Commuting time, wages and reimbursement of travel costs.
Evidence from Hungary*

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Abstract

The paper explores the hypothesis that high costs of commuting are responsible for the persistent unemployment of Hungarian villages. An attempt is made to estimate the compensating wage differential associated with commuting time using individual-level data, taken from a survey conducted among workers who have left the unemployment register and got a job in March 2001. The empirical analyses are motivated by a simple wage posting model, which implies a positive effect of commuting time on wages and on explicit reimbursement of travel expenses, conditional on the local unemployment rate in places where jobs open. We find that unemployment rate in settlements where jobs are located lowers the positive effect of commuting time on wages, but it increases the effect of commuting time on the probability of receiving some reimbursement of travel expenses. The findings suggest that commuters are perceived to be workers with low productivity, and the wages in high unemployment areas do not compensate for costly commuting. Our study therefore supports the hypothesis that persistent unemployment is maintained by high costs of commuting, relative to wage advantages.

Keywords: Commuting, Spatial Mismatch Hypothesis, Compensating Wages

JEL-classification: J31, J61, R20

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1 Introduction

One of the unique features of the Hungarian labor market is the persistence of regional differences in economic prosperity and unemployment. Unemployment rates are substantially higher in the villages situated in the North-Eastern and the Southern part of Hungary, and the rate of unemployment is persistently high since the early 1990s. Following a logic which is similar to the influential spatial mismatch hypothesis, which claims that the suburbanization of job opportunities accounts for the high unemployment rate among black inner-city residents (Kain 1992, Ihlanfeldt and Sjoquist 1998), it was proposed that the high costs of daily commuting to urban labor markets accounts for the high unemployment rates in villages (Köllő, 1997, 2006; Kertesi, 2000). Using a transportation database with settlements as units of observation, Köllő (1997, 2006) showed that in the absence of public transportation linkages, commuting with cars would use up a substantial part of the expected wages. Public transportation links are especially underdeveloped in regions where villages with high unemployment rates are typically situated. Kertesi (2000) relied on these estimates when analyzing the 1996 micro-census of the Hungarian Statistical Office and found that the probability of commuting decreased with commuting costs.

Unfortunately, the above mentioned studies estimated rather than observed the actual costs of commuting. Neither did they made at attempt to estimate the compensating wage differential ([6], [14]) associated with commuting. This paper makes an attempt to fill this gap.

The correlation between wages and commuting time is often explained with the help of search theory: prospective commuters are more critical towards low wage jobs, because the reservation wage is expected to increase in commuting distance or commuting time (Rouwendal 1998, [8]). However, standard urban economic theory offers another explanation in terms of residential choices: high-wage employees might prefer residential locations which are far away from their job ([2]), while low-income employees are forced to live close to their jobs. The Hungarian labor market provides a unique opportunity to assess the explanatory power of the former approach. Labor mobility in Hungary is substantially constrained by the small housing rental market; the vast majority, more than 90 percent of houses are owner-occupied. Besides, housing transactions involve substantial transaction costs and a bad decision may put more than the annual income at risk (Hegedűs 1994). Moving is more characteristic for high-income families, which is evidenced in the suburbanization process especially around the capital city Budapest but also around other larger towns. Given the difficulties associated with changing residence, we expect that people who wish to improve their labor market situation will choose commuting, especially those who are unemployed or often face the risk of unemployment.

\footnote{Budapest lost about 15 percent of its inhabitants during the 1990s.}
mostly think of commuting as the means of improving their economic condition.\textsuperscript{2}

In recent years, commuting research has been increasingly influenced by modern theories of monopsonistic labor markets ([7]). This line of literature argues that commuting costs are an important source of monopsony power. Theories of monopsonistic behavior rely on wage posting models, which elaborate the simple idea that even high wages may maximize profit, provided that they guarantee a steady flow of applicants and reduce the probability of job separations. Wage posting models assume the existence of a wage structure which is established unilaterally before employers meet workers. The wage setting process thus deviates from the standard assumptions of most of the job search models where wages are determined by a generalized Nash bargaining process (Pissarides 2000). We believe that the assumptions of wage posting are more realistic than that of standard search theories. It is not our ambition, however, to develop an equilibrium wage-posting model of commuting and related phenomena.

Our primary aim is to contribute to the ongoing research program of present and explain evidence about the relationship between commuting time, wages and reimbursement of travel expenses in one of the Eastern European countries, Hungary.

We begin with a benchmark model where labor mobility is not constrained by commuting costs. The problem of employers is to find the wage which maximizes the net present value of holding vacancies. The maximization problem should take into account that the wage will affect both the probability with which the “representative” worker accepts the offer and the probability with which workers quit the job. The most important assumption is that the rate at which matches emerge and terminate is endogeneous, an assumption which sharply deviates from the common assumption of exogeneous match formation and separation (Pissarides 2000). Given a simple specification of a job acceptance probability, we show that there is an unique wage offer which maximizes the net present value of holding a vacancy. Similar to simple models derived from the assumption of a generalized Nash bargaining process, the optimal offer is a weighted average of the productivity of the worker and the reservation income, defined as the income received by unemployed workers. However, our model has the distinctive feature that the weight in question depends on unemployment. More specifically, our model implies that as unemployment increases, employers attach a smaller weight to productivity and a larger weight to the reservation income.

We then extend the model to spatial labor markets. The representative worker to whom the offer must be made might occupy any spatial location and commuting is costly. Commuting costs imply a change in the probability that the representative worker finds the offer attractive, since these costs diminish the value of the job offer. In spatial labor markets, commuters behave as if their reservation income were the sum of the true reservation income and commuting costs. This implies that the profit maximizing wage offer must be higher for commuters, since the optimal wage offer is a function of the reservation income. Since our model implies that the

\textsuperscript{2}In this respect, the Hungarian case resembles the Southern-European one ([10]).
effect of reservation income on wages is conditional on unemployment, we hypothesize that returns to commuting are larger in labor markets where unemployment is high.

