding a job when benefits expire, we expect that $\frac{\partial V^{u}_{t+1}}{\partial d} > 0$. With $\rho$ being the discount rate taking values $< 1$ and $[1-\gamma(\bar{\theta})]$ being the probability of startup success that is higher than $\rho$, the whole fraction is $\frac{\rho}{(1-\gamma(\bar{\theta}))} < 1$. The denominator becomes larger, the higher an individual's ability $\theta$. Equations (26) and (27) show that searching market opportunities for self employment exhibits a smaller unemployment duration dependence of the reservation wage path ($\frac{\partial \phi_t}{\partial d}$) and also a less negative duration dependence of the search intensity path ($\frac{\partial s_t}{\partial d}$).

This implies that given Equation (20) the effect of unemployment duration on the value of searching for self-employment should be negative but less than in the case of searching for employment (compare Equation (19))

$$\frac{\partial V^{e}_{ut}}{\partial d}|\theta < \frac{\partial V^{se}_{ut}}{\partial d}|\theta < 0 \tag{28}$$

In other words, this model implies negative duration dependence when searching for self-employment out of unemployment, however, it is less negative than the duration dependence when searching for employment. This leads to the implications as described in the main text in Section 5. Thus, $\frac{\partial V^{se}_{ut}}{\partial d}$ is larger than in the case of searching for employment, i.e. there is a higher UI duration elasticity - which is in line with our empirical results in Section 4.