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# The Distributional Effect of Commuting Subsidies - Evidence from Geo-Referenced Data and a Large-Scale Policy Reform

PRELIMINARY DRAFT

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## Abstract

Drawing on a large set of geo-referenced employer-employee data, we use the unexpected repeal of commuting subsidies in Germany in 2007 for distances below a certain threshold as exogenous source of variation to analyze the distributional effects of commuting subsidies. On a microeconomic level we use a difference-in-differences design to examine whether workers are compensated by their employer for a loss in commuting subsidies. We find no causal evidence for gross wage adjustments as a result of the reform. Looking at aggregate changes in the distribution of tax savings, our results suggest that higher income groups have benefited disproportionately from the original tax breaks and, in turn, carried the burden of the repeal of commuting subsidies.

*Keywords:* Regional Labor Markets, Public Policy, Commuting, Taxation

*JEL Classification:* J22, J38, R23, R28

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## 1. Introduction

Commuting subsidies are intended to increase labor market efficiency by encouraging workers to increase their radius of job search and to commute further for a better match (see e.g. Borck and Wrede (2005)).<sup>1</sup> Therefore governments in almost all OECD countries endorse tax breaks in order to remove financial disadvantage for commuters.

In this paper we employ a difference-in-difference approach to analyze whether a partial withdrawal of governmental commuting subsidies, as it was the case for Germany in 2007, is compensated by employers in the form of gross wage adjustments. We find zero gross wage effects for all workers as well as for specific groups of workers. We further look at how the policy reform's tax burden was distributed across workers and find that mostly high income workers suffer from the governmental commuting subsidy's withdrawal. This strongly contradicts the intended purpose of the subsidy's reinforcement.

Wrede (2003), Borck and Wrede (2005) and Richter (2006) provide theoretical contributions on how to design commuting subsidies to be efficient. The only papers considering the efficiency of the Germany's governmental commuting subsidy empirically (Weiss (2009) and Boehm (2013)) both provide evidence for commuting subsidies being efficient. Their results suggest that workers commute longer distances if they can deduct commuting expenses from their wage tax. More specifically, Boehm (2013) shows that this result is to a large extent driven by workers moving into cities in order to reduce commuting distances in the face of decreasing commuting subsidies.<sup>2</sup>

In accordance with a theory of efficient wages, employers have an incentive to compensate their workers for travel expenses, if they constitute a more suitable match for their requirements than other workers having to travel less. If travel costs increase, e.g. because of a reduction in tax breaks (as it was the case in Germany in 2007), employers have an incentive to compensate workers for their losses to hold those efficient matches. The size of such wage adjustments is ex ante indeterminate as compensation payments depend on the relative bargaining power of workers as well as on the extent to which wages are flexible

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<sup>1</sup>Commuting subsidies are usually designed as deductions of commuting expenses from taxable income. As such, they offset negative effects from income tax on job search and commuting decisions (Richter et al., 2004). In a simple example, let  $\Delta w$  be the wage premium for commuting and  $c$  the commuting cost, then in the absence of taxation commuting will take place if  $\Delta w - c > 0$ . If income taxes are sufficiently high, commuting does not take place, since now  $\Delta w(1-t) - c < 0$ . If commuting is tax deductible every efficient job match will be achieved even under taxation since  $(\Delta w - c)(1-t) > 0$  holds if  $\Delta w - c > 0$ .

<sup>2</sup>While this is not the main focus of our paper, we look into the distribution of commuting distances and find no reaction to the policy. Specifically, there is no excess mass at the kink points of tax breaks, as figure B.2 in the appendix shows.

enough to adjust to worker-specific circumstances (Baldry (1998)). Empirically, compensation of workers for their commuting expenses is unobservable, as we lack a counterfactual commuting distance or cost. Using variation from firm relocations in Denmark, Mulalic et al. (2013) find that employees' gross wages are increased by 0.15% per km increase in commuting distance.

In our setting, we use a policy reform in Germany, which in 2007 substantially reduced commuting subsidies for workers commuting more than 15 kilometers while leaving tax breaks for workers with commuting distances smaller than 15km unaltered. We use this variation in commuting costs to estimate whether employers compensate their workers for travel expenses. A large and novel data set allow to estimate this effect precise and consistently: we use a 25% sample of German record data which provides geo-referenced information on workers' exact place of work and place of residence. From these data and using GIS-software we construct a precise measure of road commuting distances, which has not been available so far. We find no gross wage adjustments for all workers or specific groups of workers.

Before the withdrawal in 2007, the sum of Germany's foregone tax revenues from tax breaks on commuting amounts to six billion Euro annually (Bach, 2003). This equals 0.6 percent of overall public expenditure and corresponds roughly to the total sum spent each year on active labor market policies. These expenses are unlikely to be distributionally neutral. The obvious question is to which extent they are progressive or regressive in nature, i.e., whether they benefit mostly high-wage or low-wage workers. In the literature it is mostly assumed that high-wage workers benefit overproportionally from the subsidy as they are subject to higher income tax rates and on average commute longer distances (Bach et al., 2007). While this argument is plausible, little is known about the specific distribution of benefits from commuting subsidies across income groups.<sup>3</sup> Furthermore, if benefits are distributed unequally across workers of different income levels, commuting subsidies are likely to have a spatial component inasmuch as they might redistribute income from cities into rural areas or vice versa.

Comparing the distributional effects of the pre- and post-reform period is instructive beyond the German case as it allows to infer on the equity effects of different regimes of commuting subsidies. In several countries, commuting costs can be deducted for the full scale of commuting distances (e.g., in Finland)

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<sup>3</sup>In 2010, the German Green Party expressed their concern about commuting subsidies favoring mainly higher income groups in an official inquiry to the Federal Government ("Kleine Anfrage an die Bundesregierung zur Verteilungswirkung der Entfernungspauschale") (Bundesministerium der Finanzen, 2010), which remain unanswered by the German government.

while other countries allow for tax deductions only above a certain minimum threshold (see Borck and Wrede (2009) for an overview). In Sweden, commuting costs are only deductible from 5km onwards while in Norway and Austria commuting costs can be deducted only for distances greater than 15km and 20km, respectively.<sup>4</sup> The German case is unique inasmuch as both types of regimes were consecutively implemented within one country. We exploit this rare opportunity to compare the distributional effect of a paradigm shift in granting commuting subsidies. Our results suggest that the reform's tax burden is mainly borne by higher income workers. This result is instructive as it shows that granting tax breaks only above a certain threshold of commuting distances, as it is practiced in a number of countries, has a progressive effect on the distribution of tax burden.

The paper is structured as follows. In section 2 we explain the design of commuting subsidies in Germany before and after the policy reform in greater detail. In section 3 we summarize the data and provide descriptive statistics. In section 4 we outline the difference-in-differences design as our key identification approach to analyze wage adjustments as a result of the policy reform and provide the results obtained. In section 5 we examine the distribution of tax benefits across wage groups and across rural and urban workers, and discuss implications for different paradigms of commuting subsidies. Section 6 concludes.

## 2. Institutional Background in Germany and Policy Reform in 2006/07

Tax breaks for commuting are designed to encourage workers to take up jobs even when they have to commute longer, if it matches their skills better. First introduced in Prussia in 1891, commuting subsidies have been subject to continuous political debate and numerous adjustments<sup>5</sup>. When filing tax declaration<sup>6</sup>, every employee can deduct commuting expenses from taxable income to a maximum amount of 4,500 Euro per year<sup>7</sup>, which translates into 2,050 Euro tax savings for the maximum tax rate of 45%. According to German tax code, employees have to report the shortest road distance from their home to their workplace, irrelevant of the transportation means used. Commuting subsidies

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<sup>4</sup>The threshold in Sweden applies only to commuting by car; public transportation costs are deductible without limitations. The Austrian regime differs for usage of public transportation and private automobiles. While subsidies for public transportation are lower, workers have to proof unacceptability of public transportation to claim the higher automobile subsidy.

<sup>5</sup>Both Weiss (2009) and Boehm (2013) provide extensive historical overviews on the development and design of commuting subsidies in Germany.

<sup>6</sup>If no tax declaration is filed, the standard deduction is automatically subtracted from the taxable income.

<sup>7</sup>Even higher amounts can be claimed when taxpayers state to use own or company vehicles. According to Destatis (2012), about 60% of German commuters travel by car.

are granted as reduction from taxable income and as such are part of income related expenses. In 2008, workers have claimed 45.4 billion Euro of income related expenses (Destatis, 2012). Commuting expenses provide with almost 60% and 20.8 billion Euro by far the biggest part of work-related expenses.<sup>8</sup> On average, each worker has deducted 1,603 Euro of commuting costs from her gross wage in 2008 (Destatis, 2012).

