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Petri Böckerman
Ohto Kanninen
Ilpo Suoniemi

PALKANSAAJIEN TUTKIMUSLAITOS LABOUR INSTITUTE FOR ECONOMIC RESEARCH

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* Labour Institute for Economic Research and IZA. Address: Pitkänsillanranta 3A, FI-00530 Helsinki, Finland. Phone: +358-9-2535 7330. Fax: +358-9-2535 7332. E-mail: petri.bockerman@labour.fi
** Labour Institute for Economic Research. E-mail: ohto.kanninen@labour.fi
*** Labour Institute for Economic Research. E-mail: ilpo.suoniemi@labour.fi

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Palkansaajien tutkimuslaitos
Pitkänsillanranta 3 A, 00530 Helsinki
Puh. 09−2535 7330
Sähköposti: etunimi.sukunimi@labour.fi

Labour Institute for Economic Research
Pitkänsillanranta 3 A, FI-00530 Helsinki, Finland
Telephone +358 9 2535 7330
E-mail: firstname.surname@labour.fi

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TIIVISTELMÄ

Tutkimuksessa tarkastellaan Kelan maksaman sairauspäivärahan vaikutusta sairauspoissaolojen kestoon. Suomessa sairauspäiväraha määräytyy kahden vuoden takaisista työtuloista. Korvausuhde ei ole vakio vaan sairauspäiväraha riippuu epälineaarisesti aiemmista vuosityötuloista. Sairauspäivärahajärjestelmän vaikutuksen identifointi perustuu päivärahan korvaussuhteessa tietyillä tulotasoilla tapahtuviin hyppäyksiin. Ekonometrisena estimointimenetelmänä on ns. kulmapistemenetelmä. Kulmapistemenetelmällä kvasikokeellinen kausaalivaikutus vastemuuttujaan voidaan identifioida tilanteissa, joissa tarkastelun kohteena oleva politiikkamuuttuja on tunnettu, deterministinen ja kulmapisteellinen funktio sitä määräävästä muuttujasta. Tässä sovelluksessa politiikkamuuttuja on sairauspäivärahan laskukaava, määrittelevä muuttuja on kahden vuoden takaiset tulot ja vastemuuttuja on sairauspoissaolojakson kesto. Tutkimuksessa havaitaan, että korkeampi korvaustaso pidentää selvästi sairauspoissaolojaksoja. Sairauspoissaolojaksojen keston jousto korvaussuhteen suhteen on noin 1,4.

ABSTRACT

This paper examines the effect of the replacement rule of the Finnish sickness insurance system on the duration of sickness absence. A pre-determined, piecewise linear policy rule in which the replacement rate is determined by past earnings allows identification of the effect using a regression kink design. We find a substantial and robust behavioral response. The statistically significant point estimate of the elasticity of the duration of sickness absence with respect to the replacement rate is on the order of 1.4.

Keywords: Sick pay, labor supply, sickness absence, paid sick leave, regression kink design

JEL classification: I13, I18, J22

1. INTRODUCTION

Absenteeism is a cause of substantial loss of working time worldwide. In some OECD countries nearly 10% of annual working days are lost because of sickness absence (DICE Database, 2012).[1] The costs are considerable for employers, co-workers, and health and benefit systems. Sickness absence is also a source of major indirect costs, because it increases the risk of withdrawing from the labor force. The protected individuals are compensated for their earnings losses by a sickness insurance system. Among cash benefits, sickness insurance is one of the most important social protection schemes in Europe (Eurostat, 2011).

The key policy parameter of the sickness insurance system is the replacement rate, i.e. the ratio of sickness insurance benefits to past earnings. The replacement rate directly affects workers' financial incentives to be absent from work. Generous sickness insurance benefits may entail a moral hazard problem and thus have a negative effect on labor supply at the intensive margin. An optimal sickness insurance system should balance the moral hazard due to the reduced incentives of returning to work against the risk-sharing benefits of more generous payments to the sick.[2]

In this paper we examine the effect of the replacement rate of the Finnish sickness insurance on the duration of sickness absence.[3] We use Regression Kink Design (RKD, see Section 3) to identify the causal effect of the replacement rate. Unlike in most other countries (Frick and Malo, 2008, p. 510-511), the compensation level of sickness insurance in Finland is not a fixed fraction of past earnings, but it follows a piecewise linear scheme. This allows us to use RKD, in which the identification of the effect is based on a pre-determined, nonlinear policy rule (Card et al. 2012). Obtaining reliable estimates for the effect of the replacement rate is particularly relevant from the policy perspective, because the replacement rate is a parameter that can be easily manipulated by policy makers. Our estimates are therefore useful for the design of a more cost-effective sickness insurance system.

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[1] Treble and Barmby (2011) provide an overview.
[2] Optimal social insurance policies have recently been surveyed by Chetty and Finkelstein (2012).
[3] The European Survey on Working Conditions reveals a large cross-country variation in absenteeism. Given that Finland has the highest share of sickness absenteeism (Gimeno et al. 2004), it is of interest to analyse the determinants of absenteeism there. Sickness absence has also increased significantly in Finland during the past 15 years. The average number of sickness absence days per wage and salary earner was 10 in 2008, according to the Quality of Work Life Survey (Lehto and Sutela, 2009).

In our empirical analysis we find a substantial and robust behavioral effect. The statistically significant point estimate of the elasticity of the duration of sickness absence with respect to the replacement rate is 1.41, with a 95% confidence interval of 0.36 to 2.46.

Previous research has used policy reforms that provide exogenous variation in the replacement rates to examine the effect of sick pay level on absence. Several studies exploit legislative changes in the replacement rates and provide difference-in-difference estimates for Sweden (Henrekson and Persson, 2004; Johansson and Palme, 2005; Pettersson-Lidbom and Skogman Thoursie, 2013). There is also similar evidence for other countries (Puhani and Sonderhof, 2010; De Paola et al. 2014; Ziebarth and Karlsson, 2014; Fevang et al. 2014). In addition to studies that have exploited policy reforms within countries, there is cross-country evidence on the positive effect of the replacement rate of sickness insurance on absenteeism (Frick and Malo, 2008).

The elasticity of absence with respect to the replacement rate is positive, based on earlier research. However, the quantitative size of the effect varies substantially from study to study. Also, the comparison of the estimates is not straightforward, since the outcome variables (duration of sickness absence or number of sickness absence days) are not identical in all studies.[4] Therefore, there remains substantial uncertainty about the exact quantitative magnitude of this policy-relevant parameter.

Empirical studies based on policy reforms suffer from a number of caveats. Reforms are aimed at specific groups, the causal impact takes time to take effect, agents anticipate the upcoming reform,[5] effects are confounded by simultaneous policy changes or other shocks, etc. Thus, the causal interpretation for the difference-in-difference estimates obtained using policy reforms is not straightforward (cf. Besley and Case, 2000; Pettersson-Lidbom and Skogman Thoursie, 2013, p. 487). The method that we exploit circumvents this problem by using a kink in the benefit rule that applies to all employed persons.

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[4] Ziebarth and Karlsson (2014) summarize the existing estimates by noting that the elasticity of sick days with respect to the benefit level is ~0.9.

[5] De Paola et al. (2014, p. 349) highlight the fact that employees can adjust their sickness absence behavior in anticipation of the reform.

The paper unfolds as follows. Section 2 provides an overview of the Finnish sickness insurance system. Section 3 describes RKD. Section 4 introduces the data and the estimation results are presented in Section 5. The last section concludes.

2. THE FINNISH SICKNESS INSURANCE SYSTEM

Finland has a universal compulsory sickness insurance scheme that covers all (16-67 years old) permanent residents.[6] The scheme guarantees compensation for the loss of earnings owing to sickness and illness. Sickness allowances and reimbursements are defined in the Health Insurance Act and Decree. Sickness insurance is financed by both employers and employees. The state participates by financing the minimum allowance that is paid to those with no earnings.

The Social Insurance Institution of Finland (KELA) pays out a Sickness Allowance (SA) as compensation for the loss of earnings caused by an illness or injury.[7] The SA includes two provisions: a minimum sickness benefit and an earnings-related benefit. The earnings-related benefit is relevant for most of employed and self-employed persons.

Before receiving the SA from KELA, the person must complete a waiting period. It includes the day of onset of work incapacity and the following nine working days.[8] The incapacity for work must be certified by a doctor. The employee is entitled to normal salary during the nine-day waiting period if the employment relationship has lasted at least a month.[9]

After the nine-day waiting period the employee is eligible to receive an earnings-related SA from KELA. The maximum period for SA is 300 working days (i.e. approximately a full calendar year). All SA days within the last two years are counted towards this sum. After the maximum has been reached, there is an assessment of eligibility for a disability

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[6] This description of the system is based mainly on Toivonen (2012). Kangas et al. (2013) provide a historical account. Most countries have more fragmented sickness insurance schemes which complicate the analysis (cf. Gruber, 2000).

[7] The total amount of SA paid was 834.2 million € in 2011 (KELA, 2013, p. 3).

[8] The waiting period includes Saturdays, but not Sundays or public holidays.

[9] The employer pays a full salary for at least the first nine days, depending on the collective labor agreement, if the employment has lasted at least a month. If the employment has lasted less than a month, the beneficiary receives 50% of the salary. KELA fully compensates employers for these payments.

pension. The person is eligible to receive the SA again only after having worked for at least a year.

The earnings-related SA has no ceiling. This feature distinguishes the Finnish scheme from those of the other Nordic countries and most other European sickness insurance systems. For annual earnings of up to 34,496 euros, the replacement rate was 70% in 2012, after which it gradually decreases.

For our purposes, the most important feature of the system is that the replacement rate of the earnings-related SA follows a pre-determined, nonlinear policy rule. First, the SA is determined by past taxable annual earnings. The relevant earnings are those earned two calendar years before the claim for sickness insurance is made. For example, in 2012, the SA was calculated on the basis of taxable earnings in 2010.[10] Work-related expenses are deducted from taxable earnings, and in addition a deduction is made to account for pension and unemployment insurance contributions.

The fact that the SA is determined by past earnings is particularly useful for our purposes, because applicants are arguably able to manipulate their current earnings. This would invalidate the identification of the causal effect using RKD. But this is highly unlikely regarding past earnings. Reassuringly, we are also able to check whether there is any bunching of the data points towards the kinks in the benefit rule.

The second important feature of the system is that the replacement level follows a piecewise linear policy rule in past earnings.[11] The determination of SA for 2012 is illustrated in Figure 1. There are four earnings brackets. The benefit formula for the earnings-related SA exhibits one discontinuity and two kink points, which we define as the lower and the upper kink point. The lower kink point allows one to use RKD to identify the causal effect of the replacement rate. The discontinuity point cannot be exploited, since the replacement rate of those who are below the threshold depends on the length of the sickness absence.

Figure 1 here

[10] The amount of taxable earnings is based on the decision by the Finnish Tax Administration. An index is used to account for the rise in wage and salary earners' earnings (80 percent weight) and the cost of living index (20 percent weight).
[11] These kinks to the system were created in the early 1980s (see Kangas 2013, p. 283).

