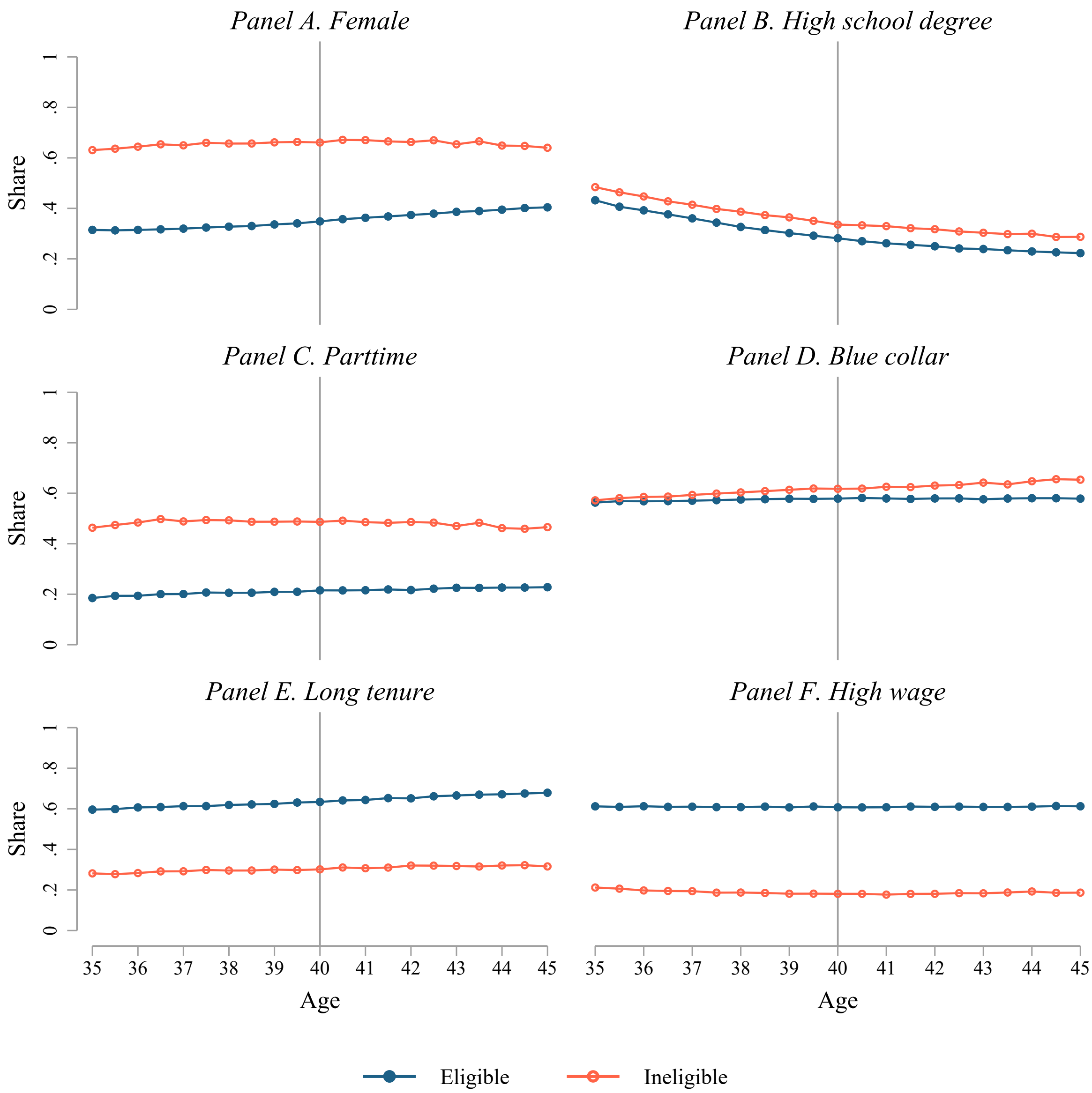
Web appendix

This web appendix contains additional tables and figures for the paper *"Outside options and worker effort"* by Alexander Ahammer, Matthias Fahn, and Flora Stiftinger.

Contents

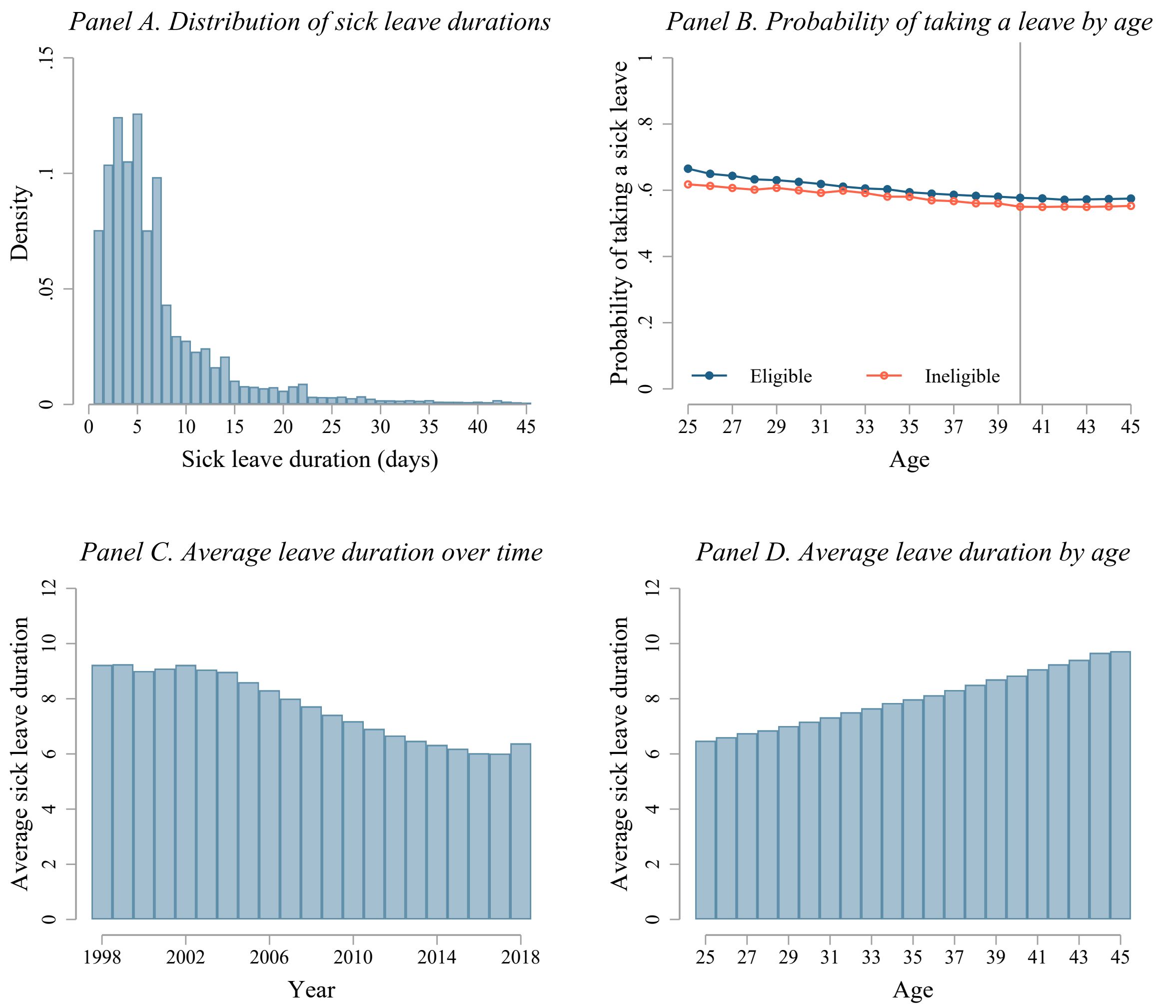
A. Additional tables and figures

Figure A.1 — Composition around the age-40 UI benefit extension cutoff



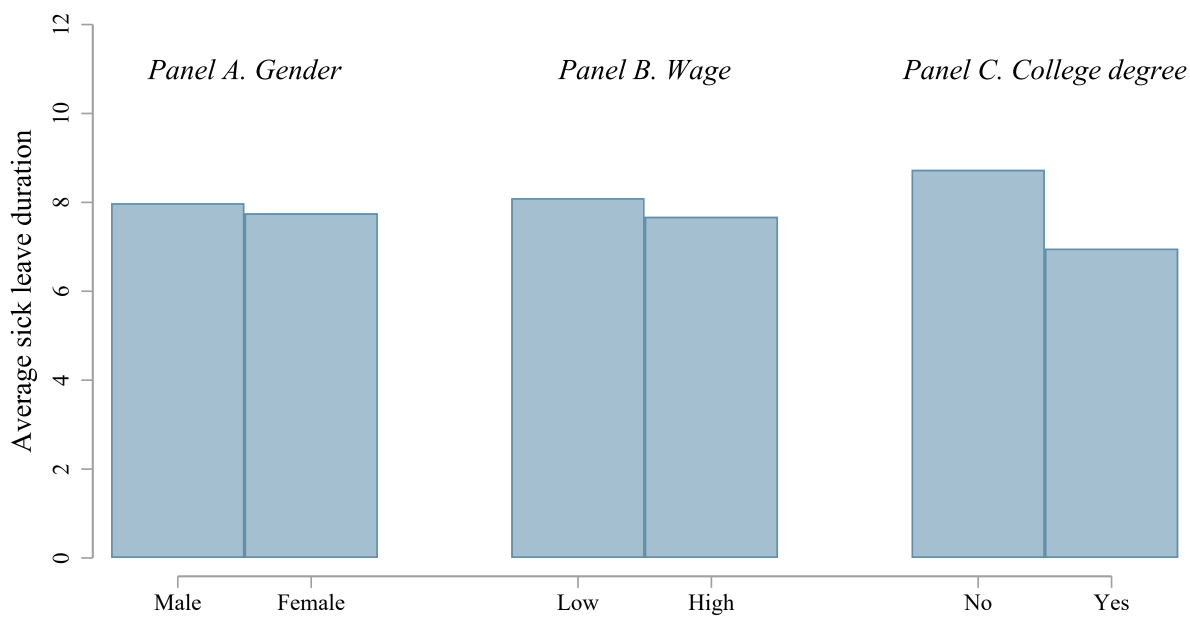
Notes: This figure shows the share of female workers (Panel A), workers with a highschool degree (*'Matura,'* Panel B), parttime workers (Panel C), blue-collar workers (Panel D), workers with above-median tenure (the median is 2 years, Panel E), and workers with above-median wage (€ 23,029, Panel F) for eligible and ineligible workers having a sick leave at a given age.

FIGURE A.2 — Descriptives for sick leaves in our data



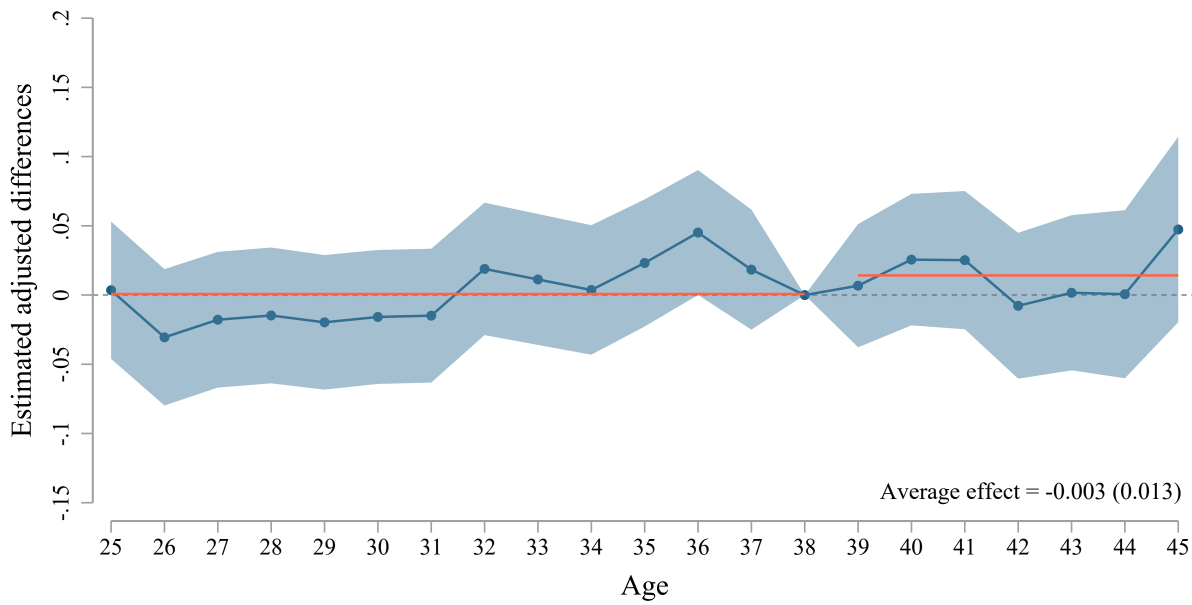
Notes: This figure depicts several descriptives for sick leaves in our data. In Panel A, we plot the distribution of durations across all sick leaves, where the bin size is one day and we omit the 100$^{\text{th}}$ percentile of sick leave durations to improve readability. Panel B plots the probability of having a sick leave at a given age for workers in our sample, separately by eligibility status. For this analysis, we collapse the data to a worker-year panel, including years where workers do not take any sick leave. Panel C shows average sick leave durations over time for workers in our sample, where averages are calculated over all sick leaves that start in a certain year. Panel D plots average sick leave durations by age for workers in our sample, where averages are calculated over all sick leaves of workers at a given age at the time of the sick leave.

