2

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ABSTRACT

Substance Use and Earnings: The Case of Smokers in Germany*

This paper examines the effect of smoking behavior on earnings. Using data from the GSOEP, both cross-sectional and longitudinal models are estimated separately for males and females. Results for the cross-sectional models confirm prior analyses inasmuch as smoking has a negative effect on earnings for males. However, applying fixed-effects estimation, this effect is found to be inverted for men aged 25 to 35 years compared to their non-smoking counterparts. That is, controlling for unobservable individual heterogeneity, the result implies that male smokers are individuals with higher time preference rates. At the early stage of the age-earnings course higher earnings are therefore found for smokers because young male non-smokers only are about to start off their occupational career. Women's earnings, however, are not affected by smoking behavior.

JEL Classification: I12, J30, J70

Keywords: smoking, earnings regressions

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I. INTRODUCTION

The relationship of health related indicators and labor market performance is well established in the economic and public health literature. Productivity losses that might occur due to bad health can clearly influence individuals' labor outcomes. Substance use, i.e. the use of illicit drugs, alcohol and tobacco, as an indicator of an individual's health behavior has therefore been addressed by a variety of analyses. Among the different socio-economic outcomes examined, labor related issues of interest e.g. are labor supply, absenteeism and wages.

Whereas there is only scarce work that examines the impact of smoking only on earnings or wages, the majority of the relevant literature examines the effects of smoking in combination to or additional to another health indicator. Since these studies are closely related to the analysis here, they will shortly be introduced.

Most of the relevant literature concentrates on the effect of alcohol use on wages (Berger and Leigh, 1988; Zarkin *et al*., 1998; MacDonald and Shields, 2001; Tekin, 2002). Results tell that there are both linear and U-shaped relationships between alcohol consumption and wages. That is, there are wage premiums for moderate drinkers in comparison to both heavy drinkers and nondrinkers.[1]

There is furthermore a small literature that addresses the impact of the use of illicit drugs on labor supply and wages (Gill and Michaels, 1992; Kaestner, 1991, 1994a, 1994b) or the influence of smoking and being overweight on earnings (Berger and Leigh, 1989). Besides these, there are a few studies that include both tobacco and alcohol use in their analyses (Auld, 2002; Lee, 1999; Lye and Hirschberg, 2001; Van Ours, 2002). Results from the latter analyses support the positive effect of moderate alcohol use but discover wage penalties for smokers. As pointed out, and to the best knowledge, smoking alone and its effect on wages has been of interest only for Levine *et al*. (1997), also yielding lower wages for smokers.

The article here examines whether smoking affects earnings in Germany. It contributes twofold to the literature. As most of the existing literature explores data for either North-America, Australia and, only recently, the Netherlands, using data for Germany for the first time adds to the possibility of international comparisons.

Furthermore, the panel structure of the data is used. This is advantageous to cross-sectional analyses as unobservable individual heterogeneity can be controlled for. That is, if

[1] These results are consistent with the findings of the medical literature that there is a U-shaped relationship between alcohol consumption and cardiovascular disease (see e.g. Marmot and Brunner (1991); for more references see Tekin (2002) or Lye and Hirschberg (2001)).

unobservable individual factors exist that are correlated both with smoking and labor market outcomes, using cross-sectional data leads to biased estimates.

The structure of the paper is as follows: section II provides a theoretical background and reviews shortly the results of previous research. Section III presents the data and the econometric methods used here. Results are discussed in section IV and are followed by concluding remarks in section V.

II. Background and previous findings

Besides a variety of (expected) subjective benefits of smoking like stimulation, stress or tension reduction, positive social effects and weight control (Rohsenow *et al*., 2002), it is nowadays a well known fact that smoking has adverse health effects. It causes heart disease, stroke, different forms of cancer and other serious diseases. Subsequently, smoking reduces the life expectancy and is found to be the largest single cause of premature death in developed countries (Peto *et al*., 1994). Projections by the WHO (1997) support this finding and, by 2020, also expect smoking to be responsible for more deaths than any other single disease.

However, and despite the more or less ubiquitous knowledge of tobacco use and its negative consequences on individuals´ health, smoking rates in Germany were stable at about 28% in the 1990's (Federal Statistical Office, 2001a and 2001b). Furthermore, the decision to start smoking tends to be influenced by a complex intergenerational transmission (Bantle and Haisken-DeNew, 2002). That is, youths living in households where one parent or even both parents smoke are more likely to smoke themselves compared to youths from nonsmoking households.

Applying the 'rational addiction theory' (Becker and Murphy, 1988) to smoking tells that the consumption of tobacco products can be seen as a result of an individual's rational decision-making process, taking into account both present and future benefits as well as costs of smoking (Becker *et al*., 1994; Chaloupka, 1991). This view has not been without contradiction in the literature as some authors find evidence for bounded rationality in the case of smoking (Laux, 2000; Gruber, 2000).

However, from the theoretical point of view, the idea that smokers are individuals with high time preference rates is one of the possible links between smoking and earnings. If smokers are individuals who strongly discount their future lifetime utility, they are less likely to invest in productivity enhancing human capital, resulting in lower wages. Empirical evidence supporting the argument that smokers hence have lower educational attainment than

nonsmokers is found by Evans and Montgomery (1994) and implicitly though by Bantle and Haisken-DeNew (2002).

A second theoretical argument is the possibly lower productivity of smokers. A decline in productivity may occur because of increased absenteeism of smokers (Leigh, 1995) that might then affect earnings negatively. Lower earnings might also result from smokers' decreased ability to perform certain manual tasks: Even though the major health effects of smoking appear in a later stage of life there is evidence that smoking is associated with poor physical fitness already among young smokers (Conway and Cronan, 1992). Welte *et al*. (2000) analyze the economic costs attributable to smoking for Germany. They find productivity losses due to work-loss days and early retirement that sum up to about 16.4 billion DM (about 8.4 billion €) for 1993.

Lower earnings of smokers might furthermore be attributed to discrimination of smokers (Levine *et al*., 1997). Public policies to promote knowledge about the deleterious effects of smoking behavior have lead to developments in the protection of nonsmokers from passive smoking by either restricting smoking in public buildings to designated areas or even banning it completely. Many private employers have followed these trends and implemented their own smoking policies that might lead to a discrimination of smokers and result in lower wages.

It is, however, doubtful whether this latter argument is applicable to the case here because smokers in Germany are not yet as exposed to discrimination as they are, for example, in the US.[2]

Empirical results of previous research on substance use and its effect on earnings or wages support the theoretical implications insofar as there in general is a negative impact of smoking on wages. Levine *et al*. (1997), applying different specifications to data from the National Longitudinal Survey of Youth, find that smokers earn 4-8% less than nonsmokers. They partially base their results on panel data estimates. They, however, focus on the wage changes between continuous smokers and those workers who quit smoking.

Berger and Leigh (1989), analyzing the relationship of smoking and being overweight, do not find any statistically significant effects of either of these two factors on current earnings. They, however, attribute these findings to the structure of the cross-sectional data they use. Auld (2002), Lye and Hirschberg (2001) and Van Ours (2002), analyzing the simultaneous effects of both smoking and drinking on wages, in general find similar results.

[2] Levine *et al*. (1997) allege that over time „... mild public intolerance of smoking has developed into fairly widespread hostility" (see Levine *et al*., 1997, p. 493).

Particularly, Auld (2002) finds a positive effect of moderate alcohol use on wages compared to heavy drinking or abstention. Smoking is accompanied with a wage loss of 8% and, after controlling for simultaneity and endogenous selection, with wage losses of 22%.

Lye and Hirschberg (2001), also correcting for endogenous selection, do not present direct effects of smoking on wages but find support for the U-shaped relationship of alcohol use for nonsmokers but not for smokers.

Van Ours (2002), using a dataset from the Netherlands, finds no significant effects of either alcohol or tobacco use on wages of females. Males, however, who drink earn about 10% more than men who do not drink. This positive effect, though, is canceled out by the negative wage effect for male smokers of also about 10%.[3]

III. DATA AND ECONOMETRIC METHODS

The data used here are drawn from the German Socio-Economic Panel (GSOEP), a wide-ranging representative longitudinal study of private households (see SOEP Group, 2001). The study is maintained by the GSOEP-group at the German Institute for Economic Research (DIW) and provides information on all household members, consisting of Germans living in the old and new German states, foreigners, and recent immigrants to Germany. The Panel was started in 1984. In 2001, there were about 12,000 households, and more than 22,000 persons sampled.[4]

The sample drawn from the data is restricted to blue collar and white collar employees aged 25 to 55 years. The earnings regression that are run separately for men and women include standard human capital variables and related background characteristics.[5] A balanced panel with data from the years 1998, 1999, and 2001 is used for the longitudinal analyses. In total, the sub-samples consist of 8,595 observations for the panel framework, while 4,580 observations are available for the cross-sectional analysis.

