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Difference in Difference analysis of the work-related implications of commuting in the Netherlands

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ABSTRACT:

Rising evidence suggests that, although commuting happens before the start of the actual working day, it has substantial spillover effects at the workplace. In this paper the effect of commuting on a set of work-related characteristics is evaluated with the help of Dutch LISS panel data. The exogenous shock in commuting times associated with the switch to working from home in 2020 is used in this paper for the Difference in Difference estimation of the effect of commuting time on the job satisfaction. Apart from that the Fixed Effect regression analysis of the association between commuting and work-related stress, satisfaction with pay and likeliness to look for the other job is conducted. It is found that the negative effects of commuting were significantly overestimated and commuting in the Netherlands is a neutral and, in some extent, even enjoyable activity.

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Introduction

Commuting is an integral part of the day of almost any working individual. Commuting by itself is not a part of the working process and it cannot be directly observed or influenced by manager, but it, nevertheless, deserves attention not only in the context of transport economists, but also in the economics of personnel. The rising research in this field univocally proposes the employers to pay more attention to commuting issues in the hiring process and in the assignment of incentives. For example, van Ommeren & Gutiérrez (2011) suggest that large commuting time is associated with higher likeliness of absenteeism. Using the data from German Socio-Economic panel researchers reveal that longer commuting workers not only come to work later and leave workplace earlier, but also have 16% higher chances of being absent. Researchers suggests that it might be optimal for employers to redline the workers, whose commuting time is too high. The abundant research in psychology also suggests that longer commuting is associated with lower concentration at work and higher work-related stress. These factors have a very close relation to worker's performance and point on point on substantial spillover effects of commuting to workplace. Nevertheless, the existing research on the relationship between commuting and the job satisfaction and job search behavior is very limited. In the current study the effect of commuting time on the job satisfaction, work-related stress, satisfaction with wage and likeliness to look for the other job is evaluated. LISS panel data encompassing the observations of 7000 Dutch workers from 2008 to 2020 is used in the conduct of OLS and Fixed Effects regressions. Further, the sample is limited only to the individuals who were working from home in 2020 and the Difference in Difference estimation of the effect of commuting on job satisfaction is performed. The switch to working from home associated with the coronavirus pandemic in 2020 is used in this study as an exogenous shock in commuting times. Because of this switch the commuting time of many workers has dropped from the 2019 level to zero and it is, therefore, expected that workers who previously had higher commuting time will experience a greater increase in the job satisfaction from relief of commuting than those whose commuting time was low. The actual results of the estimation are quite surprising. It has been revealed that longer commuting workers have received less satisfaction from the relief of commuting in 2020 than shorter commuting workers, which, in other word, implies that higher commuting time has a positive effect on the job satisfaction. It is, therefore, concluded that the negative sides of commuting in the Netherlands, revealed

in the previous economic literature, are substantially overestimated. Similar conclusions but with a lower degree of certainty are also made about the effect of commuting on the satisfaction with pay, work-related stress and the likeliness to look for the other job.

The structure of the paper is as follows: At first, the theoretical models of commuting and the empirical insights concerning the effect of commuting on stress, wage composition and the job satisfaction are summarized and evaluated in the Theoretical Framework. Then, the characteristics of data used and peculiarities of the regression analysis and the Difference in Difference estimation are described in the section Data and Methodology. Further, the estimation of the effect of the effect of commuting on different work-related indicators is performed in the Results section. And Finally, in the Discussion and Conclusion sections the validity and the practical significance of results is evaluated and suggestions for further research are made.

Theoretical framework

Commuting is a frequently discussed topic in transport economics, but it is much less popular the economics of personnel. Formally speaking commuting is not part of the working process, but the rising evidence suggests that it has a pronounced spillover effect on the worker's performance.

The negative effects of commuting are realized both by the employee and by the employer. Classical urban location models, such as the one of Alonso (1964) and many other models that built on it, suggest that individuals are only willing to accept the distant job offer if the costs of commuting (in terms of both money and time) are compensated either in the housing or in the labor market. As consequence, in equilibrium workers should make such work and housing choices that the losses from commuting are fully compensated. The more distant job offers are generally more beneficial (otherwise workers would not have even considered them) and the more distant housing opportunities are cheaper and a worker would then find a right balance in the trade-off between less commuting and higher wage/lower housing costs. If this equilibrium holds, then commuting should not have any effect on the job satisfaction – the gain in job satisfaction from better job should cancel down the loss from commuting time. Nevertheless, the existing empirical research suggests that commuting is generally associated with lower job satisfaction. Using the data from the German Socio-economic panel Stutzer &

Frey (2008) reveal that one additional hour of commuting is associated with 0.20 points lower overall subjective well-being (measured on the scale from 0 to 10), which is 1/4 as bad for an individual as losing a job. Authors also dedicate a small section of their paper to job satisfaction. They hypothesize that commuting time should have a positive effect on job satisfaction, as in theory commuting should be compensated by higher quality of the job. However, they find that 1 hour of commuting is associated with 0.24 points lower job satisfaction on the scale from 1 to 10. Furthermore, they also reveal that individuals who change job and housing, and, therefore, have an opportunity to re-optimize their location choices, eventually also arrive at the negative effect of commuting time on both job and housing satisfaction. They explain this finding by behavioral patterns that are not captured in the theoretical models – individuals may underestimate the true costs of commuting for their well-being and they may also lack willpower to adjust their work-housing location setting for commuting preferences. It is, therefore, hypothesized in this research that commuting is negatively associated with the job satisfaction and the following hypothesis is formulated:

H1: Commuting time is negatively associated with job satisfaction

To my knowledge, the paper of Stutzer & Frey is the only one where the relation between commuting and job satisfaction is evaluated explicitly. At the same there is an abundance of research in psychology on the interaction between commuting and stress. Koslowsky, et. al (1996) suggest that longer commuting is associated with higher perceived stress, higher hostility, higher chance of burnout. These findings are also confirmed by the natural experiment in the transport system described by Wener et. al (2005). Individuals, who switched to improved train service, had higher behavioral index of motivation and lower perceived job strain, which implies that stress experienced in commuting overflows to the working environment in this context. Zhou, et. al (2017) have also conducted a study that is based on diary data from 45 bus commuters, which have also revealed that commuting stress is associated with greater irritability and lower self-control in the workplace. Unlike Zhou, et. al, Wiese, et. al (2020) have evaluated not only the morning commuting, but also the commuting after the work in a similar study of German train commuters. They have revealed that commuting not only decreases the workers' concentration at work and increases the work-related stress, but also enhances the stress that was accumulated while working. The

stress generating potential of commuting is also evaluated in this enquiry and the following hypothesis is formulated in this respect:

H2: Commuting time is positively associated with work-related stress

Apart from that, there are also several papers which study the wage compensation of commuting for workers, which have direct implications for the study of job satisfaction. Using the Scottish Household Panel data Laird (2006) reveals that commuting costs (in terms of both money and time) are indeed compensated in wages (as it was predicted in theory), and it is only through wages (not through the housing prices) the commuting is compensated, but this compensation is only partial: the marginal level of compensation of commuting costs is only about 77% in Scotland. Rupert, et. al (2009) uses the cross-sectional French Time Use Survey data for the similar estimates and calculates the wage compensation level of commuting time of around 28.5%, which is drastically different from what Laird has calculated for Scotland (nevertheless, the time periods of the datasets that these researchers used are also quite distant from each other, and this fact complicates the comparison of two papers). Wales (1977) uses the American Panel of Income Dynamics to estimate the wage-commuting price elasticities; instead of looking at the actual compensation for commuting, Wales looks at workers' own assessment of commuting costs and comes to conclusion that commuting time on average is valued by workers as 2/3 of the hourly wage rate. In a more recent study, Van Ommeren & Fosgerau (2008) estimates that the marginal willingness to pay for commuting in the Netherlands is around 1/2 of the hourly wage rate. Clearly, a substantially higher wage is required to motivate the longer travelling workers and it is unlikely that the actual level of employer compensation complies with workers' own valuations of costs of commuting. The pieces of research presented above are very limited and not very much relatable to each other as they belong to different countries and time periods that are so far from each other that the mere nature of commuting (as well as its perception by workers) is not necessarily comparable. Furthermore, they mostly rely on simple regression tools (Stutzer & Frey use the most advanced methodology of all papers listed as they also include Fixed Effects in their model), which does not allow to establish a real causal relationship. Nevertheless, it is possible to draw a more or less complete preliminary picture of the wage-commuting-job satisfaction relationship from these inferences. It is clear that commuting is important for workers and it does have a pronounced effect on their wellbeing and job satisfaction. This effect is most likely

negative, as 1) commuting is a major cause of the work-related stress and 2) commuting is often only partially compensated by wage and other job qualities. If commuting is indeed only partially compensated then longer commuting should be less satisfied with their wage than short-time commuters and their overall job satisfaction should also be lower even when the wage differenced are accounted for. These insights are converted in the following two of hypotheses:

H3: Commuting time is negatively associated with the satisfaction with wage

H4: The loss in job satisfaction resulting from commuting is not fully compensated by the hourly wage rate

All the abovementioned predictions are directed on the evaluation of the role of commuting in determining the worker's attitude to the job, but apart from that commuting plays an important in the job search behavior. Simpson (1980) have developed an urban job search model incorporating the skills of workers. Model predicts that workers with certain specific skills are restricted in the choice of the future job transfer and so they search jobs in a wider area, but at the same time they have a higher valuation of commuting time than low skilled workers. Low skilled jobs, on the contrary, have a more local character and lower commuting costs. These predictions are also confirmed empirically in the regression analysis of the data from the Greater London Transport Survey. Crane (1995) reveals that more stable jobs are associated with lower time of commuting. When individuals make their residential location decisions they also consider future job opportunities and so, Crane argues, if an individual decides to move closer to a place of work, he or she should be very confident in the present place of empoyment. Van Ommeren (1998) have also added the empirical dimension to the research on job search and commuting. Using a cross-sectional Interview of the Labor Force dataset for the Netherlands, he has estimated the effect of commuting on the probability of searching for a new job. The estimated probability of looking for the other job is 10% for workers with negligible commuting time and 14.8% for the workers with 1 hour of commuting. Longer commuting workers are, therefore, almost 50% more likely to look for the other job. Furthermore, van Ommeren also reveals that the relationship between job search and commuting time is convex: workers' search effort is much less sensitive to commuting time that is under 45 minutes, but then as commuting time rises above this threshold it becomes proportionally more and more important for workers. Furthermore, Rupert, et. al (2009) have

found that the weight given by French workers to commuting distance in making a job acceptance decision is around a third of the weight of wage rate.

