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David Margolis, Victor Saldarriaga

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Minimum Wages and Contract Duration in Germany

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JEL Codes: J23, J30, J38, J63.

Keywords: Minimum Wage, Employment Contracts, Job Duration, Turnover.



Minimum Wages and Contract Duration in Germany

David N. Margolis*and Victor Saldarriaga†

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Abstract

We assess the effect of the introduction of a minimum wage policy of 8.50 EUR/hour in Germany in January 2015 on the probability of transitioning from fixed-term to open-ended contracts. Utilizing administrative data from social security records, we compare ex-ante affected (i.e., those earning below the minimum wage) workers against unaffected ones during the pre-implementation period, and find a significant decline in the probability that ex-ante affected workers employed under fixed-term contracts transition to open-ended contracts as the ending month of their fixed-term contract approaches January 2015, when the minimum wage policy was enforced. We interpret our empirical results through the lens of a job search model where firms use fixed-term contracts as a probation phase to learn about the match-specific productivity with a given worker. In this model, firms sign open-ended contracts based on a productivity threshold rule. A sufficiently high minimum wage can push this threshold up, thus reducing the probability at which workers transition from fixed-term to open-ended contracts.

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*Paris School of Economics, CNRS and IZA. Address: 48 boulevard Jourdan, 75014 Paris, France. E-mail: David.N.Margolis@gmail.com. Telephone: +33 1 80 52 18 58

†University of Edinburgh. E-mail: Saldarriaga.Victor@gmail.com.

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1 Introduction

Employment contracts play a crucial role in protecting jobs as they provide workers legal tools to increase job stability and mitigate the costs of job displacement (OECD, 2013). In Europe, where employment contracts are a legal requirement, workers can be hired under fixed-term or open-ended contracts (hereafter, FTCs and OECs respectively). The key differences between these two contractual arrangements is that the former is often used as a probation job period, has a predefined duration and is not subject to severance payments at termination.¹ Thus, employers tend to be cautious about who they hire under OECs because of the elevated separation costs; as such, labor market policies involving compensation costs can distort employers’ decisions related to contractual arrangements.

In the presence of a binding minimum wage, employers may become even more stringent when deciding which workers to hire under OECs. The reason is that this policy could push market wages above the productivity level of certain workers. In such a case, employers could prefer offering these workers FTCs as a measure to prevent future losses from over-compensation². Consequently, and depending on employers’ responses, these policies may reduce the job security of workers in the long-run.

In this paper, we investigate this possibility in the context of Germany, where a nationwide statutory minimum wage of 8.50 EUR/hour affecting roughly 15 percent of workers was introduced starting on January 01, 2015. While past work has focused on assessing the employment (Ahlfeldt et al., 2018; Caliendo et al., 2019) and wage (Fedorets and Shupe, 2021; Dustmann et al., 2022; Caliendo et al., 2023) effects of this regulation, finding positive wage redistributive effects with no associated reduction in employment, there is still limited evidence on its effects on margins such as contractual arrangements and job duration. To our knowledge, ours is the first study that analyzes such impacts.

In our empirical analysis, we aim at assessing the effect of the announcement of the implementation of the minimum wage policy on the probability that workers currently working under FTCs are offered OECs by their employers immediately after the expiration of their employment contracts. That is, we are interested in evaluating the effect of the minimum wage policy on the FTC-to-OEC transition probability in the period before it was enforced. We estimate this effect by comparing the FTC-to-OEC transition probability across workers

¹Unlike in Europe, workers in the U.S. are “employed at will,” which means that, by default, their employment can be terminated without notice and for any reason (other than a protected one such as gender, race, religion, etc.). Employees can also terminate their employment the same way.

²Alternative employer responses, such as providing training to improve worker productivity above the minimum wage level, are not addressed in this paper.

who were ex-ante affected with those who are not ex-ante affected not by the minimum wage policy — that is, those earning below and above the 8.50 EUR/hour threshold respectively — and over different contract expiration dates, using administrative data from the Weakly Anonymous version of the Sample of Integrated Biographies (SIAB-7521), assembled by the German Institute for Employment Research, over the period 2013-2014.

Our results suggest that the probability of transitioning from a FTC to an OEC declined among ex-ante affected relative to non-affected workers as the expiration date of the FTC approaches January 01, 2015 (i.e., the minimum wage policy enforcement date). In particular, we find that, after netting out seasonal effects, moving the ending date from July 01 to December 31 of the year 2014 reduces by 35 percent the probability that workers who are employed under a FTC and earn below the minimum wage transition to an OEC relative to workers who are employed under a FTC and earn at or above the minimum wage. Further analysis indicates that ex-ante affected workers employed under a FTC with expiration date December 2014 have a 10 percent lower probability of transitioning to an OEC relative to non-affected workers in comparison to what is observed in the same month of the previous year. These results are robust to different falsification tests.

We then interpret our empirical findings through the lens of a job search model with contract types and learning during the job spell. In this model, workers and firms initially observe a signal about the match-specific productivity once they meet in the labor market, and they utilize FTCs as a probation phase to learn about the underlying productivity. At the end of the probation period, firms decide whether to offer OECs to workers or not based on a threshold rule. A minimum wage policy has two effects in this setting. The first and most salient effect is the compression that the minimum wage generates in the wage distribution by means of raising its lower limit. In a wage-bargaining model, such as the one we present, this effect is akin to an increase in the bargaining power of workers who are sufficiently productive but are paid below the implicit minimum wage (Lee, 1999; Flinn, 2010; Autor et al., 2016; Cengiz et al., 2019). A second, indirect effect is that the minimum wage induces a change in the threshold values for signing both FTCs and OECs. As firms must pay workers at or above the wage floor, this imposes minimum productivity thresholds for hiring workers (Clemens et al., 2021; Gopalan et al., 2021; Kudlyak et al., 2023). These changes in the hiring standards of firms induced by the minimum wage policy can have broader implications in terms of transition probabilities and match formation, and may affect the job stability of workers in the long term.

We further deepen the analysis on employment trajectories among workers who did not

make a FTC-to-OEC transition and find no changes in the probability that ex-ante affected workers are laid off or get their employment contracts renewed/extended after the expiration of their FTCs. However, we find an increase of 40 percent in the probability that these workers are hired under a FTC by another firm relative to non-affected workers when their contract’s expiration date falls in December 2014. Together, these results indicate that, while ex-ante affected workers are not more likely to enter unemployment at the end of their FTCs, they are more likely to transition across consecutive FTCs as a result of the implementation of the minimum wage policy. This result may suggest that the minimum wage policy affected the job stability of low-wage — presumably low-skill — at least in the short to medium term.

By examining changes in margins associated with contractual arrangements that arise from the inception of a minimum wage policy, our work relates to different strands of the labor literature. First, our study links to the literature on partial employment reforms in European countries (Saint-Paul, 2000; Blanchard and Landier, 2002; Cahuc and Postel-Vinay, 2002; Dolado et al., 2002; Bentolila et al., 2019; Daruich et al., 2023). We contribute to this literature by documenting how, when combined with wage floors, the availability of FTCs may reduce workers’ employment stability. Second, our study relates to the literature on firm responses to minimum wage increases (Clemens, 2021). We add to this line of work by examining changes in contractual terms induced by the implementation of a minimum wage policy and showing how employers resort to FTCs, when available, as a way of reducing the risk of overcompensation.³ Third, our work also touches the literature on labor turnover effects of minimum wages (Portugal and Cardoso, 2006; Brochu and Green, 2013; Dube et al., 2016). In particular, we propose a novel mechanism through which minimum wages may increase labor turnover — a rise in firms’ hiring standards — and how workers are more likely to transition across consecutive FTCs in the presence of such policy.

The remainder of the paper proceeds as follows. In section 2, we discuss the institutional and legal context of our study. In section 3, we describe the data and the measures utilized for empirical purposes. In section 4, we describe the empirical methodology that we use to estimate the effect of the introduction of the minimum wage policy on the probability of transitioning from fixed-term to open-ended contracts. We discuss the results from the empirical analysis in section 5. We present the theoretical model of learning and contract length that will guide the interpretation of our empirical results and present further empirical

³The bulk of this literature has focused on assessing the effects of raising minimum wages on price adjustment (MaCurdy, 2015; Harasztosi and Lindner, 2019; Renkin et al., 2022), hours of work (Couch and Wittenburg, 2001; Gopalan et al., 2020), non-cash compensation (Royalty, 2001; Simon and Kaestner, 2004), and job amenities (Coviello et al., 2022), there is still scant evidence on how contracting arrangements respond to minimum wage changes.

evidence in section 6. In section 7 we present the conclusions of the study.

2 Institutional and Legal Context

2.1 Introduction of the Minimum Wage Policy in Germany

The Minimum Wage Law was passed by the German Parliament on July 03, 2014.⁴ The minimum wage was set to 8.50 EUR/hour and became effective in January 01, 2015. Roughly 15 percent of workers in Germany earned below the statutory minimum wage at the time of its introduction (Destatis, 2016), and the ratio of the minimum to median wage in the year 2015 was estimated at 0.48 (OECD, 2019).

Prior to the minimum wage policy, wage floors were sector-specific and set by collective agreements. Most sector-specific wage floors were higher than the statutory minimum wage, making workers employed in such sectors unaffected by it (Frings, 2013; vom Berge et al., 2013).⁵ Yet, some sectors, including agriculture and forestry, hairdressing, horticulture, laundry services, meat processing, and textile and clothing, were allowed to set wage floors below the national minimum over a determined period of time.⁶ At the individual level, exemptions of the minimum wage applied to workers under the age of 18, apprentices, interns, voluntary workers, and workers re-entering the workforce after a period of long-term (i.e., more than 12 months) unemployment.⁷ All other workers in Germany covered by social security as well as those considered marginally employed (i.e., earning a monthly salary less than 450 EUR, inclusive) were affected by the minimum wage policy.

Adjustments to the minimum wage level and revisions of the Minimum Wage Law are made by the Minimum Wage Commission, composed of members chosen by an advisory committee from the scientific community on a periodic basis. The German Customs Administration is the institution responsible for conducting inspections and audits of firms with

⁴The Minimum Wage Act (*Mindestlohngesetz* – MiLoG) was officially published in the Federal Law Gazette on August 11, 2014 (for more information, see https://www.gesetze-im-internet.de/englisch_milog/englisch_milog.html).