If employers were free to set different wages to workers with different commuting time, the theoretical compensating wage premium would be observable in wages. However, employers rarely pay different wages to workers with similar productivity but different residential location. Employers often avoid intra-firm wage discrimination because wage differences, often perceived as “unfair” by employees put team performance at risk (see, for example, Akelof and Yellen 1988). Employers therefore aim at establishing a wage structure, which is relatively independent of the personal characteristics of the employed or prospective workers. Assuming that there are no systematic differences in the productivity of workers with different commuting time, employers cannot discriminate on a spatial basis. While employers are “spatially blind” during their decisions with respect to the wage structure, they might legitimately reimburse some of the travel expenses. Indeed, employees of various European countries, including Hungary, receive explicit reimbursement of travel expenses, the extent of which being often stipulated in collective wage agreements or in labor law. Our paper does not assume that such agreements and legal rules are binding. Instead, we argue that reimbursement equals the profit-maximizing compensating wage; that is, the theoretical compensating wage premium is paid in the form of explicit reimbursement. Similar to the argument developed in the previous paragraph, the effect of commuting distance on reimbursement must be larger in settings where unemployment is more pronounced.

The paper is organized as follows. The wage posting model is presented in section 2. The remainder of the paper is devoted to empirical analyses. Section 3 describes the data and variables used in the subsequent sections. Section 4 begins with the examination of the relationship between commuting time, wages and reimbursement. Then we provide estimates for the returns to commuting time in terms of both wages and the probability of receiving reimbursement of travel expenses. Section 5 concludes.

2 The model

2.1 Wage posting without spatial considerations. The benchmark model

In the labor market, employers face the problem of setting a profit maximizing wage. Output is the sum of individual outputs, thus profit maximization boils down to maximizing the expected discounted lifetime value of a job. In other words, we proceed as if firms were sums of one-job firms (Pissarides 2000).

Jobs are either vacant (state 0) or filled (state 1). If a job is vacant, employers search for workers and incur fixed cost $k$. Vacant jobs are contacted by unemployed workers at the exogenous arrival rate $\lambda$. If vacancies and unemployed meet each other randomly, $\lambda =$
\[ 1 - \exp\left(-\frac{u}{v}\right), \] where \( u \) and \( v \) denote the number of unemployed workers and the number of vacancies, respectively.

Unemployed workers accept the wage offer \( w \) with acceptance probability \( \alpha(w) \). The choice of the functional form is motivated by the assumption that the acceptance probability must reflect the utility of the representative worker. This is achieved by normalizing the value of job offers to the unit interval. Let \( z \) be the income received while unemployed. It is reasonable to assume that wages have an upper bound \( \bar{w} \) which is the revenue of the most productive firm within the industry under study. In a vivid labor market, wages must fall into the \([z, \bar{w}]\) interval. The acceptance probability is defined as

\[ \alpha(w) = \left(\frac{w - z}{\bar{w} - z}\right)^{\sigma \theta} \quad (1) \]

where \( \sigma \) captures the shape of the wage distribution and \( \theta \equiv \frac{v}{u} \). For analytical simplicity, we assumed that the relative frequency is weakly decreasing in wages, so that \( 0 < \sigma \leq 1 \). Throughout this paper, \( \sigma \theta \) will be often referred to as the shape parameter.

Our specification of the acceptance probability reflects not only the fact that better offers are more likely to be accepted but also the fact that a particular job offer becomes more attractive as the labor market becomes less tight or the wage distribution becomes more dispersed, that is, approaches the uniform distribution. Equation (1) implies that the maximum wage offer \( \bar{w} \) is always accepted. Job offers equaling the reservation income are acceptable only if there is no wage dispersion (\( \sigma = 0 \)) or the ratio of vacancies to the number of unemployed is zero.\(^3\)

The acceptance probability plays a similar role to that of reservation wage in standard search models. Standard search theory argues that the reservation wage equals the reservation income \( z \) plus the product of the arrival rate \( \lambda(\theta) \) and the expected value of the (truncated) wage distribution above the reservation wage. The expected value of the truncated wage distribution is an increasing function of the dispersion of wages, since workers can expect a higher return to job search if wages are more dispersed. (For a closed-form expression, see Yoon 1981). Thus, reservation wage is proportional to the product of the arrival rate and wage dispersion, and effect which is captured by the shape parameter \( \sigma \theta \) in Equation (1).

To compare the acceptance probability with the traditional reservation wage, it is useful to examine the effect of labor market tightness on both the reservation wage and the acceptance probability. First consider the case when there are no vacancies, implying that \( \theta = 0 \). In this case, the reservation wage equals the reservation income \( z \), implying that if a vacancy were created, it would be taken by the worker, regardless of the wage. Our acceptance probability implies the same since \( \alpha(w \mid \theta = 0) = 1 \) for all \( w \). As the number of vacancies increase,

\(^3\)The acceptance probability might also reflect preferences towards risk if \( \theta \sigma \) is multiplied by a parameter \( \rho \) so that \( \rho < 1 \) indicates risk aversion and \( \rho = 1 \) indicates risk neutrality.
the arrival rate of job offers to workers increases as well, which implies an increase in the reservation wage. The increase in the relative number of vacancies changes the shape of the acceptance probability so that bad offers are accepted by a nonzero probability. If the number of vacancies is equal or exceed the number of job searchers, the probability of accepting bad offers approaches zero. Note that the reservation wage can be related to the acceptance probability by assuming that wage offers equal to the reservation wage are accepted by probability $\frac{1}{2}$.

When a match is formed, the worker produces $y$ units sold at unit price. Matches break up at the endogenous rate $\lambda(\theta) [1 - \alpha(w)]$.\footnote{Usually, search models assume an exogenous separation rate or a combination of exogenous and endogenous components (for example, Manning 2003a). The implications of the model presented here are not affected by neglecting the exogenous part of job separation rate.} That is, keeping the arrival rate constant, job separations are more likely in jobs that pay low wages.

The respective Bellman equations describing the net present value of vacant and filled jobs are

$$rV_0(w) = -k + \lambda(\theta)\alpha(w)(V_1(w) - V_0(w))$$  \hspace{1cm} (2)

$$rV_1(w) = (y - w) + \lambda(\theta) [1 - \alpha(w)] (V_0(w) - V_1(w))$$  \hspace{1cm} (3)

Substitution of (3) into (2) and the assumption that $r^2 = 0$ yields the following expression for the value of vacant jobs:

$$rV_0(w) = -r\lambda(\theta)^{-1}k + [\alpha(w)(y + k - w) - k].$$  \hspace{1cm} (4)

Interpretation of Equation (4) is straightforward. Assuming zero search costs, the net present value of a job, independently of being vacant or filled, equals the product of the acceptance probability and the instantaneous profit. Since the probability of filling the vacancy increases in the wage, which, in turn, decreases the instantaneous profit, there is an inverted U shaped relationship between wages and the value of the job.