3. REGRESSION KINK DESIGN

Card et al. (2012) propose a variant of the Regression Discontinuity Design (RDD) which they call RKD.[12] Their method uses a kink or kinks in a policy rule to identify the causal effect of the policy rule on the outcome variable of interest. A valid RKD setting requires the explanatory variable (in our case, the replacement level) to be a deterministic and known function of an assignment variable (in our case, earnings from two years prior). The function also has to have at least one kink point. This means that the function has segments where it is (continuous and) differentiable, but in at least one point it is non-differentiable having unequal left and right derivatives (Condition 1). The second condition for a valid RKD setting is that the assignment variable allocates the observations to the left and right segments of a kink point in a manner that is as good as random (Condition 2). Endogenous bunching of observations near kink points would invalidate this smoothness condition.

In our setup, Condition 1 holds, since we know exactly how earnings from two years prior determine the replacement level. We also have data on the relevant earnings and the replacement level. Also, as Figure 1 shows, the relationship between the assignment variable and the policy variable for the year 2012 is continuous for earnings above 1325 euros and has kinks at 34,496 and 53,072 euros. Other years in our data show a similar pattern.

The random assignment of observations (Condition 2) is not directly verifiable in empirical applications. But it seems plausible to expect that individuals would not manipulate the benefit level by altering their earnings in order to be assigned to another segment of the replacement function two years later. We can also ascertain that other benefit rules, such as the earnings-related unemployment benefit, do not have kinks or discontinuities at the same points as the sickness benefit and thus they do not affect the randomness of the assignment. Furthermore, we can test for whether the distribution of the control variables is smooth in relation to the kink point. If we find this not to be the case, Condition 2 fails, which invalidates the design. This procedure is very similar to what is usually done to validate RDD (for a review, see Imbens and Lemieux, 2008).

[12] Card et al. (2012) apply their method to answer the question whether the level of unemployment benefits affects the length of unemployment in Austria.

For a formal presentation of the model, let S_i be sickness days in the year t, for individual i∈{$1,2,\dots,n$}, Y_i is earnings in the year t-2 and B_i is the sickness allowance, which follows the deterministic assignment function $B_i = b(Y_i)$ with a kink at $Y_i = y_k$.The parameter of interest is the change in the slope of the conditional expectation function $m(y) = E[S_i|Y_i = y]$, at y_k divided by the change in the slope of the deterministic assignment function $b(y)$ at $y = y_k$. With no loss of generality, the model of interest is assumed to have a local representation in a small neighborhood of $y = y_k$:

$$S_i = \tau b(y) + g(y) + \varepsilon_i,$$

where g is a fixed function and ε_i is an error term.

Nielsen et al. (2010) show that τ, the treatment effect on those assigned on the right segment of the kink point, is identified around y_k. The identification requires that $g(\cdot)$ and $E(\varepsilon_i|Y_i = y_k)$ are smooth functions and S_i has a kink at y_k, then

$$\tau = \frac{D_+m(y_k) - D_-m(y_k)}{D_+b(y_k) - D_-b(y_k)}, \tag{1}$$

where $D_j m(y_k) = \lim_{y \to y_k^j} \frac{\partial m_i(y)}{\partial y}, D_j b(y_k) = \lim_{y \to y_k^j} \frac{\partial b_i(y)}{\partial y}, j$ ∈{+,-}. Thus, τ is the change in the slope of $E(S_i|Y_i = y)$ divided by the change in the slope of the assignment function $b(y)$ at the kink point ($y = y_k$).

The numerator in equation (1) is estimated parametrically as β_1 using the following local power series expansion:

$$E(S_i|Y_i = y) = \alpha_0 + \sum_{p=1}^{P} [\alpha_p (y - y_k)^p + \beta_p D_i (y - y_k)^p], \tag{2}$$

where P is the chosen polynomial order of the estimated function and D_i is the treatment status, where 1 means treated and 0 means not treated ($D_i(z) = 1, if\ z > 0, D_i(z) = 0$ otherwise). Note that $|y - y_k| \leq h$, where h is the bandwidth chosen for the estimation.

The bandwidth selection is a trade-off between bias and precision. We follow Card et al. (2012, pp. 32–33) and use the "rule-of-thumb" bandwidth, based on Fan and Gijbels (1996, equation 3.20, p. 67):

$$h = C_p \left\{ \frac{\hat{\sigma}^2(0)}{[\widehat{m}^{(p+1)}(0)]^2 \hat{f}(0)} \right\}^{\frac{1}{2p+3}} n^{-\frac{1}{2p+3}},$$

where p is the order of the polynomial in the main specification, $\hat{\sigma}^2(0)$ and $\widehat{m}^{(p+1)}(0)$ are, respectively, the estimated error variance and *(p+1)th* order derivative of the regression, using a wide-bandwidth polynomial regression of equation (2),[13] C_1 is 2.352 for the boundary case with a uniform kernel and $\hat{f}(0)$ is estimated from a global polynomial fit to the histogram of earnings. We use the Akaike Information Criterion (AIC)[14] for model selection and report the results for multiple bandwidths in sensitivity analysis.

The denominator in equation (1) is the change of the slope of the deterministic $B(y)$ at the kink point. The treatment effect that we estimate is the average treatment effect on the treated, $E[S_{1i} - S_{0i}|D_i = 1]$. In other words, it is the effect of the change in the policy function at the kink point on those who are just above the kink point.

Card et al. (2012, pp. 10–12) distinguish between sharp and fuzzy RKD. A fuzzy design arises when there is a significant difference between the theoretical and observed value of the kink in the policy rule. The difference stems from e.g. measurement errors or the fact that the kink in the policy rule is affected by some unobserved variables in addition to the primary assignment variable. In our setting, a likely source of error is the manner in which variables are defined and classified in the original dataset (see Section 4 and Figure A1).

For estimation of the expected change of the policy rule, we use a local regression as above:

[13] We use the data for a very wide window of 0.8 log earnings for this regression, which contains 85% of the total sample. This is done in order to keep the polynomial order within reasonable limits. The polynomial order is chosen to minimize Akaike Information Criterion. Also, the polynomial in this context is allowed to be nonlinear only in the *p*th order. This is necessary in order for $\widehat{m}^{(p+1)}(0)$ to exist.

[14] $AIC = -Nln(\hat{\sigma}^2) + 2p$, where $\hat{\sigma}^2$ is the mean squared error, *N* is the sample size and *p* is the number of parameters.

$$E(B_i|Y_i = y) = \delta_0 + \sum_{p=1}^{P} [\delta_p (y - y_k)^p + \gamma_p D_i (y - y_k)^p], \quad (3)$$

where γ_1 is the empirical counterpart of the policy rule. The elasticity of interest is $\tau = \frac{\beta_1}{\gamma_1}$. To obtain the correct standard errors for τ, we use instrumental variable (IV) regression, following Card et al. (2012, pp. 20–21). The instrument is the interaction term of past earnings and an indicator of earnings above the lower kink point, $D_i(y - y_k)$. The instrumented variable is B_i, the received compensation.

4. DATA

We use total data on Finnish sickness absence spells over the period 2004–2012. This comprehensive register-based data originate from KELA and they are derived from the database that is used to pay out the SA compensations. Therefore, some measurement error might arise from the aggregation of variables when converting the original register for research purposes.[15] The administrative data cover both wage and salary earners and self-employed persons. The data include the start and end dates for all sickness spells and the total amount of SA paid for each person. Annual earnings are deflated to 2012 prices by using the consumer price index.

Our data consist of absence spells that last for longer than the waiting period of nine full working days. The distribution is right-skewed.[16] Thus, longer sickness absences contribute disproportionately to the total days lost and absence costs. The data enable us to concentrate on those absences that are affected by the incentives of the sickness insurance system.

The data record a person's past taxable earnings that KELA obtains directly from the Finnish tax authorities. KELA uses the same information to calculate the SA for beneficiaries. The data also include useful background information such as a medical diagnosis for the reason for sick leave, which can be used to test for validity of the RKD.

[15] In particular, consecutive absence spells that start within 300 days are counted as a single spell if the diagnosis remains the same.

[16] The skewness of the distribution is 2.5 and 2.9 for the total sample and for the window of 0.0796 log earnings around the lower kink point, respectively.

The initial diagnosis of individuals is documented according to the International Classification of Diseases (ICD-10).[17] We have also linked to the data the highest completed education from the Register of Completed Education and Degrees, maintained by Statistics Finland.

The estimations are restricted to those in the labor force who are eligible for sick pay and who are between 16 and 70 years of age. The final sample used in the analysis includes compensated absence spells which are above zero in duration and whose payment criteria and initial diagnoses are known for employees with a single employer during their sickness spell.[18] The final sample around the lower kink point consists of 37,000–41,000 individuals, depending on the year. Descriptive statistics is reported in Table 1 (duration of sickness absence and background characteristics for persons).[19]

Table 1 here

Figure 2 reveals that persons with low earnings have a longer duration of sickness absence. This observation is consistent with the hypothesis that people with poorer health have lower earnings, assuming that the duration of sickness absence is a valid proxy for health.

Figure 2 also suggests that there are incentive effects present around the lower kink point. We exploit the lower kink point to identify and estimate the effect of the replacement rule for two reasons. First, the lower kink point is located in the part of the earnings distribution which contains substantial mass to support the estimation of statistically significant effects (Figure 3). The large sample size around this kink point shows as smaller variability in the length of the sickness absence within the 200 euros bins. Second, there is a large change in the benefit rule at the lower kink point (cf. Figure 1).[20]

Figures 2-3 here

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[17] ICD is the standard diagnostic tool for epidemiology, health management and clinical purposes. The classification is available at: http://www.who.int/classifications/icd/en/

[18] A part-time sickness benefit was introduced in Finland at the beginning of 2007. We exclude its recipients from the sample. Only 0.5% of the sample has no known diagnosis. Also, the 146 observations with missing received compensation were excluded. We are able to identify entrepreneurs from 2006 onwards. We exclude the 2.3% of the original sample that entrepreneurs represent. In total, we exclude c. 3.0% of the original data to construct the final sample.

[19] Table 1 shows a very low minimum value for sickness insurance compensation in euros. This is probably due to the fact that a small proportion of the insured are compensated according to an eligibility criterion other than prior earnings. Our results are robust to their exclusion from the sample.

[20] The estimated effects are insignificant at the upper kink point and thus omitted (cf. Figure A4). The point of discontinuity at a very low level of earnings is of no use for our purposes, due to the small number of individuals at this part of the distribution. Also, the replacement rate of those individuals who are below the threshold is tied to the length of their sickness absence.

5. RESULTS

Figure 4 shows the duration of sickness absence and annual earnings around the lower kink point.[21] The regression results are compiled in Table 2. The choice of bandwidth is a compromise between precision and bias. The main specification uses the "rule-of-thumb" bandwidth h, estimated to be c. 0.0796 log euros (see Fan and Gijbels, 1996, p. 67), which fulfils two criteria. First, covariates are linear, whereas they show nonlinearity at wider bandwidths (see Table A1) than 0.0796 log euros. Second, estimates are sufficiently precise, whereas a narrower band would increase standard errors.

Precision in regression analysis increases with sample size and variance in the explanatory variable. Both of these decrease as the bandwidth narrows. Note that the bandwidth in our main specification is quite narrow in terms of monthly earnings (~460 euros in 2012).

Figure 4 and Table 2 here

Using a bandwidth of 0.0796 log euros for annual earnings, we find clear evidence for the incentive effects. The estimated change of the slope at the lower kink point is -0.56. The corresponding elasticity of the duration of sickness absence (τ) with respect to the replacement rate is 1.41. The point estimate implies a high elasticity, but the estimator also has a large confidence interval [0.36, 2.46]. The wider the bandwidth used, the lower the point estimates get. This stems at least partly from the fact that a wider bandwidth brings in more non-randomly assigned observations.