One possible approach to test for the relationship of smoking and earnings is to include a dummy variable for smoking.[6] So far, information on smoking on the individual level is

[3] Using the rather poetical title "A pint a day raises a man´s pay; but smoking blows that gain away", he makes the reader aware of his results already in advance.

[4] For further information, also see http://www.diw.de/english/sop/index.html. Note that data for 2001 are preliminary.

[5] These are in particular: education, experience, the firm-specific period of employment, a dummy capturing whether overtime work is done or not, a part-time dummy, a 'blue-collar' dummy, three firm-size bands, one regional dummy that equals unity if the individual lives in one of the western federal states, dummies for nine occupations, and also dummies for fourteen branches. For details see Appendix, Table A1.

[6] An alternative approach often used in related analyses (see e.g. Berger and Leigh, 1988; Lye and Hirschberg, 2001) is to estimate (selectivity corrected) earnings regressions separately for smokers and nonsmokers. The wage differential between smokers and nonsmokers can then be analyzed by wage decomposition techniques that account for differences in coefficients and personal characteristics. Experiments with such an approach,

available in the GSOEP for only three waves, 1998, 1999, and 2001. The 1998 question distinguishes both the kinds of tobacco used (cigarettes, pipes or cigars) and the quantity that is consumed, i.e. the number of cigarettes or related tobacco products smoked. The 1999 question, however, covers possible 'yes', 'no, but in the past' and 'no, never' answers. Additional to this latter distinction, the 2001 question again asks for the quantity of tobacco products consumed, although without differing between the particular types of products.

The 'smoker'-variable used here is hence a binary variable generated from the original data and indicates whether a person smokes or does not smoke at the time of the interview. Additionally for the cross-sectional analysis that is based on data from 1998, it is possible to identify the amount of tobacco consumed, resulting in a quasi-continuous variable. To further test for specification robustness, a set of five dummy-variables is generated that covers whether the individual smokes up to 10 (11-20; 21-30, 31-40; 41 and more) cigarettes or other tobacco products per day.

Table 1: Distribution of smoking and earnings

	Smoking (respective shares)		
	Women	Men	All
All	34.0	42.4	38.9
Structure:			
25 to 35 years	36.7	43.2	40.9
36 to 45 years	36.5	44.0	40.8
46 to 55 years	28.5	39.0	34.1
Schooling:			
Basic schooling	41.8	50.3	47.4
Intermediate schooling	35.0	38.7	36.9
Secondary schooling	25.1	27.0	26.9
	Mean monthly gross earnings (in €)		
	Nonsmoker	Smoker	All
Women	1681.29	1684.64	1682.42
Men	2755.89***	2483.26***	2640.34

Notes: *** statistically different from the respective mean at the 1%-significance level
Source: GSOEP. Own calculations, unweighted; preliminary data for 2001.

however, yielded no universal statistically significant differences. Results of these estimates have thus been omitted here, but are available by the author on request.

To further motivate the following multivariate analyses, Table 1 presents the structure of smoking behavior in the sample used here. The share of men smoking is higher than the share of women who smoke. The upper age class (46 to 55 years old) shows a lower rate of smoking for both women and men than the age classes beneath. As the negative health consequences of tobacco consumption appear in the later stages of life, it might be that these consequences, once emerged, lead to quitting from smoking. Education and smoking is inversely related here. A higher level of schooling is accompanied by a lower share of smoking individuals. This might, for example, be due to the more disseminated knowledge of the detrimental health effects of smoking or due to a higher rate of time preference. Results of t-tests show that differences in age and education between smokers and nonsmokers are reflected in earnings only for men (Table 1). Male smokers earn significantly less compared to the average male earnings.

The dependent variable used in all regressions here is monthly gross earnings. As Anger and Schwarze (2002) point out, monthly labor income might overstate the remuneration of workers whose weekly hours of work exceed 40. Using hourly wages that can be generated by dividing earnings by working hours, might however understate the earnings of those who work long hours. Thus, to prevent differences in working hours from distorting the estimates, working time is used as a control variable.

The cross-sectional relationship between earnings and smoking is specified here by a Mincer-type earnings function:

$$\ln W_i = X_i'\beta_1 + S_i'\beta_2 + e_i, \qquad (1)$$

where W_i represents monthly gross earnings for individual i, X_i is a vector of exogenous standard human capital variables with its associated parameters β_1. S_i is a vector capturing the smoking behavior. To test for specification robustness and possible age cohort effects, four models are run: In Model 1, S_i is the binary indicator capturing whether the individual is a smoker or a nonsmoker. Variables interacting age and smoking are included in Model 2 instead of the simple smoker-dummy. Furthermore, Model 3 includes the continuous measure of tobacco consumption and Model 4 the vector of variables reflecting the discrete measure of tobacco consumed. In the semi-logarithmic specification here, the coefficient, β_2, can then approximately be interpreted as the percental earnings gains or losses of a smoker. e_i is the common disturbance term that is assumed to be iid$(0, \sigma^2)$.

This approach might be affected by a selectivity bias if unobservable factors exist that influence both smoking and earnings. The coefficient, β_2, would then be biased. If, for example, individuals with a high time preference rate base their tobacco consumption decision

on the current satisfaction without considering the future deleterious health effects, they may also be more likely to invest less in human capital. Smokers may thus select in jobs with flatter age-earnings profiles.

As another example, the estimate of β_2 will also be biased, if, as Levine *et al*. (1997) put it, "… people with poor judgement are likely to choose to smoke, and no measure of judgement is included in the regression …".[7] In this case, the negative earnings effect on having a poor judgement will be reflected in the smoking indicator and hence results in estimates of β_2 that are biased downward.

A possible remedy of this spurious correlation between S_i and the error term in the cross-sectional framework is to either include a rich set of personal characteristics, as possible including measures that are correlated with relevant unobservables[8] or use the instrumental variable (IV) method.

An appropriate solution to the problem of unobservable individual heterogeneity is to use panel data and, in particular, to apply the fixed-effects estimator. The Mincer-type earnings function of individual *i* at time *t* can then be formulated as

$$\ln W_{it} = X'_{it}\beta_1 + S'_{it}\beta_2 + \gamma_i + e_{it}, \qquad i=1, \ldots, N; \; t=1, \ldots, T, \tag{2}$$

where notation follows equation (1). γ_i denotes the unobservable factor that varies across individuals but is constant over time, hence called the "individual fixed effect". The error term is represented by e_{it}. It is assumed not to be correlated across individuals, i.e. $E(e_i, e_j) = 0$ for all $i \neq j$, and is furthermore to be uncorrelated with the regressors, X_{it} and S_{it}, and the individual time-invariant factor γ_i.

However, as Johnston and DiNardo (1997) and Tekin (2002) point out, this approach has its own shortcomings. First, the estimation of the individual fixed effects would result in a perceptible loss of degrees of freedom when the sample size is large. There, second, is the risk of measurement error. If, finally, the unobservable heterogeneity varies over time, the estimation bias will not be eliminated. This, however, could be removed similar to the cross-sectional framework applying IV estimation together with the fixed-effects.

IV. RESULTS

Turning first to the IV approach, and reviewing shortly the outcomes of the relevant literature, one in general finds rather conspicuous results. For example, in his analysis of the

[7] See Levine *et al*. (1997), p. 496.
[8] Levine *et al*. (1997), for example, use the Armed Forces Qualifying Test (AFQT) as such a measure. Unfortunately, "aptitude test scores" similar to the AFQT are not available in the GSOEP.

effect of both smoking and drinking on wages, Van Ours (2002) applies 2SLS and 3SLS estimates, resulting in implausibly high coefficients of both tobacco and alcohol use. He, thus, concludes that "… it is difficult to find good instrumental variables".[9]

This statement finds support in the analyses here. Experiments with both 2SLS and 3SLS estimates also result in implausibly high returns to smoking. Furthermore, poor performance of the identifying instruments in the first stage cast doubt on the validity of the results. They hence are not presented in the paper.[10]

Likewise odd findings as those from the cross-sectional framework are also seen when experimenting with the IV method in the panel framework: Again, the coefficients for smoking get implausibly high and the identifying instruments once more perform poor in the first stage. Results also are therefore not presented here but are available on request.