Assuming that the discount parameter is close to zero, differentiating (4) with respect to $w$ leads to the first order condition

$$y + k - w^* = \frac{\alpha(w^*)}{\alpha'(w^*)} = \frac{w^* - z}{\sigma\theta},$$

which immediately yields the solution

$$w^* = \frac{\sigma\theta(y + k) + z}{1 + \sigma\theta}.$$  \hspace{1cm} (5)

The profit maximizing wage offer is a weighted sum of productivity and the reservation income, the weight being a function of unemployment. The important prediction is that as unemployment increases, employers attach a smaller weight to productivity and a larger weight to the
reservation income. Note that although we assume an unilateral wage posting process, the profit maximizing wage is the solution of the generalized Nash bargaining process where the worker and the employer are characterized with the respective threat points \( z \) and \( -k \), and the “bargaining power” of the worker is \( \frac{\sigma \theta}{1 + \sigma \theta} \).

2.2 Wage posting and reimbursement in spatial labor markets

In the benchmark model, there is no room for space and commuting. Now we introduce the spatial dimension: we modify the acceptance probability so that it reflects heterogeneity in spatial location of workers. Workers living at distance \( t \) are assumed to evaluate jobs on the basis of the difference between wage \( w \) and commuting costs (Manning 2003b). That is, \( w_t = w_0 - ct \) where \( c \) captures both the monetary cost of travel and the monetary value of time associated with travel and \( w_0 \) denotes the wage offer at zero distance to residential location. We also might allow other parameters of the benchmark model to depend on commuting distance. These extensions will be considered in the next subsection.

The spatial version of the acceptance probability is

\[
\alpha(w, t) = \left( \frac{w_t - ct - z}{w_t - z} \right)^{ \sigma \theta}.
\]

Inserting Equation (6) into the value function (4) and differentiating with respect to \( w \) yields the first order condition

\[
y + k - w_t^* = \frac{\alpha(w_t^*, t)}{\alpha'(w_t^*, t)} = \frac{w_t^* - ct - z}{\sigma \theta}.
\]

The profit maximizing wage is

\[
w_t^* = \frac{\sigma \theta (y + k) + (z + ct)}{1 + \sigma \theta}.
\]

The result is simple. Employers are willing to pay higher wages to commuters because they perceive the reservation income of commuters as the sum of the true reservation income and commuting costs. This is consistent with search theoretic models claiming that the reservation wage is an increasing function of commuting distance ([11]).

If employers were free to bargain wages on an individual basis, they would pay different wages to commuters and to local residents. The wage premium, denoted by \( \Delta w(t) \), is simply the difference between the optimal wage offers \( w_t^* \) and \( w_0^* \), the later denoting the optimal wage as defined by equation (5). That is,

\[
\Delta w(t) = w_t^* - w_0^* = \frac{ct}{1 + \sigma \theta}.
\]

Central to the modern literature on monopsony is the idea of a wage structure. Offered
wages do not and cannot reflect all personal characteristics of the employed or prospective workers, even when that personal characteristics are related to productivity. Therefore, similar workers who eventually occupy different residential locations should receive the same wage; there is no spatial discrimination. While employers should remain “spatially blind” during their decisions with respect to the wage structure, they can discriminate on a spatial basis and offer reimbursement to travel expenses. In short, the compensating wage premium, as defined by equation (8) is paid in the form of explicit reimbursement.

Whatever interpretation of equation (8) is adapted, the result is that returns to commuting depend on the dispersion of wages, on the one hand, the the ratio of vacancies to unemployed, on the other hand. Employers reimburse, either implicitly in the form of higher salaries or explicitly, the fixed fraction $\frac{1}{1+\theta\sigma}$ of commuting costs.\(^5\) If the wage distribution were uniform and the number of vacancies equals the number of job seekers, half of the travel expenses were reimbursed.\(^6\) Travel expenses are fully reimbursed when the wage distribution becomes more right-skewed (that is, $\sigma \to 0$), or the labor market becomes extremely tight ($\theta \to 0$). Contrary to this, employers are not willing to reimburse travel expenses if there is substantial labor shortage ($\theta \to \infty$). The logic is as follows. Labor shortage induces firms to increase wages up to the point where wages equal productivity. The side effect of wage competition is that wages become independent of the reservation income. In the eyes of employers, commuting costs are a component of the reservation income, and not of productivity. If firms compete with offering better reimbursement schemes, it is because either there is no wage disperson or because there is excess supply of labor.

The negative effect of the improvement of labor market conditions on reimbursement can be illustrated by two additional results. First, the ratio of reimbursement to the wage is 

\[
\frac{ct}{\theta\sigma(y+k)+z}.
\]

Keeping commuting time constant, the relative amount of explicit reimbursement becomes smaller as the relative number of vacancies increases or wages become more dispersed. Second, note that employers are not willing to reimburse the costs of too long commutes. Letting the (instantaneous) profit zero, we obtain the largest commuting time

\[
t^{\text{max}} = \frac{y - \theta\sigma k - z}{c}.
\]

The largest commuting time reimbursed would be independent of tightness and wage distribution if search costs for new workers were zero. Otherwise the largest commuting time eligible for reimbursement becomes shorter as the ratio of vacancies to unemployed workers increases. Thus the improved chances of earning high wages reduce the chances of receiving reimbursement for longer commutes. The surprising implication is that employers are more

\(^{5}\)Although we assume an unilateral wage posting process, this result obtains if the worker with “bargaining power” $\frac{d\theta}{y+k}$ and the employer bargained over the splitting of commuting costs with respective threat points $-c$ and zero.

\(^{6}\)van Ommeren arrives at the same conclusion, albeit using a different reasoning.
willing to reimburse travel expenses if unemployment rate is higher.

2.3 Extensions

In the simple spatial wage posting model presented in the previous subsection, spatial aspects of the labor market were captured by the dependence of the reservation income on commuting time. The literature on spatial mismatch and commuting, however, suggest that our spatial wage posting model is too simple. Now we consider some extensions of the spatial wage posting model.