The response we observe is affected by both the employer and employee incentives (cf. Footnote 9). Using the duration of the benefit period paid out to the employer as the response variable, the estimated response is well within the confidence interval of our main specification. Employer incentives are aligned with those of the employees and also appear to matter.

We confirm the result from the main specification using different sets of controls (see Table 3). The results show a reassuring degree of robustness. Controlling for individual characteristics and the initial diagnosis at the one-letter level (21 different values) gives the same point estimate as the regression with no controls. Using an even more detailed

[21] See Figures A2 and A3 for annual graphs.

classification of diagnoses (205 different values) renders the point estimate insignificant at the 5% level. The results are significant at the 5% level when the model is estimated with the dependent variable in levels instead of in logarithms.[22] The adjusted R^2 of the model increases from 0.0003 to 0.14 once all the controls are included.

Table 3 here

The slope below the kink point, however, ceases to be significant when controls are included. This would imply that the positive slope found without controls appears to be due to earnings-correlated systematic heterogeneity in the sample, which disappears once the controls are included.

One of the best known stylized facts of the literature is that the prevalence of sickness absence is much higher for women (Holmlund, 2004). The earlier literature has also shown that the elasticity of the sickness absence days with respect to the replacement rate may differ for women vs. men (cf. Johansson and Palme, 2005). Therefore, we run separate regressions by sex, finding a significant estimate for males and an insignificant one for females.[23]

To detect whether there might be any bias induced by the size of the bandwidth or possible non-randomness in the assignment, it is necessary to check for the linearity of covariates at the kink point. The covariates are all linear, with the exception of the female indicator (Table A1, Figure A5 and A6). The fact that the three most common one-letter level diagnoses are linear is particularly important, since the diagnoses are directly linked to the duration of sickness absence. This is evident in the R^2 of the estimated regressions with and without diagnoses (Table 3).

We also test and find no evidence of bunching (i.e. no jump) in the histogram of log earnings around the lower kink point (see Figure A7 and Figure A8). This is done by fitting a polynomial on 1200 bins in a window of 0.3 log earnings. Similarly, we find no discontinuity in the derivative of the density around the lower kink point.[24] Neither is bunching found if the densities for males or females are considered separately. Therefore,

[22] We also ran the regressions using both earnings and sickness duration in levels. The result regarding elasticity is virtually identical.
[23] Johansson and Palme (2005, p. 1886) also find that the incentive effect of sickness insurance is much stronger for males than for females.
[24] We regress the density on the bin midpoints with a polynomial order of 10 allowing for a kink and a discontinuity in the first derivative, respectively. The polynomial order is determined by AIC.

we consider that the nonlinearity of the female indicator at the kink point is of minor concern for a causal interpretation of our response estimate.

Lastly, to check whether the result is a spurious one, we run 101 placebo regressions, where the lower kink point is assumed to be off the correct location by -0.5 to 0.5 of log earnings at intervals of 0.01 log earnings (see Figure A9). We use the same FG bandwidth of the true (lower) kink point for all these regressions. Of the 94 regressions not around the true kink point, ~7 (7.4%) show a significant estimated effect. Therefore, one would not be likely to observe any apparent behavioral response with this methodology without a genuine change in the policy rule.

The impact of a 5% increase in the replacement level for the year 2012 is a 0.06% [0.02%, 0.11%] reduction in GDP. For this illustration, we approximate productivity per working day by dividing annual earnings (in 2010) by 300 and adding 60% to account for indirect labor costs. The crucial (and strong) assumption is that the estimated elasticity is constant at 1.41 [0.36, 2.46] throughout the distributions of earnings and sickness absence duration. We also assume that an increase of 5% is small enough for the constancy of the elasticity.

6. CONCLUSIONS

Using total data on absence spells with a large sample size, we find a considerable incentive effect of the sickness benefit rule at the intensive margin in a quasi-experimental research setting. The point estimate of the elasticity of the duration of sickness absence with respect to the replacement rate is 1.41 with a 95 percent confidence interval from 0.36 to 2.46.

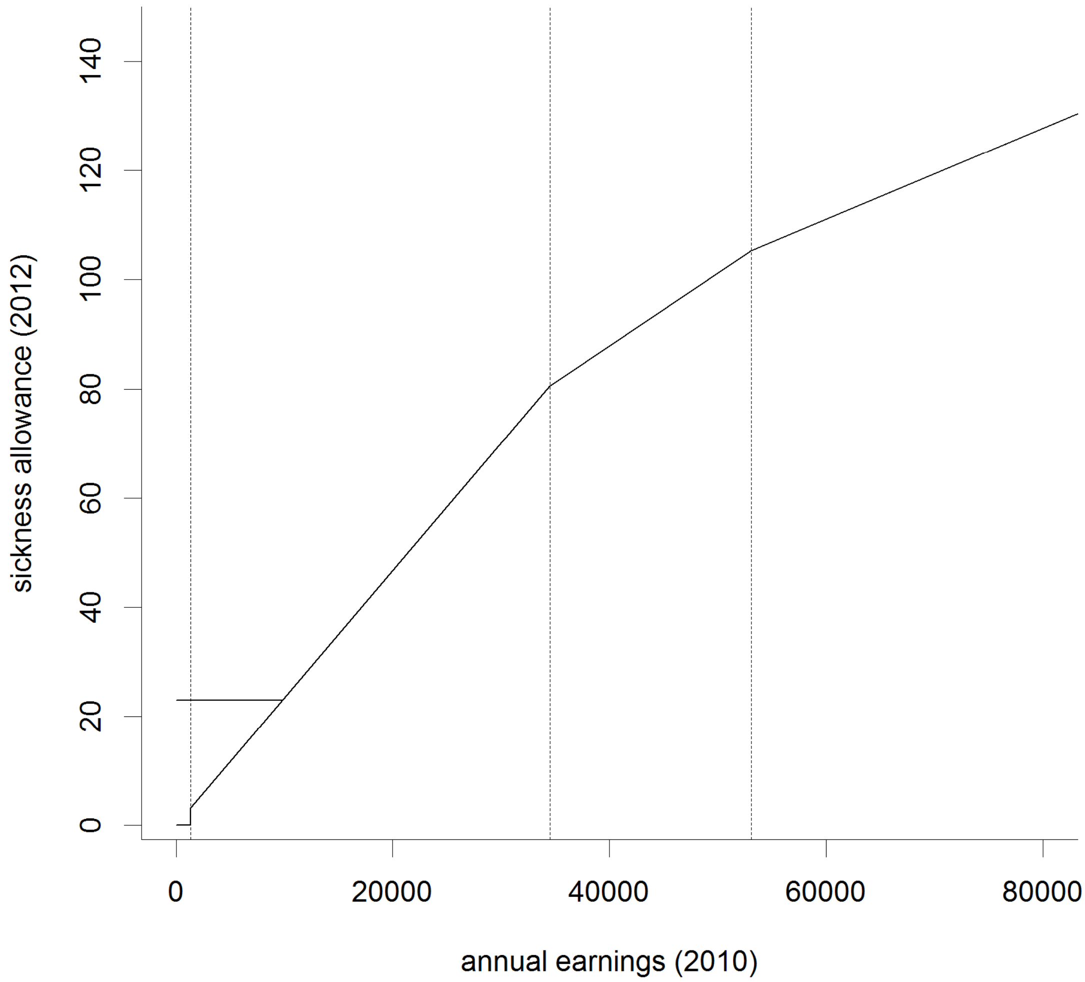
A large number of observations guarantee the robustness of our results even controlling for sickness diagnoses. Exogeneity is ensured by the fact that the sickness benefit is determined by earnings two years prior. A battery of linearity checks were run on a number of variables which might influence our results at the kink point.

Our main contribution is to exploit a research design that delivers a result with strong internal validity. However, the applicability of the results on the whole population is debatable. But, since the estimates are obtained at the earnings level close to the median earnings (within 1% in 2012), the response is likely to be similar for a large proportion of the population. Previous literature has analysed reforms, which are usually targeted at a subset of the population. The behavioral responses of the subset of the population might differ from that of the total population, which reduces the external validity of these research findings.

Our research provides a pioneering application of the regression kink design. The research design builds on exogenous variation that can be exploited for coherent causal inference in a manner that the regression discontinuity design rarely offers, since in our case the eligible persons have significantly weaker incentives to optimize their behavior with respect to the policy rule. However, to obtain statistically significant results, one has to ensure sufficient sample sizes, since the changes in the policy rule and the responses tend to be noisy and are affected by sample heterogeneity.

The result we find might prove to be interesting for policy makers who aim to improve the cost effectiveness of the compulsory sickness insurance. Although the behavioral effect is only observed around the kink point, one would expect the benefit system to have strong behavioral effects elsewhere along the benefit rule as well.

Figure 1. Relationship between prior annual earnings and daily sickness allowance in euros.



Notes: The vertical dashed lines represent the discontinuity point at 1325 euros and the lower and upper kink points at 34,496 and 53,072 euros in 2012.

Table 1. Descriptive statistics.