Figure A.3 — Average sick leave duration by gender, wage, and education



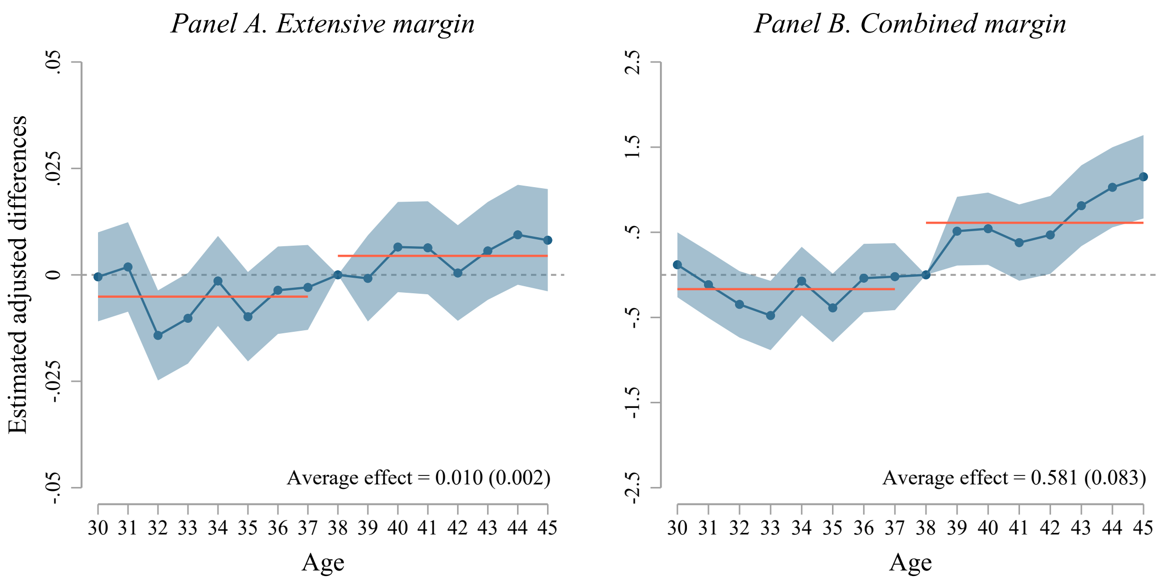
Notes: This figure plots average sick leave durations for male and female workers in Panel A, high-wage and low-wage workers in Panel B, where wages are split at the sample median of annual wages, and for workers with and without a college degree in Panel C. Averages are calculated over all sick leaves for workers with the respective characteristic.

Figure A.4 — The effect of an increase in outside options on log wages



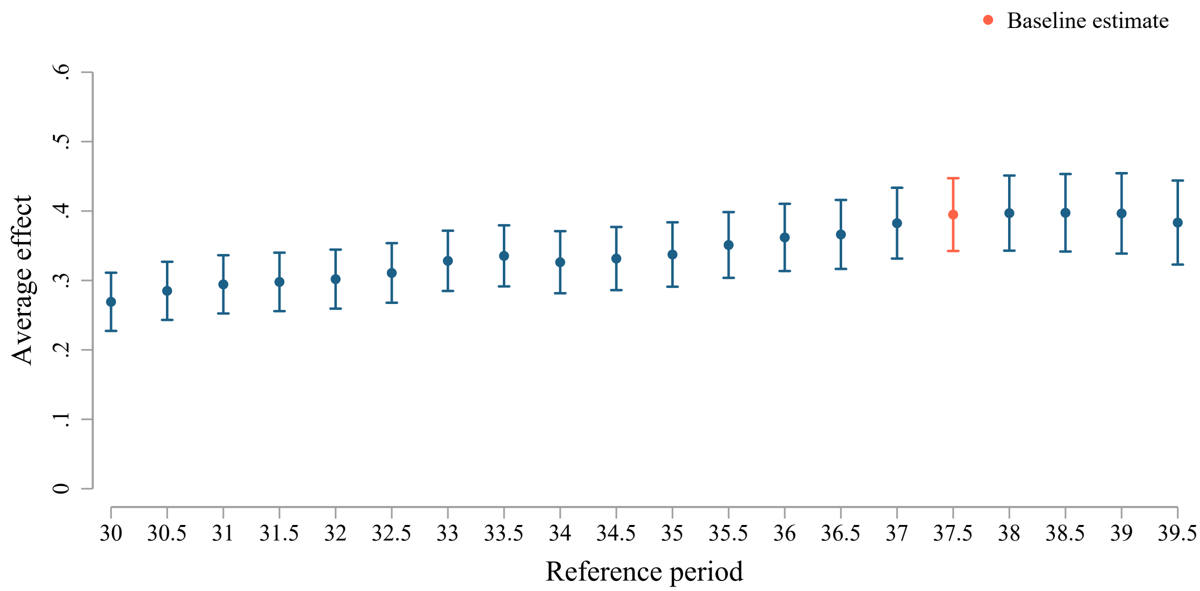
Notes: This figure provides event study estimates similar to those in equation (5) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on log annual wages. For this analysis, we collapse the data to a worker-year panel, including years where workers do not take any sick leave. Because we expect eligible workers to react already prior to age 40, we fix the reference period to $b = 38$ (because we use yearly data we cannot use 37.5), and point estimates can be interpreted as log changes in wages due to the benefit extension at a given age relative to age 38. The shaded area represents a 95 percent confidence band based on standard errors clustered at the worker level. The red horizontal lines indicate averages of age-specific estimates for both the pretreatment period $t < b$ and the posttreatment period $t \geq b$. The average effect estimate is from a model similar to equation (4). All regressions control for tenure and year fixed effects as well as gender.

Figure A.5 — Extensive and combined margin effect on sick leaves



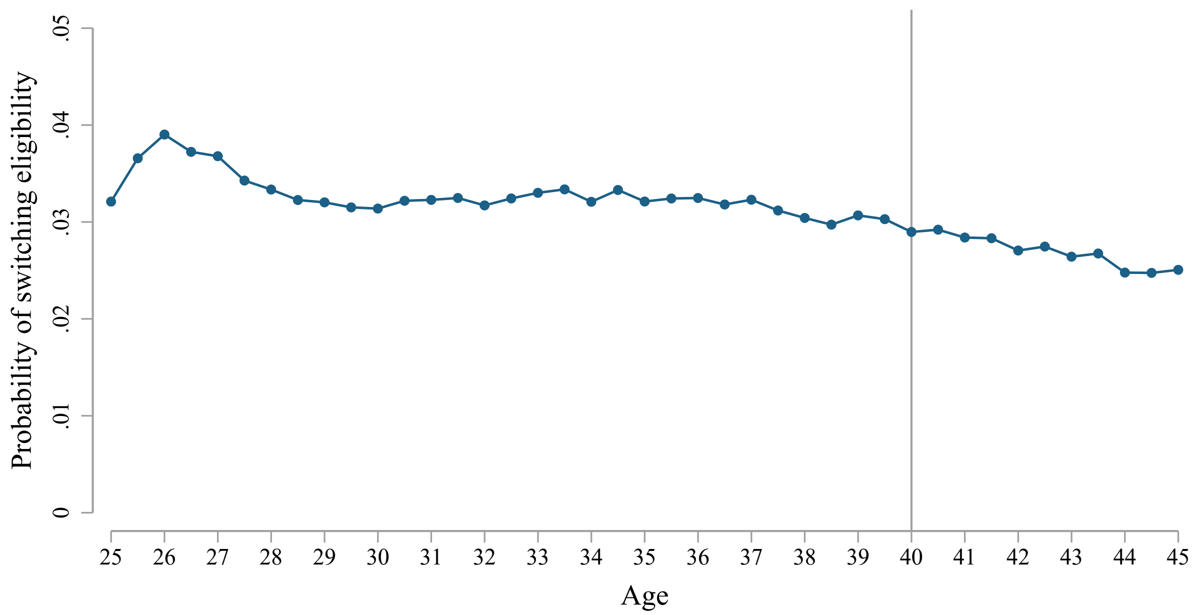
Notes: This figure provides event study estimates similar to those in equation (5) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on the probability of taking any sick leave in a given year (Panel A) and on the total number of sick days per year (Panel B). For this analysis, we collapse the data to a worker-year panel, including years where workers do not take any sick leave, and we omit workers in their first year of tenure (which includes a probation period with minimal job protection where workers hardly take sick leave). Because we expect eligible workers to react already prior to age 40, we fix the reference period to $b = 38$ (because we use yearly data we cannot use 37.5), and point estimates can be interpreted as percentage point changes in the probability of taking sick leave due to the benefit extension at a given age relative to age 38. We only consider a symmetric 8-year window around the reference period b because ineligible workers aged 25 and 26 are on slightly different extensive margin sick leave trends than ineligible workers. The shaded area represents a 95 percent confidence band based on standard errors clustered at the worker level. The red horizontal lines indicate averages of age-specific estimates for both the pretreatment period $t < b$ and the posttreatment period $t \geq b$. The average effect estimate is from a model similar to equation (4). All regressions control for tenure and year fixed effects as well as gender.

FIGURE A.6 — Robustness to different reference period choices



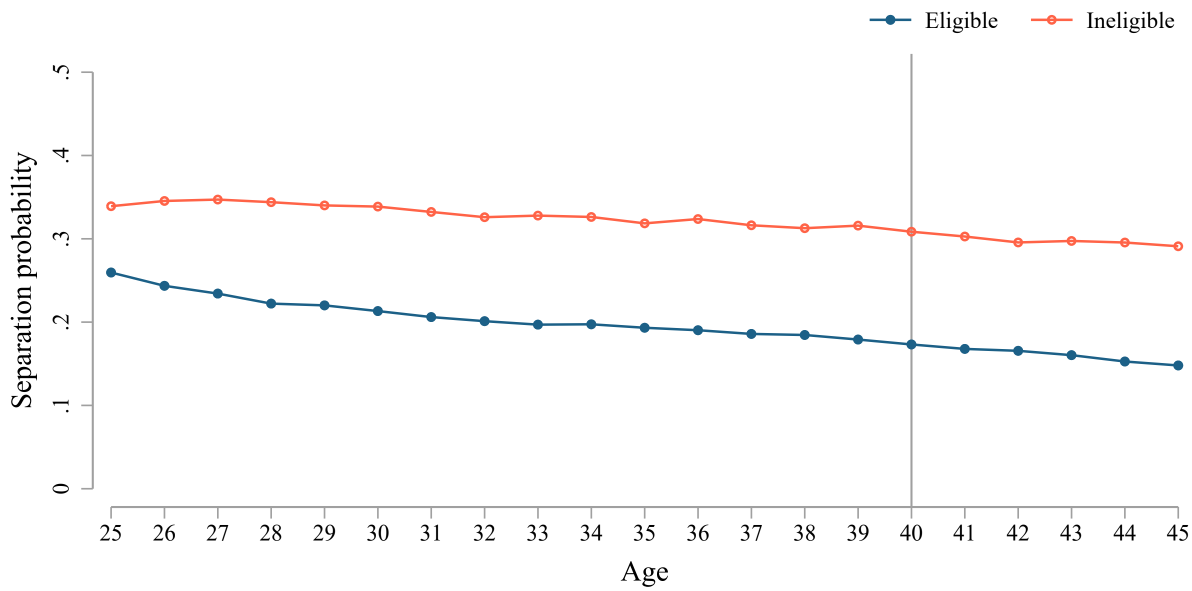
Notes: This figure shows estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers for different reference periods b. All regressions control for tenure and year fixed effects as well as gender. The error bars indicate 95 percent confidence intervals based on standard errors clustered at the worker level.