⁵In a recent work, Demir (2023) finds that some sector-specific wage floors were increased after the minimum wage policy was enacted in the year 2014.

⁶According to the German Federal Ministry of Labour and Social Affairs, these sectors set their corresponding wage floors at or above the national minimum wage in the following chronological order: (i) hairdressing (8.50 EUR in August 01, 2015); (ii) meat processing (8.50 EUR in October 01, 2015); (iii) laundry services (8.75 EUR in July 01, 2016); (iv) textile and clothing (8.50 EUR in November 01, 2016); (v) agriculture and forestry (8.50 EUR in January 01, 2017); and (vi) horticulture (8.50 EUR in January 01, 2017).

⁷For an assessment of the exemption of the minimum wage policy for the long-term unemployed, see Umkehrer and vom Berge (2020).

the aim of enforcing compliance with this and other employment laws. According to the Labour and Employment Law, minimum wage violations can be punished with a fine of up to 500,000 EUR for employers.⁸

Changes to the minimum wage were observed between the years 2017 and 2022, the most significant of which occurring in October 01, 2022. In that period, the minimum wage was set to 12.00 EUR/hour — an increase of 14.8 percent relative to the previous level of 10.45 EUR/hour set in July of the same year. As of January 2023, Germany had the second highest minimum wage (calculated on a monthly basis) among countries members of the European Union (EU) with a minimum wage legislation, just behind Luxembourg.⁹

2.2 Fixed-term Employment Contracts

Our analysis focuses on hiring under a FTCs. In Germany, the first attempt to regulate temporary hirings was enacted before reunification by the West German Employment Promotion Act in the year 1985. This law was passed during a period of sustained increase in unemployment, with the aim fostering employment through increased labor market flexibility and reduced employment protection controls.¹⁰

The German Part-time and Fixed-term Employment Act (*Teilzeit- und Befristungsgesetz* – TzBfG), adopted on December of the year 2000, is the current legal framework that serves to regulate FTCs. Regarding fixed-term work, the act distinguishes between FTCs with (*mit Sachgrund*) and without (*ohne Sachgrund*) “valid reasons.” FTCs with valid reasons include, but are not limited to, temporary replacements, seasonal workers, contractors, among others. By contrast, FTCs without a valid reason usually involve probation periods that employers use to test workers before offering permanent employment contracts.¹¹ A clear advantage over a permanent, open-ended contract (henceforth, OEC) is that, upon termination, an employer is not obliged to pay severance compensation to a worker hired under an FTC.

FTCs without a valid reason, however, are subject to some restrictions. In short, employ-

⁸See the following link for further information on the regulations contained in the Labour and Employment Law according to the German Federal Ministry of Labour and Social Affairs: <https://www.bmas.de/EN/Labour/Labour-Law/labour-law.html>.

⁹For further information on minimum wage levels across EU countries, see EUROSTAT’s minimum wage statistics at: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Minimum_wage_statistics.

¹⁰By 1985, the unemployment rate in Germany reached 8 percent (roughly twice of what was observed at the beginning of the decade); an unprecedented unemployment level only comparable to that of the post-war era (Paqué, 1990).

¹¹According to the German Dismissal Protection Act (*Kündigungsschutzgesetz* – KSchG), employers can unilaterally terminate an employment relationship under permanent contracts without paying severance compensation only within six months after initiating the employment contract.

ers may extend such employment contracts up to three times without exceeding a maximum of 24 months.¹² Furthermore, any extension must be agreed before the previous term expires; it is not possible, under any circumstance, to extend an already-expired FTC. Lastly, FTCs must be executed in writing, meaning that signatures in ink by both parties (i.e., the employer and employee) are required.

At present, FTCs are widely used as initial contractual arrangements between employers and employees in Germany. The most up-to-date study from the Institute for Employment Research (IAB for its German acronym) revealed that the share of FTCs in all employment relationships is around 10 percent, and nearly 40 percent of newly hired workers are employed under FTCs. Even more, the fraction of workers employed under FTCs taken on as permanent employees adds up to 45 percent, representing a rapid increase relative to the figure of 30 percent observed at the beginning of the decade (Gürtzgen et al., 2019). Germany belongs to the middle of the ranking regarding the rate of fixed-term jobs among EU countries, where the average is just under 11 percent.

3 Data and Measures

3.1 Data

For our empirical analysis, we utilize information from the “weakly anonymous” version of the Sample of Integrated Labor Market Biographies over the period 1975-2021 (SIAB-7521). This dataset consists of a 2 percent random sample drawn from the Integrated Employment Biographies (IEB) assembled by the IAB. The SIAB-7521 contains information on the history of labor market transitions for individuals in Germany, including employment and unemployment spells that are subject to social security contributions, benefit, or welfare receipt.¹³ Notably, the SIAB-7521 allows us to track the employment status of individuals to the exact day in any given year over the observation period (Graf et al., 2023).

For each individual, the SIAB-7521 contains a series of labor market episodes defined as spells. Each spell consists of a continuum of employment/non-employment periods, measured in days, within a particular calendar year. Thus, new spells are created when an

¹²Any employment relationship that exceeds the permitted 24 months under an FTC is assumed by law to be a permanent contract, even when the employer did not notify the social security administration about the change in the contractual arrangement.

¹³This also includes individuals officially registered as job-seekers at the German Federal Employment Agency and participating (or planning to participate) in programs related to active labor market policies but excludes civil servants as they are not subject to social contributions.

employment/non-employment period exceeds a total of 365 days (366 days in leap years) or spans the December 31-January 1 boundary; as a consequence, the great majority of spells in the original data structure have December 31 of each calendar year as their (mostly artificial) ending date.

To account for this feature of the data, we concatenate contiguous spells and eliminate breaks that arise from changes in calendar years. We also create episodes within spells that principally account for extensions of, or changes in, ongoing employment contracts, and further distinguish by chronological order in case parallel spells are observed.¹⁴ This reorganization procedure results in a dataset that is structured at the individual-by-order-by-spell-by-episode level. We provide a detailed explanation of our data reorganization procedure in Appendix A.

3.2 Sample Selection

In our empirical analysis, we are interested in estimating the change in the probability that a worker who is currently employed under a FTC is subsequently employed under an OEC by the same employer as we move closer to the date of the introduction of the minimum wage policy in Germany. In this respect, we focus primarily on spells that correspond to FTCs with an ending date prior to January 01, 2015 — the date when the minimum wage policy took place.

Our empirical sample comprises workers employed under FTCs with ending dates spanning the period from January 01, 2013 to December 31, 2014. We further restrict our focus to workers ages 18-64 years, who work in non-farming industries, who earn between 4.25 and 12.75 EUR/hour (i.e., low-wage workers), and who make social security contributions.¹⁵ Our resulting empirical sample comprises a total of 66,371 observations.

3.3 Outcome Variables

Our principal outcome variable is an indicator for whether the individual transits from a FTC to an OEC across different episodes within an spell. To construct this indicator, we inspect the job characteristics of the following episode and assign the value of 1 if the individual is employed in the same establishment under an OEC, and 0 otherwise. This outcome variable,

¹⁴Parallel spells can arise because of multiple jobs or overlap between ending and beginning dates of two consecutive jobs. Spells involving multiple simultaneous non-employment periods are represented by only a single episode.

¹⁵The last filtering criterion excludes apprentices, vocational trainees, interns, and workers in mini-jobs.

however, does not provide additional information on the worker’s employment profile in case she is not offered an OEC by her employer.

To further analyze the worker’s employment situation in case she is not offered an OEC by her employer, we construct two additional outcome variables. The first one is an indicator for whether the worker got her FTC renewed by her employer in the following episode. The second one is an indicator for whether the worker entered a non-employment period in the following spell. In the latter case, we further explore the length of the non-employment period as well as the characteristics of the employment contract after the joblessness period.

3.4 Treatment and Comparison Groups

We assign individuals to treatment and comparison groups according to their observed hourly wage levels. In the SIAB-7521, hourly wages are constructed as the ratio of the reported daily wages and hours worked. Information on hours worked was provided by the employer for the period 2010-2014. However, employers were allowed to report actual, contractual, or full-time equivalent working hours. To construct a harmonized measure of hourly wages, we follow the correction methodology described in vom Berge et al. (2023) which closely resembles the (contractual) hourly wage distribution obtained from the German Structural Earnings Survey.

Our treatment group corresponds to individuals who earn at least 4.25 EUR/hour but less than 8.50 EUR/hour during their FTC prior to January 1, 2015, and who would thus be affected by the minimum wage policy if their hourly wage were to remain unchanged once the policy was implemented. By contrast, our comparison group encompasses all individuals earning between 8.50 EUR/hour and 12.75 EUR/hour during their FTC before January 1, 2015. In a complementary robustness analysis, we expand the empirical sample to include workers earning between 12.75 and 16.00 EUR/hour.

3.5 Descriptive Statistics

In Table 1, we present sample means of socio-demographic and job characteristics for individuals in our empirical sample. We divide the sample means according to our assignment into ex-ante unaffected and affected by the minimum wage policy in columns 1 and 2, respectively. In column 3, we present the difference in means. The sub-group of ex-ante affected workers is characterized by having a higher share of women, attaining less education, and having a lower share of German citizens relative to the sub-group of unaffected ones. In

terms of job characteristics, a higher share of workers in the ex-ante affected workers are employed in part-time jobs and have a shorter job duration relative to unaffected ones.

4 Empirical Methodology

4.1 Continuous-time Regression Specification

In our first regression specification, we aim at estimating the change in the probability of transitioning from a FTC to OEC across workers who are to be affected and not by the minimum wage policy as we approach the minimum wage inception period of January 2015. Workers who are to be affected by the minimum wage policy are those whose wages are below 8.50 EUR/hour.

We estimate linear regressions of the form:

$$\begin{aligned} \text{OEC}_{id} = & \alpha_0 + \alpha_1 \cdot (t_{id} \times \mathbb{1}\{w_{id} \in \Omega_w\}) \\ & + \alpha_2 \cdot t_{id} + \alpha_3 \cdot \mathbb{1}\{w_{id} \in \Omega_w\} + X'_{id}\gamma + \varepsilon_{id}, \end{aligned} \quad (1)$$

where OEC_{id} is the indicator for transitioning from a FTC to an OEC, t_{id} is the number of days left to reach the minimum wage inception date (i.e., January 01, 2015), $\mathbb{1}\{w_{id} \in \Omega_w\}$ is an indicator for whether the individual's hourly wage falls below the minimum wage, X_{id} is an array of socio-demographic and job characteristics, and ε_{id} is an idiosyncratic error term.