In this paper, we draw on a major reform in commuting subsidies between 2006 and 2009. Before 2007, workers could either deduct 0.30 Euro per km of a one-way commute per day or make use of a lump-sum deduction of 920 Euro annually. With an average of 230 working days per year, full-time workers commuting 15km are indifferent between claiming the lump-sum or deducting 0.30 Euro per kilometer per day. Workers with lower commuting distances are better off claiming the lump-sum, while workers commuting more than 15km opt for deducting 0.30 Euro per km.

Facing the urgent need to consolidate an increasing deficit in public budgets (Deutscher Bundestag, 2006), in June 2006 the German Parliament passed a reform of tax legislation including a change of the commuting subsidy. The new law came into effect in January 2007 and fell nothing short of a paradigm shift as it declared commuting to be privately caused. As a result, commuting costs exceeding the lump-sum amount of 920 Euro were not deductible any more. As completely abolishing the subsidy was, however, politically unfeasible, commuters traveling more than 20km per way were still granted a tax exemption of 0.30 Euro/km from the 21st km onwards. This was officially referred to as “hardship regulation” (Härtefallregelung). The lump-sum deduction of 920 Euro remained unchanged. In effect, the reform shifted the indifference point substantially upwards, from 15km to 35km. Individuals living up to 35km to their workplace would now claim the standard deduction of 920 Euro per year, while only workers travelling more than 35km per one-way commute would now deduct 0.30 Euro per km for every working day.

Figure 1 illustrates how the reform has altered the distribution of tax breaks as a function of individual commuting distance. The two lines indicate the size of individual tax breaks before (solid line) and after (dashed line) the policy change in January 2007. Depending on commuting distance, three groups of workers can be identified, which differ with respect to the extent that they are affected by the reform. The size of tax breaks has remained unchanged for workers commuting less than 15km as they claim the lump-sum subsidy of 920 Euro

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<sup>8</sup>By means of comparison, expenditures for work equipment and home office, double household allowances, and membership in professional associations account for 8.3%, 5.4%, and 2.3% respectively. (Destatis, 2012)

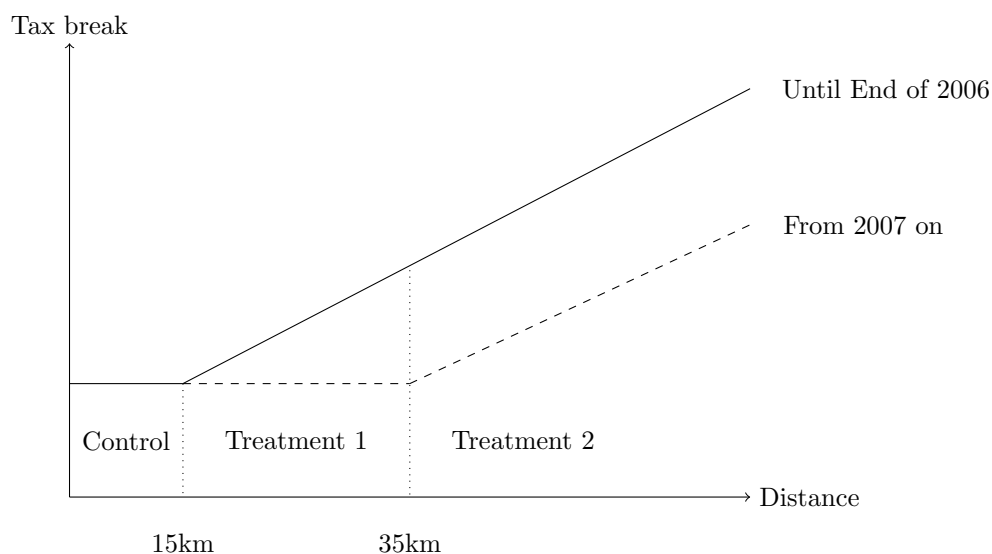


Figure 1: Policy reform and classification of treatment and control groups

before and after. We therefore use these people as a control group. Workers commuting between 15 and 35 km would have deducted 30 cents per kilometer before the reform and claim the lump-sum after 2007. Workers commuting more than 35 km per way would in both scenarios claim the km-specific deduction. In the period after the reform, however, they receive tax breaks only from km 21 onwards. The latter two groups hence are both affected by the policy but differ in the extent. We classify them as treatment 1 and treatment 2.

In December 2008 the policy experiment ended abruptly when the Federal Constitutional Court declared the regulation as unconstitutional. The Court argued that it violates the constitutional principle of equal treatment (*Allgemeiner Gleichbehandlungsgrundsatz*), as short and long distance commuters were treated differently with respect to the tax legislation.<sup>9</sup> The reform was scrapped in April 2009 and the scheme prevailing between 2004 and 2007 reinstated and has not changed ever since. Although the policy of subsidizing only long distance commuters was only effective for two years, this was not predictable in 2007 which is why we argue that behavioral responses to a policy can have occurred even in a short period of time.

<sup>9</sup>Technically, commuting costs were treated as work-related expenses only in cases where commuting distances exceeded 20km. This differential treatment was regarded by the Court as not satisfying the principle of equal treatment.

### 3. Data and Descriptives

#### 3.1. Data

We employ registry data which are collected in the administrative processes of the German Federal Employment Agency and are contained in the Integrated Employment Biographies (IEB) of the Institute of Employment Research. The IEB cover all employed persons subject to statutory social security contributions as well as all recipients of unemployment insurance or unemployment assistance. Important for our purpose, the data contains precise geo-referenced information on workers' place of living and place of work for the years 2007 to 2009 (see Scholz et al. (2012)), with an accuracy to exact addresses. These information can be used to calculate precise commuting distances. Between 2003 and 2006, the data are not geo-referenced but contain geographic information on the level of municipalities. In addition, information on wages, education, age, gender, full-time vs. part-time employment, nationality, firm size, and industry are provided.

We draw a 25% random sample of workers on the basis of 2006, the year before the policy reform was implemented. For all workers in this sample we add all existing observations from 2004 to 2009. We truncate the sample in 2004 since the regime of commuting subsidies changed between 2003 and 2004. At the upper bound, we account for the fact that the reform was taken back in early 2009 by truncating the sample after 2008.

In order to properly identify the distributional effects of commuting subsidies, we further restrict the sample in a number of aspects. First, attrition bias is a relevant issue in the present context. During the period of observation, about twenty percent of workers leave the sample at an age of 60 years or more. These retiring workers differ from the rest of the sample in terms of higher wages and lower commuting distances. In addition, especially in the first half of the period of observation, which is characterized by rising unemployment, low-qualified workers withdraw their labor supply or by become unemployed. These workers are those with comparatively low wages and short commuting distances. Both types of selective sample attrition pose a threat to the identification of how commuting subsidies and their reform impacts on the distribution of wages. Addressing this issue we restrict the sample to individuals with a full set of employment observations, i.e., we exclude all individuals that become either unemployed or leave the sample during the period of observation.

A potential reaction to the policy change could be for people to either change



work or residence in order to reduce commuting distance and therefore costs.<sup>10</sup> In our paper we are interested in the wage effect of the reform conditional on fixed commuting distances. In addition, in our difference-in-differences design we need to ensure that the assignment of treatment vs. control groups stays constant across time. We therefore restrict the sample to individuals with a constant place of residence<sup>11</sup>, who are employed at the same firm during the period of observation.<sup>12</sup> This restriction also ensures that wages are not confounded by systematic job changes.

Thirdly, since we are interested in the distributional consequences of commuting subsidies for regular commuters, we exclude commuting distances that cannot be covered on a day-to-day basis. We therefore keep only individuals with less than 100 km per one-way commute.<sup>13</sup>

Finally, we address the problem that wages in the data set are censored at the upper limit of social security contributions. In order to avoid bias from measurement errors, we delete all observations with wages above this ceiling (see Reichert (2014)). Our final sample is a balanced panel of about 1.7 million workers per year.<sup>14</sup>

This particular sample allows us to clearly identify the effects of the reform in commuting subsidies without any confounding factors. Changes in residential or work place location may both be a reaction to the reform or be driven by any other reason.

The data itself does not contain commuting distances. Drawing on the geo-references of exact addresses in the data, we calculate two types of commuting distances for each worker. First, we determine crow-fly commuting distances. Second, using GIS software and data for all German roads provided by OpenStreetMap, we calculate the exact road distance<sup>15</sup> for each worker between her place of residence and place of work. In all cases we take the shortest route, which is the distance relevant for calculating the individual tax break on commuting. Route distances are a much more accurate measure of commuting

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<sup>10</sup>Albeit this reaction is rather far reaching given average sizes of tax savings, Weiss (2009) and Boehm (2013) both find that workers have reduced their commuting distance as a result of the reform.

<sup>11</sup>Monte et al. (2015) show in a general equilibrium framework, that the elasticity of a local labor market is crucial to evaluate commuting and migration designs and policies. Not confounding these effects is another motivation for using only a balanced panel.