The first extension is related to productivity. Workers who travel long distances might be less productive than workers who live close to work ([4]). One reason is that longer trips make workers tired, and commuters are more likely to be late, especially if public transport is bad. Another reason is territorial discrimination, emerging from the spatial segregation of ethnic minorities. In Hungary, a substantial proportion of the discriminated roma minority lives in small villages far from urban areas, thus pessimistic expectations concerning the productivity of gipsies should overlap with pessimistic expectations about the productivity of commuters.

If commuting distance is negatively related to (estimated) productivity and the relationship is assumed to be linear, the profit maximizing wage is

\[ w^*_t = \frac{\sigma \theta (y_0 - y_1 t + k) + (z + ct)}{1 + \sigma \theta} = w^*_0 + \frac{c - \sigma \theta y_1}{1 + \sigma \theta} t, \]

where \( y_0 \) denotes the average productivity of workers living at distance 0, and \( y_1 \) reflects the unit change in average productivity. The compensating wage premium is

\[ \Delta w(t) = \frac{c - \sigma \theta y_1}{1 + \sigma \theta} t. \] (10)

Interpretation is straightforward. Pessimistic assessments of the productivity of commuters decrease the returns to commuting. Even the net effect of commuting distance on wages or reimbursement is not clear because the nominator may be both positive and negative. However, this extension does not change the conclusion that returns to commuting are larger in labor markets where unemployment is high.7

A second extension is related to the reservation income. One might also argue that the reservation income, net of commuting costs, is related to commuting time as well. In standard urban economic models, workers trade off commuting costs with lower prices of housing. It is well documented in Hungary that after the transition, a substantial proportion of low educated workers moved from urban areas to small villages in order to reduce the costs of housing (REFERENCE). This extension, however, does not change the main conclusion of the spatial wage posting model, namely that the returns to commuting are an increasing function of

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7One may verify that the partial derivative of the wage premium is an increasing function of unemployment.
unemployment.

A final extension considers the shape parameter of the job acceptance probability. One of the standard claims of the spatial mismatch literature is that spatially isolated workers have limited access to information about job openings ([4]). A straightforward implication of this result is that the ratio of vacancies to unemployment is underestimated by prospective commuters. One might also speculate that ignorance concerning jobs is not random; spatially isolated job seekers are less likely to be aware of better jobs. First, it is often argued that better jobs can be obtained through employee referrals (REFERENCE) or through weak ties (REFERENCE). Since personal contacts are constrained by the opportunities to meet each other (REFERENCE), urban workers are less likely to pass job information to prospective commuters. As a consequence, spatially isolated workers face a selective sample of job opportunities, where better jobs are missing with a larger probability. The biased perception of opportunities can be modeled by linking the shape parameter of the wage distribution ($\sigma$) to commuting distance, implying that commuters, compared to local workers, perceive the distribution of wages as being skewed to the left.

Under these assumptions, the spatial version of the acceptance probability is

$$ \alpha(w, t) = \left( \frac{w_t - ct - z_t}{\bar{w} - z_t} \right)^{\theta_t \sigma_t}, $$

yielding the profit maximizing wage

$$ w^*_t = \frac{\theta_t \sigma_t (y + k) + (z_t + ct)}{1 + \theta_t \sigma_t}. $$

Let $\beta$ denote the shape parameter of the acceptance probability (that is, $\beta \equiv \theta \sigma$). For analytical simplicity, assume that commuting distance has a linear effect on the shape parameter. That is, $\beta_t = \beta_0 + \beta_1 t$ where the parameters indexed by zero apply to the parameters of the aspatial model. Given the linear specifications, the compensating wage differential is

$$ \Delta w(t) = w^*_t - w^*_0 = \frac{\beta_1 (y + k - z) + (1 + \beta_0)c}{(1 + \beta_0)^2} \times \left[ \frac{1}{t} + \frac{\beta_1}{1 + \beta_0} \right]^{-1}. \quad (11) $$

While reimbursement remains a linear function of the marginal cost of travel $c$, but becomes a nonlinear function of commuting distance $t$. Note that reimbursement were infinite if the bracketed expression is zero, implying a threshold commuting distance $T = -\frac{\beta_1}{1 + \beta_0}$. Since we are interested in the problem of rural unemployment, it is reasonable to assume that $\beta_1 < 0$. This assumption implies the existence of a positive threshold value. Depending on the sign of $\beta_1 (y + k - z) + (1 + \beta_0)c$, no workers commuting less or more than $T$ might receive reimbursement. If $(1 + \beta_0)c - |\beta_1|(y + k - z) > 0$, employers pay reimbursement to workers who commute less than $T$, and reimbursement is an increasing nonlinear function of commuting distance. If, however, $(1 + \beta_0)c - |\beta_1|(y + k - z) < 0$, employers reimburse the travel expenses
of workers who commute more than $T$, and reimbursement is a decreasing nonlinear function of commuting distance.

2.4 Empirical model

In the remaining part of the paper, we will examine the simple model where all parameters except the shape parameter of the job acceptance probability are allowed to depend on commuting distance. To arrive at a tractable empirical model, we first rewrite Equation (5) as

$$w_t = \frac{u_0}{u_0 + v} \left[ z_t + ct - y - k \right] + (y + k),$$

where $u_0$ and $v$ denote the number of unemployed people and the number of vacancies at the place of work, respectively. Since the fraction appearing in the right-hand side increases with unemployment at a decreasing rate, we use the approximation

$$\frac{u_0}{u_0 + v} \approx \ln u_0 - \ln(v).$$

Substituting this approximation into (12), we obtain

$$w_t = \left[ \ln u_0 - \ln(v) \right] [z + ct - y - k] + y + k.$$

Our data, described in the next section, does not permit the observation of the number of vacancies, the shape of the wage distribution, and search costs. Substituting constants for unobserved variables leads to the linear model

$$w_t = \beta_0 + \beta t + \beta z + \beta_u \ln u_0 + \beta_y y + \beta_{ut} t \ln u_0 + \beta_{uy} y \ln u_0.$$

(13)

Recall that employers are not willing to compensate for long commutes that would turn the instantaneous profit zero or even negative. In order to account for this ceiling effect, the square of commuting time can be added. The revised version of the above model is

$$w_t = \beta_0 + \beta t + \beta t^2 + \beta z + \beta_u \ln u_0 + \beta_y y + \beta_{ut} t \ln u_0 + \beta_{uy} y \ln u_0. \quad (14)$$