Commuting time seems to be an important determinant of the worker's job search and job acceptance decisions – and this tendency is already partially captured in commuting-job satisfaction relationship. If a worker is satisfied with a job, then he or she is also less likely to look for a new one, and the choice jobs of a job with the lower commuting time is also likely to be accompanied by the expectation of a higher job satisfaction. Nevertheless, the job satisfaction is not a perfect proxy of the worker's labor market behavior and so it will also be interesting to look directly on the effect of commuting on the likeliness to look for the other job (it is especially interesting to compare these inferences with the estimates of van Ommeren (1998) and look how preferences of Dutch workers for commuting have changed since 1990s). The hypothesized relationship is as follows:

H5: Commuting time is positively associated with the probability of looking for the other job

These theoretical are indeed somewhat obvious: it is clear that commuting is negatively perceived by workers and the mere signs of commuting-job satisfaction, commuting-stress, commuting-job search relationships are not so interesting for the present inquiry (unless something unexpected is found). The magnitudes of these relationships and the way they relate to each other are more important. Past theoretical insights presented above indicate the lack of consensus on the questions of the importance of commuting for employees and employers, the size of commuting costs and the degree of their compensation. The methodology of this study aims at establishing a causal relationship between commuting and its job implications and so these questions are answered with a high degree of exactness.

Data and Methodology

The hypotheses formulated above are evaluated with the help of the LISS panel dataset covering years 2008-2020. This is a self-reported questionnaire data from 7000 workers in the Netherlands. The sample was only limited to full-time employed workers. Descriptive statistics of the key variables are presented in Table 1 in Appendix. All job satisfaction variables, such as overall job satisfaction and satisfaction with pay measure the satisfaction on the scale from 1 to 10. The mean overall job satisfaction of Dutch workers in the sample is 7.43. The average job satisfaction for workers travelling to work less than 30 hours is 7.45, for workers travelling

more than 30 minutes – 7.40, more than one hour – 7.36. Longer commuting workers are clearly less satisfied with their work, but the magnitude of these differences in satisfaction seems to be very low. Average commuting time in the sample is 27.7 minutes. The time trend in commuting time is presented in Figure 1 in Appendix. From 2012 to 2018 commuting time was constantly increasing, the overall magnitude of this rise is around 2 minutes, which is quite substantial (around 7% of the overall mean). Starting from 2018 the commuting time started to fall, and, what is especially important in the context of this enquiry – the falling trend in commuting in 2020 is even flatter than in 2019, so that the effect of pandemic and switch to working from home did not noticeably push down the trend in commuting time. In this research a series of Ordinary Least Squares regressions of overall job satisfaction on commuting time is performed to evaluate the relative importance of particular job characteristics in determining the overall satisfaction of worker. The basic regression equation has the following form:

Job satisfaction$_i$ = α + β$_1$*Commuting time$_i$ + β$_n$X$_n$ + ε$_i$

Where Xn is a vector of control variables, such as age, gender, education, working hours and profession. These factors are likely to be correlated both with the job satisfaction and with commuting time and can, thereby, bias the estimates if they are not included in the regression. Hourly wage is a particularly important control variable, as it is a primary measure of job attractiveness for the worker. Stutzer & Frey (2008) intentionally do not include wage in their regression of job satisfaction on commuting time, because they want to estimate the satisfaction coming both from the commuting time itself and from the quality of the job, which should be higher for longer commuting workers. In other words, longer commuting should (at least in theory) be rewarded in terms of wage, higher wage should compensate the longer commuting time and the resulting job satisfaction should not vary substantially with commuting. Whereas controlling for wage will allow to reveal the actual negative effect of commuting on the job satisfaction. In practice Stutzer & Frey have come to conclusion that the effect of commuting on job satisfaction is negative even without control for wage, but it is also clear that this effect should be even stronger when the wage is included. In this respect controlling for wage is important not only to estimate the actual negative effect of commuting on job satisfaction, but also to estimate the level of wage compensation of commuting. Furthermore, to perform this estimation, the monthly wage level was converted into the

hourly wage rate (estimated as: monthly wage in euros / (working hours per week * 30/7)) and, thereby, made comparable with time that is measured in minutes. Considering that the wage distribution in the sample is substantially skewed to the left, the natural logarithm of wage is taken, so as to decrease the importance of observations that lie further from common mass.

Further, the Individual Fixed Effects also added into regression, and the regression equation is then as follows:

Job satisfaction$_{i,t}$ = α$_i$ + β$_1$*Commuting time$_{i,t}$ + β$_n$X$_{n,i,t}$ + u$_{i,t}$

Fixed Effects allow us to put aside the unobserved time invariant individual characteristics that could bias the estimates. Nevertheless, even when the time-invariant OVB is controlled for, there are still many unobserved time variant factors that are not alleviated by Fixed Effects. For example, individuals may change modes of transportation and route to work, road traffic characteristics may change over time, individuals may make other life choices that influence their perception of commuting time (e.g. necessity to drive children to school before work may make commuting more (or less) acceptable for the worker). A more powerful methodology is required to account for these sources of bias and make a real causal association.

In practice, commuting time never changes by itself – there is always a variation in a certain job or commuting characteristic behind it. Many studies (such as Simpson (1979) or Crane (1995)) suggest that more distant employment opportunities are associated with a systematically different set of job characteristics. The study of the effect of commuting time on job satisfaction should clearly account for these qualitative job differences to provide reliable estimates. In my knowledge there is no study of commuting time which would focus only on companies changing offices or individuals changing locations, while staying on the position on the same job. Variation in job location is never fully isolated from the simultaneous variation in other job characteristics that may also influence the job satisfaction in the existing research, and so the endogeneity issues are very likely. The ideal experiment in this case would include random relocation of individuals to different job locations without changing their organizational position and other qualities of the job (including the qualities of the route of commuting (e.g. crowdedness of roads, mode of transport, etc.)). This experiment can in

theory be conducted within a big organization with many different offices, and if the company has offices in different cities than this experiment may be representative in terms of geography, but the external validity in terms of the type of work will most likely be limited. Nevertheless, I believe that this kind of experiment is costly, but viable and it can be conducted in further research.

With the resources available for the current study it is impossible to conduct such an experiment in a controlled organizational setting, but instead this study relies on natural experiment that in some ways is even better than controlled treatment provision. Covid 19 pandemic and the widespread shift to working from home that is associated with it, plays a role of exogenous shock in commuting times in the context of this enquiry. It is reasonable to assume that in April 2019 workers did not expect the coronavirus outbreak to happen and so they did not choose their job location (and commuting time associated with it) with the expectation to work from home in future. Dutch Individuals working on anyhow distant jobs have all been forced to switch to working from home, so that commuting time for all of them have contracted to zero, but their initial job locations were different. Individuals who were already working close to their home, were unlikely to experience any substantial increase in job satisfaction from the alleviation of commuting, whereas individuals who had previously to travel a lot to their work should have clearly benefited substantially. Fortunately, the LISS questionnaire for 2019 was conducted in April – almost half a year before the start of pandemic, whereas in April 2020 (when the next wave of questionnaire has started) the self-isolation and working from home regime was still active in the Netherlands, and so the exogenous change in commuting times can be captured between these years. This allows us to conduct a Difference in Difference estimation of the effect of commuting on job satisfaction. The resulting regression equation has the following form:

Job satisfaction$_{2020}$ - Job satisfaction$_{2019}$ = α + β$_1$*Commuting time$_{i,2019}$ + ε$_i$

For this particular set of regressions, the sample was only limited to years 2019 and 2020 and individuals, who did not switch to working from home in 2020 were also excluded from estimation, as their mode of commuting was either unaffected or affected differently by the pandemic. The main variable indicating the work from home in this study is a difference between hours worked and hours worked from home: only the individuals, who worked 0

hours in the office and a positive number of hours at home were labeled as fully working from home. Consequently, the individuals who did not completely switch to working from home (e.g. individual who have only switched on particular days of the week) were also excluded from the sample, because it is impossible to determine a treatment effect only for the home part of their work. All other fully employed Dutch workers have made a complete switch to working from home and had zero commuting time in 2020. This is why term Commuting time$_{i,2019}$ in the regression equation captures the magnitude of the switch from the initial 2019 level of commuting time to zero in 2020. Considering that commuting time is a continuous variable (and not binary, which is more traditional for the DiD setting) the resulting coefficient β_1 will measure not the binary treatment effect but the treatment intensity and its interpretation (disregarding the external validity limitations arising from the sample design) will be comparable to the previous regression estimates.

Further, a similar set of regressions is also conducted with the Work-related stress, Satisfaction with pay and likeliness to look for the other job as outcome variables. The main measure of work-related stress in the sample is a continuous variable capturing the respondent's consent with the question "Because of a heavy work burden, I am continually under time pressure" on the scale from 1 to 4. For convenience of interpretation this variable is normalized, so that the responses are situated in the range from 0 to 1. Now having a stress equal 1 means that the individual fully agrees to the proposition concerning work pressure and 0 means complete disagreement, the values in between can be interpreted as a percentage level of stress. The likeliness to look for the other job is operationalized in this study as binary response of a fully employed individual on the question "Are you currently looking for a (or another) job?". Initially this question had 4 answer options distinguishing "yes, I am seriously seeking work" and "yes, I am considering it" and two more "no" options, but for convenience these pairs of responses were merged. Nevertheless, it is important to notice that considering looking for the other job (and so doubting the permanent status the current job) is also accounted in this study. The resulting binary variable can be interpreted as a probability of looking for the other job. First, a set of OLS regressions is conducted with Stress, Satisfaction with pay and Likeliness to look for the other job as outcome variables is conducted. Further the Individual Fixed Effects are added in these regressions and then the

DiD estimation is performed in the setting of exogenous shock in commuting times resulting from the pandemic.