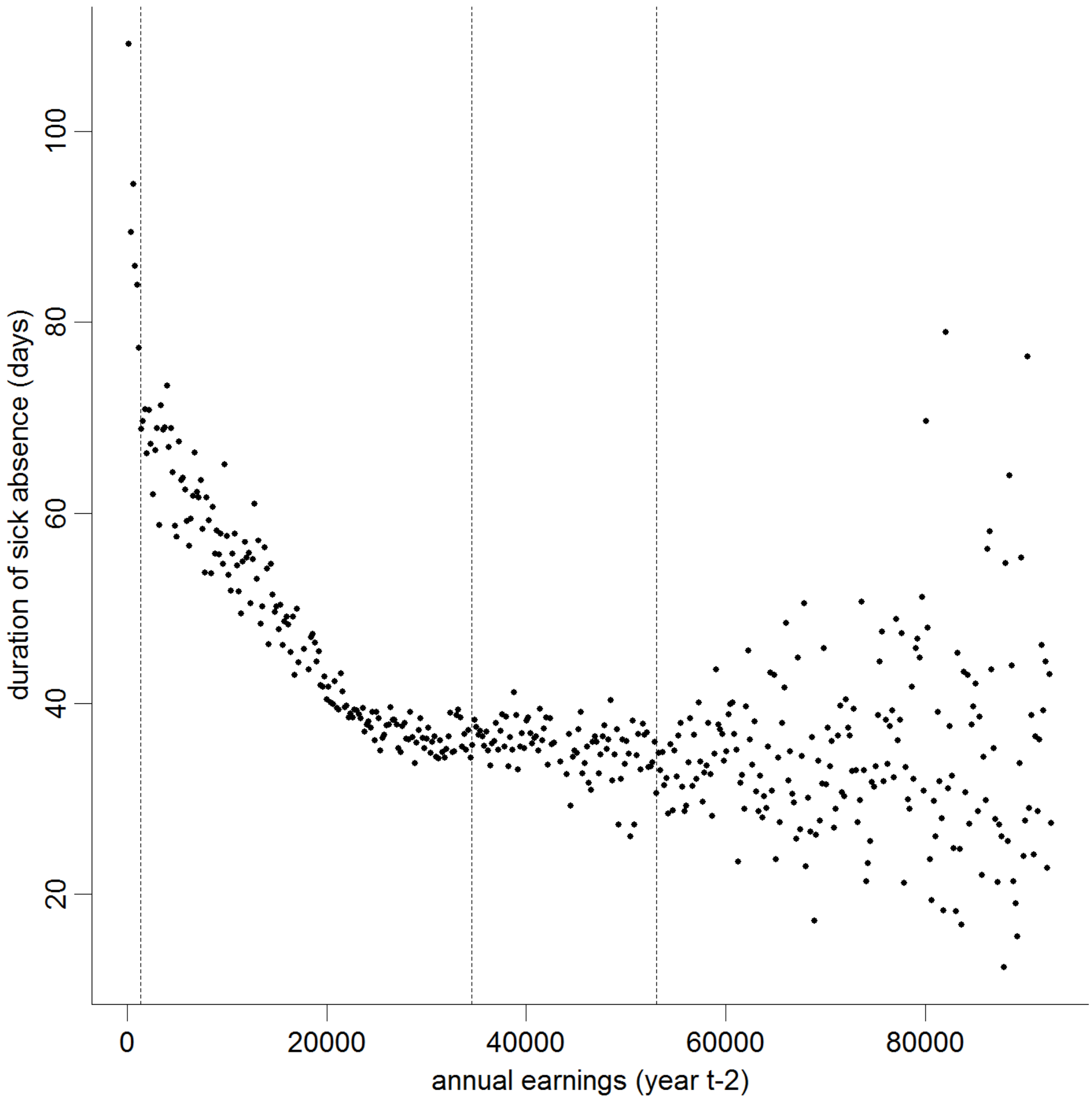
	Panel A: Total sample				Panel B: Sample around the lower kink point			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Duration of sickness absence (days)	43.76	70.73	1	575	36.36	60.94	1	454
Duration of sickness absence (log-days)	2.76	1.47	0	6	2.62	1.42	0	6.12
Earnings	26364.68	16119.64	0	6120738	33120.44	1923.67	29095	37897
Log earnings	10.07	0.67	-3.00	15.63	10.41	0.06	10.28	10.54
Age	45.13	11.35	16	70	46.53	10.01	17	69
Female	0.59	0.49	0	1	0.48	0.5	0	1
Tertiary level education	0.14	0.34	0	1	0.16	0.36	0	1
Helsinki Metropolitan Area	0.17	0.37	0	1	0.19	0.39	0	1
Sickness allowance per day (euros)	54.3	23.19	0.01	4600.56	69.16	8.26	0.02	136.21

Panel C: Sample size by year

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total
Total sample	344,590	352,446	346,747	341,527	339,949	317,618	309,893	309,333	313,101	2,975,204
Sample around the lower kink point	39,887	41,275	41,380	40,617	40,693	38,368	37,875	37,068	37,652	354,815

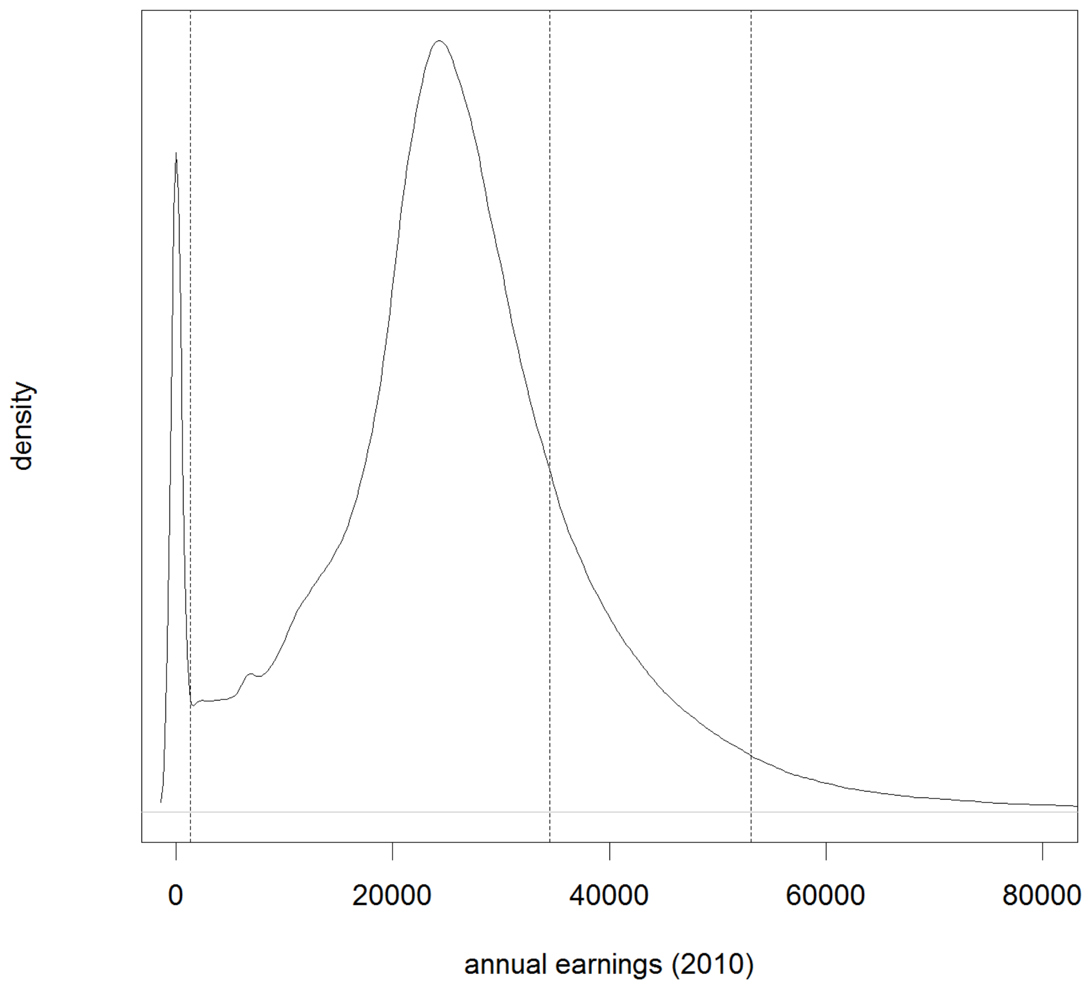
Note: The sample around the lower kink point is defined within the FG bandwidth (0.0796 log euros of annual earnings). The very low minimum value for sickness allowance is probably caused by the small proportion of the insured that get compensated according to eligibility criteria other than prior earnings. The diagnoses M, S and F represent respectively 34, 13 and 16 percent of the whole sample and 36, 14 and 14 percent of the sample around the threshold. Diagnosis M in ICD-10 refers to diseases of the musculoskeletal system and connective tissue. Diagnosis S refers to injury, poisoning and certain other consequences of external causes. Diagnosis F refers to mental and behavioral disorders.

Figure 2. Duration of sickness absence in 2012 and annual earnings.



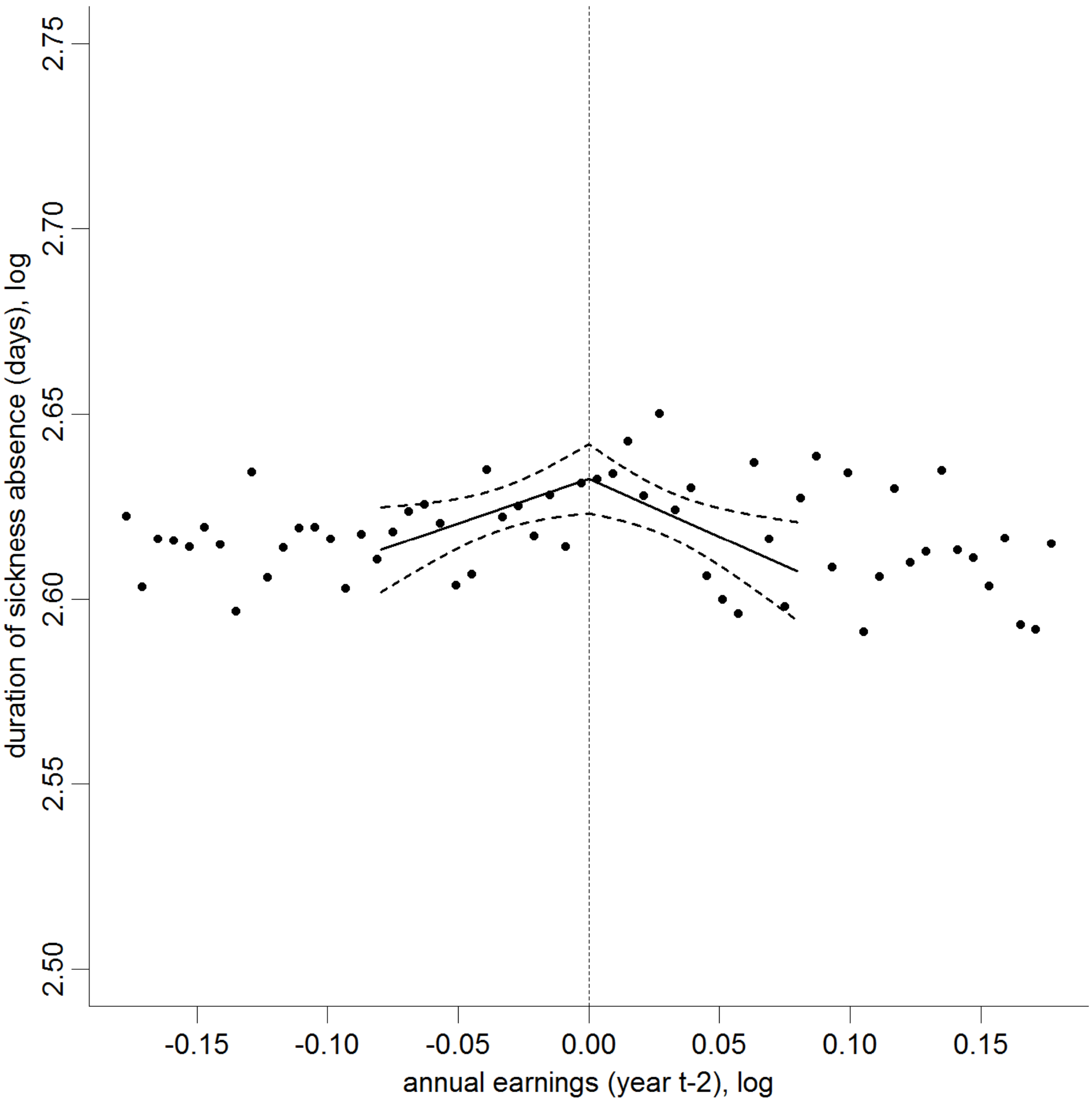
Notes: The vertical dashed lines represent the discontinuity point at 1325 euros and the kink points at 34,496 and 53,072 euros in 2012. The dots represent the mean duration of sickness absence in bins of 200 euros. One bin between each discontinuity and the kink point has been extended such that the discontinuity and the kink points are located at the bin cut-off points.

Figure 3. Kernel density estimate of the earnings distribution.



Notes: The vertical dashed lines represent the discontinuity point at 1325 euros and the kink points at 34,496 and 53,072 euros in 2012. The kernel is Gaussian and the bandwidth is set at 467 euros.