Figure A.7 — Probability of switching eligibility by age



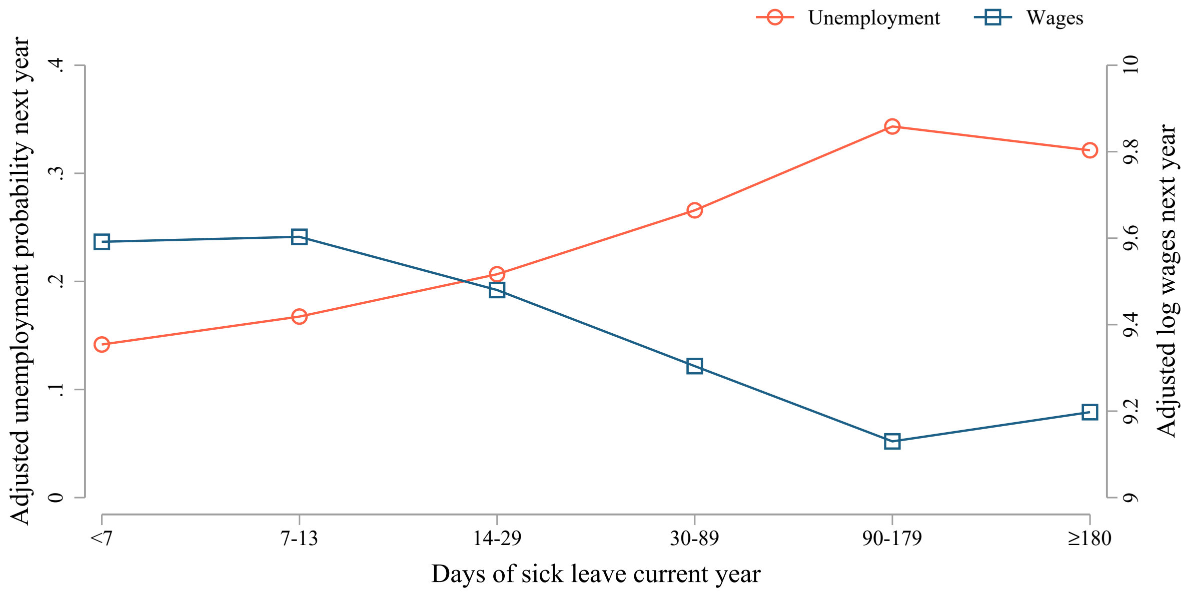
Notes: This figure plots the probability of switching eligibility status at a given age for workers in our sample. For this analysis, we collapse the data to a worker-year panel, including years where workers do not take any sick leave.

Figure A.8 — Probability of job separation by age and eligibility



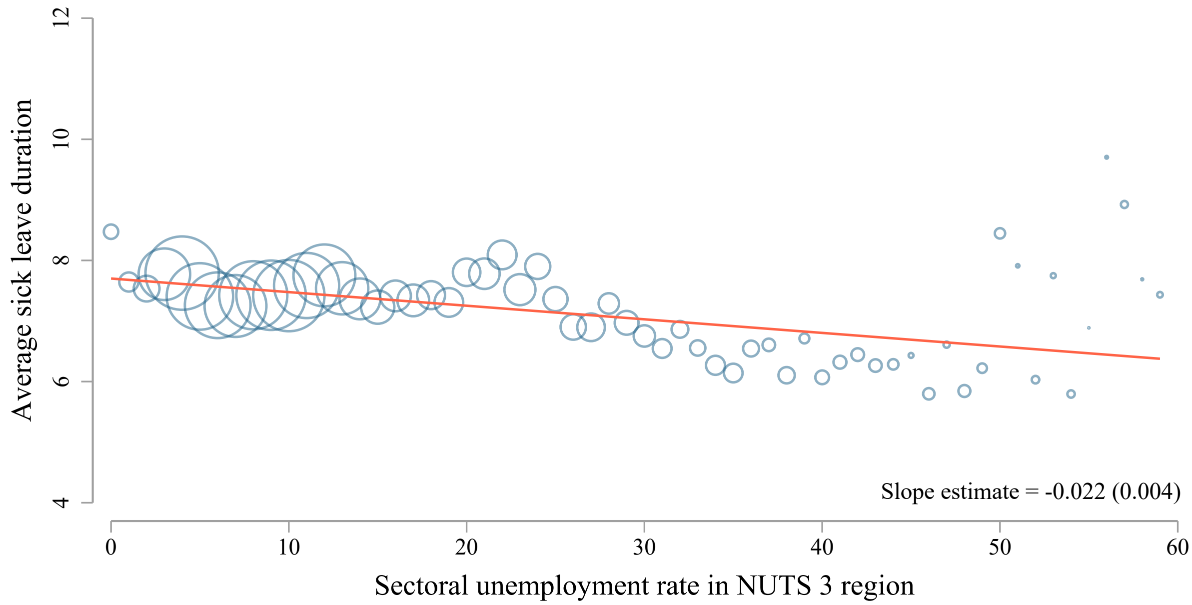
Notes: This figure plots the probability of experiencing a job separation at a given age for workers in our sample, separately by eligibility status. For this analysis, we collapse the data to a worker-year panel, including years where workers do not take any sick leave.

Figure A.9 — Relationship between sick leaves and unemployment



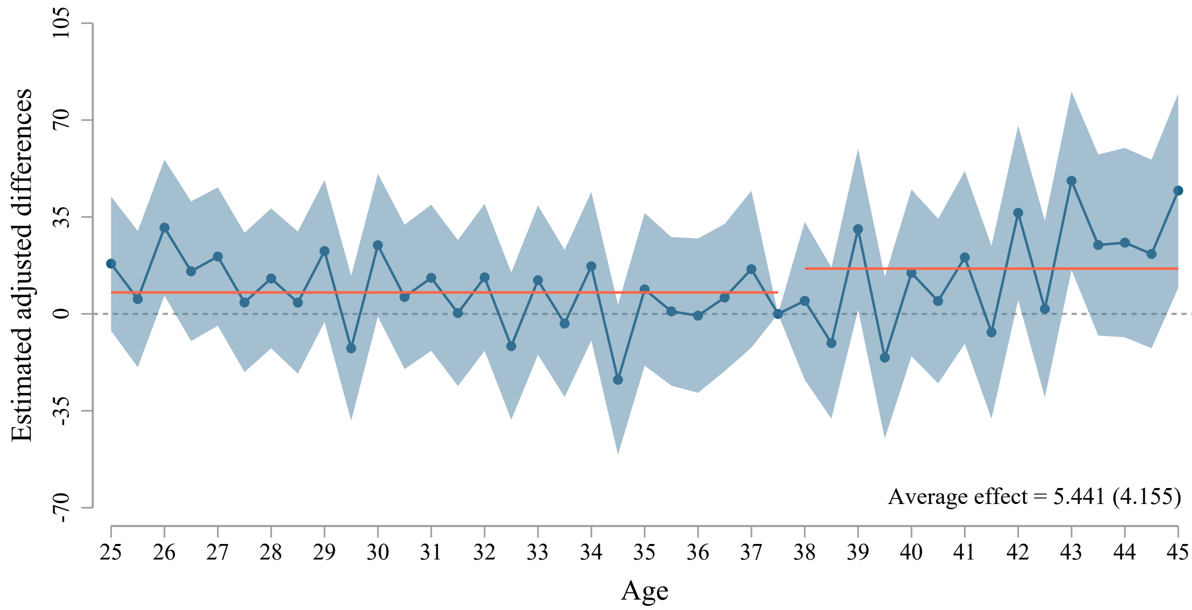
Notes: This graph shows the relationship between aggregate sick leaves in the current year and the age-adjusted probability of becoming unemployed in the next year (left axis) and age-adjusted log wages in the next year (right axis).

FIGURE A.10 — Relationship between sick leave duration and the unemployment rate



Notes: This graph depicts the relationship between sick leave duration and the sectoral unemployment rate in a region, averaged over time. The unemployment rate is calculated for every NACE95 2-digit sector and NUTS 3 combination. Both the scatters and the regression line are weighted by the number of workers at each point, which accounts for the fact that most workers are employed in sectors with relatively low unemployment rates.

Figure A.11 — The effect of an increase in outside options on total healthcare expenses

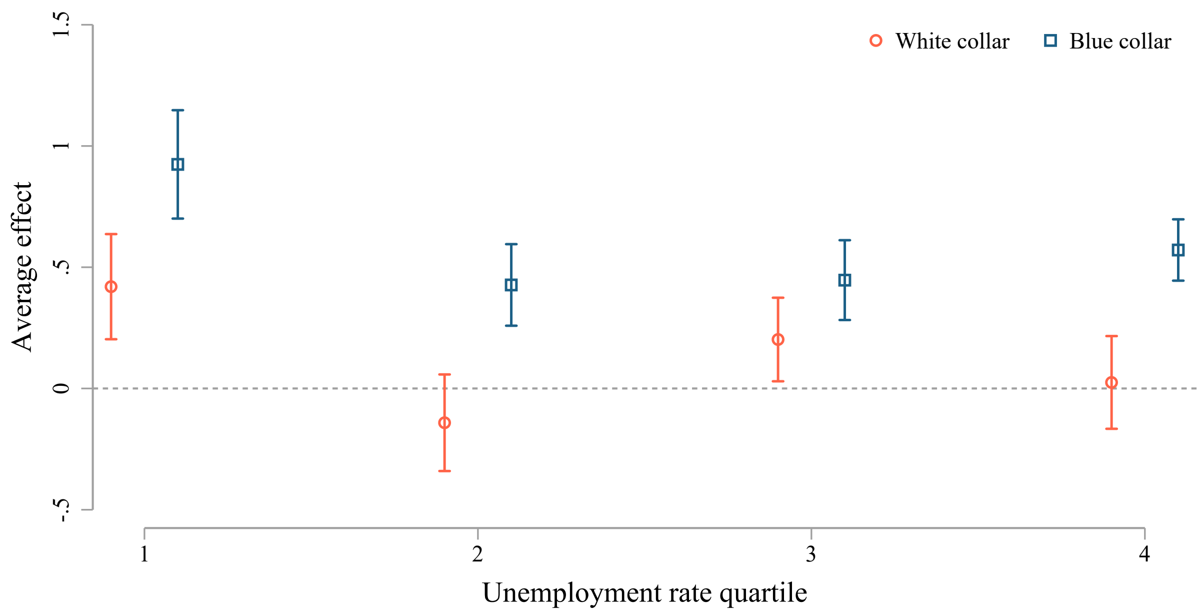


Notes: This figure provides event study estimates similar to those in equation (5) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on total healthcare expenses, which is the sum of physician fees, drug expenses, and hospital expenses. Because we expect eligible workers to react already prior to age 40, we fix the reference period to $b = 37.5$, and point estimates can be interpreted as changes in average healthcare expenses due to the benefit extension at a given age relative to age 37.5. The shaded area represents a 95 percent confidence band based on standard errors clustered at the worker level. The red horizontal lines indicate averages of age-specific estimates for both the pretreatment period $t < b$ and the posttreatment period $t \geq b$. The average effect estimate is from a model similar to equation (4). All regressions control for tenure and year fixed effects as well as gender.