Results

At first, a simple OLS regression of job satisfaction on commuting time is conducted. The results are reported in the Table 2 as a Model 1. The coefficient of commuting time is equal to - 0.001. This implies that a one minute higher commuting time is associated with 0.001 points lower job satisfaction and, consequently, one hour higher commuting is associated with 0.06 points lower job satisfaction on the scale from 1 to 10. The coefficient is negative, as it was expected, and it is also statistically significant at 1%, but its magnitude is very low and the eventual association of commuting and job satisfaction is not substantial. The R^2 of the model is equal to 0.0002, which implies that only 0.02% of the variation in job satisfaction can be explained by commuting. The possible reason for such a magnitude is that actual harm from commuting is systematically compensated by some other job characteristics. The most likely candidate for this position is wage.

Table 2. The complete regression analysis of commuting - job satisfaction relationship

	Overall Job Satisfaction							$\Delta JbSat_{2019,20}$
	Ordinary Least Squares				Individual Fixed Effects			Diff in Diff
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	7.458*** (0.014)	7.250*** (0.058)	6.900*** (0.176)	7.326*** (0.007)	7.468*** (0.020)	7.505*** (0.198)	7.598*** (0.215)	0.379** (0.195)
Commuting	-0.0010*** (0.0004)	-0.0006 (0.005)	-0.0034*** (0.0007)		-0.0014** (0.0007)	-0.0009 (0.0010)		
ln(Commuting)				-0.0329** (0.015)			-0.0480 (0.0328)	
Commuting$_{2019}$								-0.015** (0.008)
ln(Wage)		0.078*** (0.020)	0.018 (0.040)	0.081*** (0.020)		-0.031 (0.030)	-0.035 (0.030)	
Age			0.014** (0.001)			-0.003 (0.004)	-0.002 (0.003)	
Female			0.135*** (0.037)					
Working hours			0.004*** (0.002)			0.005* (0.003)	0.005* (0.003)	
Observations	27,659	16,185	8,189	16,072	27,659	14,031	13,931	238

*p-value < 0.1, **p-value < 0.05, ***p-value < 0.01. The standard errors are reported in parentheses. Model 3 also includes the categorical variable profession, which has a reference category "higher academic or independent professional". The estimations in the Model 8 are conducted only for the years 2019 – 20 and commuting time under 40 minutes.

The regression of job satisfaction on commuting and wage is summarized in the Table 2 as a Model 2. The coefficient of commuting time in this regression is almost indiscernible from zero and non-statistically significant. Surprisingly, the inclusion of wage in regression did not

intensify the negative effect of commuting, but instead this effect have become twice less pronounced. The coefficient of wage, on the contrary, is positive (which is in line with the common sense) and statistically significant. Its magnitude is 0.078, which means that a 1% increase in hourly wage is associated with 0.0008 points higher job satisfaction which is also negligible. In Model 3 (also presented in Table 2) other control variables, such as age, gender, working hours and profession are added. The resulting coefficient of commuting time is again statistically significant and now it equals -0.003, which is still very little in practice. The inclusion of other individual's personal and workplace characteristics have resulted in the coefficient of wage rate that is not statistically significant. This loss of statistical significance is not connected with the inclusion of working hours (that are used in the calculation of the hourly wage rate) or inclusion of any other control variables – the resulting coefficients of commuting time and wage (and their significance) do not change much from the inclusion or exclusion of any single control variable in this model. It seems that the positive effect of wage on the job satisfaction was actually caused by other workplace characteristics that are correlated with wage, whereas wage by itself is not a very powerful predictor of the job satisfaction. Nevertheless, commuting time does not have a very close association with the job satisfaction as well, and so the issue of wage compensation of commuting time does not even arise in this context (and, moreover, the statistical significance issues do not allow us to effectively compare the coefficients of commuting time and wage and make any numeric inferences about wage compensation of however small harm in satisfaction associated with commuting time). As for the other control variables, it is also revealed that differences in the nature of the profession are strongly associated with the job satisfaction: compared to higher academic and independent professionals (this profession is used as a reference category in the estimation), semi-skilled and unskilled manual workers tend to have 0.6 lower job satisfaction on the scale from 1 to 10, which is a very substantial difference. Number of working hours, age, gender and size of the workplace do have a statistically significant positive effect on commuting time, but the magnitude of these coefficients is very low.

Next, we estimate the Individual Fixed Effects regression equation. All the time-invariant individual variation is then cancelled down in the process of estimation, and this allows us to remove the part of the OVB. It might, for example, be that people who are more tolerant to commuting (and in some way may even enjoy it) self-select to the occupations, where they can commute longer and so the actual negative effect of commuting on the job satisfaction is undervalued by OLS (which does not take these subjective preferences into account). Apart from that the mode of transport that worker uses and its comfortability are likely to influence both the commuting time and the job satisfaction – longer commuters may, for example, be more likely to travel to work by train, which is, arguably, less irritating than travelling by bus or by car. All these unobserved time-invariant characteristics are alleviated in the Fixed Effects regression analysis, because all the Fixed Effects regression coefficients are identified only by variation within individuals over time. The basic FE regression equation is labelled as Model 5 in the Table 2. The resulting coefficient of commuting time is statistically significant at a 5% level and also equals to -0.001 as in the OLS. The magnitude of the coefficient has actually increased by 0.0004 points of job satisfaction (so that the introduction of fixed effects has made the coefficient 40% more negative compared to OLS), but this variation is negligible in

practice. This inference only confirms that the harm of commuting for the job satisfaction is much less significant than it was predicted by other similar studies for the Netherlands (such as van Ommeren (1997)). These studies are substantially older and so it is very well possible that over time commuting have become so comfortable that workers have become much less concerned with it. The indirect evidence in favor of this idea (or against it) will also be found in the further study of the effect of commuting on stress.

Even though the time invariant heterogeneity in the effect of commuting on job satisfaction was removed in the estimation process, such time-variant factors as wage and working hours and age can still distort the commuting-job satisfaction relationship. These variables are then added in the regression equation in Model 5 in the Table 2. The resulting coefficients of commuting time and wage are both not statistically significant and not much can be inferred from this model.

Before we proceed with further analysis let us check whether the relationship between commuting and the job satisfaction is linear. For this purpose, the commuting – job satisfaction regression was estimated for each 10-minute interval in commuting time. The regression output is summarized in the Figure 2 and in the Table 3 in Appendix. The coefficients of 20-30 and 30-40 minutes commuting intervals are not statistically significant (their confidence intervals are grey and dashed in the figure), but even without them it is clear that the relationship between commuting and job satisfaction is not linear. Van Ommeren (1998) suggests that workers become more sensitive to commuting time as it increases and reveals a quadratic relationship between commuting and likeliness to look for the other job (which is likely to be closely related with the job satisfaction). Nevertheless, the trend in the magnitudes of the coefficients is clearly not quadratic: as commuting time rises up to 30-40 minutes, commuting becomes less irritating for workers, but when commuting time is above 40 minutes, the coefficient of commuting time becomes more and more negative, commuting brings proportionally more dissatisfaction to workers and then again above 60 minutes this trend is reverted and workers become slightly more tolerant to commuting time. The trend in commuting time resembles a sinusoid or, otherwise, if the statistically insignificant coefficients are ignored, it shares a greater resemblance with a natural logarithm (that is inverted from the x axis). The comparison of regressions including log and sin transformations of commuting time was also conducted: the results of regression analysis did not change substantially from adding log or sin functions; regressions with the log transformation have a higher R^2 and it was, therefore, decided to use re-estimate the most important regressions with logarithms.

Figure 2. The responsiveness of job satisfaction to 10-minute changes in commuting
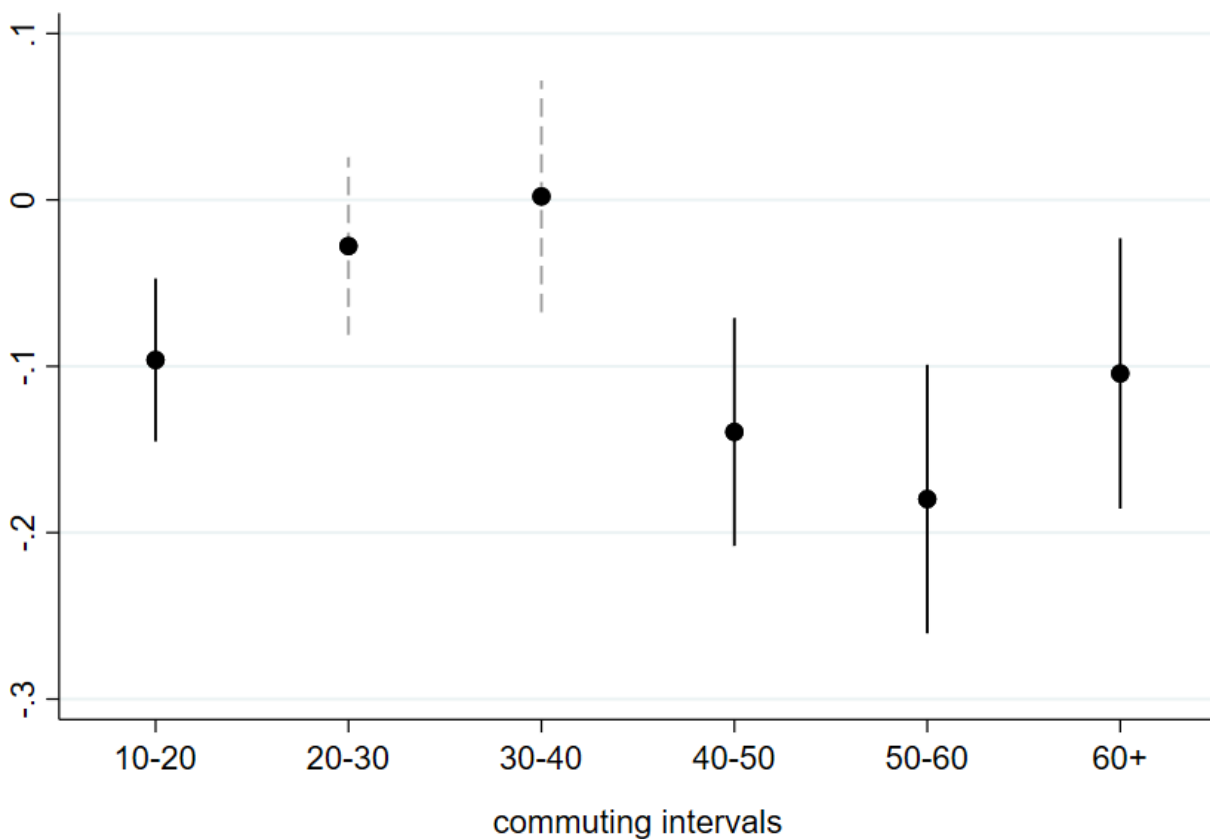
The estimates are obtained from the Table 2 in Appendix. The confidence intervals of non-statistically significant coefficients are dashed highlighted in grey. The Job Satisfaction is measured on the scale from 1 to 10.