Interest centers on the coefficients (main effects) of commuting time and on the coefficients of the product terms. The compensating wage approach to commuting time research usually boils down to estimating regression models which involve commuting time as well as personal and eventually firm-level and regional characteristics ([6], [14], [8]). Our empirical model differs from earliear models in two important respect. First, we also add the square of commuting time to allow for a ceiling effect, which is related to the fact that neither workers nor employers tolerate too long commuting. Second, we also include interaction terms between
unemployment and human capital characteristics, meaning that an increase in unemployment should reduce the returns to productivity. If our model is correct then previous regression models are misspecified and regression estimates of the compensating wage differential are biased.\(^8\)

Explicit reimbursement, denoted by \(R_t\) will be studied using the same logic. Using the above approximation, equation (8) becomes

\[
R_t = [\ln u_0 - \ln(v\sigma)] [z + ct].
\]

Given the limitations of our data, our empirical reimbursement model is

\[
R_t = \beta_0 + \beta_t t + \beta_z z + \beta_u \ln u_0 + \beta_{ut} t \ln u_0 + \beta_{uz} z \ln u_0.
\] (15)

If there is a ceiling effect, the model is extended to

\[
R_t = \beta_0 + \beta_t t + \beta_{t2} t^2 + \beta_z z + \beta_u \ln u_0 + \beta_{ut1} t \ln u_0 + \beta_{ut2} t^2 \ln u_0 + \beta_{uz} z \ln u_0.
\] (16)

### 3 Data

In April 2001, a survey was conducted among registered unemployed who were entitled to unemployment benefits (N=105,924) and got a job between 18 of March and 7 of April 2001. The primary purpose of data collection was the evaluation of the effect of the dramatic rise of the minimum wage on changes in unemployment.\(^9\) In the above mentioned period, 9474 people got a job, out of which 8339 people completed the questionnaire (Köllő, 2002). The questionnaire contains both retrospective questions about the previous job and questions about the new job. This paper will use a small subset of the data consisting of 783 observations.

Survey data are rarely free of data problems. In our dataset, two problems are of special interest. First, respondents who were reemployed by the former employee were not asked about the receipt of reimbursement. Since commuting costs cannot be assumed to remain constant, these cases must be excluded. Our sample therefore is restricted to job changers. Second, when asked about the prospective job, respondents were asked to estimate the lower and the upper bounds of the salary. Unfortunately the reported minimums and maximums differ substantially in a considerable proportion of cases. We omitted respondents where the difference between the maximum and the minimum exceeds 10 thousands HUF.

Since our focus is on the effect of commuting, and migration might disturb the empirical relationship between commuting time and commuting decisions (Ihlanfeldt and Sjoquist, \(^9\)

\(^8\)The expectation that unemployment rate should have a positive regression coefficient does not contradict the fact that unemployment is negatively associated with individual wages. A small increase in log unemployment changes wages by \(\beta_u + \beta_{ut1} t + \beta_{ut2} t^2 + \beta_{uz} z + \beta_{uy} y\), which can (and should) be negative.

\(^9\)In January 2001, the minimum wage rised from 25.5 to 40 thousands HUF.
1998), we exclude those unemployed who changed their place of residence during their un-
employment spell. Since we wish to generalize our results to the population of job seekers
with low education, we omitted respondents with college or university education. The sample
selected for analyses include full-time employees aged 15-74 in 2001, who travel to work and
back no more than four hours. Note that the sample includes cases where none of the variables
take missing values. As a result of these decisions, we are left with 783 observations for further
analyses.

Our interest centers on the relationship between wages, commuting time and reimburse-
ment. The hourly wage variable is the reported gross monthly salary and is measured in thou-
sands HUF. Commuting time is the time spent on traveling on an average day. Reimbursement
is a dummy variable indicating respondents who either received some reimbursement of travel
expenses or were transported to work on the cost of the employers. Note that we do not know
the exact amount of money received by the workers.

The productivity of workers is captured by gender, a dummy indicating general high-
school education and experience. The latter variable measures the number of years elapsed
since the first entry to the labor market, minus the years having been unemployed. The
reservation income is captured by the last gross wage (measured in thousands HUF) and the
unemployment rate at the place of residence. In our paper, all unemployment figures were
computed using the 2000 wave of the TSTAR database of the Hungarian Statistical Office.
They actually measure the settlement-level rate of the number of registered unemployed to the
size of the active population. The hourly wage variable is the reported gross monthly salary
and is measured in thousands HUF.

Table 1 shows the means and standard deviations of the variables used in subsequent
analyses. The average wage exceeds the minimum wage by 7.5 thousands HUF among women
and 12 thousands HUF among men. 44 percent of women and 52 percent of men receive some
compensation for travel expenses. Average commuting time is 0.88 hours (53 minutes) among
women and one hour among men, the grand mean being 56 minutes. The average commuter
thus does not travel more than one hour per day.

| TABLE 1 ABOUT HERE |

Our theoretical assumption is that persistent unemployment is maintained by the lack of
spatial mobility. A brief comparison of our estimates to estimates presented in other studies
shows that Hungarian workers do not lack spatial mobility in international comparison. Using
Dutch aggregate statistics, van der Vlist ([12]) reports an average commuting distance of 17.5
km among men and 11.0 km among women (the gross average being 15.3 km) for 1997. In
Hungary, traveling 15 kilometers using public transportation costs about 30 minutes, so the
approximately one hour commuting time seems to be consistent with the Dutch findings.
Using data from another Dutch survey conducted in 1998, Rouwendal and van Ommeren (2008) report an average of one hour for workers with reimbursement and half an hour for workers without reimbursement. Since 46% of the sample received reimbursement, the sample average is about 40 minutes. Almost the same figure, about 45 minutes is reported by Manning (2003) using the British Labour Force Survey for 1993-2001 and the British Household Panel Survey for 1991-2000. To summarize, the workers we study do not travel less than workers in Britain or the Netherlands. This is striking because our sample does omit people with good education and high earnings, who tend to commute larger distances (see, for example, [12]).