Figure 4. Duration of sickness absence and annual earnings 2002–2012 around the lower kink point.



Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are in logs and normalized to zero at the lower kink point. The dots represent the mean duration of sickness absence in bins of 0.006 log euros. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis (cf. Table 2).

Table 2. Regression estimates from the main specification.

Panel A: Dependent variable: duration of sickness absence (days)					
	Bandwidth				
	FG bandwidth - 0.04	FG bandwidth - 0.02	FG bandwidth	FG bandwidth + 0.02	FG bandwidth + 0.04
Change of slope at kink point (β_1)	-0.129 (0.593)	-0.908*** (0.321)	-0.556*** (0.208)	-0.402*** (0.149)	-0.286*** (0.114)
Slope below kink point (α_1)	0.236 (0.325)	0.451*** (0.174)	0.240** (0.112)	0.238*** (0.079)	0.149*** (0.060)
Yearly fixed effects	Y	Y	Y	Y	Y
Polynomial order	1	1	1	1	1
R^2 (Adj.)	0.0003	0.0003	0.0003	0.0003	0.0002
N	176,215	264,944	354,800	444,304	533,718
Panel B: Elasticity of the duration of sickness absence with respect to replacement rate					
Change in the replacement rate (γ_1)	-0.346*** (0.061)	-0.377*** (0.033)	-0.394*** (0.021)	-0.390*** (0.015)	-0.402*** (0.012)
Elasticity ($\tau = \frac{\beta_1}{\gamma_1}$)		2.409	1.411	1.031	0.712
Panel C: Instrumental variable estimation of the elasticity of the duration of sickness absence with respect to replacement rate					
Estimated elasticity (τ)	0.373 (1.72)	2.408*** (0.886)	1.411*** (0.536)	1.033*** (0.386)	0.712** (0.285)
N	176,215	264,944	354,800	444,304	533,718

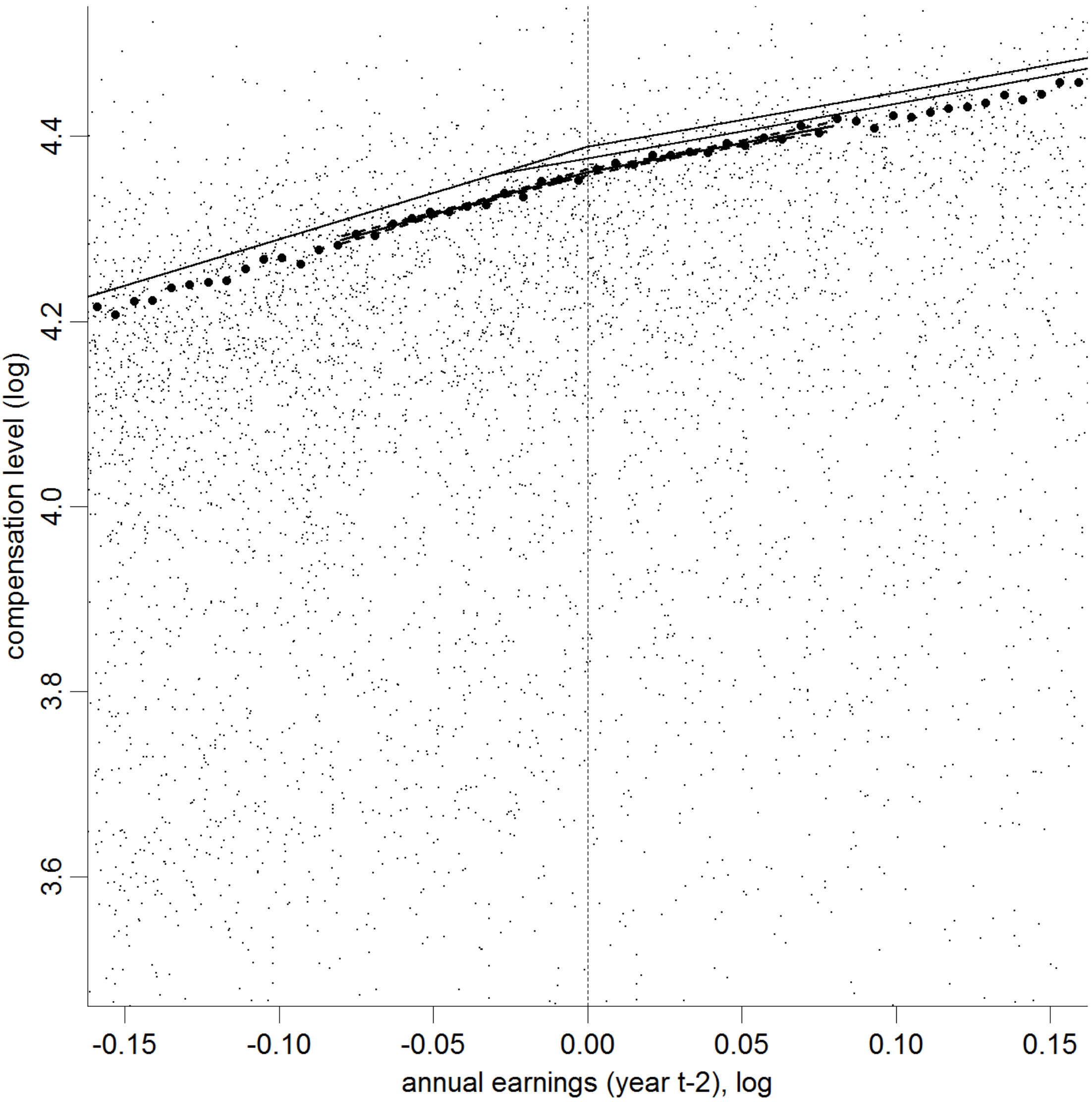
*Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Statistical significance: * p<0.1; ** p<0.05; *** p<0.01. The estimated model is equation (2). The parameter p, which defines the polynomial order, is chosen using the Akaike Information Criterion (AIC). The preferred polynomial order is 1. The FG bandwidth referring to the "rule-of-thumb" bandwidth described in Fan and Gijbels (1996) is estimated to be c. 0.0796. The 95% confidence interval for the IV estimated elasticity with a point estimate of 1.41 is [0.36, 2.46]. The instrument is the interaction term of past earnings and an indicator of earnings above the lower kink point. The F-statistic for a test of the hypothesis that the coefficient of the instrument is zero in a regression of the received compensation on the instrument is considerably higher (346) than the conventional threshold of 10 for a weak instrument. To obtain the F-statistic, we use the residualized values, i.e. the residuals from a regression on the control variables, which are the yearly fixed effects and past earnings.*

Table 3. Regression estimates from the main specification, with controls.

Panel A: Dependent variable: duration of sickness absence (days)								
	Log-duration							Duration in levels
	Total sample					Females only	Males only	Total sample
Change of slope at kink point (β_1)	-0.556*** (0.208)	-0.516** (0.206)	-0.502** (0.201)	-0.473** (0.199)	-0.302 (0.192)	-0.110 (0.293)	-0.779*** (0.294)	-19.626** (8.334)
Slope below kink point (α_1)	0.240** (0.112)	0.055 (0.111)	0.208* (0.108)	0.034 (0.107)	-0.051 (0.104)	0.077 (0.153)	0.059 (0.162)	-2.372 (4.496)
Yearly fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Individual characteristics		Y		Y	Y			Y
Initial diagnosis (at one-letter level)			Y	Y				
Initial diagnosis (at one-letter-one-number level)					Y			Y
Polynomial order	1	1	1	1	1	1	1	1
R^2 (Adj.)	0.0003	0.0134	0.0661	0.0781	0.143	0.0001	0.0011	0.1249
N	354,800	354,800	354,800	354,800	354,800	170,869	183,931	354,800
Panel B: Instrumental variable estimation of the elasticity of the duration of sickness absence with respect to replacement rate								
Estimated elasticity (τ)	1.411*** (0.536)	1.314** (0.533)	1.274** (0.517)	1.206** (0.516)	0.765 (0.491)	0.271 (0.724)	2.032** (0.79)	1.368** (0.589)
N	354,800	354,800	354,800	354,800	354,800	170,869	183,931	354,800

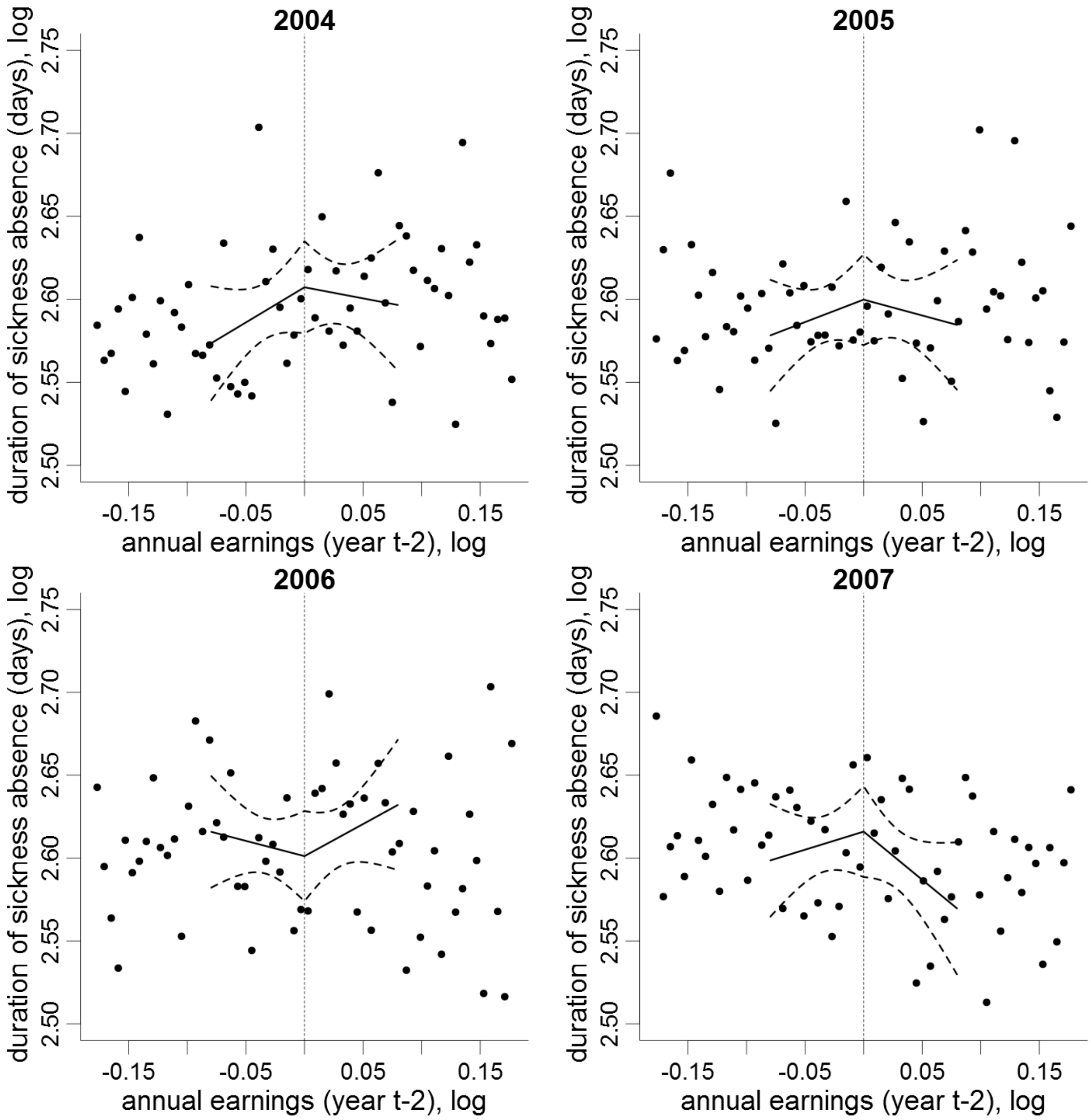
*Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Statistical significance: * p<0.1; ** p<0.05; *** p<0.01. The estimated model is equation (2). The parameter p, which defines the polynomial order, is chosen using the Akaike Information Criterion (AIC). The preferred polynomial order in all regressions is 1. Individual characteristics are age, sex, the Helsinki Metropolitan Area indicator and tertiary education indicator. Initial diagnosis is denoted at the one-letter and one-letter-one-number level, following the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10). The data have 21 and 205 different values for this variable, respectively. The FG bandwidth referring to the "rule-of-thumb" bandwidth described in Fan and Gijbels (1996) is estimated to be c. 0.0796. The instrument is the interaction term of past earnings and an indicator of earnings above the lower kink point. The lowest F-statistic for a test of the hypothesis that the coefficient of the instrument is zero in a regression of the received compensation on the instrument is 344 in the second column regression with individual characteristics as the control variables. Of the two regressions with a lower sample size the lower F-statistic is 166 in the male population regression (cf. notes in Table 2).*

Figure A1. Annual earnings and compensation level around the lower kink point in 2012.