The results of regression of job satisfaction on the logarithm of commuting time are reported in Table 2 as a Model 4. The coefficient of commuting time is equal to -0.045, which implies that a 1% increase in commuting time is associated with a 0.00045 points lower job satisfaction. Analogously, a 50% rise in commuting time (this is about 14 minutes rise for an average person in the sample) is associated with 0.018 (=0.045*ln(1.5)) points lower job satisfaction, which is still very little. Further, the logarithm of wage is added into regression. Results are labelled as Model 8. Unlike the analogous OLS with untransformed variables, this model produces the coefficients of commuting and wage that are both statistically significant. Adding wage have resulted in a substantial depreciation of the coefficient of commuting time, which now equals -0.033. Lower magnitude of the coefficient suggests that part of the negative effect of commuting on job satisfaction is taken away when the difference in wages between commuters is taken into account. The coefficient of log hourly wage equals 0.081, which implies that the loss in satisfaction associated with a 1% rise in commuting time can on average be compensated by a 0.4% (0.033/0.081) rise in wage. For an average person (who has a commuting time of 21.7 minutes and a hourly wage of 17.0 euro) a 10 minute (or 46%) rise of commuting time would then be compensated by a 3.1 euro (= 17*0.46*0.4) rise in the hourly wage, which is quite substantial. Nevertheless, the harm to job satisfaction that is associated with commuting is so low that the need in such compensation will probably never arise.

However, all the inferences presented above do not allow us to make a causal link between commuting and job satisfaction. Even the Fixed Effects regression cannot effectively control for the unobserved individual variation which is likely to be a big problem in the context of commuting time-satisfaction relationship. The characteristics of the route to work, transport advancements, changes in occupation (which is likely to accompany the change in the job location) are likely to influence both the commuting time and the job satisfaction and bias the estimates. A more powerful methodology is required to establish a causal relationship.

Natural experiment with working from home

The coronavirus pandemic of 2020 has forced many people to switch to working from home. The commuting time of these people have suddenly dropped to zero, and this should have also been reflected in the job satisfaction. This allows us to make a Difference in Difference estimation of the effect of commuting time on the job satisfaction. Both short and long commuters have experienced a common shock in commuting times in 2020 and the 2020 change in job satisfaction of workers who have little commuting is assumed to apply to longer commuters as well. All the difference that resides between groups after the 2020 change is added is then associated with a causal effect of commuting time on the job satisfaction. The sum of 2019 value of job satisfaction of longer commuters and the 2020 change in job satisfaction of shorter commuters is used as a counterfactual for the satisfaction of longer commuters as if they were not treated (i.e. their commuting time did not drop in 2020). The difference between the actual value of satisfaction of long commuters in 2020 and a counterfactual value of satisfaction as if their commuting time did not change is then the effect of the actual change in commuting time. It should also be noted that the shorter/longer commuters dichotomy was introduced for simplicity, commuting time is a continuous variable and so instead of the binary treatment/control division there will be as many groups as there are different values of commuting time and the coefficient of commuting time in this model will measure the treatment intensity (i.e. the intensity of change of job satisfaction as commuting time changes). For simplicity of the graphical representation the commuting time was divided in 4 groups by 20 minutes (0-20min, 20-40, 60-40 and 60+). The sample was limited only to the individuals who switched to working from home in 2020 and among these individuals there were no observations of commuting time over 60. This is why the plot of trends in the job satisfaction before and after corona break-out presented in Figure 3 has only three lines. The 40-60 minutes commuting group has a different attitude to the job satisfaction than the two other cohorts: switch to working from home has contributed to a decrease in the job satisfaction for them, whereas two other groups find the absence of commuting more satisfactory. It can be very well possible that people who enjoy commuting self-select to a longer commuting cohort and the switch to working from home have actually deprived them of this pleasant activity. The Difference in Difference estimation design allows to alleviate this possible initial selection bias and many other omitted biasing factors.

Figure 3. The yearly change in the job satisfaction from 2018 to 2020
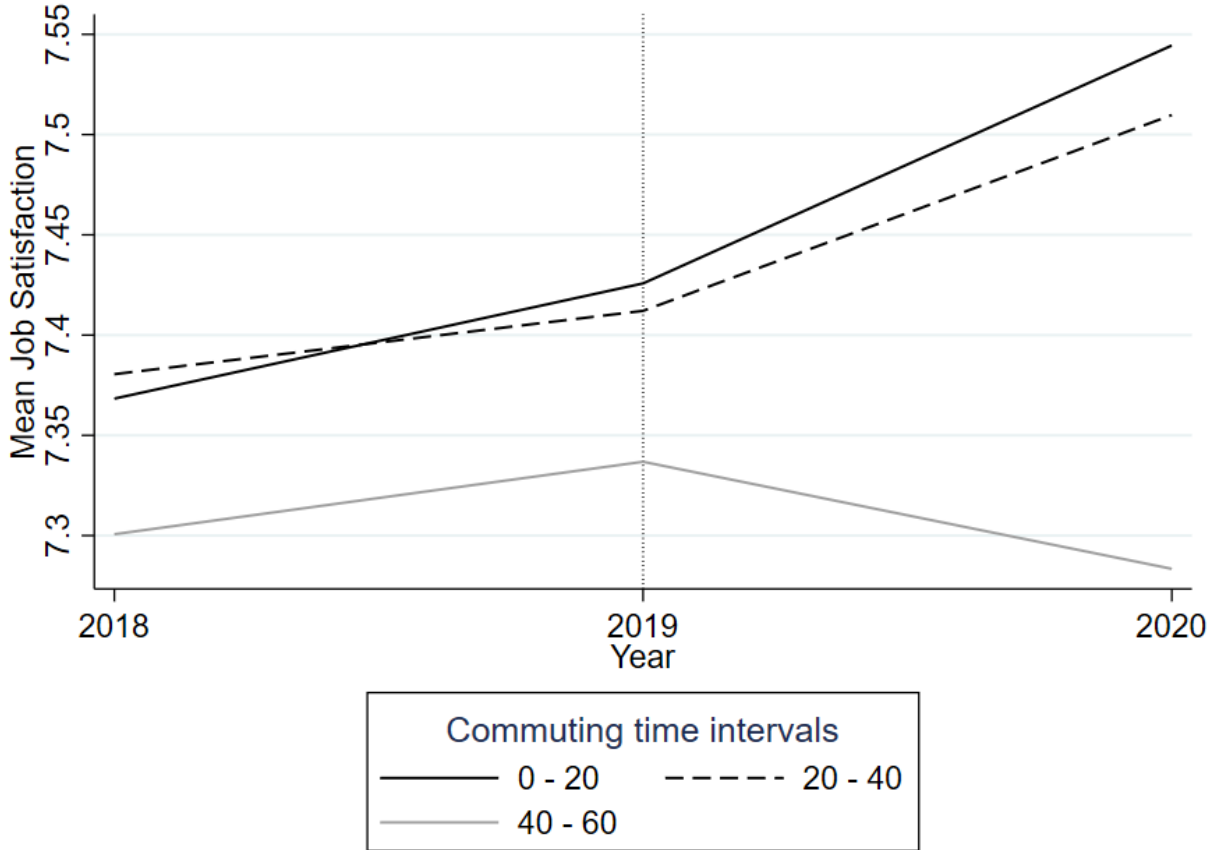
Before the actual DiD estimation is performed it is also important to make sure that the attitude of shorter commuting cohorts to the job satisfaction is a good counterfactual for such attitudes of the longer commuters. In other words, it is also important to assume that without the coronavirus intervention the trends in job satisfaction of all three groups would have evolved in the same way – the easiest way to verify this assumption is to look whether the past trends in job satisfaction were parallel. A more extensive time-plot of job satisfaction by commuting time cohorts is presented in Figure 4. Trends of 0-20- and 20-40-minutes cohorts do indeed run almost parallel to each other; lines intersect in 2019, but they stick very close to each other and a difference in slopes is clearly very low. Furthermore, a greater diversion of trends in the earlier years can be explained by the lower numbers of observations: the sample was only limited to the individuals, who were working from home in 2020 and so the number of people who have continuously participated in the survey until 2020 becomes lower and lower the earlier is the starting period of the interval taken. As for the longest commuting cohort, the job satisfaction changes over time in the more or less same direction as for two other cohorts (except the year 2018, when the trends were exactly opposite) but the slopes of the lines are too different to say that the trends are parallel. This deviation can probably be explained by the non-linearity of the commuting - job satisfaction relationship that have been revealed earlier – commuters above 40 minutes seem to have a systematically different perception of commuting time and so they cannot be effectively compared with other groups in the DiD estimation. Consequently, this group will not be included in the DiD estimation. As for other two groups, the parallel trends assumption seems to be satisfied and the estimation

will be performed. Mean job satisfaction have increased for both 0-20 and 20-40 minutes commuting groups, but the overall increase in satisfaction was higher for the workers from the lower commuting time cohort. Paradoxically, workers who travel less, seem to have a more positive attitude to alleviation of commuting in 2020 than those who had to commute more.