<sup>12</sup>We also exclude all individuals who work in establishments that changed their location.

<sup>13</sup>Note that the 95 percentile of commuting distances in the unrestricted sample ranges at 81 km; the 99th percentile lies at 370 km.

<sup>14</sup>Sample attrition from our restrictions are listed in table A.2 in the appendix.

<sup>15</sup>We compute route distances using GIS software for all observations with a commuting distance between 10-35km. For section 4 we assign treatment groups for all those individuals we have route distances for and assign those with a crow-fly commuting distance smaller than 10km to the control group and those with a crow-fly distance larger than 35km to treatment group 2.

Table 1: Commuting Distances

	<b>Commuting Distance (km)</b>		
	Mean	Median	Std. Dev.
Overall	22.65	7.18	61.03
15-24 yrs.	21.05	7.44	55.83
25-34 yrs.	25.19	7.99	65.38
35-54 yrs.	22.93	7.40	61.42
55-65 yrs.	19.76	5.68	56.84
Low Qualification	15.04	5.53	43.40
Medium Qualification	20.93	7.44	56.32
High Qualification	28.68	7.39	73.38

distance for measuring wage effects<sup>16</sup> and to evaluate commuting subsidies. To the best of our knowledge, this is the first paper to use exact road distances from both addresses of work place and residence.<sup>17</sup>

A potential threat to our design could be misreporting of commuting distances. Using matched data from the universe of Austrian taxpayers and a matched employer-employee data set, Pätzold and Winner (2014) find that around 30% of Austrian commuting allowance claims are overstated. There are several differences between the Austrian and the German system though: while Austrian taxpayers have to report their commuting distance to their employers who then should verify the distance, Germans have to report their commuting distance in their tax declaration<sup>18</sup>. German tax authorities are obliged to audit the exactness<sup>19</sup> of taxpayers' declaration according to home and work place address.<sup>20</sup>

### 3.2. Descriptives

Table 1 shows that the average crow-fly commuting distance is about 23km. A comparison between mean and median commuting distance reveals that the distribution is highly right-skewed. Both mean and median differ substantially across worker groups. With respect to age, commuting distances follow an inverted U-shape with young professionals (25-34 years) commuting the longest

<sup>16</sup>For the analysis of wage adjustments in section 4, we use both crow-fly and route distances. As figure 1 shows, the assignment to control versus treatment groups depends on commuting distance. Figure B.3 in the appendix shows, how using crow-fly distances can be misleading.

<sup>17</sup>While Pätzold and Winner (2014) also use an exact measure for road distances computed with GIS software, for the most part of their analysis they only have information on the zip code centroids, not on the exact addresses.

<sup>18</sup>Germans only have to file a tax declaration if they want to claim more than the standard deduction. The standard deduction is subtracted from taxable income automatically.

<sup>19</sup>Further, false statements can be and have been avenged as tax evasion.

<sup>20</sup>Pätzold and Winner (2014) further argue, that the control of the exactness is costly for employers as e.g. online route planners have not been available throughout their period of study. As Google Maps was launched in February 2005, this argument, too, does not hold for our case.

Table 2: Descriptives Groups

	Overall	Control	Treatment
No. Obs.	8.7 mio	6.8 mio	1.9 mio
15-24 years	2.2%	2.3%	2.0%
25-34 years	17.2%	17.0%	18.0%
35-54 years	68.0%	67.8%	69.0%
55-64 years	12.6%	13.0%	11.0%
Low Qualification	12.2%	13.2%	8.6%
Medium Qualification	72.1%	72.0%	72.6%
High Qualification	6.1%	5.3%	8.9%
Mean firm size	230	199	342
Median firm size	26	24	35
Mean yearly gross wage (Euro)	32,767	31,949	35,727
Median yearly gross wage (Euro)	31,928	31,258	34,696
Mean yearly net wage (Euro)	19,440	18,964	21,163
Median yearly net wage (Euro)	19,228	18,885	20,809
Mean subsidy (Euro)	1,120	920	2,306
Median subsidy (Euro)	920	920	1,559
Mean tax savings (Euro)	217	163	411
Median tax savings (Euro)	179	171	271

distances. In addition, the mean commuting distance rises steeply with education. In fact, highly qualified workers commute on average nearly twice as far as low-qualified workers.

Table 2 shows descriptive statistics both for the overall sample and classified into treatment vs. control group, as used in section 4. The table reveals that treatment and control groups are comparable in age structure. While medium qualified is the biggest group, which seems independent of commuting distance, especially higher qualified tend to commute longer distances, as also shown in table 1, and hence contribute a larger share to the treatment group. Treatment and control group further differ with respect to income and in the possibility to deduct commuting subsidies from their working income. Mean subsidy<sup>21</sup> in 2006 is 1,490 Euro and 1,105 Euro in 2007, which shows an overall reduction as result of the reform. For both years, the 75th percentile observation is the standard deduction of 920 Euro, indicating that the majority of workers makes use of the standard deduction. In 2006, the 90th percentile corresponds to 2,652 Euro of annual subsidy, whereas it is 920 Euro in 2007. As table 2 shows, the median in the treatment group (i.e. those living further than 15km from their workplace) is with 1,559 Euro somewhat higher.

<sup>21</sup>We outline in AppendixA how we calculate net wages and commuting subsidies in detail.

## 4. Gross Wage Adjustments as a Result of the Reform

### 4.1. Empirical Design

In this section we address the question whether workers are compensated for commuting costs by their employers when commuting subsidies are partly abolished. Consider a simple model in which firms and workers are matched in the labor market. The quality of the match (i.e. the worker's productivity) depends on the combination of the worker's skills and the specific tasks required for the job (see Brueckner et al. (2002) and Helsley and Strange (1990)). Workers bear the costs of commuting to their employers. They choose the firm that offers the highest gross wage net of travel expenses. The model makes interesting predictions about commuting reimbursement by firms. First, it explains why firms have an incentive to compensate workers for traveling. If certain workers match the firm's skill requirements perfectly but are mislocated (i.e. commuting distance to the firm is very large), the firm gains from compensating commuting as long as the firm's gains from the match with the mislocated worker exceed the expenses for this compensation. Second, the model predicts how the firms' commuting reimbursements react to a rise in transport costs, e.g. because of a reduction of governmental commuting subsidies. Again, if the firm's gains from the match are sufficiently large, the firm has an incentive to adjust gross wages in order to keep the productive but mislocated employees.

We examine whether gross wages of workers with increasing traveling costs as a result of the reform rise relatively more compared to wages of unaffected workers. To test for differences in wage adjustments we apply a difference-in-differences approach.

As mentioned above, the first treatment group (T1) consists of workers living between 15 kilometers and 35 kilometers away from their workplace. After 2007, these workers would make use of the opportunity to deduct a fixed amount of 920 Euros rather than deducting their expenses per kilometer. The second treatment group (T2) consists of workers who face a parallel shift in tax breaks. These workers would still use the per-distance option of tax deduction but could not deduct the first twenty kilometers any more. The control group (C) consists of workers living closer than 15 kilometers from their workplace. These workers claim the lump-sum deduction before and after the reform. If employers compensate workers who faced losses in net wages due to the policy change, gross wages in the treatment group(s) should rise relatively more in 2007 than gross wages in the control group. The difference  $\delta$  can then be interpreted as a causal effect of the reform. Based on these considerations we specify the following

model to identify the causal effect of the policy change on gross wages.

$$\log(\text{grosswage})_{it} = \alpha + \gamma \text{Treatment}_i + \lambda d_t + \delta(\text{Treatment} \times d)_{it} + \mathbf{X}'_{it}\beta_1 + \mathbf{Z}'_{it}\beta_2 + \mu_i + \varepsilon_{it} \quad (1)$$

We estimate equation (1) for all individuals  $i$  for the years  $t = 2004$ -2008.  $\text{Treatment}$  is a dummy variable which is equal to 1, if commuting distance between home and work exceeds 15km.  $d_t$  is a time effect which is equal to 1 for the years 2007 or 2008 (i.e., the years the policy was in effect) and zero otherwise.  $\mathbf{X}_{it}$  consists of individual time invariant controls like education, gender, nationality or industry group.  $\mathbf{Z}_{it}$  consists of time-varying covariates ( $\text{age}^2$ , firm size).  $\mu_i$  depicts individual fixed effects. The coefficient of interest is  $\delta$ , which indicates whether gross wages of treated workers rise as a result of the reform. We modify our first specification and use gross wage growth as a dependent variable to capture differences in wage developments across groups.

$$\Delta \log(\text{grosswage})_{it} = \alpha + \gamma \text{Treatment}_i + \lambda d_t + \delta(\text{Treatment} \times d)_{it} + \mathbf{X}'_{it}\beta_1 + \Delta \mathbf{Z}'_{it}\beta_2 + \mu_f + \varepsilon_{it} \quad (2)$$

To additionally control for unobserved firm heterogeneity (wage agreements, teleworking policies etc.), we add firm fixed effects  $\mu_f$  and estimate the within firm wage variation of workers that all stay with the same employer. We hence can compare the wage adjustments of workers in a firm, depending on whether they were affected by the reform or not.

$$\Delta \log(\text{grosswage})_{it} = \alpha + \gamma \text{Treatment}_i + \lambda d_t + \delta(\text{Treatment} \times d)_{it} + \mathbf{X}'_{it}\beta_1 + \Delta \mathbf{Z}'_{it}\beta_2 + \mu_i + \varepsilon_{it} \quad (3)$$

In a third specification, we use wage growth as a dependent variable and use individual fixed effects  $\mu_i$  to control for unobserved individual heterogeneity. In our estimations we differentiate between one and two treatment groups. In a first setting we differentiate solely between workers affected by the policy and workers who were not. In a second setting we differentiate between the extent to which the withdrawal of commuting allowances affects individuals. In order to satisfy the common-trend assumption, we need to make sure that gross wage growth is equal across groups before the reform. We apply placebo tests to check whether this assumption is satisfied.