Figure A.12 — Excess flu infection rate and the number of eligible workers aged 40 or older in a firm

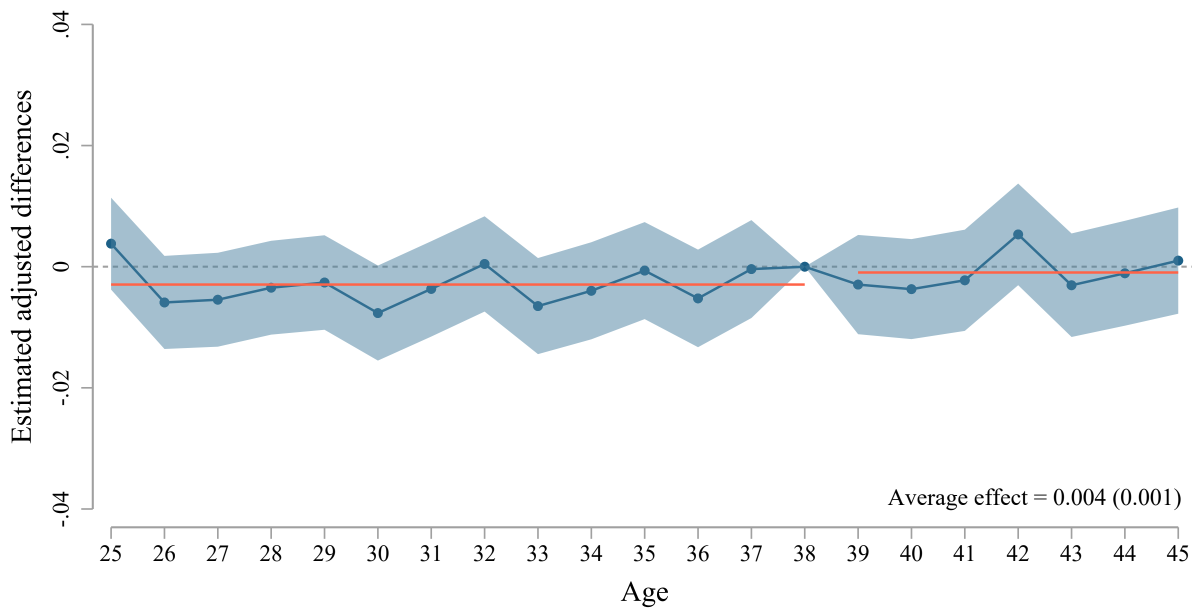
Notes: This figure depicts the relationship between the excess per-worker flu infection rate and the share of eligible workers aged 40 or older in a firm. Excess flu cases are calculated as the difference of average per-worker flu cases in the firm and average per-worker flu cases across all firms in a calendar quarter. The share of eligible workers aged 40 or older is grouped into 20 quantiles. The horizontal axis plots the average share of eligible workers aged 40 or older within these quantiles. The vertical axis plots, for each quantile, average excess flu cases. The t-test in the bottom right is against the null of no relationship between excess flu cases and the share of eligible workers aged 40 or older.

Figure A.13 — The effect of an increase in outside options on sick leaves by quartiles of the sectoral unemployment rate in a region, separately for blue-collar and white-collar workers



Notes: This figure plots estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on sick leave duration by quartiles of the sectoral unemployment rate in a region and occupation in a given calendar quarter. The unemployment rate is calculated for every NACE95 2-digit sector and NUTS 3 combination. The error bars indicate 95 percent confidence intervals based on standard errors clustered at the worker level. All regressions control for tenure and year fixed effects as well as gender.

Figure A.14 — The effect of an increase in outside options on job-to-job transitions



Notes: This figure plots event study estimates similar to equation (5) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on the probability of changing jobs in a certain year of age. For this analysis, we collapse the data to a worker-year panel, including also years where workers do not take sick leave. We fix the reference period to $b = 38$ (because we use yearly data we cannot use 37.5), and point estimates can be interpreted as changes in average turnover due to the benefit extension at a given age relative to age 38. The shaded area represents a 95 percent confidence band based on standard errors clustered at the worker level. The red horizontal lines indicate averages of age-specific estimates for both the pretreatment period $t < b$ and the posttreatment period $t \geq b$. The average effect estimate is similar to that from equation (4). All regressions control for tenure and year fixed effects as well as gender.

TABLE A.1 — Summary statistics

	Mean	Std. dev.	By eligibility status: Eligible	Ineligible	Difference	
	(1)	(2)	(3)	(4)	(5)	
Panel A. Outcome						
Sick leave duration (days)	7.31	8.62	7.50	6.86	–0.65	(0.000)
Panel B. Treatment assignment information						
Experience (years)	10.06	4.84	12.21	5.14	–7.07	(0.000)
Panel C. Socioeconomic and job information						
Female	0.42	0.49	0.35	0.58	0.23	(0.000)
High school degree[a]	0.56	0.50	0.54	0.61	0.07	(0.000)
Parttime worker[a]	0.22	0.42	0.16	0.36	0.20	(0.000)
Blue-collar worker	0.57	0.50	0.59	0.53	–0.06	(0.000)
Tenure (years)	3.49	3.18	4.14	1.98	–2.16	(0.000)
Annual wage (€ 1,000)	23.24	12.27	25.60	17.84	–7.76	(0.000)

Notes: This table provides summary statistics using only data for workers aged 37.5 years or younger. We provide statistics for the overall sample (means in column 1 and standard deviations in column 2) and by whether workers are eligible for the UI benefit extension at age 40 or not at a given age (columns 3 and 4). Column (5) gives the difference between columns (3) and (4). The number in parentheses is the p-value from a two-sample t-test of the null hypothesis that the two means are equal. The number of observations is 3,074,329.

[a] Education is missing for 0.8 percent of observations and parttime status is missing for 44 percent of observations. Means and standard deviations are calculated based on all observations with non-missing values.

Table A.2 — Robustness to different regression specifications

	OLS			Fixed effects	
	(1)	(2)	(3)	(4)	(5)
Average effect	0.442	0.395	0.554	0.453	0.424
	(0.028)	(0.027)	(0.027)	(0.040)	(0.024)
Covariates					
Female		–0.061	0.002		
		(0.013)	(0.015)		
Blue-collar worker			0.739		
			(0.014)		
Parttime worker			0.101		
			(0.019)		
High school degree			–0.481		
			(0.014)		
Annual wage (€ 1,000)			–0.025		
			(0.001)		
Tenure and year fixed effects	No	Yes	Yes	Yes	Yes
Worker fixed effects	No	No	No	Yes	No
Diagnosis fixed effects	No	No	No	No	Yes

Notes: This table reports average effect estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on sick leave duration using different regression specifications. In column (1), we run model (4) using OLS without any covariates. In column (2), we control for a gender dummy as well as tenure and year fixed effects, which is our baseline. In column (3), we additionally control for occupation, parttime work, education, and wage. In column (4), we estimate model (4) with worker fixed effects and tenure and year fixed effects. In column (5), we estimate the model with ICD-10 3-digit diagnosis group fixed effects. Whenever we control for education and parttime work, we replace missing values with zero and add a missing indicator dummy to the regression. The average sick leave duration in the pretreatment period $t < b$ is 7.3, the number of observations in each column is 4,547,032. Standard errors are clustered on the worker level and are shown in parentheses.

TABLE A.3 — Five most common diagnoses by age and eligibility

Age 25		Age 30		Age 35		Age 40		Age 45	
Eligible (1)	Ineligible (2)	Eligible (3)	Ineligible (4)	Eligible (5)	Ineligible (6)	Eligible (7)	Ineligible (8)	Eligible (9)	Ineligible (10)
J06	J06	J06	J06	J06	J06	J06	J06	J06	J06
(26.48)	(28.19)	(27.92)	(26.77)	(27.16)	(24.82)	(25.56)	(23.15)	(23.58)	(22.39)
A09	A09	A09	A09	A09	A09	A09	A09	A09	A09
(10.46)	(10.44)	(9.19)	(9.36)	(7.94)	(8.57)	(6.67)	(7.67)	(5.89)	(6.99)
J02	J02	M54	M54	M43	M54	M54	M54	M54	M54
(2.53)	(2.98)	(2.77)	(3.47)	(3.69)	(4.06)	(4.22)	(4.68)	(5.35)	(5.56)
K08	K08	M43	J02	M54	M53	M43	M53	M43	M53
(2.50)	(2.47)	(2.74)	(2.74)	(3.29)	(3.45)	(4.16)	(4.20)	(4.45)	(4.52)
M54	M54	J02	M53	M53	M43	M53	M43	M53	M43
(2.29)	(2.44)	(2.64)	(2.72)	(3.02)	(3.16)	(3.85)	(3.46)	(4.21)	(3.35)

Notes: Shares in parentheses are calculated over all ICD-10 diagnoses at a given age and for both eligibility groups.
A09: Other gastroenteritis and colitis of infectious and unspecified origin
J02: Acute pharyngitis
J06: Acute upper respiratory infections of multiple and unspecified sites
K08: Other disorders of teeth and supporting structures
M43: Other deforming dorsopathies
M53: Other dorsopathies, not elsewhere classified
M54: Dorsalgia

TABLE A.4 — Robustness to different eligibility status constraints

	Baseline	Eligibility constraints	
		Fixed at age 37.5	Drop switchers
	(1)	(2)	(3)
Average effect	0.395	0.500	0.659
	(0.027)	(0.033)	(0.035)
Tenure fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Gender and occupation	Yes	Yes	Yes
Average sick leave duration in $t < b$	7.31	7.30	7.41
Number of observations	4,547,032	4,125,013	3,070,831

Notes: This table reports average effect estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on sick leave duration using different eligibility constraints. In column (2), we consider all workers that are (in)eligible at age 37.5, regardless of whether they change eligibility status later. In column (3), we drop workers from the sample that switch eligibility status at some point. All regressions control for tenure and year fixed effects, and gender. Standard errors are clustered on the worker level and are shown in parentheses.

Table A.5 — Effort sanity tests with worker fixed effects

	Healthcare expenses		Diagnosis type		Weather		Cancer
	Baseline	Detrended	Shirking	Other	Good	Bad	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Average effect	55.4791	−41.4017	0.5310	0.4013	0.3508	0.3290	0.0003
	(6.7128)	(6.7098)	(0.2600)	(0.0412)	(0.1581)	(0.0616)	(0.0003)

Notes: This table reports average effect estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on different outcomes, controlling for worker fixed effects. In columns (2) and (3), the outcome is total healthcare expenses (see Figure A.11). Because within-worker healthcare expenses are on a slightly different trend between eligible and ineligible workers, we report both the baseline result in column (2) and—following Kleven et al. (2019)—the result from a model that accounts for a linear pretrend that is different between eligible and ineligible workers in column (3). In columns (3) and (4) we estimate results separately for shirking diagnoses and other diagnoses (see Figure 3). In columns (5) and (6) we estimate results separately for sick leaves starting on days with good and bad weather (see also Figure 3). In column (7), the outcome is the probability of having a sick leave due to cancer (see Figure 4). All regressions additionally control for tenure and year fixed effects. Standard errors are clustered on the worker level and are shown in parentheses.

Table A.6 — Probability of becoming unemployed by occupation

	Overall (1)	White collar (2)	Blue collar (3)	Difference (4)
Probability of becoming unemployed	0.19	0.10	0.26	−0.16
	(0.39)	(0.31)	(0.44)	(0.001)
Expected unemployment duration per year	17.32	9.79	23.39	−13.60
	(46.65)	(36.84)	(52.48)	(0.060)

Notes: This table reports the probability of being unemployed for more than 7 days in a year and the average unemployment duration per year by occupational collar in our data. The value in column (4) is the difference between columns (2) and (3). The numbers in parentheses in columns (1) to (3) are standard deviations, and the number in parentheses in column (4) is the standard error of the difference in means.

Table A.7 — Effects by gender and whether workers have children

		Panel A. By gender	
	Baseline	Women	Men
	(1)	(2)	(3)
Average effect	0.395	0.703	0.092
	(0.027)	(0.038)	(0.041)
t-test for effect homogeneity		-12.48 ($p = 0.000$)	
Average sick leave duration in $t < b$		7.15	7.42
Number of observations	4,547,032	1,910,411	2,636,621
		Panel B. By having children	
	Baseline	No children	Children
	(1)	(2)	(3)
Average effect	0.395	0.167	0.523
	(0.027)	(0.047)	(0.033)
t-test for effect homogeneity		6.13 ($p = 0.000$)	
Average sick leave duration in $t < b$		7.08	7.53
Number of observations	4,547,032	2,076,308	2,470,724

Notes: This table reports average effect estimates from equation (4) for the differential impact of the UI benefit extension at age 40 between eligible and ineligible workers on sick leave duration for female and male workers (Panel A) and for workers with and without children at the time of the sick leave (Panel B). All regressions control for tenure and year fixed effects, in Panel B we also control for gender. Standard errors are clustered on the worker level and are shown in parentheses.