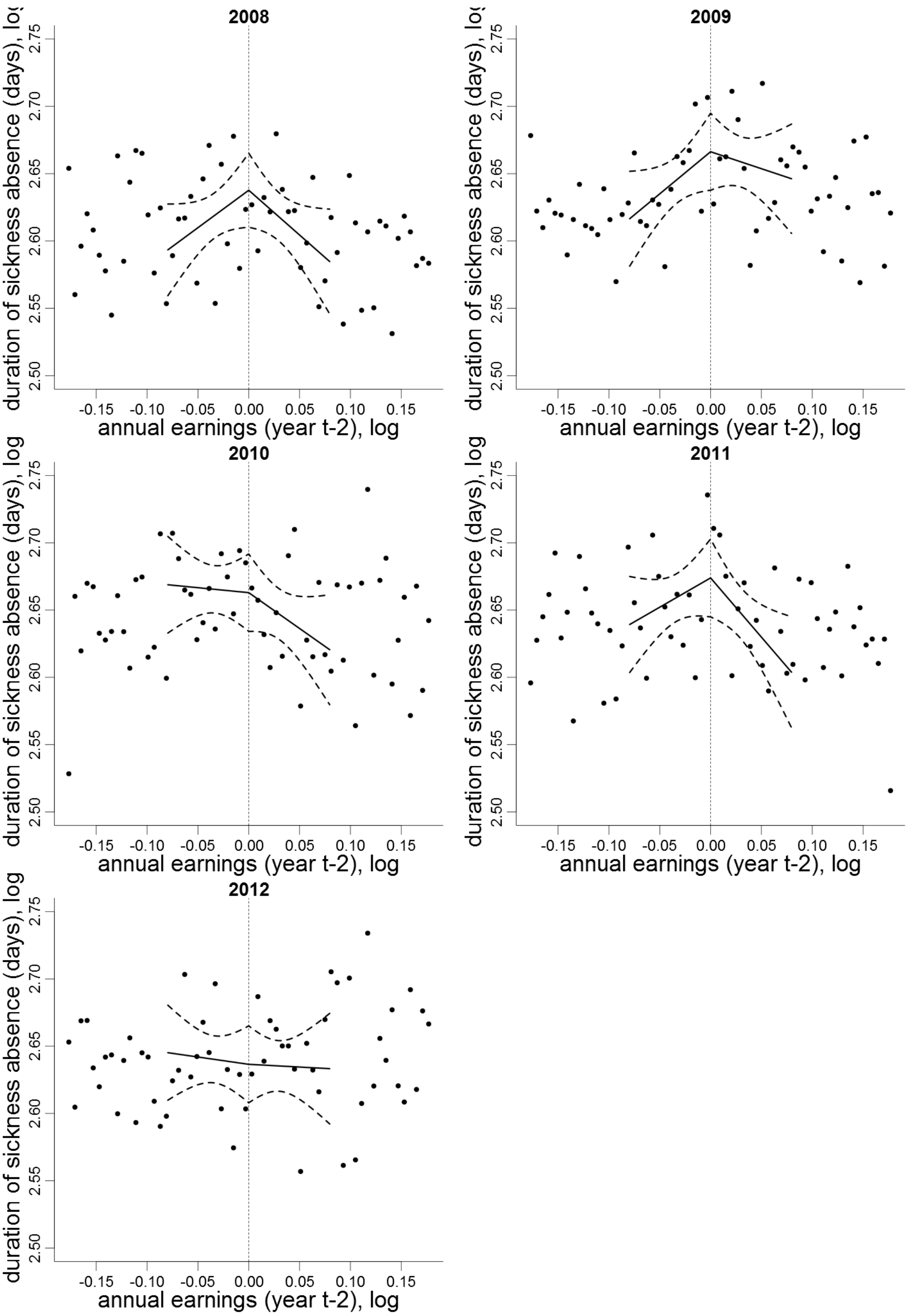
Notes: Earnings are in logs and normalized to zero at the lower kink point. The large dots represent the mean log compensation level in bins of 0.006 log euros. Each small dot represents one observation. The vertical axis has been cut at 4.5 for clarity. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis. The double line that starts right below the threshold stems from the fact that some of the benefits in 2012 data follow 2011 replacement rates. This is one source of fuzziness in the data.

Figure A2. Annual earnings and duration of sickness absence around the lower kink point 2004–2007.



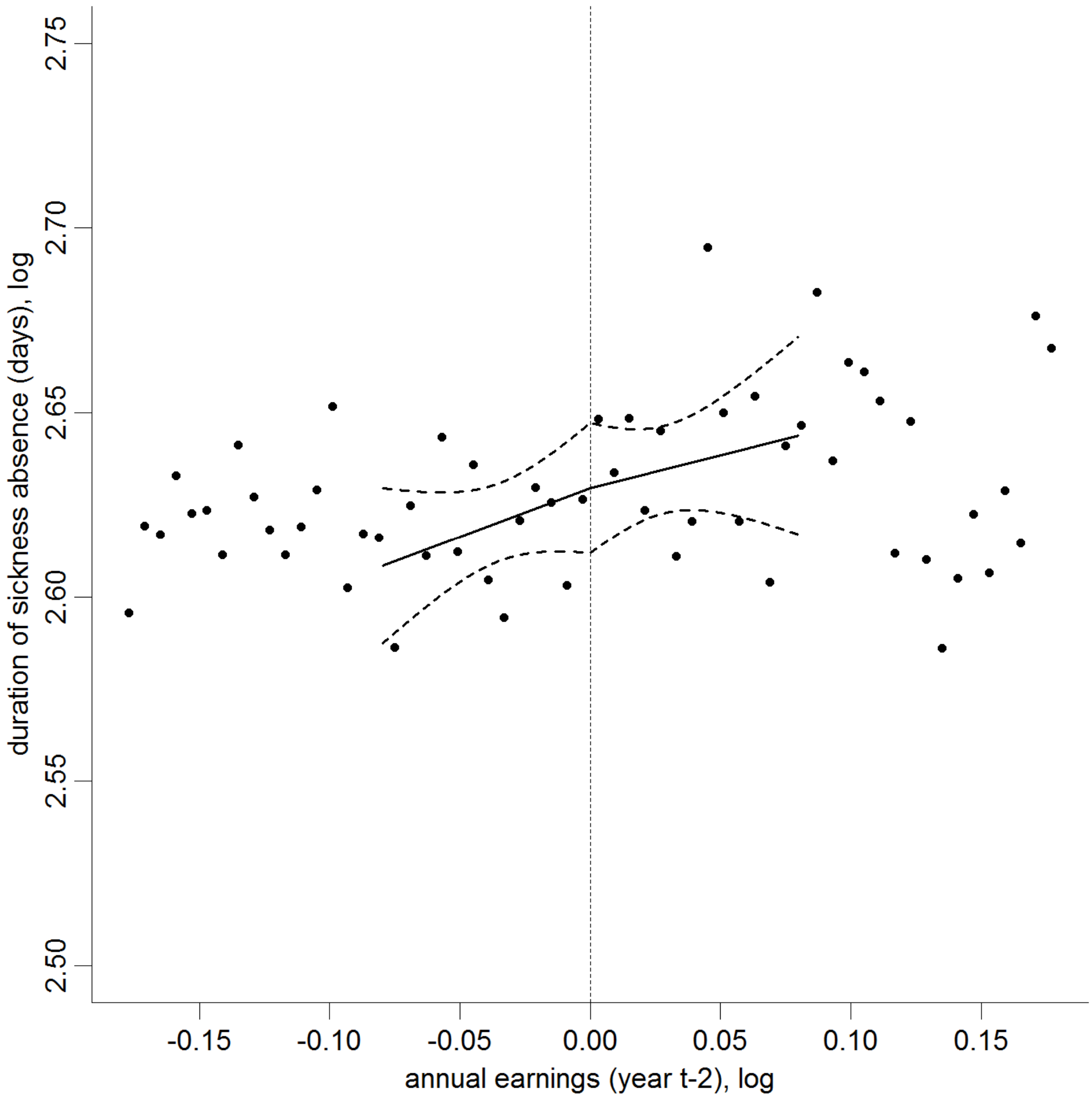
Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are also normalized to zero at the lower kink point. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis.

Figure A3. Annual earnings and duration of sickness absence around the lower kink point 2008–2012.