Table 3: Wage Effects with one treatment group

Sample Dependent Variable	Full sample		Full sample		Full sample		w/o cb		HQ	
	$\log(wage)$	$\Delta\log(wage)$	$\log(wage)$	$\Delta\log(wage)$	$\log(wage)$	$\Delta\log(wage)$	Crowfly	Routes	Routes	$\Delta\log(wage)$
Distance	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
treat	-0.0050** (.0016)	.0013*** (.0002)	.0001 (.0001)	- (.0002)	- (.0002)	.0002 (.0002)	-0.0003 (.0002)	-	-	-0.0000 (.0002)
d07	.0072*** (.0005)	.0077*** (.0005)	.0076*** (.0005)	.0089*** (.0009)	.0056*** (.0011)	.0086*** (.0006)	.0081*** (.0003)	.0033*** (.0006)	.0119*** (.0013)	.0100*** (.0007)
treat×d07	.0041*** (.0003)	-0.0001 (.0003)	-0.0000 (.0003)	-0.0004 (.0007)	-0.0001 (.0003)	-0.0001 (.0003)	.0006* (.0003)	.0001 (.0004)	.0001 (.0011)	.0001 (.0004)
Placebo										
d06	.0018* (.0007)	.0025** (.0007)	-0.0021** (.0007)	.0021* (.0009)	- (.0006)	-0.0032*** (.0007)	-0.0024*** (.0002)	-	-	-0.0016 (.0010)
treat×d06	.0022*** (.0003)	-0.0006 (.0006)	-0.0004 (.0004)	.0000 (.0005)	.0008 (.0006)	.0006 (.0004)	-0.0010** (.0003)	-0.0001 (.0006)	.0012 (.0016)	.0002 (.0005)
Ind. FE	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No
Firm FE	No	No	Yes	No	No	Yes	Yes	No	No	Yes
$N_{2007}$	8.67 mio	6.93 mio	6.93 mio	8.67 mio	6.93 mio	6.93 mio	4.21 mio	4.21 mio	423,770	4.57 mio
$N_{2006}$	5.20 mio	3.47 mio	3.47 mio	5.20 mio	3.47 mio	3.47 mio	2.10 mio	2.10 mio	315,880	2.28 mio
# groups	1.73 mio	-	443,510	1.73 mio	1.73 mio	443,510	352,188	352,188	48,287	297,106

Clustered standard errors are given in parentheses. \*/\*\*/\*\* mark significance at the 5%/1%/0.1% significance level.

#### 4.2. Results

Table 3 shows the results from estimating equations (1) to (3) with a single treatment group. The upper panel of the table displays gross wage effects as a reaction to the exemption of commuting subsidies. The lower panel shows the results from placebo tests we conduct for each specification. In the placebo test we restrict the sample to the years of 2004-2006 and re-estimate the model using the 2006 as the year of placebo treatment. If there are gross wage adjustments as a reaction to the policy change we expect the interaction effects ( $\delta$ ) in the upper panel to be statistically significant and positive, whereas those for the placebo tests should not be different from zero. We estimate the gross wage effects with both crow-fly and route distances.

In Column (1) and (4) we estimate equation 1 for the full sample of workers, with crow-fly and route distances respectively. We observe a positive and significant treatment effect of 0.0041 when using crow-fly distances. This means that all else equal, being affected by the policy change led on average to a wage increase of 0.4%<sup>22</sup>. The results from the placebo test in the lower panel, however, cast doubt on this result: although the effect is only about half the size in magnitude, there is still a positive and significant gross wage effect in a year which is not affected by the treatment. Comparing the effects of column (1) with those in column (4) (route distances), we see that there is no significant positive treatment effect by the exemption of commuting subsidies.

In Columns (2), (3) as well as (5) and (6) we therefore estimate equation 2 for the full sample with individual and firm fixed effects respectively. In both columns we find no evidence for a reaction in gross wage growth as a response to the policy. Our results with route distances further hint to an effect of exactly zero: all treatment effects ( $treat \times d07$ ) are smaller and less significant.

It might be that wage adjustments are suppressed by collective wage agreements. In fact, although wage setting has become more flexible in recent years (Dustmann et al. (2014)), major parts of the German industry are still committed to wage agreements by unions (e.g. the construction sector). In column (7) and (8), we hence restrict the sample to workers whose wages can adjust individually. We therefore exclude all industries in which more than 50% of employees are subject to collective wage agreements<sup>23</sup> and re-estimate equation 3. We observe a very small increase in gross wage growth for those treated in 2007 when using crowfly distances. This effect again becomes insignificant when using route distances. We conclude that using route distances is the more precise measure and superior to using crowfly distances. Further, our preferred

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<sup>22</sup>For an annual income of 25,00 Euro, this increase translates into 102.50 Euro per year.

<sup>23</sup>See Destatis (2013).

specification is equation 3 as using individual fixed effects we can control for unobserved heterogeneity which could affect gross wages.

If highly qualified employees are most likely to match employers' skill requirements (and are comparably hard to substitute), our simple model would predict to find wage adjustments particularly in this group.<sup>24</sup> As column (9) shows, the treatment effect has an effect of exactly zero such that we can reject the hypothesis of highly educated being an exception. The same is true for a subsample of males, where none of the relevant effects is statistically different from zero.

Table 4 shows the results when differentiating the treatment effect by two treatment groups (see figure 1). Again, we show results for both crow-fly and route distances but refer to the latter as our preferred specification. There is a positive and significant effect for the first treatment group with  $\log(\text{gross wage})$  as a dependent variable for both types of distances. Regarding the placebo effects, however, we do not interpret this as a causal effect of the policy reform. There is a slightly positive and significant treatment effect when regarding the subsample without industries that are determined by collective wage agreements (column (7) and (8)). Regarding a significance level of 5%, the result should be interpreted carefully, as the sample size is rather large. Bertrand et al. (2004) further argue that standard errors in difference-in-differences models tend to be underestimated, which is why we should regard this effect with even more caution.

In summary, we find no evidence for a systematic reaction in gross wages in response to a reduction of commuting subsidies. Although the loss in net wages is substantial at least for some individuals, we find no compensation in gross wages<sup>25</sup>, neither for the whole sample nor for specific groups of workers with arguably higher bargaining power.

As argued in section 5, we identify wage adjustments as a reaction to the policy. To the best of our knowledge, there is no other policy within our sample period which could confound the effect<sup>26</sup>. The period of analysis coincides with a period of increasing gasoline prices and overall rising prices for public transportation. If all workers are affected by such increases in commuting costs in the same way, these increases are accounted for in the year dummies  $d_t$ . Even if potential gross wage compensations depend on their group classification (meaning that people

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<sup>24</sup>Highly qualified workers are defined as those holding a degree from a university or from a university of applied science.

<sup>25</sup>Urban economic theory suggests, that adjustments could happen on the housing instead of the labor market. I.e., housing prices for those affected by the policy would decrease. As we have no information on housing prices, we solely focus on adjustments on the labor market.

<sup>26</sup>In 2007, the maximum tax rate was raised from 42 to 45%. But since we only use wages up to the limit of social security contribution (see section 3), this policy is not binding in our sample.