In this regression specification we are particularly interested in $\hat{\alpha}_1$, the OLS estimate of the coefficient associated with the interaction term between the number of days left to reach the minimum wage inception date and the indicator for being ex-ante affected by the minimum wage policy. If the estimate of $\hat{\alpha}_1$ is positive and statistically significant, then this would imply that ex-ante affected workers are less likely to transition from a FTC to an OEC relative to non-affected workers in dates closer to January 01, 2015.

4.2 Time Event Study Design

We further examine changes in the probability of transiting from a FTC to an OEC as the ending date of the FTC approaches the minimum wage inception period of January 2015 by relaxing the assumption of a linear relation between the time to introduction of the minimum wage and the probability of transitioning to an OEC. To this end, we compare changes in the outcome variable in a given episode ending month in the year 2014 relative to that of

the same month in the year 2013, between workers who are ex-ante affected and not by the minimum wage policy. By comparing changes in the probability of transitioning from a FTC to an OEC across same calendar months in different years, we not only allow for a non-linear relationship between time to introduction of the minimum wage and the probability of transitioning to an OEC, we also remove confounding factors that pertain to the seasonality of labor demand.

Formally, we estimate linear regressions of the form:

$$\begin{aligned} \text{OEC}_{id} = & \beta_0 + \sum_{\tau=-11}^{-1} \beta_{1,\tau} \cdot (\mathbb{1}\{m(d) = \tau\} \times \mathbb{1}\{w_{id} \in \Omega_{\underline{w}}\}) \\ & + \sum_{\tau=-11}^{-1} \beta_{2,\tau} \cdot \mathbb{1}\{m(d) = \tau\} + \beta_3 \cdot \mathbb{1}\{w_{id} \in \Omega_{\underline{w}}\} + \sum_{m=2}^{12} \mu_m \mathbb{1}_m + X'_{id} \delta + e_{id} \quad (2) \end{aligned}$$

where $\mathbb{1}\{m(d) = \tau\}$ is an indicator for the episode ending month associated with date d , $m(d)$, being equal to the number of months left to January 2015 denoted by τ , $\mathbb{1}_m$ is an indicator for the calendar-month in which date d occurs, e_{id} is an idiosyncratic error term, and all remaining variables are defined the same as in equation (1).

In this regression specification, we are particularly interested in $\hat{\beta}_{1,\tau}$, the OLS estimates of the coefficients associated with the interaction term between the indicator for the episode ending months and the indicator for being ex-ante affected by the minimum wage policy. These coefficients trace-out the difference in the probability of transitioning from a FTC to an OEC over time, relative to that of the same month in the year 2013. If the probability of transitioning from a FTC to an OEC changes as one approaches the minimum wage period, then this should become apparent in estimates of $\hat{\beta}_{1,\tau}$ as $\tau \rightarrow 0$, where τ takes the value of 0 in January 2015. We identify these coefficients under the assumption that changes in the outcome variable would have evolved in parallel across ex-ante affected and non-affected workers had the minimum wage policy not been put in place.

4.3 Identifying Assumptions

As mentioned above, we require that trends in the probability of transitioning from a FTC to an OEC would have evolved in parallel had the minimum wage not been implemented in order to identify our effects of interest as captured by our estimates of $\hat{\alpha}_1$ and $\hat{\beta}_{1,\tau}$ from equations (1) and (2), respectively. This condition is known as the “parallel trends” assumption. In section 5.3, we provide a detailed assessment of compliance with this assumption by examining

differences in pre-trends (i.e., in years before the minimum wage policy implementation was announced) along with additional robustness checks.

Another important assumption that we make is that firms do not adapt their hiring behavior in the period prior to the introduction of the minimum wage by hiring *more* workers on FTCs, and paying them lower wages, than they would have done had the minimum wage never been introduced. Without this assumption, the extra hiring could increase the number of layoffs among workers employed under FTCs who are ex-ante affected by the minimum wage policy in December 2014 relative to that observed in the same month of the year 2013. This would result in biased estimates of $\hat{\alpha}_1$ and $\hat{\beta}_{1,\tau}$, as they would capture the excess layoffs observed just prior to the minimum wage implementation date for reasons simply due to a larger stock of potentially affected workers on FTCs, and not due to any direct effect of the minimum wage per se.

Though this assumption is not directly testable, in Appendix B.1 we provide evidence indicating that employers did not increase their short-term workforce by hiring low-wage workers in months preceding the implementation of the minimum wage policy. In Appendix Table B.1, we report differences in averages for a range of individual and job characteristics among workers whose FTCs ended in the third and fourth quarters of the year 2014 and those whose FTCs ended in the first half of the same year, before the implementation of the minimum wage policy was announced. The set of characteristics include markers for educational attainment (Panel A), job duration (Panel B), and compensation (Panel C). We do not find statistically significant differences in any of the compared characteristics among workers whose contracts ended during the third quarter of the year vis-à-vis workers whose contracts ended during the first half of the year 2014. Yet, we find that workers whose contracts ended during the fourth quarter of the year were more educated, had longer job durations, and were better paid than workers whose contracts ended during the first half of the year 2014. The latter result suggests that employers did not increase the hiring of low-wage — presumably low-skill — workers in anticipation of the implementation of the minimum wage policy.

4.4 Additional Regression Details

We perform different regression specifications based on equations (1) and (2). In each specification, we progressively add a range of controls to adjust for individual as well as employment characteristics.

Our most parsimonious specification includes the main interaction term as well as main

effects for the number of days/months left to the minimum wage implementation period, the indicator for being ex-ante affected by the minimum wage policy and the indicator variables for the calendar month of contract expiration. In a second specification, we control for worker socio-demographic characteristics in the regressions. In particular, we condition on: an indicator for being a female, indicators for age groups (20-24 years; 25-29 years; 30-34 years; 35-39 years, 40-44 years; 45-49 years; 50-54 years; 55-59 years; 60-64 years; base: less than 20 years), indicators for educational attainment (less than high school; high school diploma; some college or higher education; base: no information on educational attainment), an indicator for German nationality, and indicators for state of residence.¹⁶ In a third specification, we add job characteristics as conditioning variables in the regressions. This set of characteristics include: an indicator for a part-time job, indicators for spell duration (12-23 months; 24-35 months; 36-47 months; 48-59 months; 60 months or more; base: 12 months or less), indicators for occupation main groups based on the German classification of occupations (KldB-2010), and indicators for major economic sections based on the European classification of economic activities (NACE-2).¹⁷ Lastly, in our most stringent specification, we add individual and establishment fixed effects, computed by the IAB based on the methodology proposed by Abowd et al. (1999), as conditioning variables in the regressions.

5 Main Results

5.1 Continuous-time Regression Results

In Table 2, we report estimates of the change in the probability of transitioning from a FTC to an OEC induced by the announcement of the minimum wage policy from the continuous-time regression specification based on equation (1). For ease of readability, all reported coefficients and standard errors are scaled by a factor of 1,000.

Our results indicate that the probability of transitioning from a FTC to an OEC increases for workers who are ex-ante affected by the minimum wage policy as one moves farther away from the implementation period (i.e., January 01, 2015). Put differently, the probability that a worker who was employed under a FTC transitioned to an OEC at the end of the probation period decays as the contract ending day approached January 01, 2015. Specifically, the probability of transitioning from a FTC to an OEC decreases by around 0.140/1000 per-

¹⁶There are a total of sixteen German federal states.

¹⁷There are thirty-seven occupation main groups (2-digit code *Berufshauptgruppen*) according to the KldB-2010 classification and twenty-one sections of economic activities according to the NACE-2 classification.

centage points with each day that goes by for ex-ante affected workers relative to unaffected ones. This estimate remains fairly stable across our different regression specifications.

In terms of magnitudes, these results imply that moving the ending date of the FTC from July 01, 2014 to December 31, 2014 would reduce the probability of transitioning to an OEC by 2.50 percentage points (35 percent relative to the implied mean of 7.30 percentage points) for ex-ante affected workers. In estimating this effect, we assumed that this effect decays linearly over time. In the next sub-section we present the results from the time event study which accounts for the possibility of non-linear effects over time.

5.2 Event Study Results

In Figure 1, we plot estimates of $\hat{\beta}_{1,\tau}$, along with their 95 percent confidence intervals, from our most stringent regression specification based on equation (2). We obtain these estimates from our most stringent regression specification that includes the full set of conditioning variables (i.e., socio-demographic characteristics, job characteristics, and AKM worker and establishment fixed effects).

The figure shows that the probability that ex-ante affected workers employed under a FTC transition to an OEC declines in the months of June through December of the year 2014 relative to what is observed in the same months during the year 2013. On average the probability that an ex-ante affected worker transition to an OEC is 0.70 percentage points lower than that observed in the same months of the previous year — a decline of roughly 10 percent relative to the implied mean of 7.30 percentage points. Interestingly, this effect is stable across all months during the second half of the year 2014, implying that the response to the announcement of the implementation of the minimum wage policy was almost immediate, and the similar effect in June of 2014, before the policy was adopted, suggests that employers were already anticipating its adoption before the law was actually enacted. Even more, based on F-tests of joint significance, we cannot reject the null-hypothesis that the estimated coefficients of $\hat{\beta}_{1,\tau}$, for $\tau = 2, \dots, 6$, equal 0; this result implies that, previous to the announcement period, the effect of the implementation of the minimum wage policy did not affect the probability of observing FTC-to-OEC transitions.

5.3 Robustness Checks

We perform a series of robustness checks, in the form of falsification tests, to provide supporting evidence in favor of our identifying assumptions.

5.3.1 Pre-implementation Period

We first test for parallel pre-trends in the outcome variable by analyzing the change in the probability of transitioning from a FTC to an OEC across ex-ante affected and unaffected workers in years prior to the announcement of the implementation of the minimum wage policy. To that end, we perform linear regressions of the form of equations (1) and (2) using data from the years 2011 through 2013. In particular, we set January 01 of the years 2013 and 2014 as our false minimum wage implementation periods (i.e., same date but in the years preceding the implementation of the minimum wage policy) with the aim of comparing inter-temporal changes in the probability of transitioning from a FTC to an OEC across ex-ante affected and unaffected workers.¹⁸

We present the results from these falsification tests in Table 3. In columns 1 and 2, we present the results arising from comparing inter-temporal changes in the outcome variables across the years 2012 and 2011. In columns 3 and 4, we present the results when comparing the years 2012 and 2013. We do not find statistically significant effects for the estimates of $\hat{\alpha}_1$ or $\hat{\beta}_{1,\tau}$ in any of our regression specifications that utilize data from the pre-implementation periods. Based on F-tests, we cannot reject the null hypotheses that estimates of $\hat{\beta}_{1,\tau}$, for $\tau = 2, \dots, 12$, are jointly equal to zero when using data from the years 2011-2012 and 2012-2013. These results provide support for our parallel trends identification assumption.