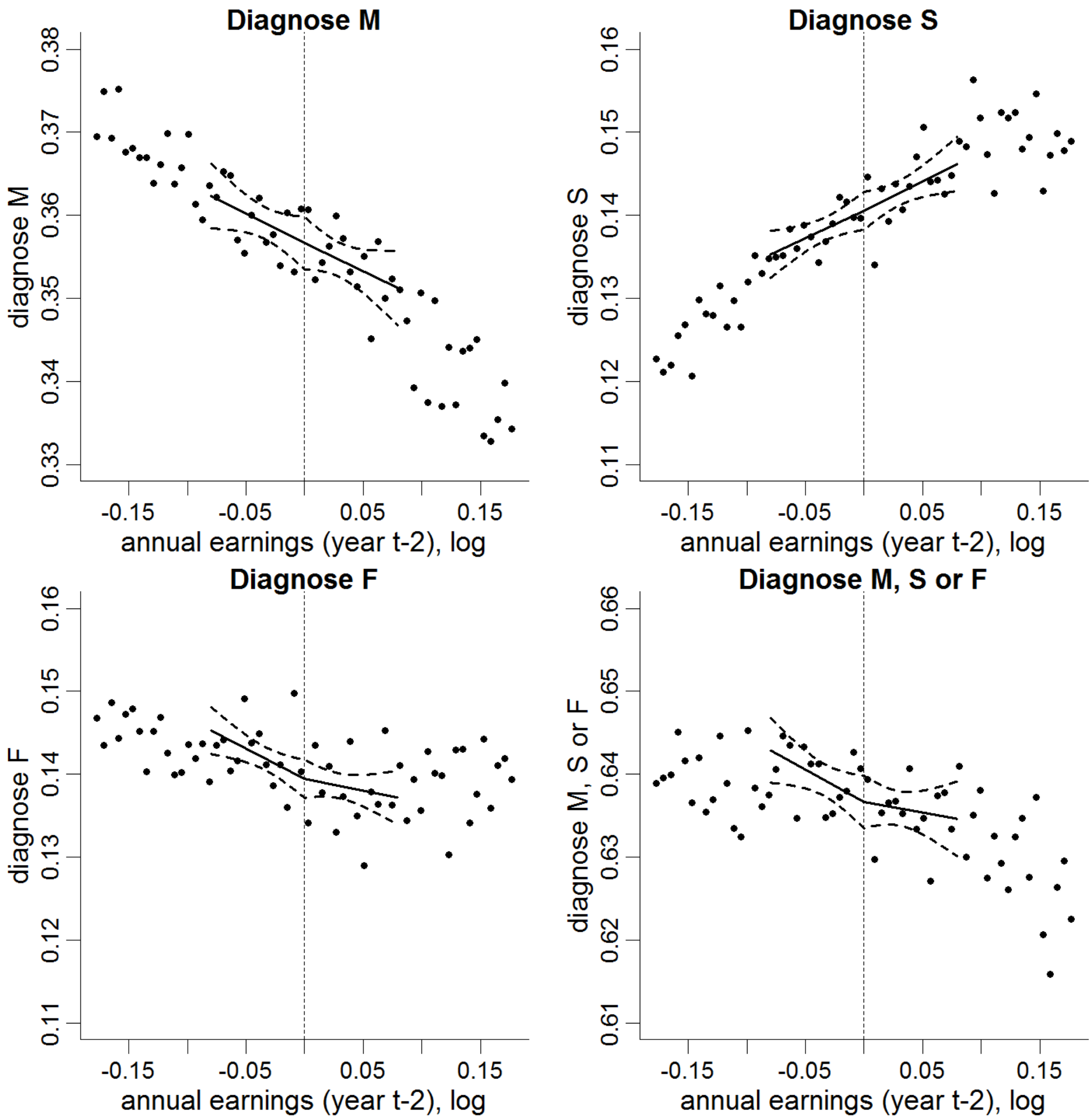
Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are also normalized to zero at the lower kink point. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis.

Figure A4. Duration of sickness absence and annual earnings 2002–2012 at the upper kink point.



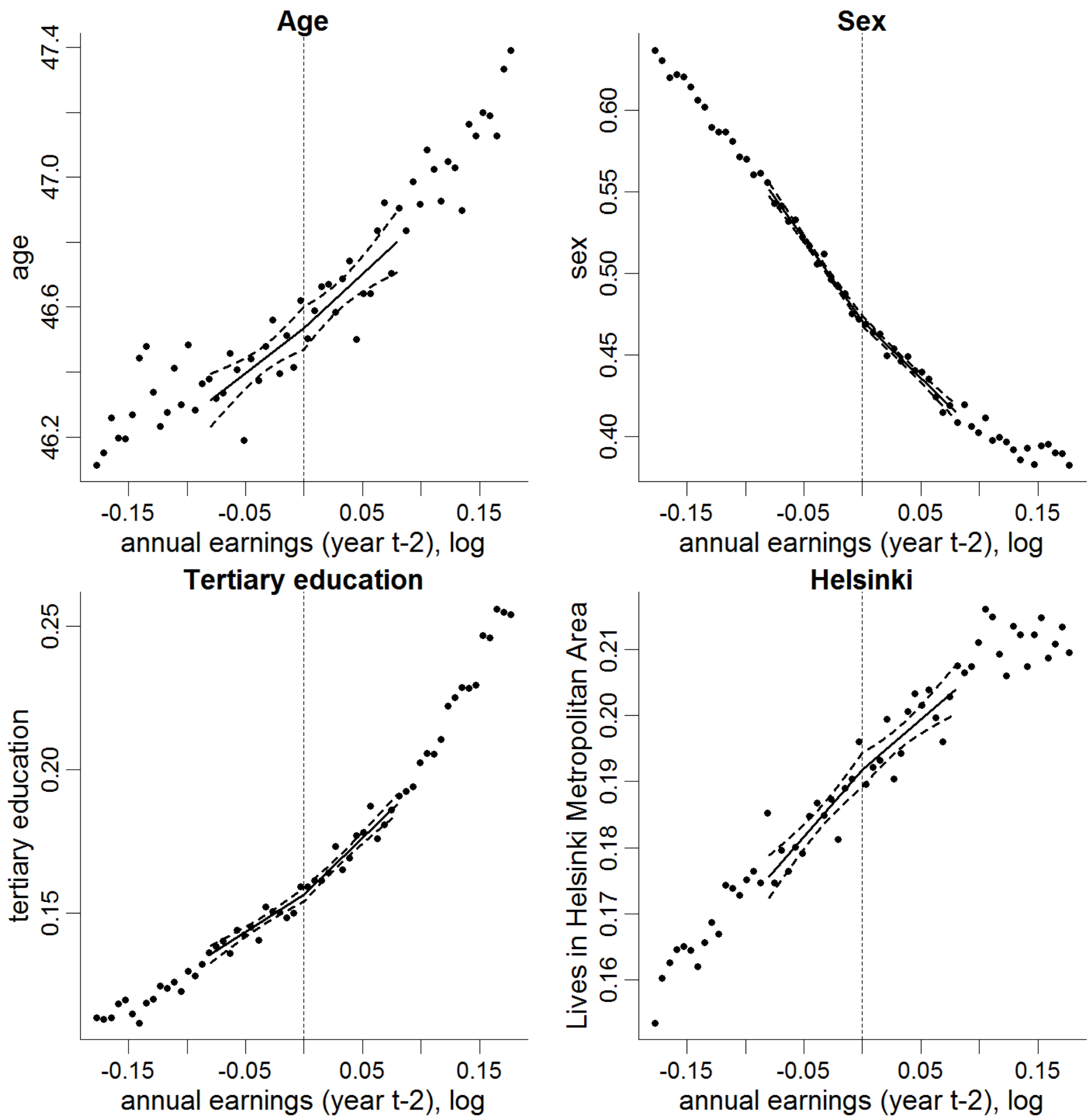
Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are in logs and normalized to zero at the upper kink point. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis.

Figure A5. Linearity of covariates: first diagnoses.



Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are in logs and normalized to zero at the lower kink point. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis. Diagnosis M in ICD-10 refers to diseases of the musculoskeletal system and connective tissue. Diagnosis S refers to injury, poisoning and certain other consequences of external causes. Diagnosis F refers to mental and behavioral disorders.

Figure A6. Linearity of covariates: age, sex (female indicator), having tertiary education and living in the Helsinki Metropolitan Area.



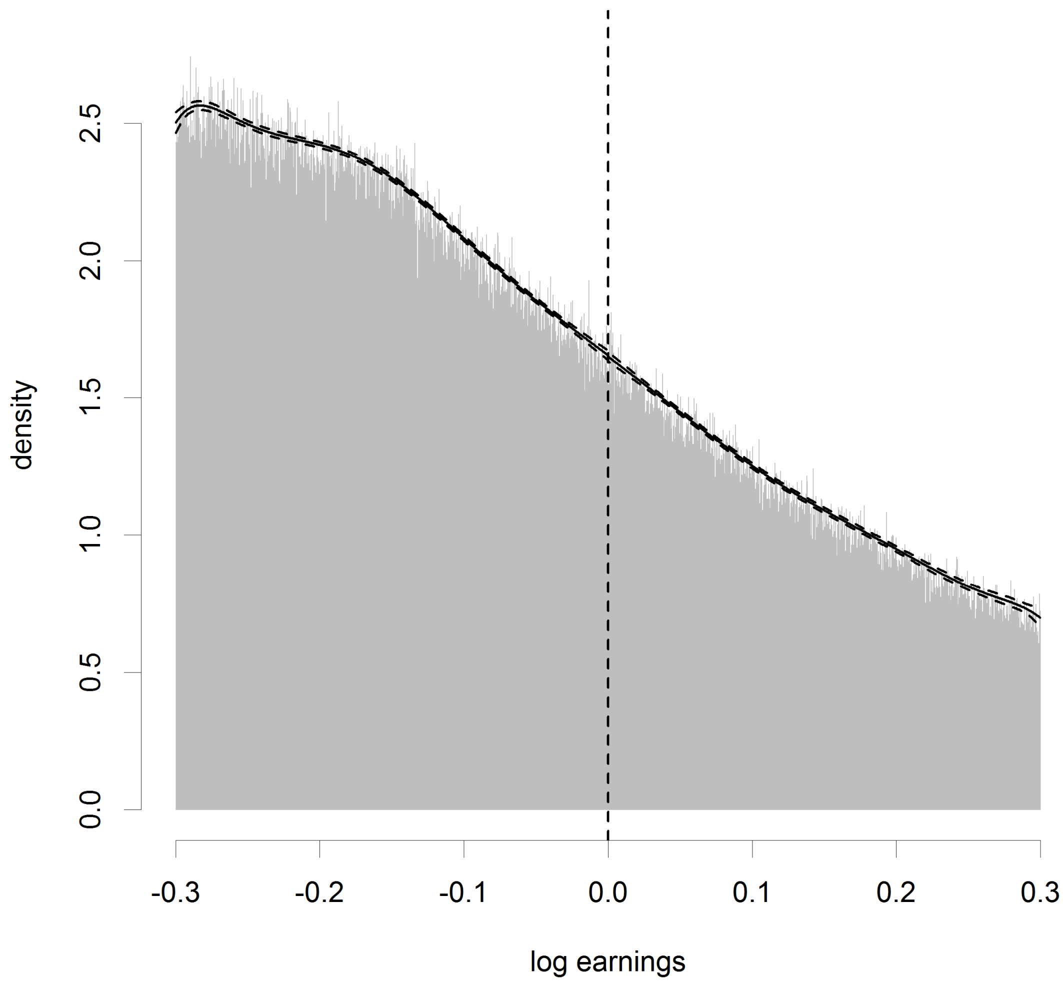
Notes: Annual earnings are deflated to 2012 prices by using the consumer price index. Earnings are in logs and normalized to zero at the lower kink point. The regression fit and 95% confidence interval are shown for the FG bandwidth (0.0796 log euros of annual earnings), which is the main specification bandwidth used in the analysis.

Table A1. Regression estimates from the main specification, covariates.