Table 4: Wage Effects with two treatment groups

Sample Dependent Variable	Full sample		Full sample		Full sample		w/o cb		HQ		HQ		males	
	$\log(wage)$	$\Delta \log(wage)$	$\log(wage)$	$\Delta \log(wage)$	$\log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
treat1	-	.0012*** (.0002)	-.0001 (.0002)	-	-.0004* (.0002)	.0002 (.0002)	-	-	-	-.0001 (.0003)	-	-	-	-.0001 (.0003)
treat2	-	.0012*** (.0003)	-.0003 (.0003)	-	-.0000 (.0003)	.0003 (.0002)	-	-	-	-.0001 (.0002)	-	-	-	-.0001 (.0002)
d07	.0076*** (.0005)	.0084*** (.0004)	.0084*** (.0004)	.0089*** (.0009)	.0086*** (.0010)	.0086*** (.0006)	.0057*** (.0005)	.0082*** (.0005)	.0120*** (.0013)	.0100*** (.0007)				
treat1xd07	.0040*** (.0003)	.0003 (.0003)	.0005 (.0003)	.0022*** (.0005)	.0003 (.0004)	.0003 (.0004)	.0009** (.0004)	.0009* (.0004)	.0012 (.0011)	.0004 (.0005)				
treat2xd07	.0053*** (.0006)	.0004 (.0005)	.0002 (.0006)	-.0012 (.0007)	-.0002 (.0003)	-.0002 (.0004)	.0002* (.0006)	-.0001 (.0004)	-.0002 (.0011)	-.0002 (.0004)				
Placebo														
d06	.0016* (.0007)	.0023** (.0007)	-.0025*** (.0005)	.0016* (.0007)	-	-.0025*** (.0005)	-.0024*** (.0002)	-	-	-.0012 (.0007)				
treat1xd06	.0019*** (.0003)	-.0004 (.0008)	-.0006 (.0005)	.0019*** (.0003)	-.0004 (.0008)	-.0005 (.0004)	-.0011*** (.0003)	-.0009 (.0004)	.0003 (.0011)	-.0006 (.0005)				
treat2xd06	.0021*** (.0006)	-.0016 (.0013)	-.0012 (.0011)	.0021*** (.0006)	-.0014 (.0012)	-.0011 (.0009)	-.0007 (.0006)	-.0009 (.0007)	.0020 (.0016)	.0016 (.0011)				
Distance	Crowfly	Crowfly	Crowfly	Routes	Routes	Routes	Crowfly	Routes	Routes	Routes	Routes	Routes	Routes	Routes
Ind. FE	Yes	No	No	Yes	Yes	No	No	Yes	Yes	No	Yes	Yes	No	No
Firm FE	No	No	Yes	No	No	Yes	Yes	No	No	No	No	No	No	Yes
$N_{2007}$	8.67 mio	6.93 mio	6.93 mio	8.67 mio	6.93 mio	6.93 mio	4.21 mio	4.21 mio	423,770	4.57 mio				
$N_{2006}$	5.20 mio	3.47 mio	3.47 mio	5.20 mio	3.47 mio	3.47 mio	2.10 mio	2.10 mio	315,880	2.28 mio				
# groups	1.73 mio	-	443,510	1.73 mio	1.73 mio	443,510	352,188	352,188	48,287	297,106				

Clustered standard errors are given in parentheses. \*/\*\*/\*\*\*/\*\*\*\* mark significance at the 5%/1%/0.1% significance level.

commuting longer distances suffer more) and thus gross wage compensation is no clear reaction to the policy, the direction of the effect would still be the same. If anything, a reaction to increases in other commuting costs would lead us to overestimate the treatment effect, which then again should not lead to zero effects as we find them. Another effect that could potentially lead to confusing is the fact that employers can - instead of increasing workers' gross wages - react to employees' net wage losses via non-wage compensation (e.g. company car, sponsored public transportation ticket or the like).<sup>27</sup> Nevertheless, we argue that it is unlikely that a mass of workers<sup>28</sup> receives a non-wage compensation as a response to the policy or the like. We discuss this issue further in the robustness checks.

One reason for the fact that we find zero effects could be the short time span of two years in which the exemption of commuting subsidies was in effect. However, using data on firm relocation Mulalic et al. (2013) provide evidence that the major part of gross wage adjustments occurs within three years after an exogenous shock on net wages. For short term adjustments, they find almost no effects. Similarly, Boehm (2013) shows that adjustments to commuting distance, also happen within two years after the reform. Alternatively, the absence of gross wage reactions could be due to the fact that the years 2007 and 2008 coincide at least partly with the recession in Germany. During that time unemployment rose, wages were held constant and short-time work was introduced as a labor market policy. If this was the main driver, however, we would expect at least wage adjustments for highly qualified workers, as for this group the unemployment rate never exceeded 4%.

#### 4.3. Robustness

We conduct several robustness tests shown in table 5<sup>29</sup>. We present results for our preferred specification with gross wage growth as dependent variable and including individual fixed effects<sup>30</sup> and using route distances. First we address the potential problem of non-wage compensations mentioned above. To avoid any confounding factors, we make two restrictions in column (1) and (2). First we exclude high qualified workers, as those are the ones most likely to receive non-wage compensations. As predicted in our model, employers are most willing

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<sup>27</sup>As non-wage compensations are not subject to social security contributions but are taxed with a lump-sum rate of 15%, we cannot observe such expenditure.

<sup>28</sup>The GSOEP data includes information on whether respondents receive other expenditures like a company car. Out of 4430 respondents, only 13 received such additional non-wage compensations. (See [www.data.soep.de](http://www.data.soep.de))

<sup>29</sup>We show results for two treatment effects here, the results with one treatment effect is virtually the same and is presented in the appendix in table A.3.

<sup>30</sup>Results are qualitatively the same throughout all specifications.

Table 5: Robustness Tests

Sample Dependent Variable	w/o HQ	w/o h w	<65km	Small w	Small Firms
	$\Delta \log(wage)$ (1)	$\Delta \log(wage)$ (2)	$\Delta \log(wage)$ (3)	$\Delta \log(wage)$ (4)	$\Delta \log(wage)$ (5)
<i>d07</i>	.0052*** (.0011)	.0051*** (.0008)	.0056*** (.0011)	.0044*** (.0011)	.0045*** (.0005)
<i>treat1 × d07</i>	.0003 (.0004)	.0005 (.0004)	.0003 (.0004)	.0015 (.0013)	.0007 (.0004)
<i>treat2 × d07</i>	-.0002 (.0003)	-.0000 (.0003)	-.0002 (.0003)	-.0019 (.0011)	.0000 (.0004)
Placebo					
<i>treat1 × d06</i>	-.0002 (.0008)	-.0004 (.0005)	-.0004 (.0008)	.0016 (.0014)	-.0006 (.0004)
<i>treat2 × d06</i>	-.0012 (.0014)	-.0009 (.0018)	-.0016 (.0012)	.0024 (.0027)	.0001 (.0006)
Distance					
Ind. FE	Routes Yes	Routes Yes	Routes Yes	Routes Yes	Routes Yes
Firm FE	No	No	No	No	No
<i>N</i> <sub>2007</sub>	6.51 mio	5.19 mio	6.18 mio	881,763	5.12 mio
<i>N</i> <sub>2006</sub>	3.25 mio	2.64 mio	3.40 mio	259,054	2.55 mio
# groups	1.63 mio	1.37 mio	1.70 mio	465,304	1.30 mio

Clustered standard errors are given in parentheses. \*/\*\*/\*\* mark significance at the 5%/1%/0.1% significance level.

to keep workers in this group, if they match their skill requirements well. Second, we exclude all workers above the 75 percentile gross wage in 2006 (39,690 Euro), as this group again is likely to benefit from non-wage compensations.<sup>31</sup> Legally, people are allowed to deduct costs for commuting up to 65km per day<sup>32</sup> if they use public transportation. This limit is not binding if the commuter uses her own or a company car<sup>33</sup>. In column (4), we test whether our results remain unchanged if we apply this legal limit to our data. The results again show zero treatment effect.

To address the concern about the Did design being fuzzy as an effect other work-related expenses we restrict the sample to yearly gross wages below 20,000 Euro<sup>34</sup>. According to Destatis (2012), in the income groups below 10,000 Euro, the share of people making use of any other deduction than the lump sum deduction of 920 Euro is only 10.3%<sup>35</sup>. For yearly gross wages between 10,000 and 20,000 Euro, the share of workers who claim more than the lump sum deduction is second smallest with 41.3%<sup>36</sup>. Column (5) shows the results for this test and reveals that again none of the relevant treatment effects is statistically different from zero.

Another issue discussed in empirical literature is the accuracy to which bigger firms report their employees working with the headquarter or at small subsidiary companies<sup>37</sup>. If there is a systematic measurement error, this could affect our results. Therefore we exclude all observations for individuals working in firms with more than 100 employees. Again the results remain unchanged.

Over all these tests confirm our finding that gross wages do not adjust as a reaction to a partial abolition of commuting subsidies. This means that workers have to bear the full costs of the reform while employers remain unaffected.

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<sup>31</sup>It may be more attractive for top earners to get non-wage compensations which are only taxed with a lump sum tax of 15% instead of experiencing small gross wage adjustments which are taxed away due to their higher tax rates.

<sup>32</sup>The legal limit is 4,500 Euro per year, which are associated with 65km of one-way commuting distance and 230 working days per year.