5.3.2 Ex-ante Unaffected Workers

Next, we analyze changes in the probability of transitioning from a FTC to an OEC among workers ex-ante unaffected by the minimum wage policy. To do so, we exclude from our empirical sample all workers earning below the minimum wage threshold and define different placebo treatment groups. We set a first placebo treatment group to be all workers earning between 8.50 and 10.625 EUR/hour. We next introduce some variations to our empirical sample, dropping all workers earning between 8.50 and 10.625 EUR/hour and adding workers earning between 12.75 and 16.00 EUR/hour. In this modified sample, we set a second placebo treatment group to be all workers earning between 10.625 and 12.75 EUR/hour. Note that, in all cases, our placebo treatment and control groups are comprised of workers earning at

¹⁸We consider two separate 2-year intervals, 2011-2012 and 2012-2013, for two reasons. By examining 2011-2012, we are further from the actual implementation date of 2015 and thus less likely to be influenced by any minimum wage discussion that may have been present at the time. However, as this period is closer to the onset of the great recession, macroeconomic conditions may be quite different in 2011 than they were in 2014. We thus use the 2012-2013 comparison to capture a period in which macroeconomic conditions more closely resemble the 2013-2014 analysis period.

or above the minimum wage threshold.

We present the results from these falsification tests in Table 4. In columns 1 and 2, we present the results arising from setting the placebo treatment group to be composed of workers earning between 8.50 and 10.625 EUR/hour. In columns 3 and 4, we present the results arising from setting the placebo treatment group to be composed of workers earning between 10.625 and 12.75 EUR/hour. We do not find statistically significant effects among the sub-group of ex-ante unaffected workers. Based on F-tests, we cannot reject the null hypotheses that estimates of $\hat{\beta}_{1,\tau}$, for $\tau = 2, \dots, 12$, are jointly equal to zero when re-defining the empirical sample to include workers whose hourly wages are in the range $[8.50 - 12.75]$ EUR/hour and $[10.625 - 16.00]$ EUR/hour. These results provide further evidence in support of our identifying assumptions.

5.4 Discussion

To sum up, we find evidence indicating that low-wage workers employed under FTCs were less likely to transition to an OEC in months preceding the implementation of the minimum wage policy in Germany. In particular, our results indicate that the probability of transitioning from an FTC to an OEC among ex-ante affected workers declined relative to that of unaffected ones in the months following the announcement (but before the implementation) of the introduction of a minimum wage policy in Germany in the year 2014. This result seems to be particular to a given period (i.e., the second half of the year 2014) and population (i.e., ex-ante affected workers), adding support to the hypothesis that the minimum wage policy affected employers' decisions to offer more stable job contracts to workers.

6 A Job Search Model with Contract Types

To further understand the empirical results presented in section 5, we construct a simple model of job search where employers can choose the employment contract type they offer to prospective workers. In this model, employers initially hire workers under a FTC to learn about the match-specific surplus; that is, FTCs serve as a learning and/or trial phase. We derive some theoretical results that are consistent with our empirical findings and provide additional empirical insights supporting the predictions of our model.

6.1 Economic Environment

The economy is set on an infinite-horizon period where time is discrete. In this economy, there are two types of ex-ante homogeneous, infinitely-lived agents: workers and firms. Both agents are risk neutral and discount per-period utility at a constant rate $\beta \in (0, 1)$.

All unemployed workers search for a job, and there is no on-the-job search. Also, job search is costless. Firms initially hire workers under FTCs that can last for one period only. FTCs serve as a time to learn about the match-specific productivity (i.e., a probation or trial phase) that is revealed at the end of the period. After observing the match-specific productivity, firms decide whether to offer workers OECs or terminate the employment relationship. In the latter case, workers return to unemployment and search for jobs in the following period.

At meeting, workers and firms draw a match-specific productivity value x from a CDF denoted by $F(x)$, with corresponding PDF denoted by $f(x)$, defined over the interval $[\underline{x}, \bar{x}]$ with mean μ_x and standard deviation σ_x . The value of x is only observed by workers and firms at the end of the period (i.e., at the end of the fixed-term contract). Instead, at meeting, agents observe a signal $\tilde{x} = x + \varepsilon$, where ε is a random variable, independent of x , drawn from a distribution with CDF denoted by $G(\varepsilon)$, with corresponding PDF denoted by $g(\varepsilon)$, defined over the interval $[\underline{\varepsilon}, \bar{\varepsilon}]$ with mean μ_ε and standard deviation σ_ε .

Once firms and workers observe x at the end of the probation period, either firms offer workers the possibility of working under OECs or not. OECs are dissolved with exogenous probability δ and firms pay workers a severance payment equal to s upon match dissolution. The wage value offered to a worker who is employed under an OEC is determined via Nash bargaining, with workers having a fixed bargaining power equal to γ .

The measure of meetings in the labor market is governed by the matching function:

$$m(u, v) = \psi (u^\alpha v^{1-\alpha}) ,$$

which implies that each worker meets a firm with probability $\lambda(\theta) = m(u, v)/u$ and each firm meets a worker with probability $q(\theta) = m(u, v)/v$, where $\theta = v/u$ is the tightness ratio in the labor market and is determined in equilibrium.

6.2 Model Assumptions

We make three assumptions to ease the exposition and interpretability of the model.

First, we assume that $\mu_\varepsilon = 0$. This assumption implies that, in expectations, the observed

signal \tilde{x} equals the underlying match-specific productivity x . In mathematical terms, this implies that $\mathbb{E}[\tilde{x}] = \mathbb{E}[x] = \mu_x$, given the assumed independence between x and ε .

Second, we assume that the wage value of a FTC with observed signal \tilde{x} , $w^F(\tilde{x})$, equals \tilde{x} . This assumption implies that firms pay newly hired workers a wage which equals the expected value of the match-specific productivity. This manner firms make ex-ante profits equal to zero from hiring workers under FTCs.

Lastly, we assume that, in expectations, the present value of employment for a worker employed under a FTC equals her present value of unemployment. Formally, this assumption implies:

$$\int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} W^F(x + \varepsilon) g(\varepsilon) f(x) d\varepsilon dx = U,$$

where the left-hand side corresponds to the unconditional expected present value of employment under a FTC and the right-hand side corresponds to the present value of unemployment. Notice that, since workers are ex-ante homogeneous, both these elements are equal for all workers.

6.3 Value Functions

The present value of employment for a worker employed under an OEC with match-specific productivity equal to x , $W^O(x)$ can be written as:

$$W^O(x) = w^O(x, \gamma) + \beta \left[(1 - \delta) W^O(x) + \delta (s + U) \right],$$

where $w^O(x, \gamma)$ is the bargained wage flow value. With probability $(1 - \delta)$, the match is not dissolved and the worker gets the present value of employment under an OEC with the firm. With probability δ , the match is dissolved and the worker receives the severance payment and gets the present value of unemployment.

The present value of employment for a worker employed under a FTC with signal equal to \tilde{x} , $W^F(\tilde{x})$, can be written as:

$$W^F(\tilde{x}) = w^F(\tilde{x}) + \beta \left[\int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \mathbb{1} \{x + \varepsilon = \tilde{x}\} \max \{W^O(x), U\} g(\varepsilon) f(x) d\varepsilon dx \right],$$

where $\mathbb{1} \{.\}$ is the indicator function. This value is composed of the wage flow value, $w^F(\tilde{x}) = \tilde{x}$, plus the continuation value which depends on whether the worker is offered an OEC or

not at the end of the probation period.

The present value of unemployment for a job seeker, U , can be written as:

$$\begin{aligned} U &= b + \beta \left[(1 - \lambda(\theta)) U + \lambda(\theta) \int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \max \{W^F(x + \varepsilon), U\} g(\varepsilon) f(x) d\varepsilon dx \right] \\ &= b + \beta U, \end{aligned}$$

and is composed of a flow value of unemployment equal to b plus a continuation value that will depend on the probability of meeting a firm in the labor market and the signal that the worker and firm draw upon meeting. In expectations, the present value of employment for a worker employed under a FTC equals the present value of unemployment. The second line follows from this assumption.

Vacant firms incur in a fixed cost equal to c for advertising a job position in the labor market. If the firm does not meet a worker in the labor market or the meeting results in no hire, then the firm receives a value equal to zero. Thus, the present value of advertising a job position for a firm, V , is:

$$\begin{aligned} V &= -c + \beta q(\theta) \left[\int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \left((x + \varepsilon) - w^F(x + \varepsilon) + \beta \max \{J^O(x), 0\} \right) g(\varepsilon) f(x) d\varepsilon dx \right] \\ &= -c + \beta^2 q(\theta) \int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \max \{J^O(x), 0\} g(\varepsilon) f(x) d\varepsilon dx, \end{aligned}$$

where the expression in brackets is the expected present value of filling a job position (i.e., signing a FTC with a worker). With probability $q(\theta)$ the firm meets a worker in the labor market and gets the expected present value of filling a job position, which is composed of the expected match-specific flow value of production minus the compensation paid to the worker plus the discounted value of offering the worker an OEC at the end of the period, J^O , in case the realization of x is sufficiently high. The second line follows from the assumption that the firm pays the worker the expected flow value of production under a FTC.

The present value of a filled job position under an OEC for a firm with match-specific productivity equal to x , $J^O(x)$, can be written as:

$$\begin{aligned} J^O(x) &= x - w^O(x) + \beta \left[(1 - \delta) J^O(x) - \delta s \right] \\ &= \frac{x - w^O(x) - \beta \delta s}{1 - \beta (1 - \delta)}, \end{aligned}$$

which is composed of the flow value of production minus the wage paid to the worker under an OEC and minus the (discounted) severance pay in case the match is dissolved, all that discounted by the expected duration of the match.