Bandwidth	FG bandwidth - 0.04	FG bandwidth - 0.02	FG bandwidth	FG bandwidth + 0.02	FG bandwidth + 0.04
Diagnose M					
Change of slope at kink point (β_1)	0.007 (0.2)	-0.127 (0.108)	0.006 (0.07)	-0.021 (0.05)	-0.040 (0.038)
R^2 (Adj.)	0.0002	0.0003	0.0004	0.0004	0.0005
N	176,215	264,944	354,800	444,304	533,718
Diagnose S					
Change of slope at kink point (β_1)	-0.023 (0.145)	0.051 (0.079)	0.004 (0.051)	0.033 (0.037)	-0.018 (0.028)
R^2 (Adj.)	0.0002	0.0002	0.0002	0.0003	0.0004
N	176,215	264,944	354,800	444,304	533,718
Diagnose F					
Change of slope at kink point (β_1)	-0.050 (0.145)	-0.008 (0.079)	0.045 (0.051)	0.009 (0.036)	0.001 (0.028)
R^2 (Adj.)	0.0004	0.0003	0.0002	0.0002	0.0002
N	176,215	264,944	354,800	444,304	533,718
Diagnose M, S or F					
Change of slope at kink point (β_1)	-0.065 (0.2)	-0.085 (0.109)	0.055 (0.07)	0.021 (0.05)	-0.057 (0.039)
R^2 (Adj.)	0.0005	0.0005	0.0006	0.0005	0.0005
N	176,215	264,944	354,800	444,304	533,718
Age					
Change of slope at kink point (β_1)	3.403 (4.144)	-2.517 (2.262)	0.568 (1.464)	2.117** (1.046)	2.667*** (0.798)
R^2 (Adj.)	0.0008	0.0009	0.0009	0.0011	0.0012
N	176,215	264,944	354,800	444,304	533,718
Female					
Change of slope at kink point (β_1)	0.437** (0.208)	0.494*** (0.113)	0.312*** (0.073)	0.318*** (0.052)	0.353*** (0.04)
R^2 (Adj.)	0.0037	0.0057	0.0085	0.0118	0.0152
N	176,215	264,944	354,800	444,304	533,718
Female (quadratic specification)					
Change of slope at kink point (β_1)	-0.002 (0.829)	0.180 (0.450)	0.638** (0.291)	0.450** (0.207)	0.316** (0.157)
R^2 (Adj.)	0.0037	0.0057	0.0085	0.0118	0.0152
N	176,215	264,944	354,800	444,304	533,718
Highest Degree Tertiary Education					
Change of slope at kink point (β_1)	0.003 (0.151)	0.210** (0.083)	0.134** (0.054)	0.131*** (0.038)	0.152*** (0.029)
R^2 (Adj.)	0.0068	0.0076	0.0080	0.0087	0.0101
N	176,215	264,944	354,800	444,304	533,718
Highest Degree Tertiary Education (quadratic specification)					
Change of slope at kink point (β_1)	-0.156 (0.605)	-0.404 (0.329)	0.062 (0.212)	0.135 (0.151)	0.104 (0.115)
R^2 (Adj.)	0.0068	0.0076	0.0080	0.0087	0.0101
N	176,215	264,944	354,800	444,304	533,718
Lives in Helsinki Metropolitan Area					
Change of slope at kink point (β_1)	-0.083 (0.164)	0.0270 (0.089)	-0.051 (0.058)	0.001 (0.041)	0.031 (0.032)
R^2 (Adj.)	0.0001	0.0004	0.0005	0.0007	0.0010
N	176,215	264,944	354,800	444,304	533,718

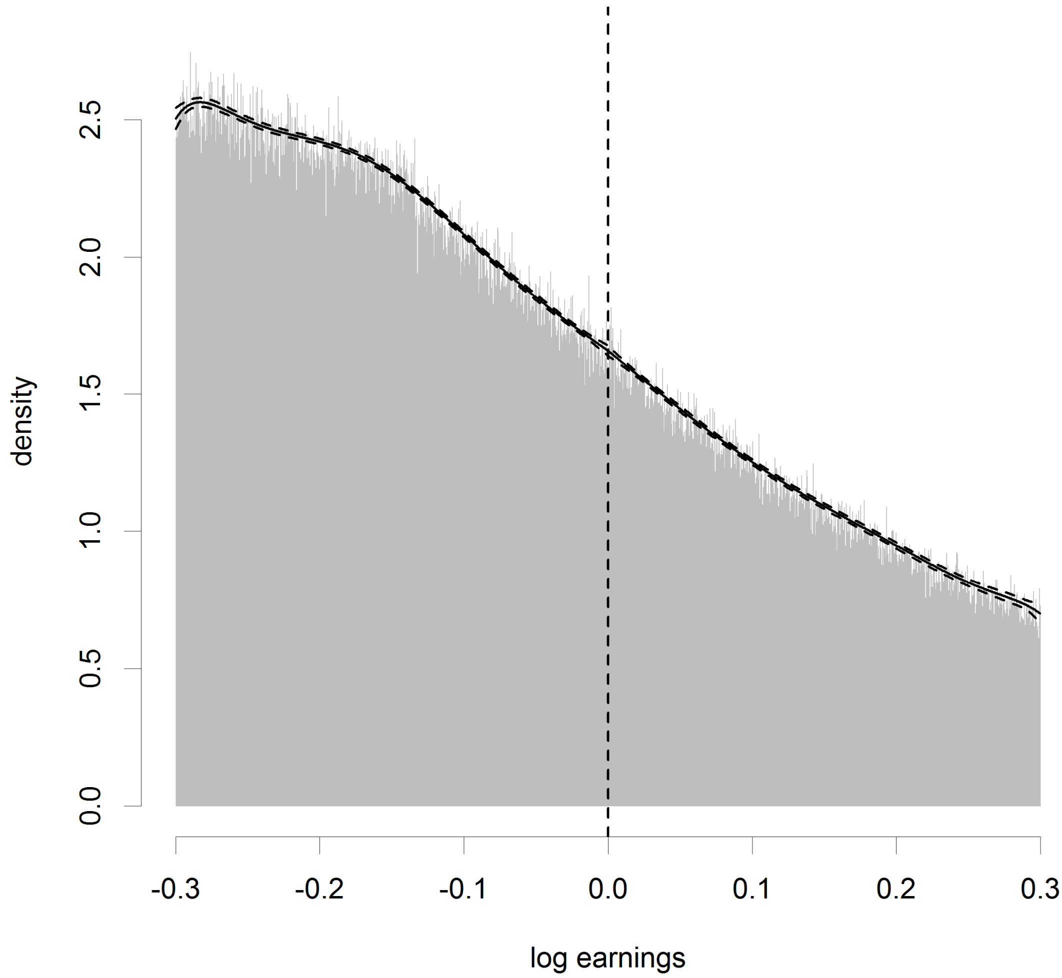
*Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Statistical significance: * p<0.1; ** p<0.05; *** p<0.01. The estimated model is equation (2). The parameter p, which defines the polynomial order, is chosen using the Akaike Information Criterion (AIC). The preferred polynomial order in all regressions is 1. Diagnosis M in ICD-10 refers to diseases of the musculoskeletal system and connective tissue. Diagnosis S refers to injury, poisoning and certain other consequences of external causes. Diagnosis F refers to mental and behavioral disorders. The FG bandwidth referring to the "rule-of-thumb" bandwidth described in Fan and Gijbels (1996) is estimated to be c. 0.0796.*

Figure A7. Density estimate for bunching at the lower kink point: a test for a jump.



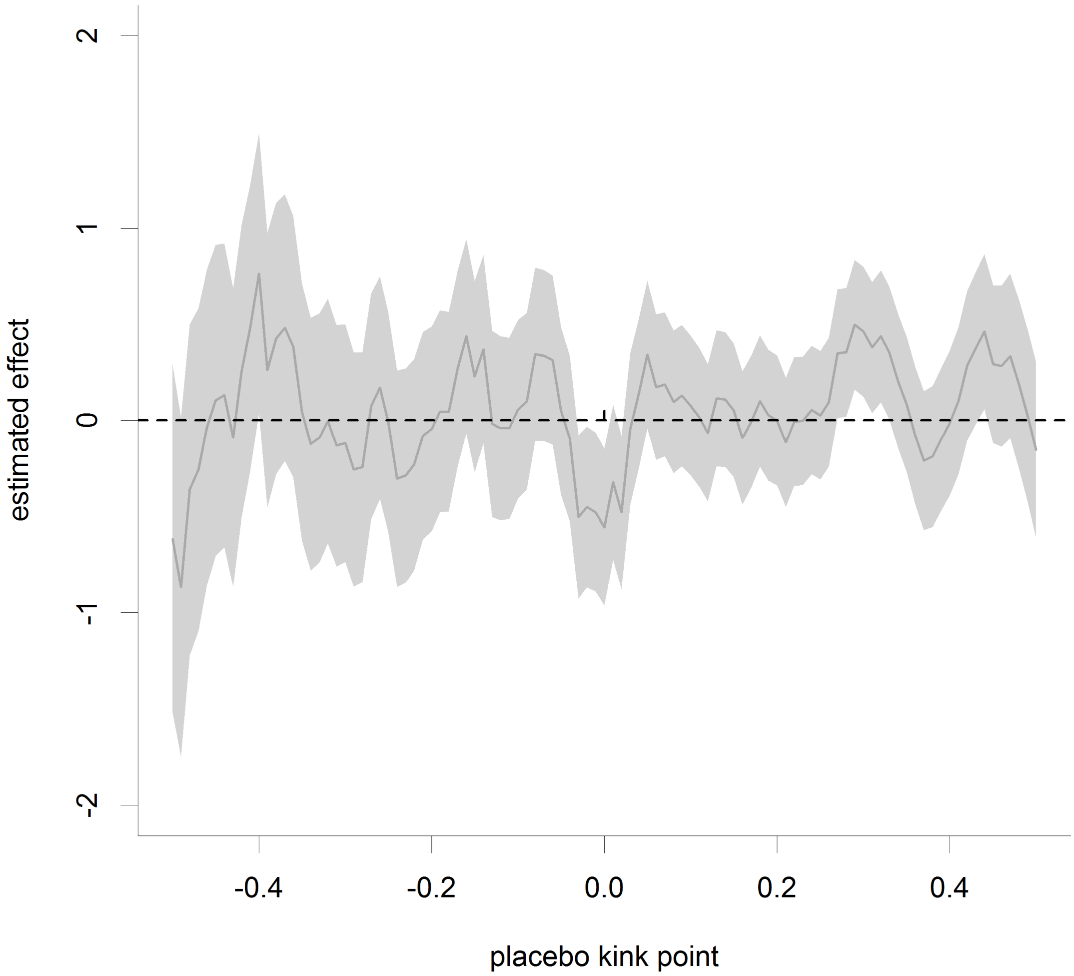
Notes: The gray color depicts the histogram of log earnings of -0.3 to 0.3 around the lower kink point in 1200 bins. The lower kink point is normalized to be at 0 of log earnings. The solid line represents a polynomial regression fit of the density on the midpoints of the bins. The polynomial order is 10 with a (statistically insignificant) jump. The 95% confidence band is depicted in dashed lines.

Figure A8. Density estimate for bunching at the lower kink point: a test for a nonlinearity.



Notes: The gray color depicts the histogram of log earnings of -0.3 to 0.3 around the lower kink point in 1200 bins. The lower kink point is normalized to be at 0 of log earnings. The solid line represents a polynomial regression fit of the density on the midpoints of the bins. The polynomial order is 10 with a (statistically insignificant) nonlinearity in the first order. The 95% confidence band is depicted in dashed lines.

Figure A9. Placebo regressions.



Notes: The graph represents 101 estimates of the kink using the main specification (log sickness absence duration on log earnings), where the lower kink point is assumed to be off the correct location by -0.5 to 0.5 of log earnings at intervals of 0.01 log earnings. The lower kink point is originally normalized to be at 0 of log earnings. The point estimates are depicted in dark gray and 95% confidence intervals in light gray.

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