Now, turning to more plausible results, the findings for the cross-sectional analyses support the results found in the relevant literature. The estimation results[11] presented in Table 2 show that women's earnings are not affected by smoking behavior. There are coefficients pointing to earnings losses of about 4% for smoking women aged 36 to 45 years and of almost 7% for women elder than 45 years who smoke, the reference being non-smoking women aged 25 to 35 years. However, the *t*-values of -1.24 and -1.19 are off any statistical significance approved. Note, nevertheless, that the sample provides 2,010 observations on females, making the power of tests not overwhelming. Furthermore, non-smoking women elder than 35 years also seem to earn less. Whereas the negative coefficient for women aged 36 to 45 years again is not statistically significant, women elder than 45 years suffer an earnings penalty of almost 10%. Looking at both smoking and non-smoking elderly women, it might be argued that it hence is the age effect that prevails here.[12]

However, smoking seems to affect male earnings negatively. The size of the estimated earnings loss is somewhat smaller for German males compared to the results from previous research (see e.g. Levine *et al*., 1997; Auld, 2002; Van Ours, 2002). That is, male smokers suffer an earnings penalty of almost 2.5% compared to nonsmoking males aged 25 to 35 years (Model 1).

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[9] See Van Ours (2002), p. 11.

[10] The instruments used here are similar indicators that can be found in previous relevant literature. These variables in particular are 'strong religious conviction' and 'being married' in the 2SLS estimation; these two as well as 'age', 'non-labor income', 'number of children up to 3 years of age', 'higher education' and 'foreign nationality' are added to the 3SLS identifying estimation.

[11] The standard human capital variables and the control variables, like the occupational dummies generated from the ISCO-code, that are included in all models behave as expected. See Appendix, Table A2 and Table A3 for full details.

[12] Also is the size of the 'Experience-squared' variable close to zero. It might hence be that some of this effect is captured by smoking/non-smoking dummies for elderly women. See Appendix, Table A2.

Table 2: OLS Regressions with Standard Control Variables

			Women 1998	
Log(Earnings)	Model 1	Model 2	Model 3	Model 4
Smoker	0.0047	—	—	—
	(0.0157)			
Smoker (age 25 to 35)	—	0.0016	—	—
		(0.0251)		
Smoker (age 36 to 45)	—	-0.0453	—	—
		(0.0365)		
Smoker (age 46 to 55)	—	-0.0694	—	—
		(0.0585)		
Non-smoker (age 36 to 45)	—	-0.0384	—	—
		(0.0345)		
Non-smoker (age 46 to 55)	—	-0.0988*	—	—
		(0.0554)		
Tobacco	—	—	0.0001	—
			(0.0009)	
Up to 10 cig. per day	—	—	—	0.0011
				(0.0220)
11 to 20 cig. per day	—	—	—	0.0087
				(0.0199)
21 to 30 cig. per day	—	—	—	0.0116
				(0.0559)
31 to 40 cig. per day	—	—	—	-0.0163
				(0.0763)
41 and more cig. per day	—	—	—	-0.2632
				(0.1890)
Observations	2010	2010	2010	2010
R^2	0.7632	0.7633	0.7632	0.7635
			Men 1998	
Smoker	-0.0250**	—	—	—
	(0.0108)			
Smoker (age 25 to 35)	—	-0.0028	—	—
		(0.0162)		
Smoker (age 36 to 45)	—	-0.0813***	—	—
		(0.0252)		
Smoker (age 46 to 55)	—	-0.0605	—	—
		(0.0409)		
Non-smoker (age 36 to 45)	—	-0.0400*	—	—
		(0.0242)		
Non-smoker (age 46 to 55)	—	-0.0173	—	—
		(0.0388)		
Tobacco	—	—	-0.0009*	—
			(0.0005)	
Up to 10 cig. per day	—	—	—	-0.0364**
				(0.0179)
11 to 20 cig. per day	—	—	—	-0.0143
				(0.0131)
21 to 30 cig. per day	—	—	—	-0.0443**
				(0.0207)
31 to 40 cig. per day	—	—	—	-0.0436
				(0.0353)
41 and more cig. per day	—	—	—	-0.0041
				(0.0706)
Observations	2570	2570	2570	2570
R^2	0.6079	0.6084	0.6076	0.6084

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998. Own calculations.

Interacting age and smoking behavior (Model 2), the estimated earnings loss accounts for even about 8% for men aged 36 to 45 years. The coefficient for men older than 45 years points to earnings that are about 6% lower than those of the reference group. However, similar to the findings for women, the coefficient is not statistically significant with a *t*-value of -1.48. Furthermore, also alike the estimates for females, non-smokers aged between 36 to 45 years earn 4% less than non-smoking males.

If the metric measure of tobacco consumed is included in the regression instead of the binary indicator or the age-smoker interactions, the finding for smokers shrinks to an earnings loss of about 0,1% (Model 3). This appears to be a huge drop, but one has to remember that this coefficient indicates the penalty for any additional unit consumed, i.e. any "marginal cigarette" smoked.

Results from Model 4, including the dummy-variables of the number of cigarettes smoked per day, show that male smokers earn about 4% less when smoking up to 10 cigarettes daily or more than 21 and up to 30 cigarettes daily. Again, the coefficient for males who smoke between 31 and 40 cigarettes per day that would account for an earnings loss also of about 4% is not statistically significant (*t*-value of -1.23). However, note that the cross-sectional sample size for men also is not extensive (*n*=2,570).

Nevertheless, it has to be remembered that all these effects stem from simple OLS regressions that do not account for unobservable individual heterogeneity. Still, the results can be used as base to evaluate the findings for the panel regressions.

Two of the three panel regressions employed here, however, do control for individual factors that might lead to biased cross-sectional OLS estimates. Table 3 presents the results of the pooled OLS regression, where individual specific effects are not accounted for, and the findings for the random-effects model and the fixed-effects model. Again, in order to control for possible age-cohort effects, two model specifications are used: Model 1 includes the binary smoker-dummy, Model 2 three age-smoking interaction variables. To economize on space, a detailed discussion of the control variables including the standard human capital variables, where overall behavior is as expected, is omitted.[13]

The results for the panel regressions for women are as follows. The equations that include the binary smoking indicator (Model 1) return no coefficients that differ statistically significant from zero. If at all, there is a tendency towards an earnings loss of about 2% for smoking women. However, the coefficient is off any relevant statistical significance with a *t*-value of -1.24.

[13] For full details of the panel regression estimates see Appendix, Table A4 and Table A5.

Table 3: Longitudinal Regressions with Standard Control Variables

	Model 1			Model 2		
	OLS	RE Model	FE Model	OLS	RE Model	FE Model
Women						
Smoker	0.0123	0.0020	-0.0230	—	—	—
	(0.0116)	(0.0138)	(0.0186)			
Smoker (age 25 to 35)	—	—	—	-0.0177	-0.0089	-0.0215
				(0.0212)	(0.0219)	(0.0257)
Smoker (age 36 to 45)	—	—	—	-0.0593**	-0.0310	-0.0368
				(0.0275)	(0.0254)	(0.0290)
Smoker (age 46 to 55)	—	—	—	-0.0748*	0.0019	-0.0256
				(0.0427)	(0.0364)	(0.0399)
Non-smoker (age 25 to 35)			(omitted reference category)			
Non-smoker (age 36 to 45)	—	—	—	-0.0647**	-0.0226	-0.0113
				(0.0263)	(0.0226)	(0.0237)
Non-smoker (age 46 to 55)	—	—	—	-0.1347***	-0.0386	-0.0051
				(0.0412)	(0.0331)	(0.0338)
Chi^2-LM-Test (DF)	1081.31 (1)			1077.76 (1)		
Hausman-Test (DF)		1089.45 (40)			1059.14 (42)	
Men						
Smoker	-0.0118	-0.0074	0.0094	—	—	—
	(0.0081)	(0.0085)	(0.0101)			
Smoker (age 25 to 35)	—	—	—	0.0133	0.0148	0.0257**
				(0.0130)	(0.0117)	(0.0128)
Smoker (age 36 to 45)	—	—	—	-0.0151	-0.0206	-0.0085
				(0.0184)	(0.0140)	(0.0150)
Smoker (age 46 to 55)	—	—	—	-0.0257	-0.0056	0.0064
				0.0133	(0.0202)	(0.0205)
Non-smoker (age 25 to 35)			(omitted reference category)			
Non-smoker (age 36 to 45)	—	—	—	-0.0087	0.0044	0.0026
				(0.0176)	(0.0124)	(0.0125)
Non-smoker (age 46 to 55)	—	—	—	0.0367	0.0175	0.0031
				(0.0291)	(0.0197)	(0.0199)
Chi^2-LM-Test (DF)	2507.78 (1)			2497.63 (1)		
Hausman-Test (DF)		792.35 (40)			797.07 (42)	

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998, 1999, and 2001. Own calculations.