B. Detailed model and proofs

In this section, we provide a detailed version of the relational contracting model outlined in Section II. Relational contracts rely on similar mechanisms as the classic models of efficiency wages, but impose fewer behavioral restrictions (Fahn, MacLeod & Muehlheusser 2023). We discuss similarities and differences between efficiency wage models and our model below. We organize this section as follows: In subsection B.I, we lay out the model environment. In subsection B.II, we formalize payoffs and the first best. In subsection B.III, we introduce relational contracts to the model. In subsection B.IV, we describe the optimization problem. In subsection B.V, we derive comparative statics. Finally, in subsection B.VI, we discuss the role of outside options and potential UI benefits in the model.

B.I. Environment

In every period t of an infinite time horizon, a risk-neutral principal/firm ("she") makes an employment offer to a risk-neutral agent ("he"). The offer contains an upfront wage $w_t \geq 0$ and a discretionary bonus $b_t \geq 0$. We describe the agent's acceptance decisions with $d_t \in \{0, 1\}$, where $d_t = 1$ corresponds to an acceptance and $d_t = 0$ to a rejection. Upon acceptance, the agent receives w_t and chooses an effort level $e_t \in \mathbb{R}_+$ which is associated with effort costs $c(e_t)$, where $c'(\cdot)$, $c''(\cdot) > 0$, $c'''(\cdot) \geq 0$ and $c(0) = c'(0) = 0$. Effort generates an (expected) output $e_t\theta$ (with $\theta > 0$) which is subsequently consumed by the principal.

Future payoffs are discounted with a common factor $\delta \in (0, 1)$; δ not only captures time preferences, but also reflects the probability with which the relationship is continued. Continuation probabilities can be driven by industry- or firm-wide, as well as personal characteristics. For our baseline model, we assume for simplicity that δ is constant over time. Later, we take into account that δ may decrease for older workers as retirement approaches.

B.II. Payoffs and first best

If the agent rejects the principal's offer in a given period, both consume their outside options which are $\bar{\pi} \in \mathbb{R}^+$ for the principal and $\bar{u}_t \in \mathbb{R}^+$ for the agent. $\bar{u}_t$ may include alternative job opportunities as well as UI benefits. We allow $\bar{u}_t$ to vary over time to capture anticipated changes in UI benefits, as used in our empirical analysis. The principal's outside option is kept constant for simplicity.

Thus, players' discounted payoff streams in a period t are

$$U_t \equiv \sum_{\tau=t}^{\infty} \delta^{\tau-t} \left[d_\tau \left(w_\tau + b_\tau - c(e_\tau) \right) + (1 - d_\tau) \, \bar{u}_\tau \right]$$

$$\Pi_t \equiv \sum_{\tau=t}^{\infty} \delta^{\tau-t} \left[d_\tau \left(e_\tau \theta - w_\tau - b_\tau \right) + (1 - d_\tau) \, \bar{\pi} \right].$$

Moreover, $\bar{U}_t \equiv \sum_{\tau=t}^{\infty} \delta^{\tau-t} \bar{u}_\tau$ and $\bar{\Pi} \equiv \bar{\pi}/(1-\delta)$. We also define

$$S_t \equiv \Pi_t + U_t$$

as the period-t surplus generated within the relationship, and $\bar{S}_t \equiv \bar{\Pi} + \bar{U}_t$. Thus, the per-period surplus if $d_t = 1$ equals $e_t\theta - c(e_t)$, and first-best effort e^{FB} is characterized by

$$\theta - c'(e^{FB}) = 0. \tag{B.1}$$

For the following, we assume that

$$e^{FB}\theta - c(e^{FB}) > \bar{\pi} + \bar{u}_t \tag{B.2}$$

holds for all t. Therefore, it is efficient for the agent to work for the principal if e^{FB} is implemented.

B.III. Contractibility, payoffs, and relational contract

Effort and output are observable to both the principal and the agent, but not verifiable to a third party, such as courts. This assumption takes into account that a worker's performance in many of today's jobs involves dimensions that are difficult to display to outsiders, such as quality, dependability, or flexibility (Gibbons & Henderson 2012). Therefore, formal incentive contracts are not possible, and only a self-enforcing *relational contract* can (potentially) be formed. In our setting without asymmetric information, it determines a subgame perfect equilibrium of the game.

We derive a relational contract that maximizes the total surplus at the onset of the game, S_1. However, note that predictions would be the same if our objective was to maximize the principal's profits, the agent's utility, or any weighted average of those (Levin 2003).

Discussion of Assumptions. Before deriving equilibrium outcomes and empirical predictions, we briefly discuss our modelling assumptions. First, effort in our setting relates to the agent's motivation on the job, and we abstract from other, easily measurable, aspects such as working hours. Such measurable dimensions could be taken care of by not-further-modeled incentive contracts. Then, our results survive as long as, without this extra motivation, employing the agent would not be valuable. Second, observability of the agent's effort is not important for our results. In Web Appendix section C.II, we demonstrate that if effort is the agent's private information and generates an observable output measure, all our predictions survive. Third, although we use the term "wage" when referring to the agent's compensation, it might go beyond monetary payments. In particular, if salaries are constrained by collective bargaining agreements or contractual obligations, firms can be restricted in setting them. Therefore, the wage in our setup reflects everything that is costly to the principal and valued by the agent. For example, it might include good working conditions, flexibility in working times, or perks. Finally, in Appendix section C.I, we show that our predictions hold even if the agent's compensation is taken as given and only firing threats are used to provide incentives. This links our approach to classic efficiency-wage models, which are the basis of relational contracting models but rely on firing threats for non-performance instead of performance-based bonus payments. We demonstrate that the underlying mechanisms are closely related. It will turn out that a relational contracting model better matches our data in one dimension: The use of firing threats in classic efficiency-wage models would result in more on-path separations as effort goes down, a link that our relational contracting model does not generate. We show later that this is not the case in our data, where separations are hardly affected by a change in workers' outside options.

B.IV. Optimization Problem

Our objective is to maximize the period-1 surplus S_1. Outcomes are restricted by a number of constraints which must be satisfied in all periods t. In the following, we display these constraints for an equilibrium in which, on the equilibrium path, the agent accepts the employment offer in every period. Later on, we make precise which conditions must hold for this to be optimal.

Since all deviations from equilibrium play are publicly observable, it is optimal to punish any deviation by a reversion to the worst possible outcome for the deviator (Abreu 1988), which in our case means that players consume their outside options forever thereafter.[32]

First, it must be in the agent's interest to accept the firm's offer, which is captured by his participation constraint (B.PC),

$$U_t \geq \bar{U}_t. \tag{B.PC}$$

Second, given the agent has accepted the contract, equilibrium effort e_t must satisfy his incentive

[32] However, note that equilibrium outcomes would be the same if a deviation did not lead to a termination, but instead to a continuation of the relationship in which the deviator would only receive their outside option (Levin 2003).

compatibility constraint (B.IC),

$$-c(e_t) + b_t + \delta U_{t+1} \geq \delta \bar{U}_{t+1}, \tag{B.IC}$$

which takes into account that, if the agent decides to deviate from equilibrium effort, he will choose zero effort instead. Note that, if effort were verifiable, a formal incentive contract would only need to satisfy these sets of constraints. Such a contract could induce the agent to choose e^{FB} in every period, for example by setting $w_t = \bar{u}_t$ and $b_t = c(e^{FB})$.

Third, since formal incentive contracts are not feasible, also the principal needs incentives to pay the b_t specified by the relational contract. This is captured by so-called dynamic enforcement (B.DE) constraints,

$$-b_t + \delta \Pi_{t+1} \geq \delta \bar{\Pi}, \tag{B.DE}$$

which implies that paying b_t must be profitable for the principal. This requires the subsequent continuation profits be sufficiently high compared to the principal's payoff after a termination. Finally, given $b_t \geq 0$, a participation constraint for the principal ($\Pi_t \geq \bar{\Pi}$) is implied by (B.DE) and can hence be omitted.

To conclude, our objective is to maximize S_1 subject to (B.PC), (B.IC), and (B.DE). These constraints must hold in every period t.

B.V. Results

B.V.1. Preliminaries

First, we simplify the optimization problem and obtain the following results.

Lemma 1. *The equilibrium is sequentially efficient, i.e., maximizing S_1 is equivalent to maximizing $e_t\theta - c(e_t)$ in every period t. Moreover, given $\Pi_t \geq \bar{\Pi}$ and $U_t \geq \bar{U}_t$, the following enforceability constraint* (B.EC) *is necessary and sufficient for implementing equilibrium effort e_t^*:*

$$-c(e_t^*) + \delta S_{t+1} \geq \delta \bar{S}_{t+1}. \tag{B.EC}$$

These results follow from Levin (2003). Sequential efficiency implies that destroying surplus on the equilibrium path cannot improve incentives, hence on the equilibrium path the agent is never fired.[33]

[33] Note that this outcome relies on the principal's ability to design an individual compensation scheme for the agent. Naturally, such flexibility may seem too strong an assumption given our objective to analyze a firm's relationship with one of many employees. There, wages are (at least partially) determined by collective bargaining agreements or a firm's central policy and not tailored to an individual employment relationship. Then, using firing threats to motivate

The (B.EC) constraint is obtained by adding the (B.IC) and (B.DE) constraints. It states that the cost of exerting effort today must be covered by the net future value of continuing the relationship which captures the fundamental mechanism of relational contracts. Sufficiency follows because of the substitutability between current and future incentives (if this condition holds, a payment scheme exists that satisfies the individual constraints stated above).

Lemma 1 implies that, if e^{FB} satisfies (B.EC) in period t, $e_t^* = e^{FB}$. Otherwise, $e_t^* < e^{FB}$ and is determined by the binding (B.EC) constraint. Finally, for the employment relationship never to be terminated on the equilibrium path, $e_t^*\theta - c(e_t^*) \geq \bar{\pi} + \bar{u}_t$ must hold for all t.

B.V.2. Comparative Statics

Next, we demonstrate how the level of the inherent marginal productivity of effort, θ, and the discount factor determine equilibrium outcomes.

Lemma 2. *S_t strictly increases in θ and δ. It weakly decreases in $\bar{S}_{t+1}$.*

Proof. Assume a profit-maximizing equilibrium with effort levels e_t^*, and that θ goes up to θ'. Holding e_t^* constant, this directly increases each per-period surplus $e_t^*\theta - c(e_t^*)$ and thus each S_t. Moreover, all (B.EC) are relaxed in t and higher effort levels can and will be implemented because a higher θ also increases e^{FB}. Holding equilibrium effort levels constant, a higher δ increases S_t, which further relaxes all (B.EC) constraints. Finally, a higher $\bar{S}_{t+1}$ has no direct effect on S_t, but tightens (B.EC) in t and therefore reduces S_t if the constraint binds. ■

Higher θ and δ have a direct positive effect on the within-relationship surplus, which is further amplified by a relaxed (B.EC) constraint. An increase in outside options tightens (B.EC) and thus potentially reduces the surplus. Next, we present a general result that is the foundation of the predictions we derive later on.

Proposition 1. *Assume (B.EC) binds in a period t. Then, equilibrium effort e_t^* decreases in $\bar{S}_{t+1}$. This effect is more pronounced if S_{t+1} is smaller or if $\bar{S}_{t+1}$ is larger to begin with. If (B.EC) in a period t is slack, equilibrium effort e_t^* is unaffected by a marginal change in $\bar{S}_{t+1}$.*

Proof. Assume $e_t^* < e^{FB}$ is characterized by the binding (B.EC) constraint. Then, the implicit function theorem yields

$$\frac{de_t^*}{d\delta_t(S_{t+1} - \bar{S}_{t+1})} = \frac{1}{c'(e_t^*)} > 0,$$

---

the agent may indeed be optimal. However, we show in Appendix section C.I that our main results continue to hold in such a setting.

which implies $de_t^*/d\bar{S}_{t+1} < 0$. Moreover,

$$\frac{d^2 e_t^*}{d\left(\delta_t(S_{t+1} - \bar{S}_{t+1})\right)^2} = -\frac{c''(e_t^*)}{\left(c'(e_t^*)\right)^2}\frac{1}{c'(e_t^*)} < 0.$$

The last statement follows since $e_t^* = e^{FB}$, and e^{FB} is unaffected by outside options. ■

The intuition for this Proposition is as follows. If the future relationship value is sufficiently high, (B.EC) is slack and first-best effort is implemented. Then, a marginal change in the value has no effect on equilibrium effort. If the relationship value is small and (B.EC) binds, a reduction decreases equilibrium effort. Because the effort cost function is convex, this reaction is stronger for a small relationship value and the corresponding low effort.