Figure 4. The yearly trend in the mean job satisfaction estimated separately by 20 minute intervals of commuting.
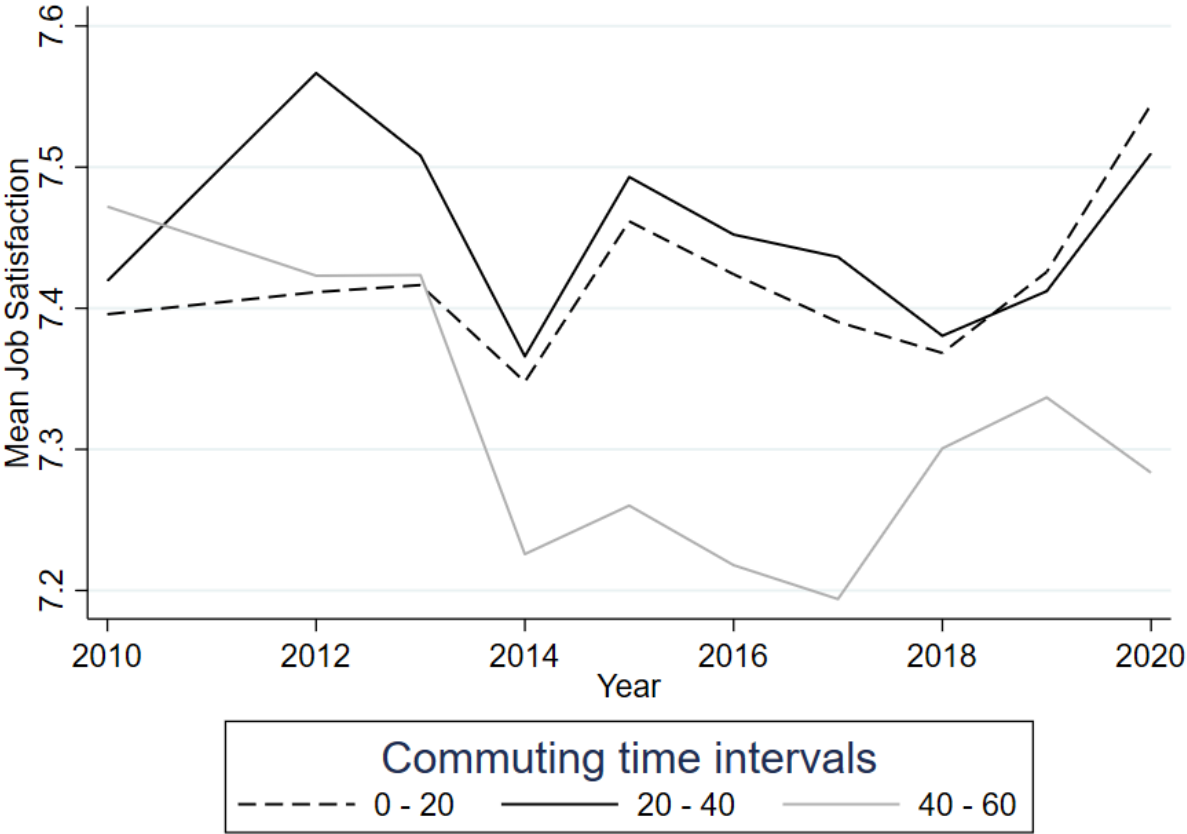
The results of the DiD estimation of the effect of commuting time on the job satisfaction are reported in Table 2 as a Model 8. The coefficient of commuting time is statistically significant at 6% level and equal to - 0.015, which implies that workers, who had to travel 1 minute longer before the pandemic have experienced on average 0.015 points lower rise in the job satisfaction from the switch to working from home. Consequently, a 40 minutes higher commuting time in 2019 is associated with a 0.6 points lower rise in the job satisfaction in 2020 on the scale from 1 to 10. These results suggest a moderate positive causal effect of commuting time on job satisfaction. This effect is the opposite of what was initially expected. It seems that commuting by itself is actually a pleasant activity: workers who commute longer may organize their day around the route to work and combine commuting with shopping, driving children to school and other daily activities that may induce individual to travel. Apart from that, the positive satisfaction from commuting may also be connected with the high

comfortability of the Dutch transport system.[1] Nevertheless, the magnitude of the revealed relationship is moderate – the effect is clearly more pronounced than it was predicted by OLS and FE models, but it is still too low to make a noticeable change in the job satisfaction (even a maximum possible change of 0.5 points of job satisfaction on the scale from 1 to 10 is unlikely to have any significant practical implications). The R^2 of the model is equal to 0.008, and this also confirms that commuting time is not a very powerful predictor of the job satisfaction. Its importance seems to be overvalued in the past economic literature.

Further, a similar set of regressions is conducted for other outcome variables that both by themselves and in the interaction with the job satisfaction can help to explicate the workers' attitude to commuting time.

Commuting and work-related stress

It is possible that job satisfaction simply does not capture the actual harm of commuting that is so widely discussed in the economic literature. The most obvious alternative indicator of harm of commuting, the relevance of which is also emphasized by a strong evidence in psychology is the work-related stress. It has just been revealed that some workers tend to be very tolerant to commuting and may even enjoy it, but commuting at the same time is frequently cited as a major cause of stress and stress-related productivity issues.

First, the stress-generating potential of commuting is evaluated with use of the simple OLS regression model. The results of all the estimated regressions with stress are reported in Table 4. The coefficient of commuting time is statistically significant and equals 0.001, which implies that 1-minute increase in commuting time is associated with 0.1% higher probability of experiencing stress. Analogously, 1 hour increase in commuting time is associated with 6% higher probability of experiencing stress, which is very small. Adding age, gender, wage and profession into regression results in an even lower and not statistically significant coefficient of wage. With the introduction of Fixed Effects, the revealed coefficient of commuting becomes statistically significant once again, but does not change much in magnitude and stays equal to 0.001. It seems that in the context of this study, commuting is indeed associated with higher stress (as studies in psychology have suggested), but the magnitude of this difference is too little to take this seriously in practice. The revealed association only reinforces the previous finding that the negative effects of commuting time for workers are largely overvalued. Nevertheless, this is not yet a causal inference. The graph of trends in the mean satisfaction with wage by commuting time cohorts (presented in Figure 3) suggests that even for the lowest commuting time groups the trend in stress level is not really parallel – lines frequently go in opposite directions and their slopes in general are quite different. The parallel trends assumption is likely to be violated in this case, but even if it is disregarded, the DiD estimation (both for all commuting time groups and only for the lowest two of them) results in the coefficient of commuting time that is not statistically significant.

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[1] For example, the Netherlands claimed a 3rd place in the world ranking of the best transport communications made by the Travel and Leisure magazine. This is the highest result for Europe (Mcclure, 2017).

Table 4. The complete regression analysis of commuting - stress relationship

	Work-related Stress				$\Delta Stress_{2019,20}$
	Ordinary Least Squares Regression		Individual Fixed Effects		Diff in Diff
	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.326*** (0.005)	- 0.185*** (0.059)	0.324*** (0.007)	0.089** (0.046)	-0.095 (0.088)
Commuting	- 0.001*** (0.000)	- 0.000 (0.000)	0.001*** (0.000)	0.001* (0.000)	
Commuting$_{2019}$					0.002 (0.004)
ln(Wage)		0.016 (0.013)		- 0.017* (0.010)	
Age		0.001** (0.000)			
Female		0.129*** (0.013)			
Working hours		0.012*** (0.001)		0.009*** (0.001)	
Observations	26,801	8,218	26,801	15,394	228

*p-value < 0.1, **p-value < 0.05, ***p-value < 0.01. The standard errors are reported in parentheses. Model 2 also includes the categorical variable profession, which has a reference category "higher academic or independent professional". The estimations in the Model 5 are conducted only for the years 2019 – 20 and commuting time under 40 minutes.

Figure 5. The yearly trend in the mean work-related stress estimated separately by 20 minute intervals of commuting.
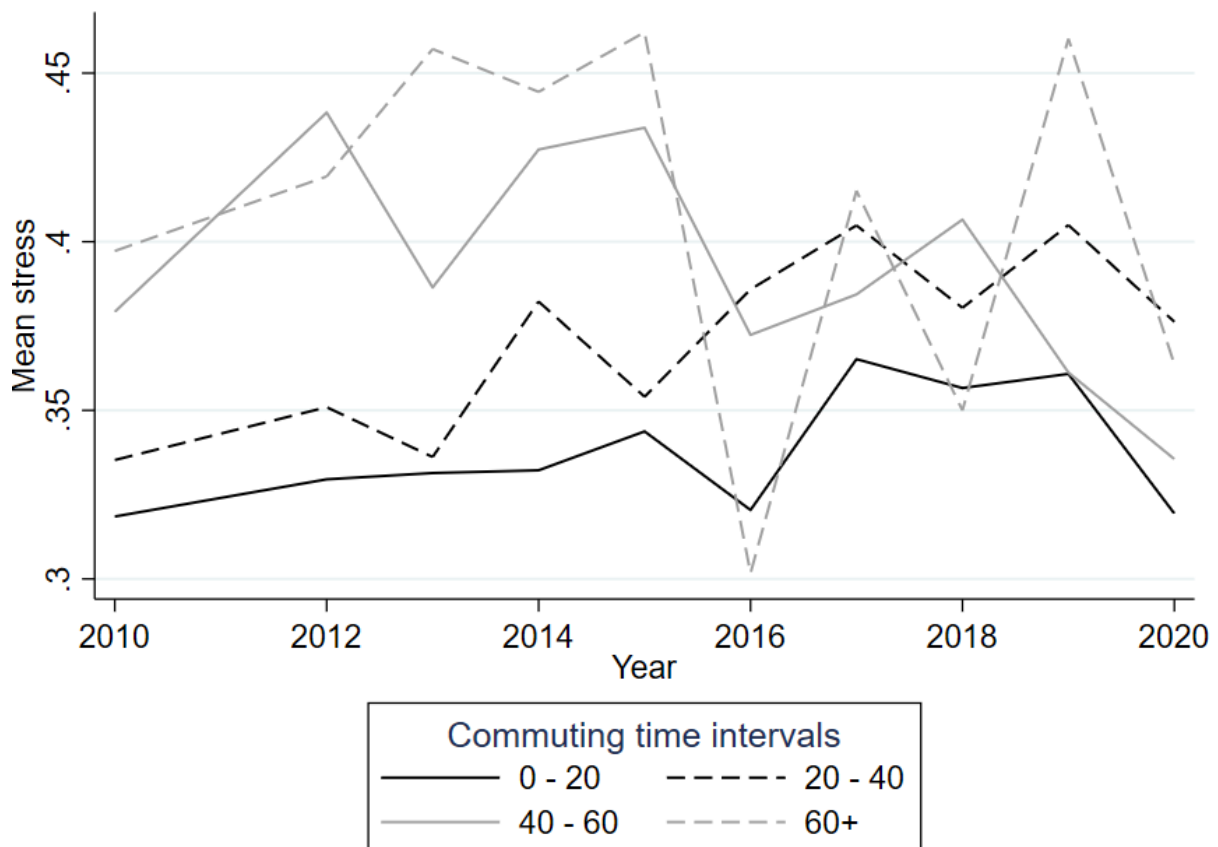
Commuting and satisfaction with pay

More distant job opportunities are in general more attractive in terms of wage, and if commuting costs (in terms of money, time, stress, etc.) are indeed fully compensated then the satisfaction with wage should not vary substantially with commuting. Nevertheless, the economic literature suggests that in practice the discomfort from commuting is almost never fully compensated by wage and so the negative association between commuting time and the satisfaction with wage was initially anticipated. But considering the prior findings of this study it seems there is actually no need for employer to compensate the commuting by wage and it is very unlikely that any significant negative association between commuting and the satisfaction with wage will be found.