6.4 Equilibrium

Define $S^\circ(x) = (W^\circ(x) - U) + (J^\circ(x) - V)$ as the surplus of a match on an OEC with match-specific productivity equal to x . Then, the set of feasible matches under OECs can be determined by the following condition: $S^\circ(x) \geq 0$. This condition implies that the gains from pairing exceeds the combined values of not forming the match for the worker and the firm. The gains from pairing equals the sum of the present value of employment for the worker and the present value of a filled job position for the firm: $W^\circ(x) + J^\circ(x)$. The combined value of not forming the match equals the present value of unemployment for the worker and the present value of advertising a job position for the firm: $U + V$. In equilibrium, the free entry condition implies $V = 0$. Then, $S^\circ(x)$ can be expressed as:

$$S^\circ(x) = \frac{x - b}{1 - \beta(1 - \delta)},$$

which implies that firms are willing to offer OECs to workers under the condition $x \geq b$. Any match-specific productivity below b would render the surplus of the match negative.

Similarly, the threshold value for hiring a worker under a FTC can be obtained from the assumption that, in expectations, the present value of employment for a worker employed under a fixed-term contracts equals her value of unemployment. Together with the fact that workers get a share γ of the surplus of OECs through bargaining, i.e. $W^\circ(x) - U = \gamma S^\circ(x)$, this assumption implies:

$$\begin{aligned} \int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} (x + \varepsilon) g(\varepsilon) f(x) d\varepsilon dx &= \int_{\underline{x}}^{\bar{x}} x f(x) dx \\ &= b - \beta \int_b^{\bar{x}} \gamma \left(\frac{x - b}{1 - \beta(1 - \delta)} \right) f(x) dx, \end{aligned}$$

where the first line follows from the independence between x and ε , and the second line follows from the present value of $S^\circ(x)$ and its limits over the support of x . Further, this assumption uniquely pins down the value of μ_x ; any signal \tilde{x} below this value will not end up in a hire. For ease of exposition, we refer to this value as \tilde{x} . It is important to note that $\tilde{x} \leq b$.

An equilibrium for this economy consists of three equations: a wage equation, an equilibrium unemployment equation, and an equilibrium tightness ratio equation. The wage equation follows from Nash bargaining given γ , and implies:

$$w^o(x, \gamma) = \gamma x + (1 - \gamma) b - \beta \delta s,$$

which is a weighted average of the flow values of employment and unemployment minus the discounted expected value of the severance payment. The equilibrium tightness ratio follows from the free-entry condition, $V = 0$, and implies:

$$\theta^* = \left[\frac{\beta^2 \psi}{c} \left(\int_b^{\bar{x}} (1 - \gamma) \left[\frac{x - b}{1 - \beta(1 - \delta)} \right] f(x) dx \right) \right]^{\frac{1}{\alpha}},$$

which uses the fact that $J^o(x) = (1 - \gamma) S^o(x)$. Lastly, the equilibrium unemployment follows from equating inflows to and outflows from unemployment, and implies:

$$u^* = \frac{\delta}{\delta + \lambda(\theta) \Sigma},$$

where the expression for Σ in the denominator is:

$$\Sigma = \left[\int_b^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \mathbf{1} \{ (x + \varepsilon) \geq \tilde{x} \} g(\varepsilon) f(x) d\varepsilon dx + \delta \left(\int_{\underline{x}}^{\bar{x}} \int_{\underline{\varepsilon}}^{\bar{\varepsilon}} \mathbf{1} \{ (x + \varepsilon) \geq \tilde{x} \} g(\varepsilon) f(x) d\varepsilon dx \right) \right],$$

which implies that, for any u^* , there is only one v^* that satisfies the equilibrium pair (u^*, θ^*) given the set of model parameters and distributions.

6.5 Employment Effects of a Minimum Wage Policy

We now turn to examine the effect of imposing a minimum wage policy in the economy. Our goal is to analyze how the probability of transitioning from a FTC to an OEC changes once the minimum wage policy is enacted.

Let w^{MW} be the statutory minimum wage level. Define x^{MW} as the productivity level such that $w^o(x^{\text{MW}}, \gamma) = w^{\text{MW}}$. In words, x^{MW} is the productivity level whose corresponding bargained wage equals w^{MW} . Further, define $\underline{x}^{\text{MW}}$ as the productivity level such that $w^o(\underline{x}^{\text{MW}}, 1) = w^{\text{MW}}$. This is the productivity level that makes the bargained wage equal to w^{MW} when $\gamma = 1$; that is, when the worker has all the bargaining power (i.e., no monopsony power from the firm). Lastly, define $\gamma_{(x)}^{\text{MW}}$ as the bargaining power value such that

$w^o(x, \gamma_{(x)}^{\text{MW}}) = w^{\text{MW}}$. From this definition, $\gamma_{(x)}^{\text{MW}}$ is the bargaining power value that makes the bargained wage equal to w^{MW} when the productivity level is x .

From the expression of $S^o(x)$, a statutory minimum wage such that $\underline{x}^{\text{MW}} > b$ would increase the productivity threshold for signing OECs. In such case, any productivity value $x \in [b, \underline{x}^{\text{MW}})$ would require the firm to transfer part of her value, $J^o(x)$, to the worker to afford paying her the minimum wage. Thus, any worker employed under a FTC whose match-specific productivity belongs to this set will not be offered an OEC at the end of the probation period — this would not occur in the absence of the minimum wage policy. By contrast, a statutory minimum wage such that $\underline{x}^{\text{MW}} \leq b$ would cause no change in the probability of transitioning from a FTC to an OEC.

Further, under the assumption that firms do not pay workers employed under a FTC wages greater than the signal and that \tilde{x} is the lowest value of the signal that results in a FTC hire, a statutory minimum wage such that $w^{\text{MW}} > \tilde{x}$ would increase the productivity threshold for signing FTCs. In particular, any signal $\tilde{x} \in [\tilde{x}, w^{\text{MW}})$ drawn after a meeting between a worker and a firm will not end up in a hire since firms are not willing to pay workers more than their expected productivity (recall that, in expectations, firms make zero profits from employing workers under FTCs). By the same token, any statutory minimum wage such that $w^{\text{MW}} \leq \tilde{x}$ would not produce any employment change in the economy as firms are still willing to pay at or above the minimum wage to workers employed under FTCs.

In Figure 2, we depict the changes in the productivity threshold values generated by the introduction of a minimum wage policy. In Panel A, we depict the change in the match-specific productivity threshold for signing OECs, once the value of x is revealed. In Panel B, we depict the change in the match-specific signal threshold for hiring workers under FTCs. A minimum wage policy that pushes the threshold value for signing OECs above b would reduce the probability that workers currently hired under FTCs transition to OECs after the implementation of this policy. In such case, all workers whose match-specific productivity lies in the set $[b, \underline{x}^{\text{MW}})$ would no longer be able to sign an OEC after the minimum wage policy is enacted. Similarly, a wage floor that pushes the threshold value for signing FTCs above \tilde{x} would reduce the probability that meetings in the labor market end up in hires for all unemployed workers in the economy. As a result, the effect of introducing a minimum wage policy on the probability of transitioning from a FTC to an OEC in the medium run (accounting for the effects on both FTCs and OECs) is ambiguous and would depend on how both of these thresholds move.

6.6 Additional Empirical Results

Our empirical results indicate that the probability of transitioning from a FTC to an OEC declined before the implementation of the minimum wage policy. This result is in line with the first prediction of the model: that the minimum wage policy reduced FTC-to-OEC transitions among workers employed under FTCs. We next perform additional regressions to provide additional insights on workers' job profiles after the announcement of the introduction of the minimum wage policy.

We begin by analyzing how the educational attainment of workers who made a FTC-to-OEC transition changed in the months preceding the implementation of the minimum wage policy. We perform regressions of the form of equation (2) using an indicator for college education as the dependent variable, restricting our focus to those who made an FTC-to-OEC transition. We graphically show the results in Figure 3. We do not find statistically significant effects on the fraction of workers with college education, which implies that the composition of workers in terms of educational attainment did not change in favor of high-skill ones at least during the pre-implementation period.

We further explore the employment trajectories of workers who were not offered OECs at the end of their trial period. Specifically, we analyze whether these workers were offered an extension/renewal of their FTCs or were laid off (i.e., transitioned into a non-employment state) at the end of their trial period. We present the results from these regressions in Panels A and B of Figure 4, respectively. We do not find statistically significant effects of the implementation of the minimum wage policy on the probability that ex-ante affected workers who did not make an FTC-to-OEC transition were offered an extension of their previous employment contract or were laid off at the end of their trial period.

Lastly, we explore whether workers who were laid off by their previous employer were hired by another firm under an FTC. We graphically present the results in Figure 5. We find that the probability of being hired under a FTC with another firm in the following job spell increased by 3.25 percent (40 percent relative to the implied mean) among ex-ante affected workers whose trial period expired in December 2014 and did not make a FTC-to-OEC transition. This additional piece of evidence indicates that workers were more likely to transit across FTCs in response to the implementation of the minimum wage policy, which is consistent with the idea of these workers drawing a new signal that is sufficiently high to allow employment on an FTC even in the presence of the minimum wage.

7 Conclusions

We analyze how the probability of transitioning from a FTC to an OEC changes across workers earning below and above the minimum wage of 8.50 EUR/hour introduced in Germany in the year 2015. Our results indicate that workers employed under a FTC contract who earn below this wage floor have a lower probability of transitioning to an OEC as the end date of the job trial period approaches January 01, 2015 — the date when the minimum wage policy was enforced.

We link our empirical results to a model where employers utilize FTCs as a trial period to learn about the match-specific productivity and decide to offer workers OECs based on the realization of this variable using a threshold rule. A minimum wage policy raises the productivity threshold for OECs, thus lowering the probability that workers transition from a FTCS to an OEC contracts among those who were already employed on FTCs when the minimum wage law was introduced.

In a complementary analysis, we do not find changes in the probability that workers who did not make a FTC-to-OEC transition extended/renewed their previous FTCs nor in the probability that these workers were laid off by their employers at the end of their trial period. We did however, find that workers who did not make a FTC-to-OEC transition at the end of their trial period were hired by other firms also under FTCs. This result may suggest that the probability that workers transition across FTCs increased in response to the implementation of the minimum wage policy, leading to increased job instability but not higher unemployment.