<sup>33</sup>According to the German microcensus, 64% of Germans use a car for daily commute (Breiholz et al., 2005)

<sup>34</sup>In 2006, the 25th percentile of gross wages is at 25,092 Euro, while the 10th percentile is at 18,208 Euro. All in all, 1.1 million observations are left with this restriction which is about 12% of our sample.

<sup>35</sup>Of these 10.3%, 53% are due to commuting, i.e. they live farther than 15km from there work place.

<sup>36</sup>In total, there were 2.0 million claims in this wage categories of which 1.9 million were due to commuting expenses above the limit for lump sum deduction. (Destatis, 2012)

<sup>37</sup>Although we have data on establishment level, some bigger firms may still report their employees to work at headquarters instead of small departments.

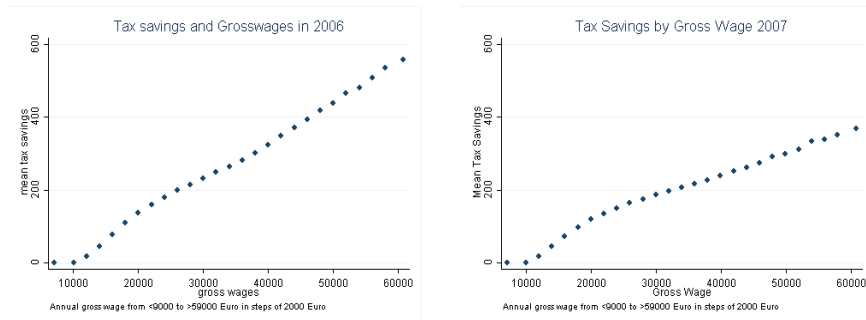


Figure 2: Tax Savings from Commuting Subsidy and Gross Wages, 2006 and 2007 (absolute)

## 5. The Distribution of Benefits Across Worker Groups

To get an impression of the reform’s effects on income distribution, we plot tax savings across wage groups before and after the reform. We use the same sample as in section 4.1, which consists of individuals with stable full time employment and stable residence. As before, we truncate commuting distances at an upper threshold of 200km. We compute bins<sup>38</sup> of gross wages from 5000 Euro to > 57,000 Euro in steps of 2,000 Euro. For each of these bins we compute the mean of tax savings<sup>39</sup>.

While the reform obviously led to an overall reduction of subsidies (see figure B.4 and B.5 in the appendix), we focus on changes in tax savings to discuss the distributional effects across worker groups. Figure 2 shows mean tax savings and gross wages before and after the reform. We see that higher earnings categories profit more from commuting subsidies, as they are characterized by longer commuting distances as well as higher tax rates as a result of progressive taxation. For incomes below 20,000 Euro annually, tax savings remain virtually unchanged. In contrast, the decrease for higher income groups is more obvious.

Figure 3 shows relative changes in tax savings<sup>40</sup> and gross wages. Although changes are small for all income groups (between -0.3% and 0), the graph shows that higher incomes lose relatively more than lower incomes. This pattern suggests that the reform actually has a redistributive character, as higher incomes lost relatively more while lower incomes were mostly unaffected. As we can measure only reductions from taxable income due to commuting but cannot

<sup>38</sup>A complete list of numbers of observations per year can be found in table A.4 in the Appendix.

<sup>39</sup>We do the same for tax breaks and show all results in the appendix. For consistency reasons we focus only on tax savings throughout the text. The patterns described hold for subsidies as well.

<sup>40</sup>The relative change in subsidy is calculated as  $\frac{1}{n} \sum_i^n \frac{\Delta \text{subsidy}_i}{\text{grosswage}_i}$  for  $n$  individuals in an income category.

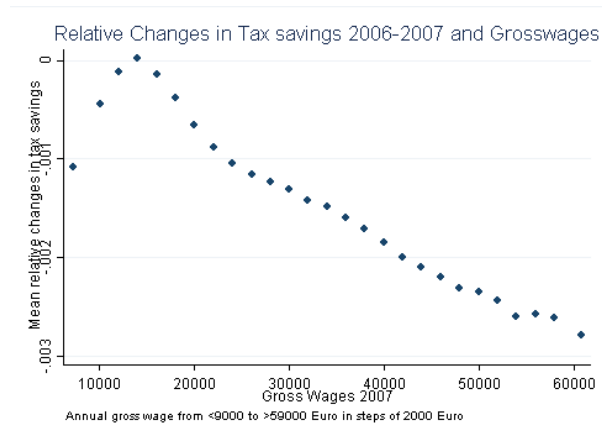


Figure 3: Changes in Relative Tax Savings from Commuting Subsidy and Gross Wages, 2006 and 2007

observe other income related expenses, especially tax savings for higher income classes are only a lower bound. As mentioned in section 2, apart from commuting costs workers can also deduct expenses for home offices or costs for double housekeeping etc. These expenses are more likely to arise for workers of higher income classes. As Destatis (2012) show, commuting costs as “income related expenses” are most important for higher middle incomes (30,000-40,000 Euro annually), while especially top earner make little use of this sort of tax break. Therefore it is likely that the distributional effects are even larger than shown here.

Overall, we observe that lower incomes are better off after the policy reform in 2007<sup>41</sup>. As our graphical analysis suggests, the regime prevailing in in 2007/2008 led to distributional effects which disadvantaged higher incomes while leaving lower incomes relatively unaffected. From an equity perspective, the reform seems to be more desirable to the regime before and after. Together with about 2.5 billions Euro of additional tax revenues per year (Donges et al., 2008), it seems that the reform was preferable.

To deepen the insight from the graphical descriptions, we use Theil indices for measures of inequality to quantify the reform’s distributional effects across workers. We are further interested if a change in commuting policy affects the distribution of tax savings differently for groups with different geographic characteristics. In the context of commuting characteristics in Germany we expect some differences for East and West Germany as well as for rural and

<sup>41</sup>As after the Federal Constitutional Court’s verdict in December 2008, the law was reinforced to the state as in 2006 and has not changed ever since, the legislative is equivalent to today’s commuting subsidy law.

non-rural (i.e. urban) areas. Therefore we subdivide the sample in East/West and rural/urban and calculate separate inequality measures for each subgroup. When mutually exclusive and exhaustive subgroups are considered the Theil index has some useful properties as compared to other inequality measures<sup>42</sup> and is defined as follows:

$$T = \frac{1}{n} \sum_i \frac{y_i}{\bar{y}} \ln \left( \frac{y_i}{\bar{y}} \right) \quad (4)$$

where  $y_i$  is the outcome variable of interest (here tax savings) for individual  $i$ ,  $y$  denotes the value of the outcome variable for all  $n$  individuals and  $\bar{y}$  is the respective mean value. The Theil index ranges between 0 and  $\infty$  where a value of 0 describes an equal distribution. The higher the value the larger the inequality. The index can be decomposed into  $K$  subgroups (see Shorrocks (1980)). As subgroups, consider two types of geographical groups: we examine whether East and West Germany as well as rural and urban areas differ with respect to the distribution of tax savings both before and after the reform. As tax breaks for commuting are intended to facilitate job search in remote areas with lower employment opportunities, it is interesting to see whether there are regional differences in the affectedness of the policy. Table 6 shows the Theil index for the whole sample ( $T$ ) as well as for the relevant groups ( $T_k$ ). Both overall and for our regional subgroups, the decreasing Theil indices suggest a more equal distribution of tax savings after the reform. In 2006 as well as in 2007, tax savings are less equally distributed in East Germany as compared to the West. The same is true for rural as opposed to urban tax savings. In the eastern part there is a larger share of long-way commuters compared to west (see e.g. Redding and Sturm (2008)) and in urban areas the share of long-way commuters is in general negligible, see Winkelmann (2010). Although the decrease in Theil indices is larger in Western and rural areas, the general pattern remains unchanged by the reform.<sup>43</sup>

In sum, the reform has left the regional distribution of tax savings largely unaltered. From a political view point, this is interesting as differences between East and West as well as rural vs. urban are often used as reasons for the prevalent design of commuting tax breaks<sup>44</sup>. Neither commuting subsidies which reimburse all distances (the policy before the reform) nor a design which only

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<sup>42</sup>It can be shown that for this type of analysis the Theil index is superior to other inequality measures (as e.g. the Gini coefficient), see e.g. Morduch and Sicular (2002).

<sup>43</sup>We also decompose the Theil index into within and between component (as shown in table A.5 in the appendix) and find that the main driver of inequality in all subgroups is the within component, whereas between only adds about 1%. The reform has no effect on this decomposition.

<sup>44</sup>See e.g. Bundesministerium der Finanzen (2010).