4 Empirical analyses

4.1 The relationship between commuting time, wages and reimbursement

Before making any attempt to explain the relationship between commuting and wages, we first examine the question whether there is any relationship to explain. Table 2 shows the distribution of daily commuting time, as well as mean wages and the level of reimbursement of travel expenses as a function of commuting time. The distributions are presented separately for female and male workers. The vast majority of workers (80 percent of women and 74 percent of men) do not travel more than one hour, and the proportion of workers commuting more than 2 hours is very low. The distribution of commuting distances resembles the exponential distribution among women and the log-normal distribution among men. This pattern is not surprising: since the household is supposed to be run by women, they find longer commutes more costly than men. Our descriptive findings are similar to those reported in the literature on commuting.10

TABLE 2 HERE

The distribution of commuting time is not surprising if we look at the relationship between wages and commuting time. While average wages are monotonically increasing with commuting time among men, an inverted U shaped pattern describes the relationship among women. Given our estimates, men and women should follow different commuting strategies in order to realize the highest marginal increase in wages. Men might find it rational to commute 31-60 minutes instead of 1-30 minutes because this change improves the wage of the average male

10For the United Kindom, Manning (2003b) finds that about 80 percent of employees commute less than or equal to one hour; for selected cities, an average of 4.5 km is found ([3]). For the Netherlands, van Ommeren (1996) found that half of the workers commute less than 8 kilometers and only 10 percent of workers commute more than 32 kilometers. In terms of commuting time, half of the workers commute less than 20 minutes. (These estimates use the so-called Enquete Beroepsvolking, having been conducted in 1992.) For the United States, estimates are 8.7 miles ([5]), estimates in commuting time are 22.5 minutes ([13]). Recent overviews of empirical findings ([9]) suggest that average commuting time in US cities ranges between 14 and 23 minutes and average commuting distance ranges between 14 and 25 kms.
worker by about 10 percent. However, women do not gain anything from commuting 31-60 minutes or even one and half hours; if they wish to improve their wages substantially, they should commute 2-3 hours.

The proportion of people receiving any reimbursement is an increasing function of commuting time among both sexes. Especially commuters traveling more than one and half hours receive some reimbursement with a probability equal or larger than 90 percent. However, short travels, not exceeding the half an hour value, are not likely to be covered by employers. Unlike wages, the relationship between reimbursement and commuting time does not differ substantially between men and women.

Table 2 also shows that reimbursement and wages are positively correlated among men. Keeping daily commuting time constant, the higher the wages, the higher the probability of receiving some reimbursement. This finding might seem to contradict to our theoretical model assuming the absence of intra-firm wage discrimination. If workers oppose intra-firm wage discrimination, employers are forced to pay the compensating wage premium in the form of explicit reimbursement, being independent of actual wages. The assumption of wage bargaining, which allows for intra-firm discrimination, seems to be more capable of explaining the positive correlation. Employers ready to pay high wages can pay a relatively small proportion of wages in the form of explicit reimbursement. The underlying incentive is tax-evasion: explicit reimbursement in Hungary is not taxed, therefore both employers and workers are interested in receiving a part of the wage in the form of reimbursement (see for example, Rouwendal and van Ommeren 2008). Since firms paying (and workers receiving) high wages gain more from tax evasion, the correlation between wages and reimbursement must be positive.

However, the conclusion that a positive association between wages and reimbursement is at odds with the assumption of no intra-firm wage discrimination is premature. First, both high wages and reimbursement might be caused by a third variable. For instance, larger firms pay higher wages, and these are large firms as well who are more likely to comply the legal rules prescribing the reimbursement of travel expenses. possible, we would observe an explicit wage premium that compensates for costly commuting. It is also possible that respondents who received some reimbursement misinterpreted the survey question concerning the wage and reported a higher figure.\footnote{Unfortunately, the survey question did not make it clear to the respondents that they should not think of reimbursement when they estimate or tell their wages.}

4.2 The effect of commuting time on wages

We proceed with the regression analysis of the relationship between wages and commuting time in order to estimate the net effect of commuting time. We will estimate the models as specified in Equations (13) and (14), being labeled the linear and curvilinear specifications, respectively. The models are estimating using ordinary least squares. In the literature, returns to commuting
time are often estimated using household or individual level fixed effects regressions. The aim of this modeling strategy is to minimize the bias arising from endogeneous residential choices and to remove spurious correlations arising from the effect of unobserved characteristics on both wages and commuting time. Endogeneous moving are not a concern here because our sample do not include people who have changed place of residence. We believe that the last wage, which is intended to capture the reservation income, also reflects unobserved personality traits. The assumption here is that employers can observe the personality traits that were hidden at the beginning of the match and update their beliefs about workers’ productive abilities. The last wage variable refers to the end of a worker-job match, thus it can be expected to incorporate the employers’ assessment of productive abilities. We therefore use simple ordinary least squares instead of using fixed-effects regressions.

Estimation results are presented in Table 3. While the coefficient of commuting time lacks statistical significance in the linear specification (Model 1), it is significant in the curvilinear specification (Model 2). The same applies to the interaction between commuting time and log unemployment at place of work. The significance level of other variables is not affected by the choice of specification. The interpretation of the results therefore is based on the estimates of the curvilinear specification (Model 2). As we well see, the results from Model 2 also explain why we failed to find a significant effect of commuting time in Model 1.

Since our regression models include interaction terms, the positive main effect of commuting time together with the negative main effect of its square does not imply that there is an inverted U shaped relationship between commuting time and wages. The main effects of commuting time variables are indeed conditional effects: they show the effect of commuting time provided that there is no unemployment in the place of work. If this were the case, there is indeed an inverted U shaped relationship; the wage-maximizing commuting time is about 71 minute among women and 94 minute among men. Note, however, that the interaction between log unemployment and commuting time is positive and the interaction between log unemployment and the square of commuting time is negative. This means that as unemployment at place of work increases, the relationship between commuting time and wages first becomes more and more flat then U shaped. Another implication is that the wage-maximizing commuting time approaches zero and turns into as unemployment at place of work increases. Among women, the wage maximizing commuting time is zero (or lower than zero) if unemployment

\[ \text{TABLE 3 HERE} \]

\[ \text{12The unemployment at the place of work variable (u) was logarithmized using the transformation log}_{10}(u + 1). \text{ The wage maximizing commuting time is defined by } \frac{b_1 + c_1 \log_{10}(u + 1)}{2(b_2 + c_2 \log_{10}(u + 1))}, \text{ where } b_1 \text{ is the main effect of commuting time, } b_2 \text{ is the main effect of the square of commuting time, } c_1 \text{ is the interaction between log unemployment and commuting time, and } c_2 \text{ is the interaction between log unemployment and the square of commuting time.} \]

16
at place of work is 5 percent or higher. Among men, optimal commuting time reduces to zero if unemployment at place of work is about 10 percent or higher. In our sample, the average of unemployment at place of work is about 5 percent, which explains why the commuting time variable lacked statistical significance in the linear specification (Model 1).