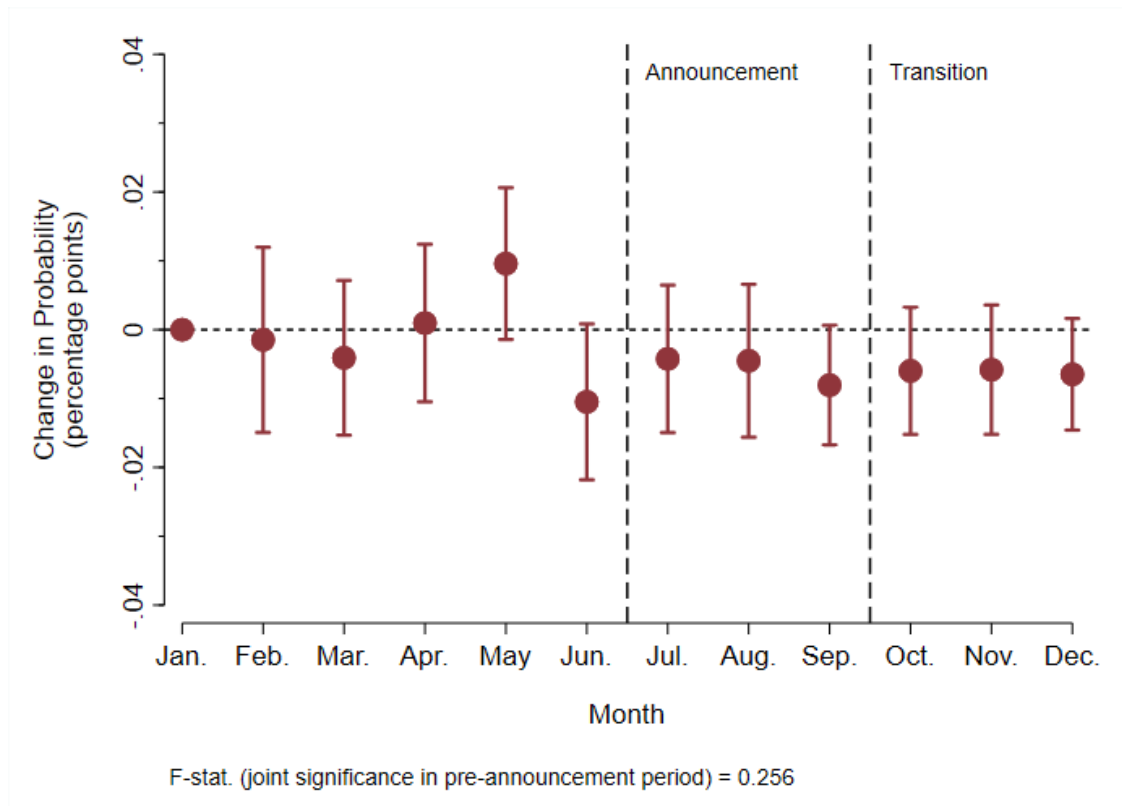
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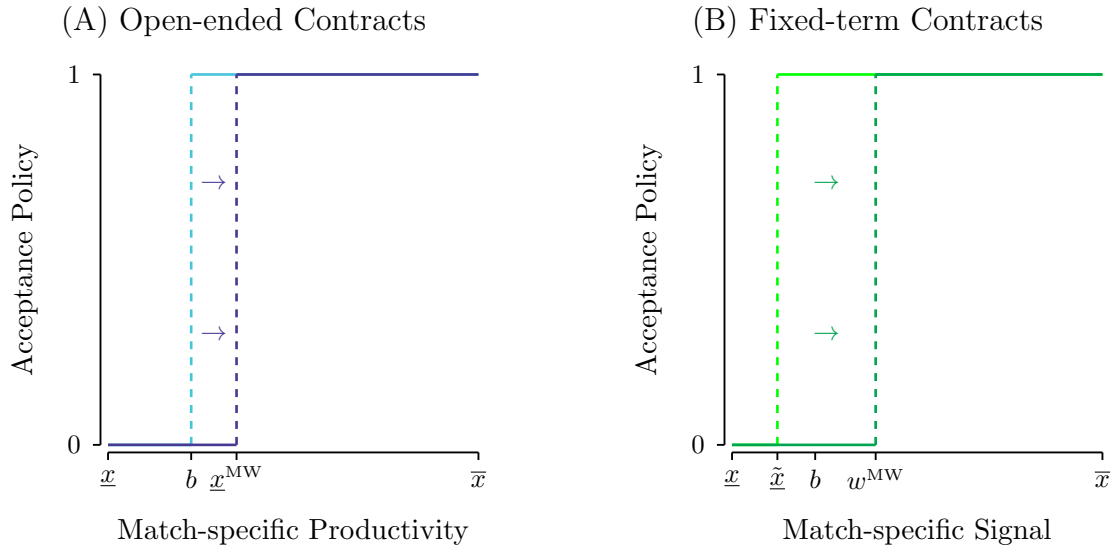
Figure 1: Time Event Study Results



Note: The figure shows estimates of $\hat{\beta}_{1,\tau}$, along with their 95% confidence intervals, from equation (2) in section 4. The outcome variable is an indicator for attaining college education. The sample is conformed by the sub-group of workers who made a FTC-to-OEC transition.

Source: Authors' calculations based on the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

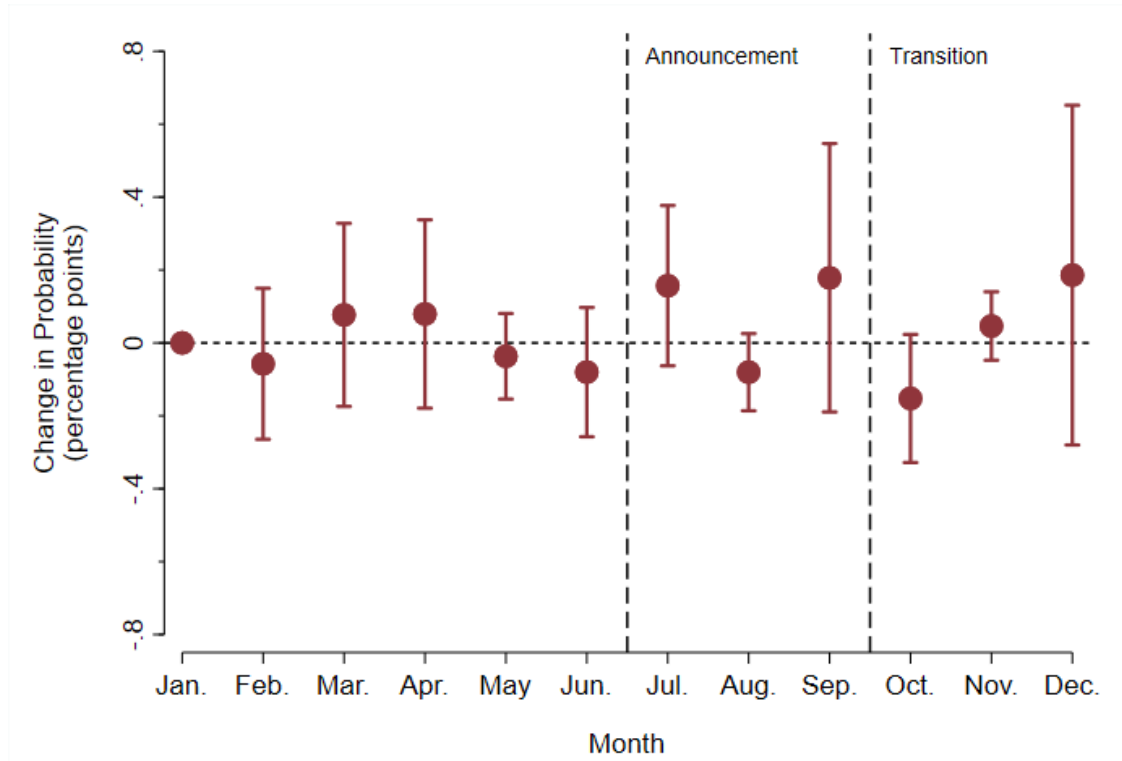
Figure 2: Change in the Productivity Threshold Values



Note: The figure shows model-implied changes in the match-specific productivity threshold values and signals for signing open-ended (Panel A) and fixed-term (Panel B) contracts caused by the introduction of a minimum wage policy in the economy.

Source: Authors' calculations based on model results.

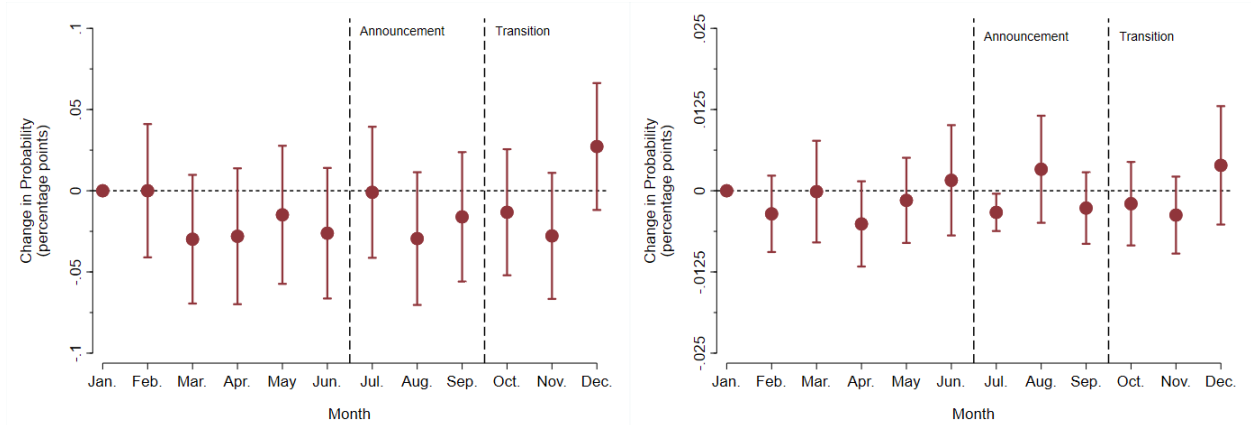
Figure 3: College Education Among Workers Making a FTC-to-OEC Transition



Note: The figure shows estimates of $\hat{\beta}_{1,\tau}$, along with their 95% confidence intervals, from equation (2) in section 4. The outcome variable is an indicator for attaining college education. The sample is conformed by the sub-group of workers who made a FTC-to-OEC transition.