First, a simple OLS regression of satisfaction with wage on commuting time is conducted; the results are reported in Table 5. The coefficient of commuting is statistically significant and equals to 0.003, which implies that 1 extra minute of commuting is associated with a 0.003 points higher job satisfaction on the scale from 1 to 10, which is very low. When wage is added into regression, the coefficient becomes slightly lower, so that the higher satisfaction with wage of longer commuters may be partially explained by their wage levels, but a slight difference between shorter and longer commuters in the satisfaction they get from wage pertains even when the size of wage is controlled for. The introduction of other control variables as well as the introduction of Fixed Effects results in statistically insignificant but still positive coefficient of commuting time. The positive sign of the commuting coefficient is rather surprising: it suggests that longer commuters are more satisfied with their wage than shorter commuters. The possible explanation for this association is that people may overestimate the discomfort from commuting when they make wage-commuting choices and so people who have sacrificed higher wage for the possibility to commute less are actual worse off than those who opted for longer commuting. Nevertheless, the magnitude of the coefficient is very low and almost indiscernible from zero, so that the positivity of the coefficient can be ignored and it can be concluded that commuting time is most likely to be unrelated to the satisfaction with wage.

The trend in the satisfaction with wage by commuting groups is presented in Figure 4. The trends of 0-20 and 20-40 minutes commuting groups are traditionally almost parallel – the only suspicious period is years 2014 and 2015, when lines crossed twice, but the overall direction of change have stayed the same throughout the period, and the magnitude of these suspicious changes was within 0.01 points of satisfaction with wage, which is very low. The 40-60 group on the contrary has a substantially different slope in terms of both the direction and magnitude and is, therefore, excluded from estimation. The magnitude of the resulting coefficient of commuting time in the output of the DiD estimation (presented in Table 5) does not differ substantially from results estimated earlier. Nevertheless, the coefficient is not statistically significant, and, consequently, anyhow exact causal inference concerning the effect of commuting time on the satisfaction with wage cannot be made in this context.

Table 5. The complete regression analysis of commuting – satisfaction with pay relationship

	Satisfaction with Pay					$\Delta\text{SatPay}_{2019,20}$
	Ordinary Least Squares			Individual Fixed Effects		Diff in Diff
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	6.713***	5.967***	6.198***	6.815***	4.699***	0.025
	(0.017)	(0.071)	(0.206)	(0.023)	(0.221)	(0.188)
Commuting	0.003***	0.003***	- 0.001	- 0.000	- 0.001	
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	
Commuting_{2019}						0.005
						(0.007)
ln(Wage)		0.288***	0.217***		0.043	
		(0.025)	(0.046)		(0.033)	
Age			0.013**		0.048***	
			(0.002)		(0.004)	
Female			- 0.092**			
			(0.044)			
Working hours			0.000		0.003	
			(0.002)		(0.003)	
Observations	27,385	16,066	8,123	27,385	13,926	235

*p-value < 0.1, **p-value < 0.05, ***p-value < 0.01. The standard errors are reported in parentheses. Model 3 also includes the categorical variable profession, which has a reference category "higher academic or independent professional". The estimations in the Model 6 are conducted only for the years 2019 – 20 and commuting time under 40 minutes.

Figure 6. The yearly trend in the mean satisfaction with pay estimated separately by 20 minute intervals of commuting.
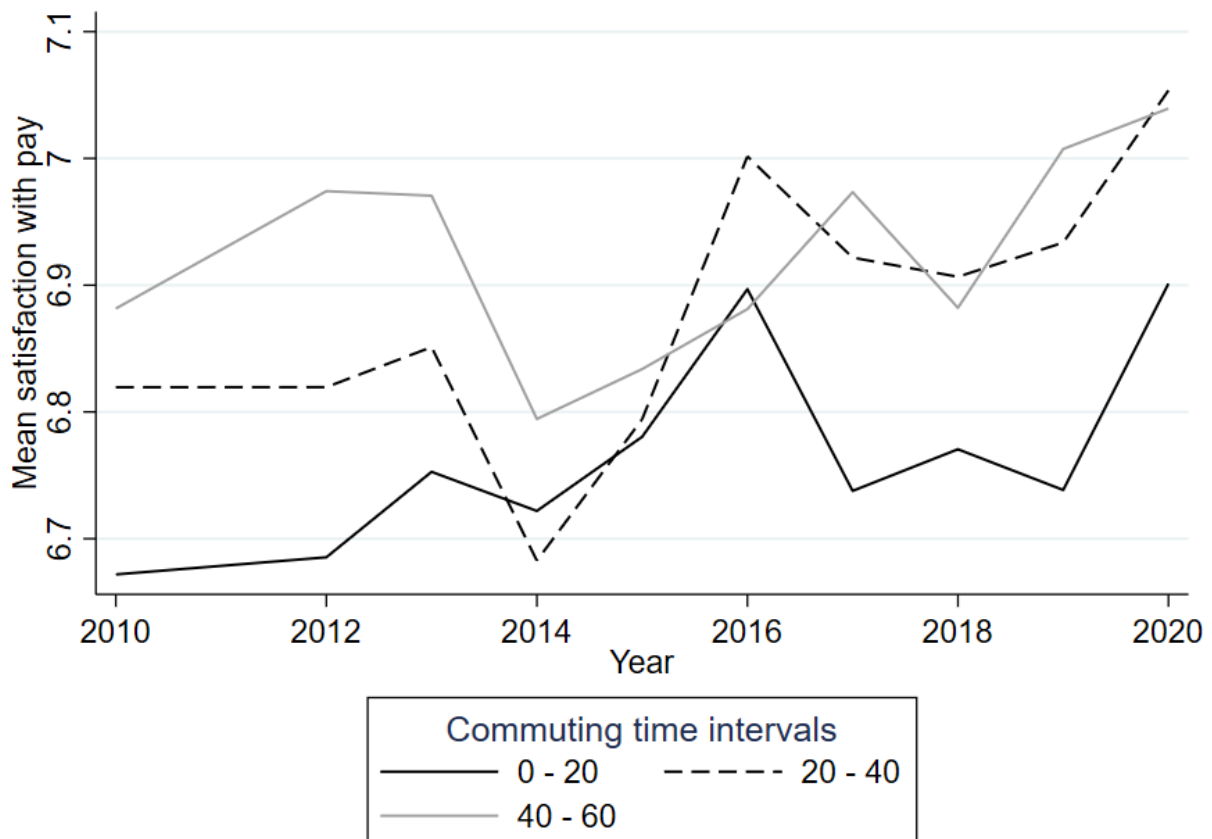
Commuting and likeliness to search for the other job

Finally, the job satisfaction is also very closely connected with the likeliness to look for the other job. It was initially hypothesized that commuting time is negatively associated with the job satisfaction and it was also reasonable to hypothesize that less satisfied longer commuting workers are also more likely to look for the other job. Nevertheless, the findings discussed above present a completely different picture of commuting – job satisfaction relationship. Longer commuting workers are more satisfied with their job and their wage and have only slightly higher chance of experiencing stress compared to shorter commuters. Considering that workers of less distant jobs are slightly less satisfied with their job and wage, they should also be more likely to look for the other job that would bring them more satisfaction, but the size of this difference in job search behavior of shorter and longer commuters should probably also be very low.

The output of a simple OLS regression of job search on commuting time for full-time employed Dutch workers is presented in Table 6. The resulting coefficient of commuting time is statistically significant and equals to 0.0002, which implies that 1 minute longer commuting is associated with a 0.002% higher chance of looking for the other job. This effect is almost indistinguishable from zero it would probably be reasonable to say that commuting is unrelated to the job search behavior.

**Table 6.** The complete regression analysis of commuting – satisfaction with pay relationship

	Likeliness to search for the other job				$\Delta \text{JobSearch}_{2019,20}$
	Ordinary Least Squares		Individual Fixed Effects		Diff in Diff
	Model 1	Model 2	Model 3	Model 4	Model 5
Intercept	0.051*** (0.002)	0.093*** (0.027)	0.054*** (0.004)	0.248** (0.038)	-0.072 (0.051)
Commuting	0.0002*** (0.0001)	0.0005*** (0.0001)	0.000 (0.000)	0.0004* (0.0002)	
Commuting$_{2019}$					0.003 (0.002)
ln(Wage)		0.006 (0.006)		0.013** (0.006)	
Age		- 0.001*** (0.000)		- 0.004*** (0.001)	
Female		0.004 (0.006)			
Working hours		- 0.001*** (0.000)		- 0.001* (0.001)	
Observations	27,910	8,223	27,910	14,087	239

*p-value < 0.1, **p-value < 0.05, ***p-value < 0.01. The standard errors are reported in parentheses. Model 2 also includes the categorical variable profession, which has a reference category "higher academic or independent professional". The estimations in the Model 5 are conducted only for the years 2019 – 20 and commuting time under 40 minutes.

Van Ommeren (1997) suggests that the relation between commuting time and job search behavior has a quadratic shape. The possibility of non-linearity of this relationship is, therefore, tested by the regression of job search on a set of dummies standing for 10-minute

intervals in commuting time. The plot of coefficients is presented in Figure 5. Unfortunately, the coefficients of 3 dummies are not statistically significant, but even with these dummies the overall trend is not exactly clear. The coefficient of 50-60 group is much higher than for the group with 30-40 minutes commuting and this allows us to suppose that the shape is quadratic, but the coefficient of 60+ minutes group is substantially lower and this puts the quadratic shape under question. In any way, the coefficient of quadratic term was not statistically significant in all of the models conducted and so it was decided only to report the results of regressions without it.