Our wage posting framework implies that unemployment at place of work modifies the returns to both human capital and the reservation income. More specifically, if unemployment in the center of local labor markets increases, returns to human capital should decrease but returns to the reservation income should increase. Our results do not support this prediction unambiguously. The main problem is with the coefficient of the commuting time variable. Unemployment does affect returns to commuting time, but the direction of effect is negative instead of being positive. This finding contradicts our expectations because commuting time was assumed to be a component of the reservation income, and our model predicts that the returns to reservation income should increase with unemployment at place of work. In order to explain the negative interaction effect, one must assume either that the reservation income decreases with commuting time or that longer commuting time signals a higher level of productivity. The latter assumption would be realistic if our sample consisted mainly of qualified workers with longer commutes. However, our sample includes people with low education, and further analyses (not reported here) revealed no substantial association between human capital characteristics and commuting time. The first assumption is more easy to believe: especially in local labor markets matching the monocentric model, commuters are likely to reside in smaller towns or villages where costs of living are lower. The assumption of a negative relationship between commuting time and reservation income is also consistent with one of the possible extensions of the spatial wage posting model (see subsection 2.3).

Another puzzling finding is the positive interaction effect between log unemployment at workplace and unemployment at residence among men. Our model implies that unemployment at place of work should decrease the (negative) effect of residential unemployment on wages since the latter is negatively associated with the reservation income. The finding can be explained with the assumption that unemployment at place of residence also expresses a low level of productivity. High unemployment rate are likely to undermine individual motivation, and high unemployment might also signal that the individual is coming from a poor and possibly roma community. The spatial location of the worker thus signals not only a low reservation income but also a low level of productivity.

One should also note that unemployment at place of work does not seem to modify the returns to human capital, with the exception of gender in the full sample. A straightforward explanation of the lack of empirical support concerns the characteristic of our sample. First, the sample include people who were successful in escaping unemployment. Since productive abilities deteriorate during unemployment, it might be the case that employers think of past unemployment of individuals as a dominant signal of productive abilities, which suppress other
available information, like education and experience. Besides, the discovery of interaction effects is usually difficult in samples which are larger than our sample.

4.3 The effect of commuting time on reimbursement

Finally, we examine the effect of commuting time on reimbursement. Again, we estimate both a linear and a curvilinear specification, as described in Equations (15) and (16). The estimation method is logistic regression. We omit human capital variables since they do not appear at the right-hand sides of that equations. But we do include monthly wages in order to check whether reimbursement is independent of the wage. Under the assumption of no intra-firm discrimination, the probability of receiving some reimbursement must independent of wages. If, however, reimbursement is a form of tax evasion, we should observe a positive relationship between reimbursement and wages, since the gains from tax evasion increase with wages.

The estimated coefficient are shown in Table 4. Contrary to the previous wage equations, the linear specification seems to perform better than the curvilinear one. Although the main effect of commuting time lacks statistical significance, its interaction with unemployment at place of work is positive and significant in the sample of men. This means that longer commutes imply a higher probability of receiving reimbursement only if unemployment rate is sufficiently high at the place of work. Our estimates suggest that sufficiently high means an unemployment rate of about ten percent or higher. This pattern clearly supports the theoretical prediction that unemployment should increase the returns to commuting in terms of reimbursement. Unfortunately, the interaction effect is not significant among women.

The interaction between the two unemployment variables is also significant. The negative sign is consistent with the assumption that unemployment rate at place of work is a negative indicator of reservation income, but contradicts the assumption that it is a negative indicator of productivity. In the previous analyses, we interpreted the unexpected positive interaction of the unemployment variables using the assumption that unemployment at place of residence expresses a low level of productivity. The change in the interpretation seems to be a contradiction. However, one should keep in mind that the decision on reimbursement differs from wage setting in an important respect: employers do consider productivity when deciding on wages, but they do not consider productivity when making decisions on reimbursement. If workers oppose intra-firm wage discrimination and employers establish a wage structure, the decision to reimburse travel expenses is made independently of productivity. Therefore, the finding of a negative interaction between the unemployment variables in the reimbursement regression does not contradict the positive interaction between the same variables in the wage
regression, since only the latter is affected by the fact that employers think of unemployment at place of work as a negative signal of productivity.

Under the assumption of a wage structure, the willingness to reimburse travel expenses should be independent of wages. Although this independence seems to hold among men, it is clearly a false assumption among women. In the sample of female workers, the actual wage has a positive and significant effect on the probability of receiving some reimbursement. Recall that the expected positive interaction between commuting time and unemployment at place of work is significant only among men. TRY TO EXPLAIN THIS GENDER DIFFERENCE

5 Conclusions

Observers of the persistent regional differences in unemployment argued that high costs of commuting prevent residents of high unemployment areas from finding employment in other areas. This paper examines the relationship between commuting distance, on the one hand, and wages and the receipt of explicit reimbursement, on the other. We develop a simple wage posting model, which implies not only a positive effect of commuting time on wages and reimbursement, but also that returns to commuting must be larger if the unemployment rate where jobs are situated is large as well. We test our predictions using data on low educated workers who were registered unemployed and got a job in March 2001.

We find some evidence that returns to commuting is indeed conditional on unemployment rate. First, we find a positive effect of commuting time on wages, which, however, decreases with unemployment at place of work. This conditional effect contradicts our expectation of a positive impact of unemployment on returns to commuting time. However, the found pattern can be explained with the assumption that commuting time is also a signal of low productivity: if this is the case, the observation is consistent with our wage posting model, which hypothesize a negative effect of unemployment on returns to productivity. We also find evidence among male workers that commuting time increases the probability of receiving some reimbursement of travel expenses, conditional on high unemployment at place of work. This finding is consistent with our theoretical framework.