Source: Authors' calculations based on the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

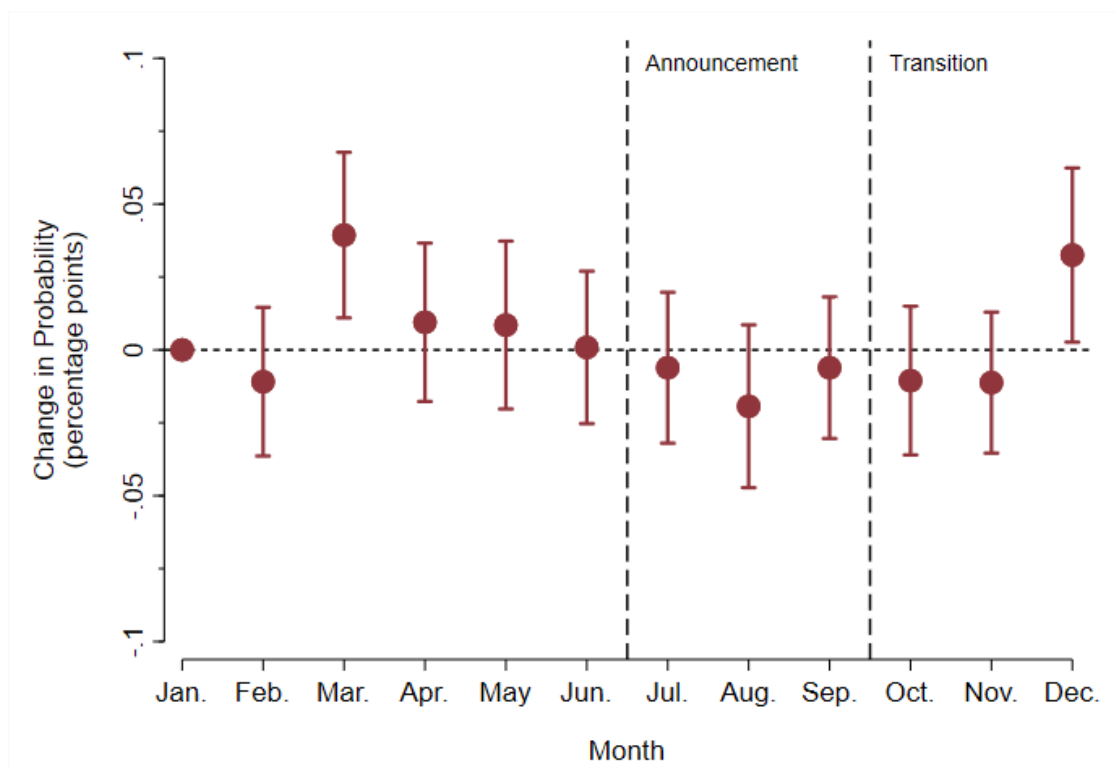
Figure 4: Extension/Renewal of FTC and Unemployment
 (A) FTC Renewal (B) Unemployment



Note: The figure shows estimates of $\hat{\beta}_{1,\tau}$, along with their 95% confidence intervals, from equation (2) in section 4. The outcome variable in the graph in Panel A is an indicator for a renewal/extension of the fixed-term contract. The outcome variable in the graph in Panel B is an indicator for a following unemployment period. The sample is composed of workers who did not make a FTC-to-OEC transition.

Source: Authors' calculations based on the Weekly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

Figure 5: FTC with Another Firm



Note: The figure shows estimates of $\hat{\beta}_{1,\tau}$, along with their 95% confidence intervals, from equation (2) in section 4. The outcome variable is an indicator for being hired under a fixed-term contract by another firm. The sample is composed of workers who did not make a FTC-to-OEC transition. Source: Authors' calculations based on the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

Table 1: Descriptive Statistics

Variable	(1) Not Affected	(2) Affected	(3) Diff.
Female	0.450	0.541	0.091
Age (years)	36.287	37.875	1.570
Education: Less than high school	0.096	0.148	0.052
Education: High school diploma	0.763	0.741	-0.022
Education: Some college or higher education	0.123	0.077	-0.046
German nationality	0.872	0.839	-0.033
Part-time job	0.245	0.385	0.140
Job tenure (months)	19.919	15.055	-4.864
Number of Observations	55,871	10,500	

Note: The table shows descriptive statistics (sample means) for individuals in our estimating sample according to our assignment into ex-ante affected and not affected by the minimum wage policy introduced in Germany in the year 2015. Not affected workers are those earning at or above 8.50 EUR/hour. Affected workers are those earning below 8.50 EUR/hour. The sample is composed workers employed under fixed-term contracts with ending dates spanning the period from January 01, 2014 to December 31, 2014, whose ages are between 18 and 64 years, who work in non-farming industries, who earn between between 4.25 and 12.75 EUR/hour, and who make social security contributions. The sample size is 66,371. The data come from the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

Table 2: Results from Continuous-time Regression Specification

Dependent Variable:	(1)	(2)	(3)	(4)
	Worker Transitioned from a Fixed-term to an Open-ended Contract (Mean: 0.073)			
Days to MW period \times Affected worker	0.143*** (0.016)	0.140*** (0.016)	0.138*** (0.016)	0.135*** (0.016)
<i>N</i>	66,371	66,371	66,371	66,371
R-squared	0.110	0.113	0.127	0.130
Socio-demographic characteristics	No	Yes	Yes	Yes
Job characteristics	No	No	Yes	Yes
AKM worker and establishment fixed effects	No	No	No	Yes

Note: ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels respectively. The table shows estimates of $\hat{\alpha}_1$ from equation (1) in section 4. Huber-White heteroskedasticity-robust standard errors are shown in parentheses. All estimated coefficients and standard errors have been multiplied by 1,000 for ease of readability. The minimum wage implementation period is January 01, 2015. Affected workers are those whose wages fall below 8.50 EUR/hour. The array of socio-demographic characteristics includes: an indicator for being a female, indicators for age (20-25 years; 25-29 years; 30-34 years; 35-39 years; 40-44 years; 45-49 years; 50-54 years; 55-59 years; 60-64 years; base: less than 20 years), indicators for educational attainment (less than high school; high school diploma; some college or higher education; base: no information on educational attainment), an indicator for German nationality, and indicators for state of residence. The array of job characteristics includes: an indicator for a part-time job, indicators for spell duration (12-23 months; 24-35 months; 36-47 months; 48-59 months; 60 months or more; base: 12 months or less), indicators for occupation main groups based on the German classification of occupations (KldB-2010), and indicators for major economic sections based on the European classification of economic activities (NACE-2). Further details of each specification are described within the table. See the notes to Table 1 and the main text for information about the sample composition. The data come from the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

Table 3: Falsification Tests (Pre-implementation Period)

Dependent Variable:	(1)	(2)	(3)	(4)
	Worker Transitioned from a Fixed-term to an Open-ended Contract			
Days to (false) MW period \times Affected worker	-0.000 (0.000)		0.000 (0.000)	
M02 \times Affected worker		-0.002 (0.005)		-0.002 (0.004)
M03 \times Affected worker		-0.001 (0.005)		-0.002 (0.004)
M04 \times Affected worker		-0.001 (0.005)		-0.001 (0.005)
M05 \times Affected worker		-0.001 (0.004)		-0.001 (0.005)
M06 \times Affected worker		0.003 (0.004)		-0.001 (0.004)
M07 \times Affected worker		0.001 (0.004)		0.000 (0.005)
M08 \times Affected worker		-0.003 (0.004)		-0.007** (0.003)
M09 \times Affected worker		-0.003 (0.004)		-0.004 (0.004)
M10 \times Affected worker		-0.001 (0.003)		0.002 (0.004)
M11 \times Affected worker		-0.002 (0.003)		-0.002 (0.004)
M12 \times Affected worker		0.001 (0.003)		-0.002 (0.003)
N	55,369	55,369	88,199	88,199
R-squared	0.010	0.012	0.010	0.013
Dependent variable mean	0.071	0.071	0.072	0.072
F-statistic ($H_0: \beta_{1,\tau} = 0; \tau = 2, \dots, 12$)		0.360		1.310

Note: ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels respectively. The table shows estimates of $\hat{\alpha}_1$ (columns 1 and 3) and $\hat{\beta}_{1,\tau}$ (columns 2 and 4) from equations (1) and (2), respectively, in section 4. Huber-White heteroskedasticity-robust standard errors are shown in parentheses. Estimated coefficients and standard errors shown in columns 1 and 3 have been multiplied by 1,000 for ease of readability. The false minimum wage implementation periods are set to January 01, 2013 (columns 1 and 2) and January 01, 2014 (columns 3 and 4). Affected workers are those whose wages fall below 8.50 EUR/hour. All regressions include the full set of conditioning variables. Further details of each specification are described within the table. Pre-implementation years are 2011-2012 in columns 1 and 2, and 2012-2013 in columns 3 and 4. See the notes to Table 1 and the main text for further information about the sample composition. The data come from the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

Table 4: Falsification Tests (Unaffected Workers)

Dependent Variable:	(1)	(2)	(3)	(4)
	Worker Transitioned from a Fixed-term to an Open-ended Contract			
Days to MW period \times Falsely affected worker	0.057 (0.090)		0.050 (0.080)	
M02 \times Falsely affected worker		0.010 (0.009)		0.006 (0.009)
M03 \times Falsely affected worker		0.001 (0.007)		-0.003 (0.009)
M04 \times Falsely affected worker		0.018** (0.008)		-0.001 (0.008)
M05 \times Falsely affected worker		-0.003 (0.009)		-0.019** (0.009)
M06 \times Falsely affected worker		0.007 (0.006)		0.006 (0.007)
M07 \times Falsely affected worker		0.003 (0.007)		0.015* (0.009)
M08 \times Falsely affected worker		0.008 (0.007)		0.001 (0.007)
M09 \times Falsely affected worker		0.001 (0.005)		-0.002 (0.006)
M10 \times Falsely affected worker		0.001 (0.006)		0.001 (0.005)
M11 \times Falsely affected worker		0.002 (0.006)		0.005 (0.006)
M12 \times Falsely affected worker		0.007 (0.005)		0.001 (0.006)
N	44,645	44,645	43,603	43,603
R-squared	0.105	0.136	0.130	0.166
Dependent variable mean	0.040	0.040	0.057	0.057
F-statistic ($H_0: \beta_{1,\tau} = 0; \tau = 2, \dots, 12$)		1.340		1.520

Note: ***, **, and * denote statistical significance at the 0.01, 0.05, and 0.10 levels respectively. The table shows estimates of $\hat{\alpha}_1$ (columns 1 and 3) and $\hat{\beta}_{1,\tau}$ (columns 2 and 4) from equations (1) and (2), respectively, in section 4. Huber-White heteroskedasticity-robust standard errors are shown in parentheses. Estimated coefficients and standard errors shown in columns 1 and 3 have been multiplied by 1,000 for ease of readability. Falsely affected workers are those whose wages fall in the interval [8.500 – 10.625] EUR/hour for columns 1 and 2 and in the interval [10.625 – 12.750] EUR/hour for columns 3 and 4. All regressions include the full set of conditioning variables. Further details of each specification are described within the table. The hourly wage range utilized as a sample inclusion criterion is [8.500 – 12.750] EUR/hour for columns 1 and 2 and [10.625 – 16.000] EUR/hour for columns 3 and 4. See the notes to Table 1 and the main text for further information about the sample composition. The data come from the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).