Figure 6. The responsiveness of propensity to look for the other job to 10-minute changes in commuting
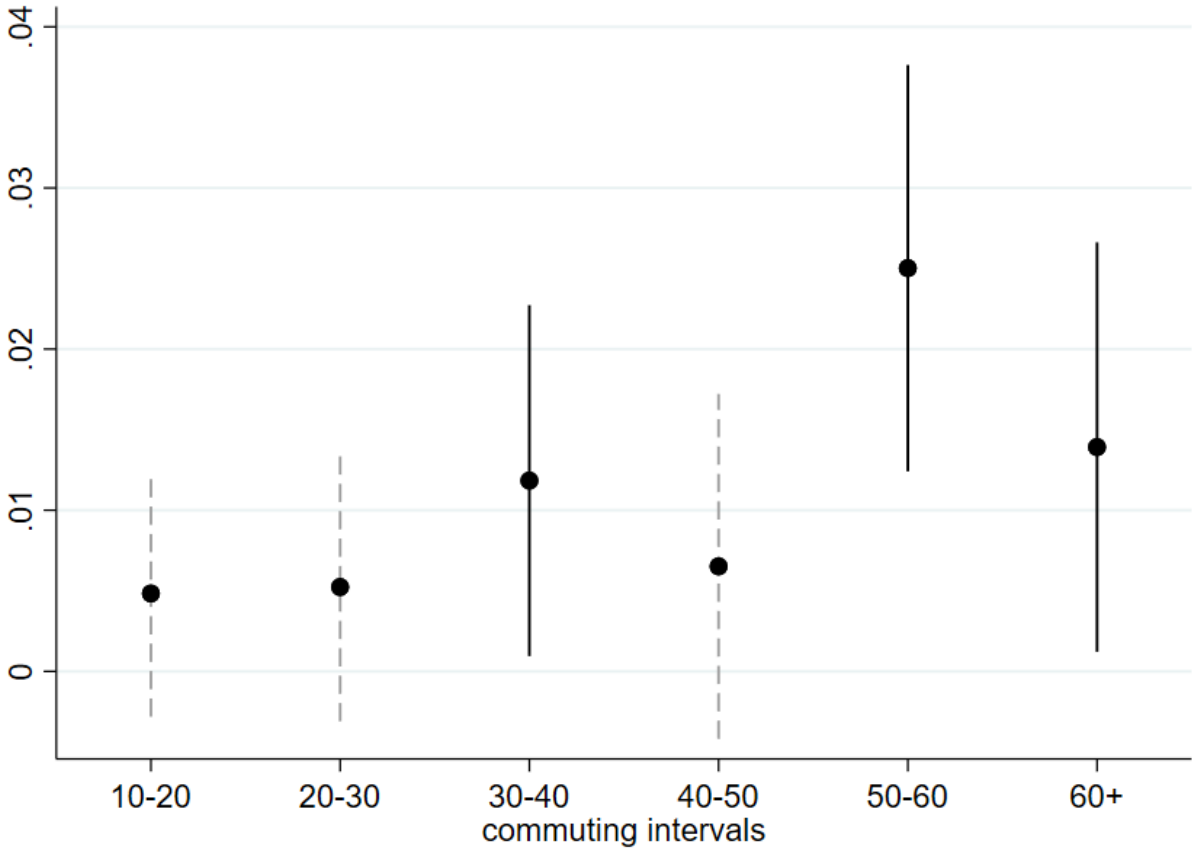
The confidence intervals of non-statistically significant coefficients are dashed highlighted in grey. The propensity to look for the other job is measured on the scale from 0 to 1.

The introduction of age, gender, wage, working hours and profession into the regression has produced a slightly higher coefficient of the commuting time, which is still almost indistinguishable from zero. Furthermore, the simple regression model with Fixed Effects produces the coefficient of commuting time that is not statistically significant, but the inclusion of time-variant controls, such as age, wage and working hours, have resulted in a coefficient that is statistically significant at 7% and equal to 0.0004. Consequently, a minute rise of commuting time is associated with 0.04% higher likeliness of searching for other job and a 45 minutes rise of commuting, respectively, is associated with a 1,8% higher likeliness. The coefficient of commuting time in the DiD estimation is again not statistically significant. All in all, there seems to be almost no association between commuting time and job search

behavior and a moderate satisfaction-generating potential of commuting did not seem to have reflected in the likeliness to look for the other job. Using the Fixed Effects regression of a similar type van Ommeren (1997) have estimated the likeliness of longer commuting (i.e. having commuting time of more than 45 minutes) Dutch workers to look for the other job be 4,8% higher than that of commuters, who have a negligible commuting time. The corresponding probabilities revealed in this enquiry are more than by half lower and so it seems that Dutch longer commuting workers have become more loyal to their relatively distant jobs compared to the 1990s.

Discussion

The findings of this study are in many ways unexpected and go against the existing research on the workers' perception of the commuting time. First of all, a slight positive effect of commuting time on the job satisfaction has been revealed. Initially, the OLS and Fixed Effects regression models have predicted that commuting is negatively associated with the job satisfaction and 1 minute of commuting time is associated with around 0.001 lower level of satisfaction on the scale from 1 to 10. But a more robust DiD estimation, which is based on the natural experiment with the working from home, have revealed that the rise in job satisfaction from the switch to working from home is 0.12 points lower for each minute of commuting forgone. In other words, people who commute less tend to benefit more from the alleviation of commuting than people who commute longer, and as commuting time rises, it becomes a more pleasant activity for the worker. This positive effect of commuting on the job satisfaction is rather unexpected and makes us reject the first hypothesis of this research stating that "commuting time is negatively associated with job satisfaction". Nevertheless, the magnitude of this effect is very low, and it can hardly be said that workers do really enjoy commuting, instead it would be more appropriate to say that commuting is perceived as a neutral activity that is not as harmful as it was frequently described in the economic literature. This is exactly why this very weak causal association is economically significant - it undermines the stereotype that workers dislike commuting.

Let us now evaluated the internal validity of these estimates. First of all, the reverse causality can present a problem for this research. It is possible that certain individuals spend more time on commuting as consequence of their low job satisfaction. Unsatisfied workers are likely to be less concerned with getting to work on time and may even intentionally choose longer routes, so as to come to work later, and this explanation is also indirectly supported by Van Ommeren & Gutiérrez (2011), who claim that longer commuting workers have much higher chances of absenteeism and tend to leave workplace earlier. The reverse causality can, therefore, explain the negative effect of commuting on job satisfaction that has been in the linear regression analysis and in the Fixed Effects estimation. However, the reverse causality should not present a problem for the DiD estimation. In this context the effect of commuting time in 2019 on the change in job satisfaction from the switch to working from home in 2020 was estimated. This explicit time dimension of estimation as well as the unpredictability of corona pandemic and the working from home in 2020 should relief the suspicion in the reverse causality. Nevertheless, the DiD estimation can also be subject to a bias associated with self-selection to working from home. In the time when the LISS questionnaire was conducted (in

April - May 2020) strict lockdown measures were already eased in the Netherlands and the working from home assignment was more flexible. In this context, individuals, who dislike commuting were more likely to convince their manager to keep on working from home and this may bias downwards the results of the estimation. This is why it is possible that the actual effect of commuting on the job satisfaction is even more positive and the alleviation of this bias would only reinforce the revealed relationships.

Apart from that, the evident non-linearity of commuting time – job satisfaction relationship has been revealed. It seems that under 40 minutes commuting becomes less and less unsatisfactory as it rises, whereas as commuting continues to rise over 40 minutes workers start to perceive it more and more negatively. This is also a likely reason why the parallel trends assumption for the Difference in Difference estimation holds only for commuting cohorts under 40 minutes and above 40 minutes trends in the job satisfaction start to deviate from each other substantially. Workers, who commute over 40 minutes, were excluded from estimation and this poses a significant limitation on the external validity of this research – the inference concerning the slightly positive effect of commuting, therefore, only holds for relatively short or moderate commuting time cohorts. Whereas commuting that is longer than 40 minutes is likely to show a different association with the job satisfaction. The number of long-time commuters who have switched to working from home in 2020 is very small in the data that is used in this research and so it is hardly possible to make any inferences about them. This difference in satisfaction preferences between short and long-time commuters, its sources and implications, can, therefore, be a topic for further research that would complement this enquiry.

Furthermore, the effect of commuting on the work-related stress was also evaluated. It was found that 1 minute of commuting is associated with 0.001% higher probability of experiencing stress on the job. Formally speaking, the association is positive and the second hypothesis of this research stating that "Commuting time is positively associated with work-related stress" cannot be rejected. Nevertheless, the coefficient of stress is indistinguishable from zero and in practice it would be more appropriate to say that there is no association between stress and commuting. This contradicts the inferences of the previous research, which univocally suggests that commuting is a very stressful activity. Nevertheless, none of these papers were conducted for the Dutch workers. Lancée et. al (2017) have made a study of mood of Dutch workers during commuting, and they have also revealed that commuting time per se is not necessarily perceived negatively, but it is only in combination of specific commuting time and commuting mode the depressed mood is exhibited. Commuting by bike or by foot, for example, is actually associated with an uplift mood, whereas commuting by public transport is generally less positive. 30% of all daily commuting in the Netherlands is performed by bicycle, and this is a very specific characteristic of Dutch commuting that is much less prominent in other countries (Statistics Netherlands, 2016). This specificity of the mode of transport and the high quality the transport system in general can explain why commuting in the Netherlands is perceived much more positively as in other countries. This also explains why irrespective of having one of the best infrastructures in Europe Dutch people also have the highest average time of daily commute to work (NL Times, 2019). It is very well possible

that Dutch people prefer a pleasurable and healthy commute by bicycle to a faster but less enjoyable commuting by car or by public transport. Furthermore, the DiD estimation in this research was performed only for commuting that is shorter than 40 minutes and so commuting by bicycle or by foot is more likely within this interval, whereas commuters above 40 minutes are likely to switch to less enjoyable types of transport (and this is not only a switch from bicycle to a car, but also a switch from one bus to two buses or from car to train, for example). This is why the non-linearity in commuting patterns and a rising dissatisfaction with travelling time that is above 40 minutes can also be connected with the mode of transportation employed. Unfortunately, the LISS questionnaire does not include any data on the type of transportation that is used in commuting, but the further research would clearly benefit from a separate estimation of the effect of commuting time on the job satisfaction and work-related stress by different modes of transport. Furthermore, considering that modes commuting vary substantially temporally and geographically, a cross-country comparison of enjoyability of commuting in different infrastructural contexts can also shed light on the workplace implications of commuting.