B.VI. Outside options

Now, we put more structure on the development of the agent's outside option to better relate to the empirical environment we study. There, we analyze the consequences of an anticipated increase of employees' unemployment benefits at the age of 40, which we model as a permanent increase in the agent's outside option. Hence, we assume that there is a $T > 1$ such that

$$\bar{u}_t = \begin{cases} \bar{u} & \text{for } t < T \\ \bar{u}^H & \text{for } t \geq T, \end{cases} \tag{B.3}$$

with $\bar{u}^H > \bar{u}$.

Note that we use this specification for expositional simplicity. Assuming that the higher outside option only materializes if the agent actually works in period T or later does not affect our results qualitatively. In such a setting, the future outside option would determine the future surplus within the relationship and consequently equilibrium effort in earlier periods.

Proposition 2. *For all periods $t \geq T-1$, equilibrium effort $\tilde{e}$ is constant; moreover, there is a $\tilde{\delta} < 1$ such that $\tilde{e} = e^{FB}$ for $\delta \geq \tilde{\delta}$ and determined by $-c(\tilde{e}) + \delta\left[\tilde{e}\theta - \left(\bar{\pi} + \bar{u}^H\right)\right] = 0$ otherwise.*

If $\delta \geq \tilde{\delta}$, $e = e^{FB}$ also in all previous periods $t < T-1$. If $\delta < \tilde{\delta}$, $e_t > \tilde{e}$ for all $t < T-1$. Then, there exist $\tilde{\delta}_t < \tilde{\delta}$ such that $e_t = e^{FB}$ for $\delta \geq \tilde{\delta}_t$ and determined by the binding (B.EC) *otherwise, with $\tilde{\delta}_t$ increasing. Finally, $e_t \geq e_{t+1}$, with a strict inequality if $\delta < \tilde{\delta}_{t+1}$.*

Proof. The stationarity of effort in all periods $t \geq T-1$ follows from standard arguments (see Levin 2003). Regarding existence of $\tilde{\delta}$, note that $\tilde{e}$ is constrained by $-c(\tilde{e})+\delta\left[\tilde{e}\theta - \left(\bar{\pi} + \bar{u}^H\right)\right] \geq 0$. For $\left[\tilde{e}\theta - \left(\bar{\pi} + \bar{u}^H\right)\right] > 0$, the left hand side is increasing in δ. For $\delta \to 1$, the constraint holds for e^{FB}, for $\delta \to 0$, it is violated for e^{FB}.

Now, take period $T-2$. There, effort is constrained by

$$\text{(B.EC)} \qquad -c(e_{T-2}) + \delta \frac{\tilde{e}\theta - c(\tilde{e})}{1-\delta} \geq \delta \left(\bar{\pi} + \bar{u} + \delta \frac{\bar{\pi} + \bar{u}^H}{1-\delta} \right),$$

which can be rewritten to

$$\text{(B.4)} \qquad -c(e_{T-2}) + \delta \left[\tilde{e}\theta - \left(\bar{\pi} + \bar{u}^H \right) \right] + \delta \left[c(e_{T-2}) - c(\tilde{e}) + \left(\bar{u}^H - \bar{u} \right)(1-\delta) \right] \geq 0.$$

If $\tilde{e} = e^{FB}$, (B.EC) also holds for $e_{T-2} = e^{FB}$. If $\tilde{e} < e^{FB}$ and $\delta \left[\tilde{e}\theta - \left(\bar{\pi} + \bar{u}^H \right) \right] \geq c(\tilde{e})$, (B.EC) becomes $\delta \left(\bar{u}^H - \bar{u} \right) \geq (c(e_{T-2}) - c(\tilde{e}))$, thus $e_{T-2} > \tilde{e}$. Existence of $\tilde{\delta}_{T-2}$ is immediate: At $\tilde{\delta}$, $\bar{u} < \bar{u}^H$ implies that (B.EC) is slack for $e_{T-2} = e^{FB}$. Continuity and monotonicity in δ deliver the stated properties.

The rest of the proposition follows: The earlier a period, the smaller the weight of $\bar{u}^H$ relative to $\bar{u}$ in the respective (B.EC) constraint. ■

Proposition 2 states that equilibrium effort is smaller in later than in earlier periods. This effort reduction is caused by the change in the agent's outside option which permanently increases in period t. Importantly, the effort reduction already unfolds in period $T-1$ or earlier because today's effort is constrained by the *future* relationship value. Moreover, moving to earlier periods diminishes the weight of the higher outside option which steadily increases the (future) value of the relationship. Therefore, equilibrium effort goes up as we move backwards, either until the very first period or until e^{FB} can be implemented.

Formal Discussion of Prediction 6. Assume two productivity levels, θ^l and θ^h. If the (B.EC) constraint binds for both values, the prediction follows from Lemma 2, which states that the surplus increases in θ, as well as Proposition 1. It thus remains to show that (B.EC) is "more likely to bind" for θ^l than for θ^h. To do that, we compute the critical discount factors above which first-best effort can be implemented and explore whether it is indeed larger for θ^l.

For that, we focus on period $T-1$ after which the relational contract is stationary. Then, first-best effort—characterized by $\theta - c'(e^{FB}) = 0$—can be implemented if it satifies $-c(e^{FB}) + \delta \left(\theta e^{FB} - \bar{u}^H - \bar{\pi} \right) \geq 0$, or if

$$\delta \geq \bar{\delta} \equiv \frac{c(e^{FB})}{\left(\theta e^{FB} - \bar{u}^H - \bar{\pi} \right)}.$$

Moreover,

$$
\begin{aligned}
\frac{d\bar{\delta}}{d\theta} =& -\frac{c(e^{FB})e^{FB}}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}}+\frac{c'(e^{FB})\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)-c(e^{FB})\theta}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}}\frac{de^{FB}}{d\theta} \\
=& -\frac{c(e^{FB})e^{FB}}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}}+\frac{c'(e^{FB})\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)-c(e^{FB})\theta}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}c''(e^{FB})} \\
=& \frac{c'(e^{FB})\theta e^{FB}-c(e^{FB})\theta-c''(e^{FB})c(e^{FB})e^{FB}}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}c''(e^{FB})} \\
& -\frac{c'(e^{FB})\left(\bar{u}^{H}+\bar{\pi}\right)}{\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)^{2}c''(e^{FB})} \\
=& \frac{c'(e^{FB})c'(e^{FB})e^{FB}-c(e^{FB})c'(e^{FB})-c''(e^{FB})c(e^{FB})e^{FB}}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}c''(e^{FB})} \\
& -\frac{c'(e^{FB})\left(\bar{u}^{H}+\bar{\pi}\right)}{\left(\theta e^{FB}-\bar{u}^{H}-\bar{\pi}\right)^{2}c''(e^{FB})}.
\end{aligned}
$$

Since $\bar{u}^H+\bar{\pi}>0$, for $d\bar{\delta}/d\theta<0$ to hold it is sufficient that the numerator of the first term is non-positive. For a standard effort cost function $c(e)=\frac{e^n}{n}$, with $n\geq 2$, this term becomes (for any e)

$$
\begin{aligned}
& e^{2n-1}-\frac{e^{2n-1}}{n}-(n-1)\frac{e^{2n-1}}{n} \\
=& e^{2n-1}\left(\frac{n-1}{n}-\frac{n-1}{n}\right)=0.
\end{aligned}
$$

■

Formal Discussion of Prediction 9. Assume effort costs are $c(e,k)$, with $c_e, c_k, c_{ee}, c_{kk}>0$ and $c_{ek}\geq 0$. k indicates the amount of care work the agent is responsible for, with a higher k increasing the total and marginal costs of exerting effort on the job. We want to explore whether the negative effect of a higher $\bar{u}$ is more pronounced if k is larger. We again focus on period $T-1$ after which the relational contract is stationary. Then, the (B.EC) constraint equals $-c(e,k)+\delta(e\theta-\bar{u}-\bar{\pi})\geq 0$. First, we assume that (B.EC) binds, hence

$$
\begin{aligned}
\frac{de}{dk} &= \frac{c_k}{-c_e+\delta\theta}<0 \\
\frac{de}{d\bar{u}} &= \frac{\delta}{-c_e+\delta\theta}<0 \\
\frac{d^2e}{dk\,d\bar{u}} &= \frac{c_{ek}\left(-c_e+\delta\theta\right)+c_k c_{ee}}{\left(-c_e+\delta\theta\right)^2}\frac{de}{d\bar{u}}.
\end{aligned}
$$

This term is negative if $c_{ek}\left(-c_e+\delta\theta\right)+c_k c_{ee}$ is positive, which holds for $c_{ek}=0$. For $c_{ek}>0$, assume the standard effort cost function $c(e,k)=k\frac{e^n}{n}$, for which

$$
\begin{aligned}
& c_{ek}\left(-c_e+\delta\theta\right)+c_k c_{ee} \\
=& e^{n-1}\left(-ke^{n-1}+\delta\theta\right)+k\frac{e^n}{n}(n-1)e^{n-2} \\
=& e^{n-1}\left(\delta\theta-\frac{ke^{n-1}}{n}\right) \\
=& e^{n-1}\left(\bar{u}+\bar{\pi}\right)>0.
\end{aligned}
$$

To assess whether a higher k also makes it "less likely" that the (B.EC) binds, we again state the critical discount factor above which e^{FB} can be implemented,

$$
\bar{\delta}\equiv\frac{c(e^{FB},k)}{\theta e^{FB}-\bar{u}-\bar{\pi}},
$$

with

$$
\begin{aligned}
\frac{d\bar{\delta}}{dk}=&\frac{c_k}{\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)}+\frac{c_e\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)-c(e^{FB},k)\theta}{\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)^2}\frac{de^{FB}}{dk} \\
=&\frac{c_k}{\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)}-c_{ek}c_e\frac{\left(c_e e^{FB}-c(e^{FB},k)\right)}{c_{ee}\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)^2} \\
&+\frac{c_{ek}c_e}{c_{ee}}\frac{\left(\bar{u}+\bar{\pi}\right)}{\left(\theta e^{FB}-\bar{u}-\bar{\pi}\right)^2},
\end{aligned}
$$

which clearly is positive for $c_{ek}=0$. For $c_{ek}>0$, we again assume the standard effort cost function $c(e,k)=k\frac{e^n}{n}$, with $n\geq 2$, for which this term becomes (for any e)

$$
\begin{aligned}
&\frac{\frac{e^n}{n}}{\left(\theta e-\bar{u}-\bar{\pi}\right)}\left(1-\frac{ke^n}{\left(\theta e-\bar{u}-\bar{\pi}\right)}\right)+\frac{c_{ek}c_e}{c_{ee}}\frac{\left(\bar{u}+\bar{\pi}\right)}{\left(\theta e-\bar{u}-\bar{\pi}\right)^2} \\
=&-\frac{e^n}{n}\frac{\left(\bar{u}+\bar{\pi}\right)}{\left(\theta e-\bar{u}-\bar{\pi}\right)^2}+\frac{e^n}{(n-1)}\frac{\left(\bar{u}+\bar{\pi}\right)}{\left(\theta e-\bar{u}-\bar{\pi}\right)^2} \\
=&\frac{e^n}{n(n-1)}\frac{\left(\bar{u}+\bar{\pi}\right)}{\left(\theta e-\bar{u}-\bar{\pi}\right)^2}>0.
\end{aligned}
$$

■

C. Theoretical Robustness

Our predictions are based on a model of relational contracts, which we assume is optimally tailored for each individual agent. We argue that the particular interpretation of this model is not crucial for our findings; what matters is that the value of the future relationship influences current decisions. Furthermore, in Subsection C.III, we demonstrate that this relational contracting mechanism provides a more accurate explanation of our observations than commonly used alternative models.