Model 2 then shows a finding that is similar to the results from the cross-sectional analysis. There is evidence that women who smoke and who are older than 35 years earn less than non-smoking women aged 25 to 35 years. But again, non-smoking women older than 35

years also seem to earn less, with an earnings loss of even about 13% of women older than 45 years. However, two points need to be mentioned. First, as above, it might be argued that the coefficients here partially capture age or experience effects.[14] Furthermore, this result stems from the pooled OLS estimation where unobservable individual heterogeneity is not accounted for. However, a test for the absence of individual effects is clearly rejected. That is, unobservable individual factors that might influence both smoking behavior and earnings have to be accounted for. Subsequently, random and fixed effects models are estimated. Again, the Hausman test stresses the relevance of the latter (Chi^2-value of 1059.42). First, the supposed earnings loss of about 13% for non-smoking women older than 45 years drops to almost zero when controlling for unobservable individual heterogeneity.

All other coefficients of the fixed effects model also have negative signs with, the size of the coefficients for smokers range from about 2% to almost 4% supposed earnings losses. However, there again is no statistical significance.

Turning to the results for men, there are two aspects worth to mention. First, the size of most of the negative coefficients decreases and, more important, the statistical significance of all these variables vanishes both in Model 1 and Model 2. Second, looking at the results from the relevant fixed effects estimates (Hausman-Chi^2-value of 797.42) there is a finding that might puzzle at first glance: The size of all coefficients except one lies around null and they also do not differ statistically from zero. Furthermore, the common negative effect of smoking behavior is found to be inverted for men aged 25 to 35 years. That is, young men who smoke earn about 2.5% more than non-smoking men of that age. This effect surprises inasmuch as it contradicts results from previous research.

In our opinion, there is only one possible explanation for this effect. First, it is doubtable that short term benefits like stress reduction or stimulation lead to higher individual productivity that is rewarded by higher earnings for young men. Therefore, this finding supports the hypothesis that smokers are individuals with higher time preference rates. They hence select in jobs with flatter age-earnings profiles. This is not inconsistent with the earnings gain of 2.5% for young smokers. This is, because non-smokers, i.e. individuals with lower time preference than smokers, are more likely to invest in human capital like, for example, further education. Hence, non-smokers at young age are more or less only starting off in their occupational career while young smokers might already be employed for several years with accompanying earnings that reward their experience.

[14] Again, the coefficient for 'Experience-squared' is close to zero. See Appendix, Table A5.

However, other tests that refer to the theoretical implications outlined above did not yield further empirical evidence. Experiments with interaction terms between smoking behavior and, for example, experience have been applied to the regressions. Other experiments that examine a possible discrimination of smokers have also been employed. However, and alike Levine *et al*. (1997), these analyses did not lead to any clear support for the potential explanations for the earnings penalty usually associated with smoking.[15]

It might hence be that other theoretical implications apart from a higher time preference of smokers do not hold for the case of Germany.

V. CONCLUSIONS

Using data from the German Socio-Economic Panel (GSOEP) to examine the relationship between smoking behavior and earnings, results from previous research are only partially confirmed here. In general, women's earnings are not affected by smoking. Further, and similar to other studies, earnings differentials are found for males in the cross-sectional analysis for 1998. Depending on the model specification, the earnings losses for smokers range from 2% to about 8% compared to the reference category, young non-smokers aged 25 to 35 years.

However, cross-sectional findings can be spurious as they might be influenced by unobservable individual heterogeneity and lead to a downward bias in the smoking coefficients. Thus, panel regressions are performed to account for these characteristics and hence to increase the reliability of the results. In particular, random and fixed effects models are estimated. While there is no earnings differential in the results of the random effects estimations, a surprising result is found for the fixed effects model. It implies that young men (25 to 35 years old) who smoke earn about 2.5% more than their non-smoking counterparts.

This somewhat surprising finding contradicts the results from the relevant literature. As most of the relevant literature argues towards *a priori* negative effects of smoking on earnings, there is only one theoretical argument that would justify this finding. We argue that male smokers are individuals with high time preference rates. That is, due to their high time preference smokers one the hand do not account for adverse health effects that might occur in the future and, on the other hand, also select in jobs with flatter age-earnings profiles. They subsequently do not invest in human capital as much as their non-smoking counterparts. Hence, young smokers are likely to have occupational experience that non-smokers are only about to establish. Rewards for this experience might therefore explain the differential in this

[15] The results of these experiments are thus omitted here but are available on request.

early stage of life. Other theoretical implications like, for example, a possible discrimination of smokers are not supported for the German case examined here.

Future work might explore in more detail the relationship between smoking and productivity related issues. A promising point to start off such analysis might, for example, be the examination of the relationship between smoking and absenteeism.

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Appendix Table A1: Description and descriptive statistics of variables used in the regression models

Variable		Mean (SD)	
		Women	Men
Log(Earnings)[+]	Logarithm of gross monthly earnings, Deutsche Mark	7.94 (0.61)	8.47 (0.39)
Smoker	Smoking behavior: 1=yes	0.34	0.42
Smoker (age 25 to 35)	Aged 25 to 35 years and smoking: 1=yes	0.10	0.16
Smoker (age 36 to 45)	Aged 36 to 45 years and smoking: 1=yes	0.16	0.17
Smoker (age 46 to 55)	Aged 46 to 55 years and smoking: 1=yes	0.08	0.09
Non-smoker (age 25 to 35)	Aged 25 to 35 years, non-smoking: 1=yes (ref. cat.)	0.17	0.21
Non-smoker (age 36 to 45)	Aged 36 to 45 years and non-smoking: 1=yes	0.28	0.22
Non-smoker (age 46 to 55)	Aged 46 to 55 years and non-smoking: 1=yes	0.20	0.15
Tobacco*	Number of tobacco products consumed per day	5.00 (8.49)	8.18 (11.23)
Up to 10 cig. per day*	Tobacco consumed: =1, if up to 10 units per day	0.13	0.10
11 to 20 cig. per day*	Tobacco consumed: =1, if 11 to 20 units per day	0.18	0.23
21 to 30 cig. per day*	Tobacco consumed: =1, if 21 to 30 units per day	0.02	0.07
31 to 40 cig. per day*	Tobacco consumed: =1, if 31 to 40 units per day	0.01	0.02
41 and more cig. per day*	Tobacco consumed: =1, if more than 41 units p. d.	0.00	0.01
Years of education	Length of education in years	11.98 (2.32)	12.11 (2.59)
Experience	Length of potential work experience in years	22.35 (8.03)	20.92 (7.82)
Experience squared	Length of potential work experience in years, squared	564.1 (364.6)	498.7 (347.3)
Period of employment	Work experience at the same employer	9.32 (7.73)	10.01 (8.28)
Temporary job	Temporary employment contract: 1=yes	0.04	0.04
Part-time job	Part-time employment: 1= yes	0.32	0.01
Log(Hours)	Logarithm of actual working hours	3.47 (0.44)	3.76 (0.19)
Overtime	Doing overtime work: 1=yes	0.48	0.60
Blue collar	Blue collar worker : 1=yes	0.24	0.56
White collar	White collar worker : 1=yes (reference category)	0.76	0.44
Management	Job category: 1= Management	0.03	0.06
Professional	Job category: 1= Professional	0.11	0.13
Technician	Job category: 1= Technician	0.29	0.13
Service	Job category: 1= Service (reference cat. for women)	0.14	0.03
Craft	Job category: 1= Craft (reference category for men)	0.04	0.34
Clerk	Job category: 1= Clerk	0.26	0.08
Plant operator	Job category: 1= Plant operator	0.04	0.15
Agriculture	Job category: 1= Agriculture	0.01	0.01
Elementary occupation	Job category: 1= Elementary occupation	0.10	0.07
Firm size 1 to 20	Firm size < 20 employees	0.27	0.18
Firm size 20 to 200	Firm size > 20 and < 200 employees	0.28	0.32
Firm size 200 to 2000	Firm size > 200 and < 2000 employees	0.26	0.25
Firm size 2000 and more	Firm size > 2000 employees (reference category)	0.18	0.25
Branch: Agriculture/Fishery	Branch of employment: =1, if Agriculture/Fishery	0.01	0.01
Branch: Energy/Water	Branch of employment: =1, if Energy/Water	0.01	0.02
Branch: Chemicals	Branch of employment: =1, if Chemicals	0.02	0.05
Branch: Plastics	Branch of employment: =1, if Plastics	0.01	0.01
Branch: Stone	Branch of employment: =1, if Stone	0.01	0.02
Branch: Metal	Branch of employment: =1, if Metal	0.06	0.24
Branch: Wood	Branch of employment: =1, if Wood	0.02	0.04
Branch: Textiles	Branch of employment: =1, if Textiles	0.01	0.01
Branch: Food	Branch of employment: =1, if Food	0.01	0.02
Branch: Construction	Branch of employment: =1, if Construction	0.02	0.10
Branch: Wholesale/Retail	Branch of employment: =1, if Wholesale/Retail	0.16	0.08
Branch: Transport	Branch of employment: =1, if Transport	0.03	0.06
Branch: Banking/Insurance	Branch of employment: =1, if Banking/Insurance	0.05	0.03
Branch: Other services	Branch of employment: =1, if other services	0.34	0.10
Branch: Private Households	Branch of employment: =1, if private households	0.00	0.00
Former West Germany*	Residence in the Western Federal States: 1=yes	0.69	0.74

Notes: * data for 1998 only; [+] Note that the descriptive results in Table 1 are based on German marks and are only afterwards recalculated to €.