Table 6: Evolution of Theil-T index of tax savings for different geographic groups

	2006	2007	$\Delta$
$T$	0.3365	0.2143	-0.122
$T_{East}$	0.3917	0.2955	-0.0962
$T_{West}$	0.3237	0.1973	-0.1264
$T_{Rural}$	0.3470	0.2267	-0.1203
$T_{Urban}$	0.2937	0.1789	-0.1148

subsidizes long distance commuting has an effect on these regional differences.

## 6. Discussion

In this paper we discuss two dimensions of distributional effects of commuting subsidies. Drawing on a large-scale policy reform in Germany, we estimate gross wage compensations in a difference-in-differences approach. We find no evidence for gross wage adjustments as a result of the reform, which supports the notion that commuting costs are mainly paid for by workers. In the second part of the paper we therefore turned to the question how the benefits of commuting subsidies are distributed across workers of different wage groups and who in the workforce carried the burden of the reform. Our results show that the repeal of commuting subsidies affects mainly workers with a higher income whereas lower incomes remain relatively unaffected.

As there has not been a reform of commuting subsidies ever since, politicians should reconsider the legal distinction of short and long distance commuting for subsidies again, as it is used e.g. in Sweden, Norway, and Austria. Furthermore, giving incentives to use public transportation instead of using automobiles could additionally have a positive effect on environmental protection. Although the latter aspect is not discussed in this paper, future research should make use of the new geocoded data sets to gain insight on environmental effects of commuting subsidy policies.



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## Appendix

### Appendix A. Deriving Net wages and Subsidies

To determine tax savings before and after the policy reform we need to calculate each worker's individual net wage. We therefore derive the commuting subsidy as well as the individual tax rate for each worker using the procedure proposed by Günselmann (2014) to which we add information on individual commuting distance, which allows for calculate the size of commuting subsidies. Figure B.1 outlines how net wages are derived from gross wages and how commuting subsidy are embedded in the German tax system.

The point of departure is a worker's contractual gross wage, which is either negotiated collectively between employer organizations and unions or individually agreed upon between workers and firms. We observe daily gross wages in the data. The first step to obtain net wages is to deduct three types of expenses, of which each reduces the taxable wage. These expenses encompass pension payments, extraordinary expenses like, e.g., high health costs, and income-related expenses.<sup>45</sup> The latter category contains all expenses that are necessary for a worker to keep up her employability. These entail commuting expenses, expenditures for work equipment and home office, double household allowances and membership in professional associations.

Unfortunately, we lack information on pension payments and extraordinary expenses. However, Reichert (2014) shows that net wages calculated from administrative data do not differ systematically from those reported in a survey. More precisely, he finds that on average calculated and reported annual net wages differ only by 6 Euro which means that measurement error is unsystematic and very small. We can therefore safely conclude that pension of all other forms of deductibles do not influence our calculations systematically.

We subtract the standard deduction for income related expenses if commuting distance is below the threshold of 15 km between 2004 and 2006, or below 35km from 2007 onwards. For calculating commuting subsidies without standard deduction, we use exact information on distance between workplace and residence, which is multiplied by working days times 0.30 Euro.<sup>46</sup>

The expense-adjusted gross wage is taxed with a progressive rate, which depends on wage level and individual tax category. Due to a lack of further information we assume all individuals to fall under tax category I, which is the category

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<sup>45</sup>For all employees, a standard minimum deduction is considered automatically; all further claims have to be filed individually by workers in their tax declarations.

<sup>46</sup>We use the number of working days=calendar days - state specific number of holidays - 30 days. 30 days are subtracted as this is the number of vacation days for regular employment in Germany.

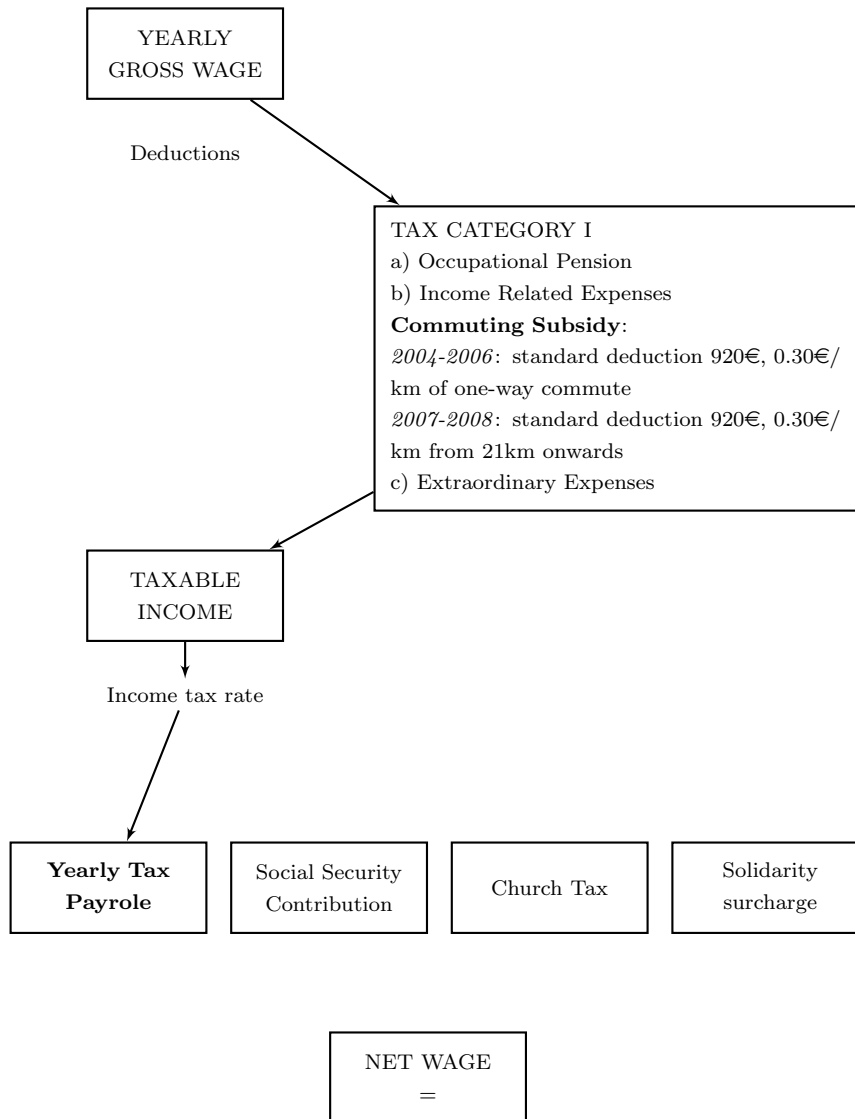
for single workers. Tax category I is the most commonly used category which applies to 38% of all tax paying individuals<sup>47</sup>. Importantly, the specific tax category has no effect on concession and size of commuting subsidies. Our calculations leave us with three new variables, namely individual commuting subsidy, tax savings, and net wage. Tax savings are defined as the individual commuting subsidy  $\times$  individual tax rate.

## **Appendix B. Figures**

Figure B.1: Procedure of Deriving Net Wages from Gross Wages

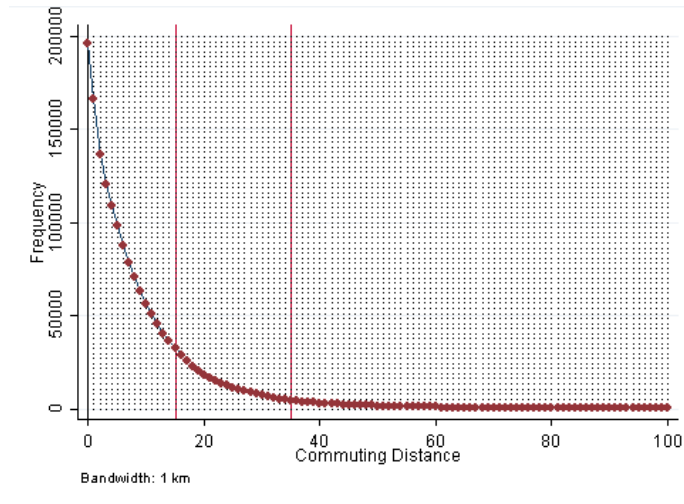
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<sup>47</sup>In 2012 27.75 million of Germans were subject to payroll tax of which 10.7 millions belonged to tax category I. The second biggest group is category III, the category for married individuals, with 8.8 millions of observations. (Bundesministerium der Finanzen, 2014)



$$\text{Taxable Income} - \text{Tax Payrole} - \text{Social Security Contribution} - \text{Church Tax} - \text{Solidarity Surcharge}$$

Figure B.2: Distribution of commuting distances in Germany



## Appendix C. Tables

Table A.1: Overview on Changes in Tax Breaks for Commuting

2004 - 2006	Deduction of 0.30 Euro per km for one-way commute; Commuting distances up to 15km fall within a lump-sum tax deduction
2007 - 2008	Deduction of 0.30 Euro per km for one-way commute only for distances further than 20km; de facto all commuting distances <35km fall within the lump-sum deduction
from 2009 on	Regime as from 2004-2006