C.I. Fixed wages and a standard efficiency wage model

Although a worker's compensation contains many components besides monetary payments, one might argue that our model allows for too much flexibility in determining individual compensation when our objective is to capture the situation in Austria. As described above, the Austrian labor market is characterized by centrally bargained wages and working conditions, and on top by weak job protection. In the following, we therefore show that our results do not rely on the principal's ability to tailor compensation systems to individual workers, but can also be generalized in a more constrained setting. Suppose wages are exogenously given and incentives are solely provided by firing threats upon non-performance. We thus rule out the use of an informal performance-based bonus. Such a setting resembles classic models of efficiency wages which generally are relational contracting models with restrictions on the forms of compensation (see MacLeod & Malcomson 2023). With a given compensation, the only individualized aspect of the employment relationship is the agent's effort. Thus, assume that the agent is supposed to exert effort e_t^*. If he complies, he remains employed, otherwise he is fired at the end of the period. We focus on an equilibrium in which the agent remains employed on the path of play—which implicitly requires the wage to be high enough to satisfy the agent's participation constraint and low enough to satisfy the principal's participation constraint—hence his utility in a period t is

$$U_t = w - c(e_t^*) + \delta U_{t+1}.$$

Equilibrium effort is constrained by his (C.IC) constraint,

$$-c(e_t^*) + \delta U_{t+1} \geq \delta \bar{U}_{t+1}, \tag{C.IC}$$

where $\bar{U}_{t+1}$ is defined as in our main model. Now, equilibrium effort and comparative statics are not determined by the total future surplus, but by the agent's continuation payoff. It is immediate that $\delta\left(U_{t+1} - \bar{U}_{t+1}\right)$ increases in w and δ (given $U_\tau - \bar{U}_\tau > 0\,\forall\,\tau$) and decreases in $\bar{U}_{t+1}$. If this continuation rent is large enough, $e_t = e^{FB}$, otherwise, e_t^* is determined by the binding (C.IC).

Equivalently to the proof to Proposition 1, we can show that e_t^* increases in $\delta\left(U_{t+1}-\bar{U}_{t+1}\right)$ if (C.IC) binds and otherwise does not respond to it. Moreover, the effect of a higher continuation rent on effort is more pronounced if this rent has initially been smaller. If we also suppose that $\delta\left(U_{t+1}-\bar{U}_{t+1}\right)$ goes down as time passes, this setting can as well generate Predictions 1–5. If a higher inherent productivity θ and consequently a higher relationship rent also increases w_t, we can furthermore generate Prediction 6. Therefore, treating wages as exogenously given and providing incentives only via firing threats does not change our predictions. The reason is that the main mechanism, that workers are motivated by future rents from employment, still drives the results.

C.II. Effort is private information

In this subsection, we demonstrate that our results do not rely on the principal being able to observe the agent's effort. Suppose effort is the agent's private information, and the principal can observe a non-verifiable output measure $y_t = \{0, \theta\}$, where $y_t = \theta$ with probability e_t and $y_t = 0$ with probability $1 - e_t$. Moreover, we assume effort is between 0 and 1 and θ sufficiently small to always guarantee an interior solution. Now, the agent is incentivized if his payoffs are larger after a high than after a low output. As in our main model, such a reward can either take the form of a bonus paid at the end of a period or higher payments in the future. Here, we assume that only future payoffs are used for that purpose, thus no bonuses are paid but only wages. This assumption is without loss of generality because any bonus paid after a high output provides the same incentives as an equivalent increase of next period's wage (multiplied by δ). We do so to not have to deal with potentially negative bonuses which we would otherwise have to consider after a low output (and consequently a (DE) constraint for the agent). In the following we use the superscript "+" to indicate continuation payoffs after a success, and "−" for continuation payoffs after a failure. Therefore,

$$
\begin{aligned}
U_t &= w_t + e_t \delta U_{t+1}^{+} + (1 - e_t)\delta U_{t+1}^{-} - c(e_t) \\
\Pi_t &= e_t\left(\theta + \delta \Pi_{t+1}^{+}\right) + (1 - e_t)\delta \Pi_{t+1}^{-} - w_t.
\end{aligned}
$$

Now, the following constraints must be satisfied by a self-enforcing relational contract:

$$
\begin{aligned}
&\text{(C.IC)} && -c'(e_t) + \delta\left(U_{t+1}^{+} - U_{t+1}^{-}\right) = 0 \\
&\text{(C.PCP)} && \Pi_{t+1}^{+}, \Pi_{t+1}^{-} \geq \bar{\Pi} \\
&\text{(C.PCA)} && U_{t+1}^{+}, U_{t+1}^{-} \geq \bar{U}_{t+1},
\end{aligned}
$$

where (C.PCP) and (C.PCA) indicate the principal's and the agent's participation constraints, respectively, and effort in (C.IC) is determined by the agent's first-order condition.

As Levin (2003) has demonstrated, we can again separate the provision of incentives from the allocation of the resulting surplus. Therefore, we once more focus on maximizing the relationship surplus at the beginning of the relationship. Moreover, this problem is sequentially efficient, hence maximizing the initial surplus is equivalent to maximizing the surplus in every period t. This also implies that no firing threats are used to provide incentives, and equilibrium effort and incentives in a period are independent of whether a success or failure has been previously observed. Finally, it is without loss to let the period-t wage constitute the only difference between U_t^+ and U_t^-, and Π_t^+ and Π_t^-. Thus, $U_t^+ > U_t^-$ and $\Pi_t^+ < \Pi_t^-$, as well as $U_t^+ + \Pi_t^+ = U_t^- + \Pi_t^- \equiv S_t$, and the problem becomes to maximize S_t in every period t, subject to

$$\text{(C.IC)} \qquad -c'(e_t) + \delta\left(U_{t+1}^+ - U_{t+1}^-\right) = 0$$

$$\text{(C.PCP)} \qquad \Pi_{t+1}^+ \geq \bar{\Pi}$$

$$\text{(C.PCA)} \qquad U_{t+1}^- \geq \bar{U}_{t+1}.$$

Multiplying both sides of (C.PCP) and (C.PCA) with δ and adding all constraints yields the enforceability constraint

$$\text{(C.EC)} \qquad -c'(e_t) + \delta\left(S_{t+1} - \bar{S}_{t+1}\right) \geq 0,$$

where $\bar{S}_{t+1} = \bar{\Pi} + \bar{U}_{t+1}$.

Levin (2003) shows that, as long as each player at least gets their outside option, this constraint is necessary and sufficient for obtaining equilibrium effort e_t. Therefore, $e_t = e^{FB}$ if it satisfies this condition, otherwise e_t is determined by the binding (C.EC) constraint. In the latter case, e_t increases in the future net surplus $\delta\left(S_{t+1} - \bar{S}_{t+1}\right)$, thus in δ and θ, and decreases in $\bar{S}_{t+1}$. Hence, Predictions 1 and 3 would also be generated in a setting with private effort. For our other predictions, it can immediately be shown that the positive effect of the future net surplus is more pronounced for an initially smaller surplus if and only if $c''' > 0$.

The same holds if, as in Section C.I, the principal cannot tailor compensation to an individual employment relationship and is not able to use performance-based compensation. Then, firing threats are the only means to provide incentives. Here, we assume that the principal fires the agent after a low output with some probability $1 - \alpha \in [0, 1]$. For simplicity, we take α as given; if α was set to maximize profits, its level would not be stationary and potentially depend on the whole history of the game (Fong & Li 2017). Such an analysis is beyond the scope of this paper, though, and would not affect our results qualitatively. The agent's utility in such a setup is

$$\text{(C.1)} \qquad U_t = w_t - c(e_t) + \delta\left[e_t U_{t+1} + (1 - e_t)\left(\alpha U_{t+1} + (1 - \alpha)\bar{U}_{t+1}\right)\right],$$

hence effort is characterized by

$$c'(e_t) = \delta(1-\alpha)\left(U_{t+1} - \bar{U}_{t+1}\right).$$

It follows that, for $c''' > 0$, comparative statics are as in Section C.I.

C.III. Alternative models of the labor market

Finally, we argue that the relational contracting mechanism that we propose does a better job explaining our observations compared to other models of the labor market. For this comparison, we focus on the most widely used alternatives, the competitive model as well as search-and-matching models.

C.III.1. Competitive model of the labor market

We argue that a standard, competitive model of the labor market is not well suited to generate our predictions. To do so, we first identify potential links between prospective UI benefits and worker absenteeism in this model (if such a link does not exist, we do not need to proceed). For example, higher UI benefits might reduce stress levels on the job, but then we would expect eligible workers' sick days to go down instead of up. Alternatively, a higher outside option might have a direct positive effect on the worker's inherent productivity on the job and therefore allow them to reduce effort. Even though such a mechanism could generate our main prediction, it would be more challenging to justify why the negative impact of increased outside options on effort is stronger for older employees or those in declining or low-wage firms, thus providing a basis for predictions 4, 5, and 6.

C.III.2. Search models

Next, we discuss a model in which labor markets are characterized by search-and-matching frictions. There, we focus on on-the-job search as a means that can potentially affect worker absenteeism.[34] Consider a worker who spends some of their working time searching for alternative jobs and assume that more search increases absenteeism. Then, higher UI benefits can affect the worker's incentives to conduct search if there is some probability that they will lose their job and if this probability increases in their search effort. In this case, extended UI benefits would indeed increase absenteeism, caused by a mechanism that is very similar to the one captured by our model: More

[34] Naturally, more generous UI benefits could also reduce incentives to search for those without a job and consequently increase the unemployment rate, thereby influencing incentives for the employed. However, we do not expect such a link to matter in our setting because the policy we utilize is not a labor market reform but instead an institutional feature that affects some employees differently than others.

search increases absenteeism and thus decreases productive effort. Thereby, the worker captures private benefits (as with an effort reduction), and the firm's payoff goes down. However, if higher absenteeism indeed was caused by more on-the-job search instead of other consequences of a reduced effort, this would result in better job offers and consequently more job-to-job transitions (presuming that at least some of these outside offers are not matched by the current employer). In Appendix Figure A.14, we therefore test whether eligibility for more generous UI benefits increases job-to-job transitions and find little evidence that this might be the case.

D. Other age cutoffs

We would wrongly attribute absenteeism effects to a change in potential UI duration if eligible, but not ineligible workers were affected by other policies at a cutoff around age 40. In Table D.1 we present other potentially relevant age-based cutoffs. Importantly, other age-based cutoffs and labor market policies are not relevant for individuals aged between 35 and 45, and these cutoffs are not experience-rated.

D.I. UI benefits

Apart from the UI benefit extensions we exploit in this paper (as described in section III.A), there are some additional age-based cutoffs in the Austrian UI system. The base of UI benefits of workers aged 45 or older is protected. Since UI benefits are based on earnings from the prior year, UI benefits could decrease when a worker takes a lower paid job. Workers aged 45 or older and become unemployed are protected against a decrease in UI benefits. Additionally, while there is no general job protection in Austria, employees aged 50 or older benefit from more generous protection against unfair dismissal on social grounds if they decide to sue their former employer. Importantly, both features affect eligible and ineligible workers to the same extent.

D.II. Retirement

The Austrian retirement system consists of different schemes. Prior to full retirement, workers can take up partial retirement, which allows them to reduce their working time by 40 to 60 percent with full wage compensation in the five years prior to their retirement. The usual retirement age in Austria in the relevant time period was, at the minimum, 55 for women and has increased up to 65 for men (for a more detailed discussion, see Appendix Section F). Generally, workers need to have contributed to their retirement fund for at least 15 of the last 30 years. Note that this experience cutoff is tremendously higher than the one we use in our design (6 of last 10 years). Workers contribute to retirement insurance either by being employed, receiving unemployment insurance, being on parental leave, and can also voluntarily self-insure. Thus, being eligible for retirement is primarily driven by age.