Source: GSOEP, 1998, 1999, and 2001.

Appendix Table A2: Earnings functions for females, OLS 1998

Log(Earnings)	Model 1	Model 2	Model 3	Model 4
Smoker	0.0047	—	—	—
	(0.0157)			
Smoker (age 25 to 35)	—	0.0016	—	—
		(0.0251)		
Smoker (age 36 to 45)	—	-0.0453	—	—
		(0.0365)		
Smoker (age 46 to 55)	—	-0.0694	—	—
		(0.0585)		
Non-smoker (age 36 to 45)	—	-0.0384	—	—
		(0.0345)		
Non-smoker (age 46 to 55)	—	-0.0988*	—	—
		(0.0554)		
Tobacco	—	—	0.0001	—
			(0.0009)	
Up to 10 cig. per day	—	—	—	0.0011
				(0.0220)
11 to 20 cig. per day	—	—	—	0.0087
				(0.0199)
21 to 30 cig. per day	—	—	—	0.0116
				(0.0559)
31 to 40 cig. per day	—	—	—	-0.0163
				(0.0763)
41 and more cig. per day	—	—	—	-0.2632
				(0.1890)
Aged 36 to 45 years	-0.0405	—	-0.0405	-0.0416
	(0.0314)		(0.0314)	(0.0315)
Aged 46 to 55 years	-0.0896*	—	-0.0897*	-0.0920*
	(0.0534)		(0.0534)	(0.0535)
Years of education	0.0264***	0.0264***	0.0263***	0.0266***
	(0.0047)	(0.0047)	(0.0047)	(0.0047)
Experience	0.0182***	0.0183***	0.0182***	0.0181***
	(0.0057)	(0.0057)	(0.0057)	(0.0057)
Experience squared	-0.0003**	-0.0003**	-0.0003**	-0.0003**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Period of employment	0.0081***	0.0081***	0.0081***	0.0081***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Temporary job	-0.0312	-0.0316	-0.0312	-0.0320
	(0.0300)	(0.0300)	(0.0300)	(0.0301)
Part-time job	-0.0438**	-0.0438**	-0.0438**	-0.0430**
	(0.0184)	(0.0184)	(0.0184)	(0.0184)
Log(Hours)	0.9430***	0.9431***	0.9431***	0.9425***
	(0.0187)	(0.0187)	(0.0188)	(0.0188)
Overtime	-0.0099	-0.0101	-0.0098	-0.0106
	(0.0160)	(0.0160)	(0.0160)	(0.0160)
Blue collar	-0.1046***	-0.1045***	-0.1043***	-0.1023***
	(0.0258)	(0.0258)	(0.0258)	(0.0260)
Management	0.3130***	0.3139***	0.3132***	0.3142***
	(0.0581)	(0.0582)	(0.0581)	(0.0582)
Professional	0.3400***	0.3412***	0.3400***	0.3406***
	(0.0476)	(0.0477)	(0.0476)	(0.0477)
Technician	0.1780***	0.1794***	0.1782***	0.1786***
	(0.0420)	(0.0420)	(0.0420)	(0.0420)
Craft	-0.0647	-0.0635	-0.0647	-0.0646
	(0.0429)	(0.0430)	(0.0429)	(0.0430)
Clerk	0.0697*	0.0713*	0.0699*	0.0717*
	(0.0414)	(0.0415)	(0.0414)	(0.0415)
Plant operator	-0.0143	-0.0131	-0.0141	-0.0147
	(0.0501)	(0.0501)	(0.0501)	(0.0501)
Agriculture	-0.1565	-0.1546	-0.1567	-0.1562

	(0.1014)	(0.1015)	(0.1014)	(0.1015)
Elementary occupation	-0.0855**	-0.0840*	-0.0855**	-0.0868**
	(0.0429)	(0.0429)	(0.0429)	(0.0429)
Firm size 1 to 20	-0.2550***	-0.2545***	-0.2551***	-0.2557***
	(0.0237)	(0.0237)	(0.0237)	(0.0238)
Firm size 20 to 200	-0.1328***	-0.1320***	-0.1330***	-0.1332***
	(0.0230)	(0.0230)	(0.0230)	(0.0231)
Firm size 200 to 2000	-0.0332	-0.0325	-0.0333	-0.0334
	(0.0231)	(0.0231)	(0.0231)	(0.0231)
Branch: Agriculture/Fishery	-0.0600	-0.0594	-0.0599	-0.0598
	(0.0816)	(0.0816)	(0.0816)	(0.0817)
Branch: Energy/Water	0.1359	0.1326	0.1355	0.1346
	(0.0997)	(0.0998)	(0.0997)	(0.0999)
Branch: Chemicals	0.0174	0.0190	0.0175	0.0166
	(0.0454)	(0.0455)	(0.0454)	(0.0455)
Branch: Plastics	-0.1151	-0.1170	-0.1153	-0.1149
	(0.0964)	(0.0965)	(0.0964)	(0.0965)
Branch: Stone	-0.0533	-0.0519	-0.0534	-0.0550
	(0.0895)	(0.0896)	(0.0895)	(0.0896)
Branch: Metal	0.0843**	0.0838**	0.0845**	0.0841**
	(0.0382)	(0.0383)	(0.0382)	(0.0383)
Branch: Wood	0.0277	0.0282	0.0281	0.0272
	(0.0573)	(0.0574)	(0.0573)	(0.0574)
Branch: Textiles	-0.0592	-0.0571	-0.0593	-0.0592
	(0.0564)	(0.0565)	(0.0564)	(0.0564)
Branch: Food	-0.0603	-0.0622	-0.0599	-0.0602
	(0.0559)	(0.0559)	(0.0559)	(0.0559)
Branch: Construction	0.0432	0.0440	0.0434	0.0423
	(0.0575)	(0.0575)	(0.0575)	(0.0576)
Branch: Wholesale/Retail	-0.0939***	-0.0947***	-0.0937***	-0.0925***
	(0.0264)	(0.0265)	(0.0264)	(0.0265)
Branch: Transport	0.0018	0.0008	0.0019	0.0005
	(0.0451)	(0.0452)	(0.0452)	(0.0452)
Branch: Banking/Insurance	0.0656*	0.0661*	0.0654*	0.0648*
	(0.0375)	(0.0375)	(0.0375)	(0.0375)
Branch: Other services	-0.0036	-0.0034	-0.0035	-0.0032
	(0.0202)	(0.0202)	(0.0202)	(0.0202)
Branch: Private Households	-0.1618	-0.1623	-0.1619	-0.1613
	(0.1064)	(0.1065)	(0.1064)	(0.1064)
Former West Germany	0.2291***	0.2286***	0.2290***	0.2290***
	(0.0171)	(0.0171)	(0.0172)	(0.0173)
Constant	3.9587***	3.9562***	3.9597***	3.9572***
	(0.1271)	(0.1272)	(0.1270)	(0.1272)
Observations	2010	2010	2010	2010
R-squared	0.7632	0.7633	0.7632	0.7635

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998. Own calculations.