A. Data Assembling

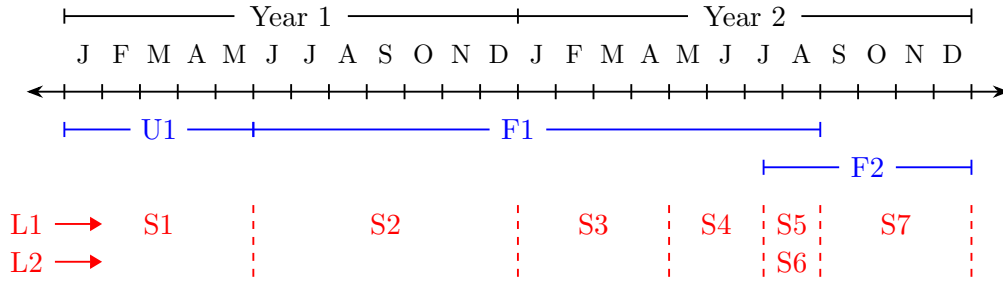
A1. Original Data Structure

The SIAB-7521 is organized by labor market spells across individuals. A labor market spell is defined as the continuum of time (measured in days) that an individual spends in employment or non-employment within a given calendar year. Hence, a labor market spell cannot exceed 365 days in total (366 days in a leap year).

All labor market spells contain information on starting and ending dates and basic socio-demographic characteristics (i.e., sex, year of birth, nationality, and marital status). For employed workers, the SIAB-7521 includes complementary information on socio-demographic (i.e., educational attainment) and establishment/job characteristics. In case of overlapping labor market spells within a given period (which can occur, for instance, when a worker holds more than one job or when the starting date of a new job precedes the ending date of a previous job as indicated in the corresponding employment contracts), different labor market spells are created and are distinguished by an ancillary variable that records the employment level (an indicator for the chronological order of the labor market spells).

Figure A1.1 shows the original data structure for an individual’s hypothetical labor market spells observed across two consecutive years. The first labor market spell (S1) corresponds to an unemployment period from January 01 of Year 1 to May 31 of Year 1. The individual is then employed in Firm 1, from June 01 of Year 1 to August 31 of Year 2. This job period is divided into four labor market spells: a first one spanning the period from June 01 to December 31 of Year 1 (S2), a second one spanning the period from January 01 to April 30 of Year 2 (S3), a third one spanning the period from May 01 to July 15 of Year 2 (S4), and a fourth one, which coincided with a parallel employment spell, spanning the period from July 16 to August 31 of Year 2 (S5). Note that S2 and S3 coincide with the same job episode in Firm 1 that is divided into two labor market spells given the break in calendar years, whereas S4 and S5 may be part of another job episode in Firm 1 that can be thought of an extension of the employment contract broken into two labor market spells given the overlap in beginning and ending job periods. The individual is then employed in Firm 2 from July 16 to December 31 of Year 2. This job period is divided into two labor market spells: a first one running from July 16 to August 31 of Year 2 (S6), and a second one running from September 01 to December 31 of Year 2 (S7). Parallel employment spells, S5 and S6, are distinguished by employment levels in chronological order — respectively L1 and L2.

Figure A1.1: Recording of Labor Market Spells in the SIAB-7521



Notes: The figure shows an individual’s hypothetical labor market spells observed between January 01 of Year 1 and December 31 of Year 2.

Source: Authors’ elaboration.

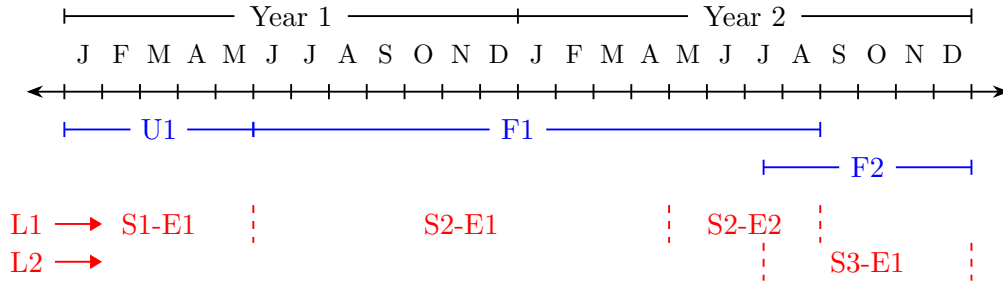
A2. Data Reorganization

We reorganize the data by concatenating labor market spells within job periods. In this manner, an employment spell is defined as the continuum of time (measured in days) that an individual spends with a firm uninterrupted. Following this definition, we treat any job spell involving a rehire in interrupted/isolated periods as a separate employment spell.

We further distinguish by employment episodes within an employment spell, which account for contract renewals or changes in the contracting terms within a job spell and disregard breaks associated to changes in calendar years. Labor market spells involving non-employment periods are collapsed within one labor market episode only. Parallel employment spells are distinguished by the employment level, following the chronological order established in the original data structure and prioritizing the longest employment spell in case of similar starting dates.

We present a graphical depiction of the data restructuring in Figure A2.1, following the example shown above. In this new data structure, we leave unchanged the employment episode 1 (S1-E1), whereas we concatenate labor market spells S2 through S5 and labor market spells S6 through S7 depicted in Figure A1.1. Labor market spells S2 through S5 belong to the continuum of time that the individual is employed in Firm 1. In this employment spell, though, we distinguish between employment episodes 1 (S2-E1) and 2 (S2-E2), as the latter likely involves a contract renewal. Labor market spells S6 and S7 belong to the continuum of time that the individual is employed in Firm 2. We classify this employment spell as one with a single episode (S3-E1) of employment level 2 since it involves a parallel employment episode that started later in time.

Figure A2.1: Reorganization of Labor Market Spells Recorded in the SIAB-7521



Notes: The figure shows an individual’s hypothetical reorganized labor market spells, employment episodes, and employment levels observed between January 01 of Year 1 and December 31 of Year 2.

Source: Authors’ elaboration.

A3. Construction of Outcome Variables

In our empirical analysis, we are principally interested in determining the probability that workers initially employed under a fixed-term contract (FTC) transition to an open-ended contract (OEC) at the end of their contracting period. To capture this notion, we construct our outcome variables by assigning the contract characteristics of the following employment episode to the current one. In this regard, our principal outcome variable is an indicator for whether the following employment contract is an OEC with the same establishment; that is, this indicator takes on the value of one if two conditions are met: (i) the following employment contract features an OEC and (ii) the contract is signed by the worker and her previous employer (as captured by the establishment identifier of the current and following employment episodes).

With the aim of assessing the employment profiles of workers employed under an FTC who were not offered an OEC by their employers at the end of their FTCs, we construct two additional outcome variables. The first one is an indicator for a renewal/extension of the FTC with the same employer in the following employment episode. The second one is an indicator for an unemployment period in case of no renewal/extension of the FTC. In the latter case, we further explore the length of the unemployment period and the characteristics of the employment contract following this jobless period.

A4. Sample Inclusion Criteria

Our sample inclusion criteria respond to our empirical purpose of determining the employment profiles of workers initially hired under an FTC before the minimum wage period (i.e., before January 01, 2015). To this end, we keep in our main empirical sample workers aged between 18 and 64 years, who are employed under FTCs over the period from January 01,

Online Appendix Material: “Minimum Wage and Contract Duration in Germany”

2013 to December 31, 2014, who contribute to social security, who work in non-farming industries, and whose hourly wages fall between 50% and 150% of the statutory minimum wage (i.e., between 4.25 and 12.75 EUR/hour). Lastly, we retain workers with complete information on socio-demographic, job, and establishment characteristics.

B. Complementary Empirical Analysis

B1. Worker Characteristics by Contract Ending Dates

Appendix Table B.1: Comparison of Workers with Different Contract Ending Dates

Variable	(1) Not Exposed	(2) Partially Exposed	(3) Fully Exposed	(4) Diff. (2)-(1)	(5) Diff. (3)-(1)
Panel A: Education Attainment					
Education: Less than high school	0.110	0.113	0.093	0.003	-0.018
Education: High school diploma	0.754	0.755	0.766	0.001	0.012
Education: Some college or higher education	0.113	0.112	0.121	-0.001	0.007
Panel B: Job Duration					
Spell duration (months)	13.795	14.763	27.260	0.968	13.465
Episode duration (months)	6.942	7.947	19.903	1.004	12.961
Panel C: Compensation					
Hourly wage (EUR/hour)	12.060	12.071	12.875	0.011	0.815
Daily wage (EUR)	61.205	61.649	66.348	0.443	5.142
Number of Observations	X	X	X		

Note: The table shows descriptive statistics (sample means) for individuals in our estimating sample according to their exposure to the announcement of the minimum wage policy. Not exposed workers are those whose contracts ended between January and June of the year 2014. Partially and fully exposed workers are, respectively, those whose contracts ended between July and September and between October and December of the year 2014. The sample is composed workers employed under fixed-term contracts with ending dates spanning the period from January 01, 2014 to December 31, 2014, whose ages are between 18 and 64 years, who work in non-farming industries, who earn between between 4.25 and 12.75 EUR/hour, and who make social security contributions. The sample size is X. The data come from the Weakly Anonymous version of the Sample of Integrated Labor Market Biographies (SIAB-7521).