D.III. Labor market policies

The Austrian labor law does not stipulate age limits for public sector jobs, such as public service or police, other than being at least 18 years old. However, there are specific labor market policies that apply to people aged 50 or older as well as long-term unemployed people. In 2017, the Austrian government enacted a job guarantee program to employ long-term unemployed people over 50 in public employment with the program financing 100 percent of their wage cost. This program aimed to reintegrate long-term unemployed people in the labor market, but was terminated in December 2017. The Austrian ministry of labor additionally subsidizes firms with a distinct focus on hiring older employees, long-term unemployed people, as well as other vulnerable groups. There are further wage subsidies for firms that hire employees older than 50 and long-term unemployed people.

D.IV. Adult education subsidy

Workers who want to obtain further education in Austria can take government-subsidized leave while attending university or other adult education programs. In such a case, workers remain employed with the current firm but the government covers part of their wage bill for up to one year. There is no age or tenure limit on the eligibility of the adult education subsidy.

D.V. Fertility and school starting age

Additionally, we show that the mean age at birth in our sample is approximately 26.6 for mothers (26.0 for ineligible and 26.9 for eligible mothers) and 31.5 for fathers (32.0 for ineligible and 31.4 for eligible fathers). The usual school starting age is 6 years, but this does not differ between eligible and ineligible workers.

Table D.1 — Summary of other relevant age-based regulations

	Age	Description
Panel A. Unemployment insurance		
Dismissal protection[†]	≥ 50	Increases protection against unfair dismissal on social grounds.
UI benefits base protection[‡]	≥ 45	After the 45th birthday the assessment base of UI benefits cannot decrease anymore.
Panel B. Retirement		
Partial retirement	≤ 5 years before regular retirement	Allows working hours reduction by 40 to 60 percent with full wage.
Retirement age[††]	≥ 55	The minimum retirement age in our sample is 55 and increases over time.
Panel C. Labor market policies[‡‡]		
Public service	no age limit	There is no age limit to become a public servant.
Employment subsidy	≥ 50	Aims to create public sector jobs for older long-term unemployed people and subsidize up to 100 percent wage costs (only in 2017).
Secondary labor market institutions[¶]	≥ 50	Subsidized employment to build bridge to primary labor market
Wage subsidy	≥ 50	Aims to integrate older employees into the labor market by partly substituting wage costs.
Panel D. Adult education subsidy		
Adult education subsidy	no age limit	Subsidized leave for employees to obtain adult education.
Panel E. Fertility		
Age at birth[*]	Mothers: 26.6, Fathers: 31.5	

Notes: This table provides an overview of other age-cutoffs, labor market policies, education and training, as well as fertility.

[†] Austrian labor law only provides protection against dismissal in specific cases, e.g., pregnancy, unfair dismissal on social grounds, and union membership.
[‡] UI benefits are calculated based on prior wages. If an employee becomes unemployed after 45, takes a lower paid job, and then becomes unemployed again, their UI benefits cannot be lower than the initial UI benefits.
[††] For further discussion of the retirement age see Appendix Section F.
[‡‡] Many labor market policies also apply for long-term unemployed persons (≥ 1 year or ≥ 6 months for persons aged ≤ 25).
[¶] Institutions on the secondary labor market have a distinct focus on hiring vulnerable groups, e.g., workers 50 or older and long-term unemployed people.
[*] Ages are based on own calculations using births in in our sample.

E. Breakpoint detection

To find an initial value for the reference group b in our event studies, we perform a simple breakpoint detection method that follows Evans et al. (2019). Define D_t as the difference in average sick leave durations between eligible and ineligible workers at age t in the raw data,

$$D_t = \overline{\text{duration}}_t^{\text{eligible}} - \overline{\text{duration}}_t^{\text{ineligible}}. \tag{E.1}$$

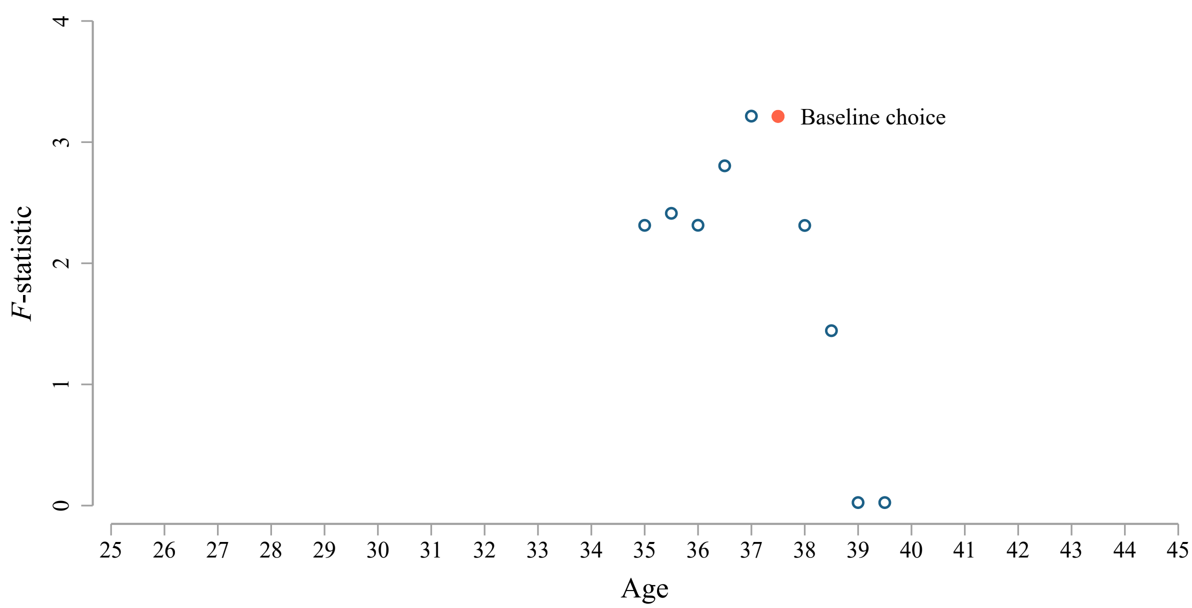
Then, for each potential break point c along the age distribution, estimate the quadratic splines

$$D_t = \alpha + \beta_1 t_c (1 - A_t^c) + \beta_2 t_c^2 (1 - A_t^c) + \gamma_1 t_c A_t^c + \gamma_2 t_c^2 A_t^c + u_t \tag{E.2}$$

where $A_t^c = \mathbb{1}[t \geq c]$ and t_c is a linear age trend centered around c, $t_c = t - c$. Break points will have large F-statistics on the test of a break in trend ($\beta_1 = \gamma_1$ and $\beta_2 = \gamma_2$). Similar to Evans et al. (2019), we first pick a window where the gap in sick leave durations visually begins to open based on Figure 1, which is between 35 and 39.5 years of age. In Figure E.1, we plot F-statistics for different values of c in this age window.

We see that the F-statistic is largest for $c = 37$ and $c = 37.5$, before it drops off significantly at age 38. We pick 37.5 as the baseline reference group because it is closer to the UI cutoff at age 40. In any case, we show that the reference group choice has little impact on our estimates in section III.E.

Figure E.1 — F-statistics for different potential breakpoints



Notes: This figure shows F-statistics for the test that $\beta_1 = \gamma_1$ and $\beta_2 = \gamma_2$ based on equation E.2 for different possible break points c between age 35 and 39.5.

F. Alternative identification strategy

As a validation exercise, we use changes in the Austrian early retirement age (ERA) as an alternative source of variation in outside options. In this Appendix we describe the institutional setting and the two pension reforms we consider in more detail. We draw heavily from Staubli & Zweimüller (2013) and Manoli & Weber (2016), who study employment effects and actual pension takeup of the ERA reforms.

F.I. The pension system

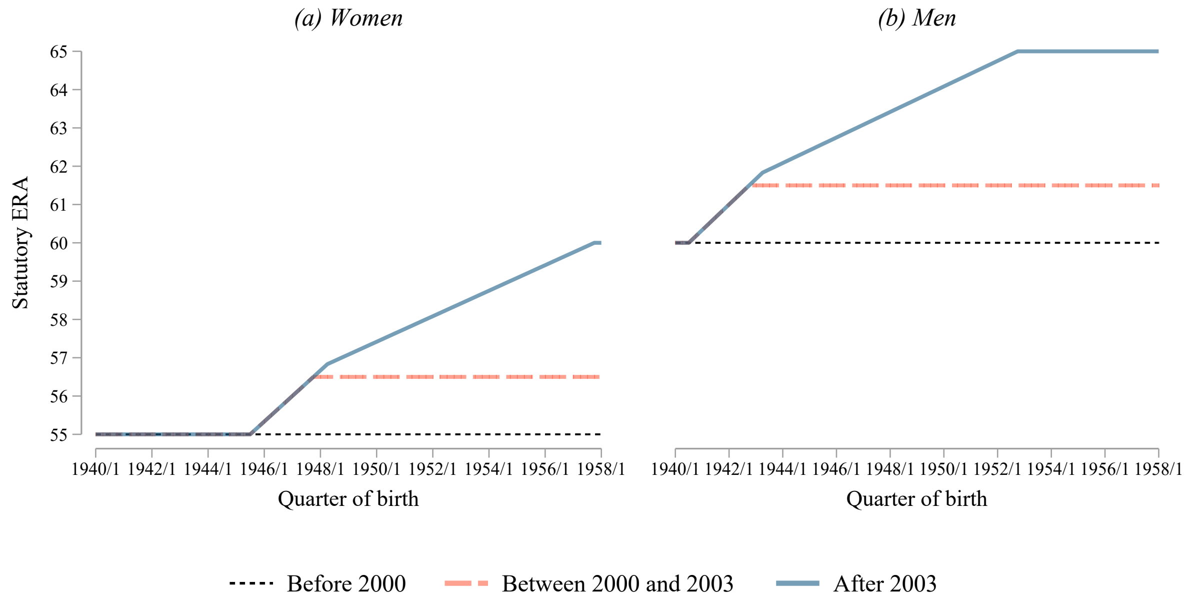
The Austrian public pension system is universal and private-sector workers are automatically enrolled. Financing is based on a pay-as-you-go scheme, with payroll taxes being withheld from the worker's salary up to a contribution cap. The system covers three types of pension: regular old age pension, early retirement, and disability pension. Currently, the statutory retirement age is 65 years for men and 60 years for women. Until 2000, early retirement was possible from age 60 for men and age 55 for women, provided they had worked for at least 35 years or if they had been long-term unemployed but had worked for at least 15 years in total. Pension benefits are assessed based on pre-retirement wages multiplied with a 'pension coefficient,' which is a factor of up to 0.8 that increases with work experience. The penalty for retiring early amounts to around 2 percentage points per year of retiring before the regular retirement age.

F.II. The pension reforms

For the purpose of fiscal consolidation, the Austrian government enacted two pension reforms in 2000 and 2003 that increased the ERA gradually by quarter of birth cohort. Figure F.1 provides a graphical representation. The 2000 reform, which became effective on October 1, 2000, increased the ERA by 1.5 years in two-month steps for every quarter of birth for both men and women. The first affected cohort for men was 1940/q4, where the ERA was increased to 60 years and 2 months, and 1945/q4 for women, where the ERA was increased to 55 years and 2 months. The last affected cohorts were 1942/q4 (men) and 1947/q4 (women), for whom the ERA was increased to 61.5 (men) and 56.5 (women). The statutory ERAs by cohort after 2000 are represented by the red dashed line in Figure F.1.

The second reform was enacted in 2003 and became effective on January 1, 2004, effectively abolished early retirement by increasing the ERA to the regular old age pension age (65 for men and 60 for women). Again, the ERA increase was phased-in based on quarter of birth cohorts. For men, the ERA was raised in two-month steps for those born in 1943/q1 and 1943/q2 and then in one-month steps for those born between 1943/q3 and 1952/q4. Similarly, for women, the ERA was

Figure F.1 — Statutory ERAs over time, by quarter of birth, and by gender



Notes: This figure depicts the statutory ERAs by quarter of birth and for both genders. The black dashed line represents the initial situation where the ERA was 55 for female workers and 60 for male workers. The red dashed line represents the situation between after the first reform in 2000 and before the second reform became effective in 2004. The blue line represents the current ERAs that are in effect since January 1, 2004.

increased in two-month steps for those born in 1948/q1 and 1948/q2 and in one-month steps for those born between 1948/q3 and 1957/q4. This is depicted as the blue line in Figure F.1.