Appendix Table A3: Earnings functions for males, OLS 1998

Log(Earnings)	Model 1	Model 2	Model 3	Model 4
Smoker	-0.0250**	—	—	—
	(0.0108)			
Smoker (age 25 to 35)	—	-0.0028	—	—
		(0.0162)		
Smoker (age 36 to 45)	—	-0.0813***	—	—
		(0.0252)		
Smoker (age 46 to 55)	—	-0.0605	—	—
		(0.0409)		
Non-smoker (age 36 to 45)	—	-0.0400*	—	—
		(0.0242)		
Non-smoker (age 46 to 55)	—	-0.0173	—	—
		(0.0388)		
Tobacco	—	—	-0.0009*	—
			(0.0005)	
Up to 10 cig. per day	—	—	—	-0.0364**
				(0.0179)
11 to 20 cig. per day	—	—	—	-0.0143
				(0.0131)
21 to 30 cig. per day	—	—	—	-0.0443**
				(0.0207)
31 to 40 cig. per day	—	—	—	-0.0436
				(0.0353)
41 and more cig. per day	—	—	—	-0.0041
				(0.0706)
Aged 36 to 45 years	-0.0579***	—	-0.0574***	-0.0581***
	(0.0216)		(0.0216)	(0.0216)
Aged 46 to 55 years	-0.0315	—	-0.0312	-0.0319
	(0.0376)		(0.0376)	(0.0376)
Years of education	0.0217***	0.0218***	0.0219***	0.0218***
	(0.0034)	(0.0034)	(0.0034)	(0.0034)
Experience	0.0391***	0.0386***	0.0391***	0.0393***
	(0.0039)	(0.0039)	(0.0039)	(0.0039)
Experience squared	-0.0008***	-0.0008***	-0.0008***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Period of employment	0.0065***	0.0065***	0.0065***	0.0066***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
Temporary job	-0.1940***	-0.1946***	-0.1949***	-0.1944***
	(0.0231)	(0.0231)	(0.0231)	(0.0231)
Part-time job	-0.4709***	-0.4710***	-0.4707***	-0.4676***
	(0.0439)	(0.0439)	(0.0439)	(0.0440)
Log(Hours)	0.4757***	0.4751***	0.4763***	0.4760***
	(0.0259)	(0.0259)	(0.0259)	(0.0259)
Overtime	0.0484***	0.0475***	0.0479***	0.0489***
	(0.0112)	(0.0112)	(0.0112)	(0.0112)
Blue collar	-0.1336***	-0.1340***	-0.1338***	-0.1339***
	(0.0188)	(0.0188)	(0.0188)	(0.0188)
Management	0.2848***	0.2838***	0.2853***	0.2844***
	(0.0286)	(0.0286)	(0.0286)	(0.0286)
Professional	0.1674***	0.1676***	0.1684***	0.1666***
	(0.0265)	(0.0265)	(0.0265)	(0.0265)
Technician	0.0222	0.0218	0.0230	0.0207
	(0.0228)	(0.0228)	(0.0228)	(0.0228)
Service	-0.1102***	-0.1110***	-0.1092***	-0.1101***
	(0.0357)	(0.0357)	(0.0357)	(0.0357)
Clerk	-0.0201	-0.0199	-0.0192	-0.0207
	(0.0260)	(0.0260)	(0.0260)	(0.0261)
Plant operator	-0.0044	-0.0039	-0.0035	-0.0036
	(0.0169)	(0.0169)	(0.0170)	(0.0170)
Agriculture	-0.1007	-0.0968	-0.0989	-0.1014

	(0.0620)	(0.0620)	(0.0620)	(0.0620)
Elementary occupation	-0.1255***	-0.1245***	-0.1255***	-0.1245***
	(0.0218)	(0.0218)	(0.0219)	(0.0219)
Firm size 1 to 20	-0.2134***	-0.2133***	-0.2136***	-0.2140***
	(0.0172)	(0.0172)	(0.0172)	(0.0173)
Firm size 20 to 200	-0.1063***	-0.1062***	-0.1069***	-0.1069***
	(0.0150)	(0.0151)	(0.0151)	(0.0151)
Firm size 200 to 2000	-0.0543***	-0.0539***	-0.0545***	-0.0553***
	(0.0153)	(0.0153)	(0.0153)	(0.0154)
Branch: Agriculture/Fishery	-0.1562***	-0.1578***	-0.1574***	-0.1565***
	(0.0498)	(0.0498)	(0.0498)	(0.0498)
Branch: Energy/Water	0.0750**	0.0732**	0.0768**	0.0735**
	(0.0367)	(0.0367)	(0.0367)	(0.0367)
Branch: Chemicals	0.0487*	0.0486*	0.0490*	0.0478*
	(0.0260)	(0.0260)	(0.0260)	(0.0260)
Branch: Plastics	0.0202	0.0216	0.0213	0.0202
	(0.0507)	(0.0507)	(0.0508)	(0.0508)
Branch: Stone	-0.0711**	-0.0720**	-0.0708**	-0.0707**
	(0.0358)	(0.0358)	(0.0358)	(0.0358)
Branch: Metal	0.0430**	0.0422**	0.0443**	0.0423**
	(0.0174)	(0.0174)	(0.0174)	(0.0174)
Branch: Wood	0.0080	0.0090	0.0094	0.0077
	(0.0309)	(0.0309)	(0.0309)	(0.0309)
Branch: Textiles	-0.1463***	-0.1452***	-0.1466***	-0.1479***
	(0.0551)	(0.0551)	(0.0551)	(0.0552)
Branch: Food	-0.0559	-0.0575*	-0.0574*	-0.0581*
	(0.0341)	(0.0341)	(0.0341)	(0.0341)
Branch: Construction	0.0300	0.0307	0.0310	0.0306
	(0.0206)	(0.0206)	(0.0206)	(0.0206)
Branch: Wholesale/Retail	-0.0957***	-0.0949***	-0.0960***	-0.0968***
	(0.0221)	(0.0221)	(0.0221)	(0.0221)
Branch: Transport	-0.0265	-0.0253	-0.0262	-0.0269
	(0.0241)	(0.0241)	(0.0241)	(0.0241)
Branch: Banking/Insurance	0.0357	0.0365	0.0357	0.0367
	(0.0340)	(0.0340)	(0.0340)	(0.0340)
Branch: Other services	-0.0997***	-0.0990***	-0.1005***	-0.0986***
	(0.0209)	(0.0209)	(0.0209)	(0.0209)
Former West Germany	0.3177***	0.3177***	0.3185***	0.3185***
	(0.0128)	(0.0128)	(0.0129)	(0.0129)
Constant	5.8058***	5.8014***	5.7967***	5.8019***
	(0.1176)	(0.1177)	(0.1177)	(0.1180)
Observations	2570	2570	2570	2570
R-squared	0.6079	0.6084	0.6076	0.6084

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998. Own calculations.