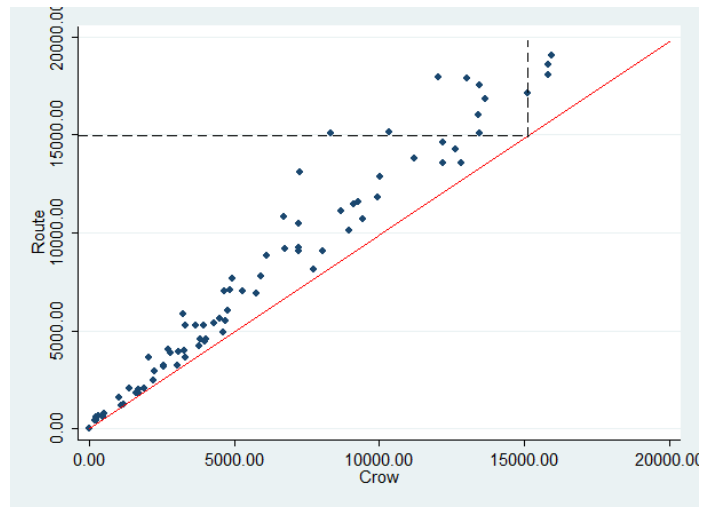


Figure B.3: Crow-fly vs. Route Distances

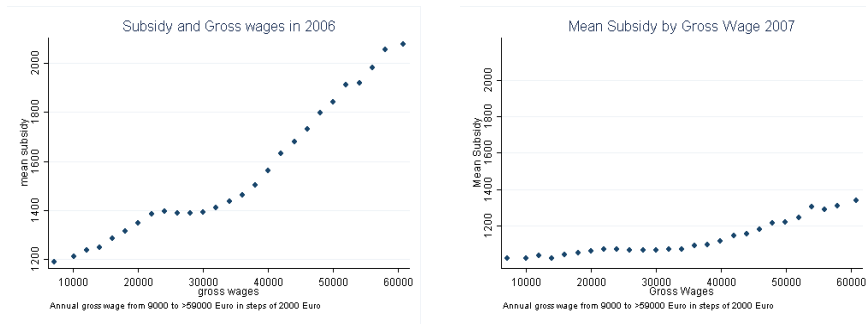


Figure B.4: Commuting Subsidy and Gross Wages, 2006 and 2007

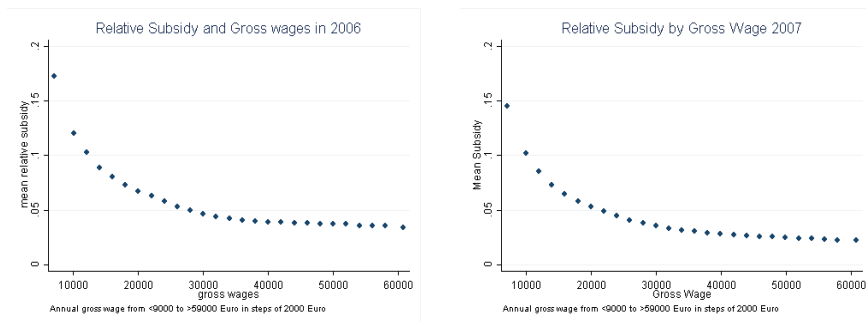


Figure B.5: Relative Commuting Subsidy and Gross Wages, 2006 and 2007

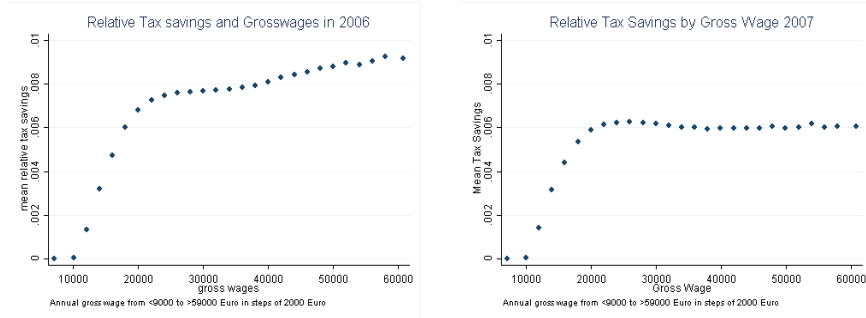


Figure B.6: Relative Tax Savings from Commuting Subsidy and Gross Wages, 2006 and 2007

Table A.2: Sample Attrition

Sample	Deleted	Observations
Full sample		71,201,183
Employed only	9,462,808	61,738,375
Commuting distance <200km	13,796,352	47,942,023
Only 2004-2009	19,832,259	28,109,764
Stable residence (community)	600,646	27,509,118
Stable workplace (establishment)	2,658,280	24,850,838
Stable workplace (community)	608,892	24,850,838
Balanced Panel	11,006,526	13,235,420
Fulltime employment	3,973,384	9,262,036
< assessment ceiling	480,150	8,781,886
> marginal employment	112,906	8,668,980
Final sample		8,668,980

Table A.3: Robustness Tests - One treatment effect

Sample	w/o HQ	Rural only	w/o hw	<65km	Small w	Small Firms
Dependent Variable	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$	$\Delta \log(wage)$
	(1)	(2)	(3)	(4)	(5)	(6)
<i>d07</i>	.0047*** (.0008)	.0051*** (.0008)	.0056*** (.0011)	.0124*** (.0012)	.0045*** (.0005)	
<i>treat × d07</i>	-.0002 (.0003)	.0001 (.0004)	-.0001 (.0003)	-.0021 (.0012)	.0002 (.0004)	
Placebo						
<i>treat × d06</i>	.0009 (.0007)	.0002 (.0007)	.0008 (.0006)	.0012 (.0017)	-.0002 (.0005)	
Distance	Routes	Routes	Routes	Routes	Routes	Routes
Ind. FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	No	No	No	No
<i>N</i> <sub>2007</sub>	6.51 mio	5.00 mio	5.19 mio	6.18 mio	881,763	5.12 mio
<i>N</i> <sub>2006</sub>	3.25 mio	2.50 mio	2.64 mio	3.40 mio	259,054	2.55 mio
# groups	1.63 mio	1.25	1.37 mio	1.70 mio	465,304	1.30 mio

Clustered standard errors are given in parentheses. \* / \*\* / \*\*\* mark significance at the 5%/1%/0.1% significance level.

Table A.4: Annual Gross Wage Categories, in Euro

Gross Wage Category	2006	share 2006	2007	share 2007
≤ 9,000	18,208	1.05%	16,981	0.98%
9,000-11,000	17,380	1.00%	16,719	0.96%
11,000-13,000	25,485	1.47%	23,876	1.38%
13,000-15,000	33,558	1.95%	31,486	1.82%
15,000-17,000	45,895	2.65%	42,661	2.46%
17,000-19,000	55,804	3.22%	52,320	3.02%
19,000-21,000	64,301	3.71%	60,439	3.49%
21,000-23,000	76,343	4.40%	71,016	4.10%
23,000-25,000	91,798	5.29%	84,918	4.90%
25,000-27,000	114,631	6.61%	105,921	6.11%
27,000-29,000	128,875	7.43%	121,991	7.04%
29,000-31,000	138,216	7.97%	131,931	7.61%
31,000-33,000	134,601	7.76%	130,908	7.55%
33,000-35,000	124,900	7.20%	123,854	7.14%
35,000-37,000	110,185	6.36%	112,070	6.49%
37,000-39,000	92,069	5.31%	96,361	5.56%
39,000-41,000	77,860	4.49%	81,681	4.71%
41,000-43,000	69,718	4.02%	72,458	4.18%
43,000-45,000	58,454	3.37%	62,129	3.58%
45,000-47,000	50,762	2.93%	52,646	3.04%
47,000-49,000	43,671	2.52%	46,405	2.68%
49,000-51,000	36,377	2.10%	39,034	2.25%
51,000-53,000	31,954	1.84%	34,753	2.00%
53,000-55,000	24,865	1.43%	29,809	1.72%
55,000-57,000	21,711	1.25%	25,239	1.46%
57,000-59,000	18,165	1.05%	22,444	1.29%
>59,000	28,010	1.62%	43,746	2.52%
Total	1.73 Mio	100%	1.73 Mio	100%

Table A.5: Decomposition of Theil-T Index of Tax Savings

	2006	Rel. Contribution	2007	Rel. Contribution
Overall	0.3365		0.2143	
Within (East/West)	0.3338	0.99	0.2125	0.99
Between (East/West)	0.0027	0.01	0.0018	0.01
Within (rural/urban)	0.3340	0.99	0.2141	0.99
Between (rural/urban)	0.0025	0.01	0.0002	0.01