The validity issues discussed above point on the low reliability of simple regression tools in commuting studies. Commuting time cannot vary by itself, there is always something behind this variation – it is either the change of the job (or housing) location, change of the type of transport, route of commuting, and many other factors that change together with the commuting time and most of these factors are also likely to have implications for the job satisfaction, stress, satisfaction with wage and job search behavior. This is why even the Fixed Effects estimation, which cancels down all the unobserved time-invariant OVB, cannot provide a reliable estimate, unless all these time-variant factors are control for. However, in the Difference in Difference estimation the change in commuting time was isolated from other factors: the switch to working from have changed the initial commuting time to zero and the magnitude of this change was different for short and long-time commuters, whereas all other aspects of working from home are unrelated to the level of commuting time before the switch. This is why the effect of commuting on the job satisfaction that was estimated is truly causal. Unfortunately, the coefficients of commuting time in the Difference in Difference estimations of other outcome variables used in this research were not statistically significant and so the causal inference concerning the effect of commuting on work-related stress, satisfaction with job and likeliness to look for the other job is not possible. Nevertheless, the associations reveled in the OLS and Fixed Effects regression analysis can still be useful as they complement the initial analysis of commuting and job satisfaction and allow to sketch a broader picture of the workers' view of commuting time.

Apart from the negligible positive relationship between commuting and stress, it has also been revealed that longer commuting is associated with a slightly higher probability to look for the other job. One extra minute of commuting is associated with 0.04% higher likeliness of searching for other job and one extra hour of commuting is associated with a 2,4% higher likeliness, respectively. Even though, longer commuting time increases the job satisfaction, long commuters are still slightly more likely to look for the other job. Therefore, the fifth hypothesis of this research stating that "Commuting time is positively associated with the

probability of looking for the other job" cannot be rejected. However, the size of this positive association is too small to consider it seriously in practice. It would be a waste of time for a manager investigating the high employee turnover to look at commuting time of the workers, when such a miserable association of commuting and job search is exhibited.

Furthermore, it was also initially expected that the negative effects of commuting time can be compensated by wage and the two compensation related hypotheses were formulated. However, the eventual estimations show that commuting increases the job satisfaction its negative effects on stress and likeliness to look for the other job are also miserable. Commuting is clearly not as harmful as it was initially expected and it does not seem to require any compensation from the employer. Nevertheless, the actual effect of commuting time on the job satisfaction does indeed become less negative when wage differences are accounted. So, it seems that more distant jobs are indeed better paid, but the coefficient still remains negative, so these wage differences are not sufficient to fully compensate the possible harm from commuting (which was initially revealed in the Fixed Effects estimation). This is why the fourth hypothesis of this research stating that "the loss in job satisfaction resulting from commuting is not fully compensated by the hourly wage rate" cannot be rejected. More precisely, it was estimated that a 100% rise of commuting time in this context can on average be compensated by a 40% rise of hourly wage. Considering that the marginal willingness to pay for commuting in the Netherlands was estimated to be around 50% of the hourly wage (Van Ommeren & Fosgerau, 2008) it can, therefore, be said that longer commuters should not win from commuting-wage trade-off. However, a slight positive association between commuting and satisfaction with wage was found. It was estimated that one extra minute of commuting is associated with on average 0.003 points higher satisfaction with wage on the scale from 1 to 10. Again, this is very little in practice, but this result is still very interesting, considering that the negative association was expected initially. The third hypothesis of this research stating that "commuting time is negatively associated with the satisfaction with wage" is, therefore, rejected. Nevertheless, the magnitude of the revealed association is almost indistinguishable from zero and it would be more appropriate to say that the satisfaction with wage is unrelated to the commuting time. This finding also reinforces the previous results: although the possible harm of commuting becomes less pronounced when the wage is accounted for, the commuting by itself is quite enjoyable and there is no need in any wage compensation. It seems that workers themselves realize that commuting does not need to be compensated and so their wage preferences (reflected in the satisfaction with wage) are almost completely independent from their mode of commuting.

Conclusion

Even though the existing literature on commuting points on significant effects of commuting on the workplace performance, commuting today still remains predominantly a topic of transport economics, and much less attention is drawn to it in the economics of personnel. This is especially true, when the empirical research is concerned. The likely reason for the low popularity of this topic is a difficulty arising with isolating the effect of commuting from other work-related factors that vary together with it. The existing empirical research in this field relies mostly on the linear regression analysis and regressions with Fixed Effects, which cannot

provide a real causal inference concerning the effect of commuting on work-related characteristics. In this paper an attempt was made to estimate the causal effect of commuting on a set of work-related characteristics. With the use of LISS panel data encompassing 7000 Dutch individuals for the years 2008 – 2020, the Difference in Difference estimation of the effect of commuting time on the job satisfaction was estimated. It was found that commuting time has a moderate positive effect on the job satisfaction. Apart from that, the Fixed Effect regression analysis have also revealed that commuting has almost no association with work-related stress, and slightly positive associations with likeliness to look for the other job and with the satisfaction with wage. Unfortunately, the DiD coefficients of commuting time in the corresponding relationships were not statistically significant, and so the reliable causal inferences could not be made. The further research in this field would clearly benefit from datasets, where working from home is more common (as the number of people working from home is very low in the dataset of the current study, and so the estimates performed are quite noisy)

Furthermore, a clear non-linearity of commuting - job satisfaction and commuting - job search relationships was revealed. As commuting time rises above 40 minutes workers start to exhibit systematically different patterns in their attitude to the job and this clearly should be accounted for in the further research. It is hypothesized that this non-linearity is likely to be connected with changes in mode of transport that is used in commuting and a study of the work-related implications of commuting by different modes of transport can probably be a fruitful topic for further research as well.

The results of this enquiry are relevant both for the employers and for the transport policy makers. It is clear from this study that the seeming negative effects of commuting are largely overestimated, and commuting in the Netherlands can actually be enjoyable. Longer commuting worker are slightly more satisfied with their work and with their wage than shorter commuters, and they clearly do not require any additional compensation or motivation to fulfill their functions. This implies that such initiatives as provision of company transport or public transport travels cards are less relevant in the context of Dutch commuting. Employers in general do not need to pay much attention to commuting habits of workers, and they clearly have no reason to discriminate by commuting time in the hiring process. Therefore, the suggestion of van Ommeren & Gutiérrez (2011) to redline the workers with high commuting time is clearly not supported in the context of this enquiry. However, it should also be noted that the most reliable estimates of this research were conducted only for commuting time under 40 minutes, and the graphical analysis does suggest that above this level commuters are more likely to have a negative attitude to their job. The systematically distinct job attitudes of commuters above 40 minutes should also be noted in the transport policy making – especially long commuting is likely to bring less satisfaction and more work-related stress, and so might be in the interest of the government to increase the comfortability of the infrastructure that is used in the long commuting (and is likely to be a different kind of infrastructure that used for the short commuting). Nevertheless, this suggestion is based on the less reliable estimates a further research on the work implications of especially long commuting is, therefore, required to complete this enquiry.

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Appendix

Table 1. Descriptive statistics of the key variables

	Observations	Mean	SD
Commuting	27,910	28.08	21.77
Job satisfaction	27,660	7.43	1.47
Stress	27,211	0.36	0.48
Satisfaction with pay	27,419	6.81	1.75
Looking for other job	28,732	0.06	0.23
Hourly wage	19,076	17.02	8.83
Age	26,118	44.90	11.30
Female	23,664	0.51	0.50
Working hours	34,042	34.29	11.65

Figure 1. The yearly trend in commuting time in the Netherlands
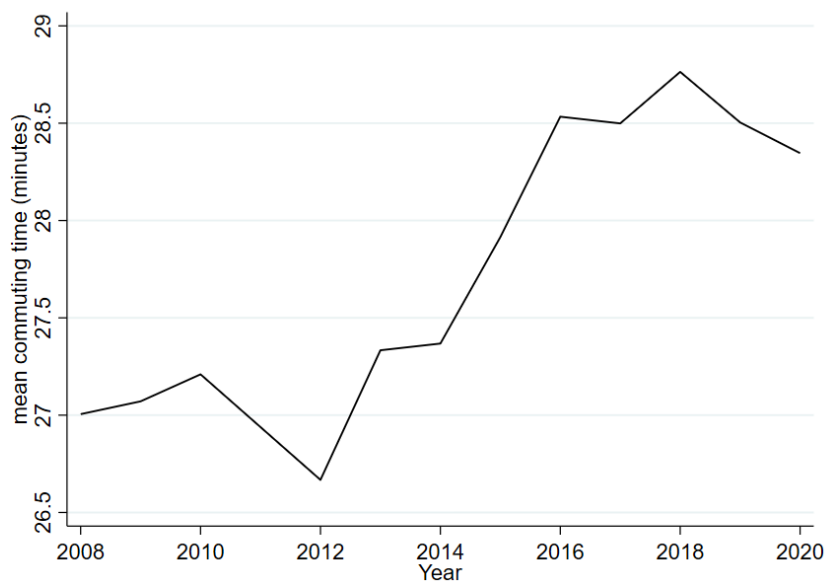
Table 3. The regression of commuting intervals on the job satisfaction

Commuting intervals:	Overall Job Satisfaction
	Ordinary Least Squares
10 - 20 min.	-0.096***
	(0.025)
20 - 30 min.	-0.028
	(0.027)
30 - 40 min.	0.002
	(0.036)
40 - 50 min.	-0.139***
	(0.035)
50 - 60 min.	- 0.180***
	(0.412)
60+ min.	-0.104**
	(0.041)
Intercept	7.490***
	(0.019)
Observations	27,659

*p-value < 0.1, **p-value < 0.05, ***p-value < 0.01. The standard errors are reported in parentheses.