Appendix, Table A4: Earnings functions for females, longitudinal analyses

Appendix, Table A4: Earnings functions for females, longitudinal analyses

Log(Earnings)	Model 1			Model 2		
	Pooled OLS	RE Model	FE Model	Pooled OLS	RE Model	FE Model
Smoker	0.0123	0.0020	-0.0230	—	—	—
	(0.0116)	(0.0138)	(0.0186)			
Smoker (age 25 to 35)	—	—	—	-0.0177	-0.0089	-0.0215
				(0.0212)	(0.0219)	(0.0257)
Smoker (age 36 to 45)	—	—	—	-0.0593**	-0.0310	-0.0368
				(0.0275)	(0.0254)	(0.0290)
Smoker (age 46 to 55)	—	—	—	-0.0748*	0.0019	-0.0256
				(0.0427)	(0.0364)	(0.0399)
Non-smoker (age 36 to 45)	—	—	—	-0.0647**	-0.0226	-0.0113
				(0.0263)	(0.0226)	(0.0237)
Non-smoker (age 46 to 55)	—	—	—	-0.1347***	-0.0386	-0.0051
				(0.0412)	(0.0331)	(0.0338)
Aged 25 to 35 years	-0.0537**	-0.0217	-0.0127	—	—	—
	(0.0241)	(0.0204)	(0.0212)			
Aged 36 to 45 years	-0.1060***	-0.0220	-0.0049	—	—	—
	(0.0395)	(0.0310)	(0.0308)			
Years of education	0.0253***	0.0271***	-0.0754	0.0254***	0.0271***	-0.0754
	(0.0036)	(0.0040)	(0.2268)	(0.0036)	(0.0040)	(0.2269)
Experience	0.0078	0.0100*	-0.0624	0.0082*	0.0100*	-0.0624
	(0.0048)	(0.0053)	(0.2265)	(0.0048)	(0.0053)	(0.2266)
Experience (squared)	-0.0000	-0.0002	-0.0004**	-0.0000	-0.0002	-0.0004**
	(0.0001)	(0.0001)	(0.0002)	(0.0001)	(0.0001)	(0.0002)
Period of employment	0.0066***	0.0064***	-0.0005	0.0065***	0.0063***	-0.0005
	(0.0008)	(0.0010)	(0.0015)	(0.0008)	(0.0010)	(0.0015)
Temporary job	-0.0682**	-0.0070	-0.0033	-0.0684**	-0.0077	-0.0035
	(0.0279)	(0.0235)	(0.0240)	(0.0279)	(0.0235)	(0.0241)
Part-time job	-0.0630***	-0.1014***	-0.0664***	-0.0635***	-0.1013***	-0.0664***
	(0.0139)	(0.0143)	(0.0169)	(0.0139)	(0.0143)	(0.0169)
Log(Hours)	0.8368***	0.6493***	0.4589***	0.8373***	0.6499***	0.4590***
	(0.0153)	(0.0153)	(0.0177)	(0.0153)	(0.0153)	(0.0177)
Overtime	-0.0039	0.0170*	0.0197*	-0.0039	0.0171*	0.0197*
	(0.0116)	(0.0098)	(0.0101)	(0.0116)	(0.0098)	(0.0101)
Blue collar	-0.1611***	-0.1182***	-0.0443**	-0.1616***	-0.1185***	-0.0444**
	(0.0188)	(0.0184)	(0.0218)	(0.0188)	(0.0184)	(0.0218)
Management	0.3215***	0.3039***	0.1633***	0.3199***	0.3017***	0.1632***
	(0.0378)	(0.0397)	(0.0471)	(0.0378)	(0.0397)	(0.0472)
Professional	0.3335***	0.2364***	0.0579*	0.3321***	0.2366***	0.0582*
	(0.0263)	(0.0268)	(0.0318)	(0.0263)	(0.0268)	(0.0319)
Technician	0.1798***	0.1619***	0.0562**	0.1782***	0.1616***	0.0563**
	(0.0198)	(0.0202)	(0.0242)	(0.0198)	(0.0202)	(0.0242)
Craft	0.0974***	0.0807**	0.0441	0.0923***	0.0786**	0.0440
	(0.0346)	(0.0347)	(0.0408)	(0.0346)	(0.0347)	(0.0408)
Clerk	0.1017***	0.1181***	0.0568**	0.1014***	0.1180***	0.0568**
	(0.0202)	(0.0201)	(0.0234)	(0.0202)	(0.0201)	(0.0234)
Plant operator	0.0437	0.0278	0.0145	0.0418	0.0271	0.0144
	(0.0333)	(0.0352)	(0.0432)	(0.0333)	(0.0352)	(0.0432)
Agriculture	-0.1664**	-0.2025**	-0.1533*	-0.1573*	-0.1995**	-0.1534*
	(0.0832)	(0.0787)	(0.0875)	(0.0833)	(0.0788)	(0.0876)
Elementary occupation	-0.0678***	-0.0599**	0.0044	-0.0680***	-0.0600**	0.0044
	(0.0263)	(0.0256)	(0.0292)	(0.0263)	(0.0256)	(0.0292)
Firm size 1 to 20	-0.2850***	-0.2355***	-0.1167***	-0.2856***	-0.2355***	-0.1168***
	(0.0177)	(0.0197)	(0.0253)	(0.0177)	(0.0197)	(0.0253)
Firm size 20 to 200	-0.1322***	-0.0978***	-0.0310	-0.1316***	-0.0968***	-0.0309
	(0.0168)	(0.0183)	(0.0224)	(0.0168)	(0.0183)	(0.0225)
Firm size 200 to 2000	-0.0425**	-0.0134	0.0247	-0.0408**	-0.0122	0.0247
	(0.0166)	(0.0172)	(0.0201)	(0.0166)	(0.0172)	(0.0201)
Branch: Agriculture/Fishery	-0.1839***	-0.1166	0.0586	-0.1841***	-0.1150	0.0585
	(0.0641)	(0.0721)	(0.1026)	(0.0640)	(0.0721)	(0.1026)
Branch: Energy/Water	0.0642	0.0222	-0.1174	0.0595	0.0206	-0.1172
	(0.0711)	(0.0854)	(0.1186)	(0.0711)	(0.0853)	(0.1186)
Branch: Chemicals	0.1325***	0.0942**	0.0944*	0.1365***	0.0980**	0.0944*
	(0.0369)	(0.0402)	(0.0490)	(0.0369)	(0.0403)	(0.0492)
Branch: Plastics	-0.0373	-0.0130	0.0177	-0.0367	-0.0163	0.0172

	(0.0630)	(0.0525)	(0.0533)	(0.0631)	(0.0525)	(0.0535)
Branch: Stone	0.0112	0.0494	0.1385*	0.0139	0.0519	0.1387*
	(0.0661)	(0.0687)	(0.0799)	(0.0661)	(0.0687)	(0.0799)
Branch: Metal	0.0832***	0.0208	0.0020	0.0816***	0.0205	0.0020
	(0.0249)	(0.0248)	(0.0286)	(0.0249)	(0.0248)	(0.0286)
Branch: Wood	0.0967**	-0.0227	-0.0927**	0.1002**	-0.0212	-0.0926**
	(0.0405)	(0.0399)	(0.0452)	(0.0405)	(0.0399)	(0.0452)
Branch: Textiles	-0.1538***	-0.1811***	-0.2299**	-0.1504***	-0.1790***	-0.2299**
	(0.0471)	(0.0599)	(0.0937)	(0.0471)	(0.0599)	(0.0937)
Branch: Food	-0.0736	-0.0438	-0.0013	-0.0740	-0.0444	-0.0016
	(0.0513)	(0.0468)	(0.0501)	(0.0513)	(0.0468)	(0.0502)
Branch: Construction	-0.0194	-0.1175***	-0.1629***	-0.0203	-0.1181***	-0.1631***
	(0.0429)	(0.0437)	(0.0502)	(0.0428)	(0.0437)	(0.0502)
Branch: Wholesale/Retail	-0.1058***	-0.1034***	-0.0369	-0.1066***	-0.1033***	-0.0370
	(0.0191)	(0.0209)	(0.0278)	(0.0191)	(0.0209)	(0.0278)
Branch: Transport	-0.0837**	-0.0736*	-0.0843*	-0.0886**	-0.0755**	-0.0845*
	(0.0353)	(0.0376)	(0.0466)	(0.0353)	(0.0376)	(0.0466)
Branch: Banking/Insurance	0.0438	-0.0269	-0.1774***	0.0415	-0.0269	-0.1771***
	(0.0276)	(0.0329)	(0.0490)	(0.0276)	(0.0329)	(0.0490)
Branch: Other services	-0.0088	-0.0215	-0.0221	-0.0082	-0.0212	-0.0221
	(0.0148)	(0.0144)	(0.0165)	(0.0148)	(0.0144)	(0.0165)
Branch: Private Households	-0.1113	-0.0999	-0.0011	-0.1141	-0.1002	-0.0011
	(0.0853)	(0.0803)	(0.0869)	(0.0853)	(0.0803)	(0.0869)
Year 1999	0.0315**	0.0327***	0.1201	0.0311**	0.0325***	0.1201
	(0.0131)	(0.0082)	(0.2269)	(0.0131)	(0.0082)	(0.2270)
Year 2001	0.0616***	0.0751***	0.3439	0.0609***	0.0748***	0.3439
	(0.0135)	(0.0091)	(0.6800)	(0.0135)	(0.0091)	(0.6803)
Constant	4.6167***	5.2272***	8.7723	4.6217***	5.2273***	8.7717
	(0.0944)	(0.0999)	(7.4787)	(0.0945)	(0.1000)	(7.4819)
Person-Year-Observations	3579	3579	3579	3579	3579	3579
Number of individuals	3579	1193	1193	3579	1193	1193
R^2	0.7278	0.7202	0.3437	0.7283	0.7207	0.3437
F-Test / Chi^2 for RE	236.54	4476.78	30.71	225.71	4485.71	29.22
Prob > Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998, 1999, and 2001. Own calculations.

Appendix, Table A5: Earnings functions for males, longitudinal analyses

Log(Earnings)	Model 1			Model 2		
	Pooled OLS	RE Model	FE Model	Pooled OLS	RE Model	FE Model
Smoker	-0.0118	-0.0074	0.0094	—	—	—
	(0.0081)	(0.0085)	(0.0101)			
Smoker (age 25 to 35)	—	—	—	0.0133	0.0148	0.0257**
				(0.0130)	(0.0117)	(0.0128)
Smoker (age 36 to 45)	—	—	—	-0.0151	-0.0206	-0.0085
				(0.0184)	(0.0140)	(0.0150)
Smoker (age 46 to 55)	—	—	—	-0.0257	-0.0056	0.0064
				(0.0301)	(0.0202)	(0.0205)
Non-smoker (age 36 to 45)	—	—	—	-0.0087	0.0044	0.0026
				(0.0176)	(0.0124)	(0.0125)
Non-smoker (age 46 to 55)	—	—	—	0.0367	0.0175	0.0031
				(0.0291)	(0.0197)	(0.0199)
Aged 25 to 35 years	-0.0195	-0.0134	-0.0137	—	—	—
	(0.0158)	(0.0106)	(0.0105)			
Aged 36 to 45 years	0.0064	0.0012	-0.0059	—	—	—
	(0.0279)	(0.0176)	(0.0172)			
Years of education	0.0147***	0.0265***	0.0109	0.0147***	0.0265***	0.0119
	(0.0025)	(0.0025)	(0.0222)	(0.0025)	(0.0025)	(0.0222)
Experience	0.0256***	0.0330***	0.0387*	0.0243***	0.0328***	0.0396*
	(0.0034)	(0.0034)	(0.0225)	(0.0034)	(0.0034)	(0.0225)
Experience (squared)	-0.0005***	-0.0007***	-0.0008***	-0.0005***	-0.0007***	-0.0008***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Period of employment	0.0056***	0.0040***	-0.0001	0.0057***	0.0040***	-0.0001
	(0.0006)	(0.0007)	(0.0010)	(0.0006)	(0.0007)	(0.0010)
Temporary job	-0.1279***	-0.0705***	-0.0534***	-0.1285***	-0.0709***	-0.0537***
	(0.0208)	(0.0143)	(0.0142)	(0.0208)	(0.0143)	(0.0142)
Part-time job	-0.5265***	-0.5221***	-0.4744***	-0.5230***	-0.5224***	-0.4752***
	(0.0395)	(0.0338)	(0.0363)	(0.0394)	(0.0338)	(0.0363)
Log(Hours)	0.2449***	0.1259***	0.0925***	0.2452***	0.1266***	0.0930***
	(0.0232)	(0.0166)	(0.0168)	(0.0231)	(0.0166)	(0.0168)
Overtime	0.0614***	0.0325***	0.0213***	0.0605***	0.0321***	0.0210***
	(0.0084)	(0.0058)	(0.0058)	(0.0084)	(0.0058)	(0.0058)
Blue collar	-0.1874***	-0.1267***	-0.0163	-0.1869***	-0.1271***	-0.0168
	(0.0134)	(0.0116)	(0.0137)	(0.0134)	(0.0116)	(0.0137)
Management	0.3021***	0.1368***	0.0258	0.3024***	0.1364***	0.0254
	(0.0211)	(0.0168)	(0.0179)	(0.0210)	(0.0168)	(0.0179)
Professional	0.2104***	0.1044***	-0.0140	0.2107***	0.1048***	-0.0134
	(0.0188)	(0.0160)	(0.0181)	(0.0188)	(0.0160)	(0.0181)
Technician	0.0785***	0.0460***	-0.0156	0.0779***	0.0450***	-0.0165
	(0.0161)	(0.0139)	(0.0156)	(0.0161)	(0.0139)	(0.0156)
Service	-0.1346***	-0.0741***	-0.0432	-0.1357***	-0.0747***	-0.0432
	(0.0270)	(0.0265)	(0.0303)	(0.0270)	(0.0264)	(0.0303)
Clerk	-0.0342*	-0.0045	-0.0217	-0.0345*	-0.0045	-0.0218
	(0.0187)	(0.0169)	(0.0190)	(0.0187)	(0.0169)	(0.0190)
Plant operator	0.0226*	-0.0039	-0.0024	0.0222*	-0.0033	-0.0014
	(0.0127)	(0.0122)	(0.0138)	(0.0127)	(0.0122)	(0.0138)
Agriculture	-0.1258***	-0.1065**	-0.0576	-0.1194**	-0.1070**	-0.0587
	(0.0487)	(0.0480)	(0.0547)	(0.0487)	(0.0480)	(0.0547)
Elementary occupation	-0.0936***	-0.0574***	-0.0342**	-0.0929***	-0.0576***	-0.0344**
	(0.0173)	(0.0149)	(0.0160)	(0.0173)	(0.0149)	(0.0160)
Firm size 1 to 20	-0.2419***	-0.1486***	-0.0364**	-0.2433***	-0.1495***	-0.0374**
	(0.0133)	(0.0137)	(0.0166)	(0.0133)	(0.0137)	(0.0166)
Firm size 20 to 200	-0.1618***	-0.0951***	-0.0130	-0.1624***	-0.0956***	-0.0137
	(0.0110)	(0.0112)	(0.0132)	(0.0110)	(0.0112)	(0.0132)
Firm size 200 to 2000	-0.0644***	-0.0297***	0.0030	-0.0651***	-0.0299***	0.0028
	(0.0112)	(0.0106)	(0.0119)	(0.0112)	(0.0106)	(0.0119)
Branch: Agriculture/Fishery	-0.2062***	-0.1860***	-0.1121*	-0.2055***	-0.1841***	-0.1077*
	(0.0394)	(0.0442)	(0.0574)	(0.0394)	(0.0442)	(0.0574)
Branch: Energy/Water	0.0325	0.0216	0.0155	0.0329	0.0194	0.0134
	(0.0284)	(0.0276)	(0.0312)	(0.0284)	(0.0276)	(0.0312)
Branch: Chemicals	0.0611***	0.0395*	0.0218	0.0604***	0.0391*	0.0216
	(0.0197)	(0.0207)	(0.0249)	(0.0197)	(0.0206)	(0.0249)
Branch: Plastics	0.0085	-0.0196	-0.0147	0.0118	-0.0185	-0.0141
	(0.0360)	(0.0241)	(0.0239)	(0.0360)	(0.0241)	(0.0239)
Branch: Stone	-0.0283	-0.0718***	-0.0661**	-0.0301	-0.0734***	-0.0678**

	(0.0285)	(0.0262)	(0.0288)	(0.0285)	(0.0262)	(0.0288)
Branch: Metal	0.0653***	0.0244**	0.0133	0.0654***	0.0242**	0.0131
	(0.0119)	(0.0096)	(0.0103)	(0.0119)	(0.0096)	(0.0103)
Branch: Wood	0.0368	-0.0071	-0.0098	0.0388*	-0.0056	-0.0086
	(0.0227)	(0.0220)	(0.0249)	(0.0227)	(0.0220)	(0.0249)
Branch: Textiles	-0.1471***	-0.1542***	-0.0655	-0.1457***	-0.1521***	-0.0657
	(0.0455)	(0.0561)	(0.0782)	(0.0454)	(0.0560)	(0.0781)
Branch: Food	-0.0415	-0.0517**	-0.0371	-0.0429	-0.0517**	-0.0368
	(0.0297)	(0.0224)	(0.0230)	(0.0297)	(0.0224)	(0.0230)
Branch: Construction	0.0245	-0.0088	0.0094	0.0257	-0.0088	0.0092
	(0.0159)	(0.0146)	(0.0163)	(0.0159)	(0.0146)	(0.0163)
Branch: Wholesale/Retail	-0.0998***	-0.0308**	0.0118	-0.0991***	-0.0304**	0.0124
	(0.0168)	(0.0148)	(0.0162)	(0.0168)	(0.0148)	(0.0162)
Branch: Transport	-0.0610***	-0.0168	0.0147	-0.0583***	-0.0170	0.0140
	(0.0185)	(0.0168)	(0.0186)	(0.0185)	(0.0167)	(0.0186)
Branch: Banking/Insurance	0.0972***	0.0572**	-0.0200	0.0994***	0.0576**	-0.0192
	(0.0243)	(0.0247)	(0.0299)	(0.0243)	(0.0247)	(0.0299)
Branch: Other services	-0.0622***	-0.0140	0.0063	-0.0613***	-0.0132	0.0068
	(0.0152)	(0.0122)	(0.0129)	(0.0152)	(0.0122)	(0.0129)
Branch: Private Households	0.1614	0.1133	0.1151	0.1731	0.1343	0.1314
	(0.2742)	(0.1625)	(0.1579)	(0.2739)	(0.1626)	(0.1580)
Year 1999	0.0169*	0.0174***	0.0228	0.0174*	0.0175***	0.0219
	(0.0095)	(0.0047)	(0.0224)	(0.0095)	(0.0047)	(0.0224)
Year 2001	0.0705***	0.0741***	0.0947	0.0711***	0.0742***	0.0920
	(0.0097)	(0.0055)	(0.0662)	(0.0097)	(0.0055)	(0.0662)
Constant	7.1674***	7.3596***	7.5753***	7.1674***	7.3511***	7.5369***
	(0.0997)	(0.0815)	(0.7039)	(0.0998)	(0.0815)	(0.7037)
Person-Year-Observations	5016	5016	5016	5016	5016	5016
Number of individuals	5016	1672	1672	5016	1672	1672
R^2	0.5030	0.4724	0.2465	0.5043	0.4729	0.2479
F-Test / Chi^2 for RE	125.85	2293.80	27.03	120.45	2306.20	25.91
Prob > Chi^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Notes: Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Source: GSOEP, 1998, 1999, and 2001. Own calculations.

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