Our research is an attempt to contribute to the explanation of persistent regional inequalities in Hungary. In regions where unemployment is high, the unemployment rate in the large towns which can be considered as CBSs have an unemployment rate of approximately 10 percent. Our findings suggest that in such a labor market commuting time is not associated with a compensating wage premium, but it is associated with a higher probability of receiving reimbursement. Although we did not observe the actual value of reimbursement, it is safe to assume that all commuting costs are never reimbursed. First, labor law prescribes that employers must reimburse a percentage of the monetary costs of travel, which is lower than 100 percent. Second, employers probably do not wish to reimburse the monetary value of time
spent on traveling. These facts together imply that employers do not compensate for costly commuting. Our study therefore supports the conclusion of previous studies: commuting is too costly to induce people living in high unemployment regions to find a work in urban areas (Köllö, 1997, 2006; Kertesi, 2000).

Our findings might suggest that reimbursement of expenses on the part of employers is a necessary condition for the reduction of persistent regional inequalities. This conclusion, however, neglects the possibility that employers will reduce labor demand as a reaction to increases in labor costs. If employers cut labor demand, it is difficult to predict the net effect of reimbursement of expenses on regional differences in unemployment rates. Knowing the precise effect of reimbursement of expenses on labor demand is a necessary condition for formulating firm policy recommendations on the basis of our empirical results.

A fundamental limitation of our study is absence of information on the level of reimbursement. Our theoretical model predicts a trade-off between wages and reimbursement. An exact test of the model predictions requires data about the amount of reimbursement received. Unfortunately, we do not have such data at our disposal. Therefore, our interpretations of the evidence is not the final word on the subject.

Our study has limitations because of the sample and the estimation method we used. A substantial limitation of our study is that our sample is probably not free of sample selection problems ([1]). Our sample was talen from a survey of unemployed, and unsuccessful job searchers are not included in the sample. This might lead to the problem of self-selection if unobserved factors determining the success of job search (getting a job) are correlated with unobserved determinants of wages or commuting decisions.

References


### Table 1
Means and standard deviations of variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Women (N=344)</th>
<th></th>
<th>Men (N=439)</th>
<th></th>
<th>Total (N=783)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>mean</td>
<td>sd</td>
<td>mean</td>
<td>sd</td>
<td>mean</td>
<td>sd</td>
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<td>Dependent variables</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>gross monthly wage</td>
<td>47.536</td>
<td>12.333</td>
<td>55.764</td>
<td>17.658</td>
<td>52.149</td>
<td>16.064</td>
</tr>
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<td>log monthly wage</td>
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<td>0.212</td>
<td>3.978</td>
<td>0.283</td>
<td>3.916</td>
<td>0.264</td>
</tr>
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<td>Receipt of reimbursement</td>
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<td>0.498</td>
<td>0.517</td>
<td>0.5</td>
<td>0.485</td>
<td>0.5</td>
</tr>
<tr>
<td>Independent variables</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commuting time</td>
<td>0.881</td>
<td>0.638</td>
<td>0.987</td>
<td>0.714</td>
<td>0.941</td>
<td>0.683</td>
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<td>1.893</td>
<td>1.483</td>
<td>2.283</td>
<td>1.351</td>
<td>2.124</td>
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<td>Last monthly wage</td>
<td>45.163</td>
<td>48.419</td>
<td>52.417</td>
<td>28.782</td>
<td>49.23</td>
<td>38.798</td>
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<td>Unemployment rate at place of residence</td>
<td>5.488</td>
<td>2.77</td>
<td>5.979</td>
<td>3.512</td>
<td>5.764</td>
<td>3.215</td>
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<td>Log unemployment rate at place of work</td>
<td>0.74</td>
<td>0.159</td>
<td>0.753</td>
<td>0.158</td>
<td>0.747</td>
<td>0.158</td>
</tr>
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<td>Interaction of log unemployment at workplace with Commuting time</td>
<td>0.631</td>
<td>0.447</td>
<td>0.722</td>
<td>0.516</td>
<td>0.682</td>
<td>0.489</td>
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<tr>
<td>Commuting time squared</td>
<td>0.82</td>
<td>1.264</td>
<td>1.06</td>
<td>1.58</td>
<td>0.955</td>
<td>1.453</td>
</tr>
<tr>
<td>Last monthly wage</td>
<td>32.595</td>
<td>33.343</td>
<td>38.674</td>
<td>21.476</td>
<td>36.003</td>
<td>27.478</td>
</tr>
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<td>Unemployment rate at place of residence</td>
<td>4.387</td>
<td>3.284</td>
<td>4.877</td>
<td>4.246</td>
<td>4.662</td>
<td>3.858</td>
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</table>

### Table 2
Distribution of wages and reimbursement by commuting distance

<table>
<thead>
<tr>
<th>Commuting time</th>
<th>N</th>
<th>Women</th>
<th>Men</th>
<th>% receive reimbursement</th>
<th>N</th>
<th>Men</th>
<th>% receive reimbursement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Mean</td>
<td>Mean</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>wage</td>
<td>wage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-30 minutes</td>
<td>144</td>
<td>45.94</td>
<td>51.97</td>
<td>15.97</td>
<td>156</td>
<td>51.97</td>
<td>19.87</td>
</tr>
<tr>
<td>31-60 minutes</td>
<td>133</td>
<td>46.99</td>
<td>56.64</td>
<td>15.79</td>
<td>167</td>
<td>56.49</td>
<td>58.68</td>
</tr>
<tr>
<td>61-90 minutes</td>
<td>27</td>
<td>46.59</td>
<td>70.37</td>
<td>9.77</td>
<td>44</td>
<td>57.31</td>
<td>72.73</td>
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<tr>
<td>91-120 minutes</td>
<td>26</td>
<td>51.6</td>
<td>92.31</td>
<td>5.31</td>
<td>50</td>
<td>60.3</td>
<td>90.00</td>
</tr>
<tr>
<td>121-180 minutes</td>
<td>12</td>
<td>66.04</td>
<td>63.45</td>
<td>91.67</td>
<td>19</td>
<td>63.45</td>
<td>94.74</td>
</tr>
<tr>
<td>181-240 minutes</td>
<td>2</td>
<td>47.5</td>
<td>65.67</td>
<td>100.00</td>
<td>3</td>
<td>65.67</td>
<td>100.00</td>
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Table 3
Estimates of linear regressions of log monthly wages

<table>
<thead>
<tr>
<th>Variable</th>
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<th>Men</th>
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<tr>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
<td>Model 1</td>
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<td><strong>Main effects</strong></td>
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<td>0.0428</td>
<td>0.4536*</td>
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</tr>
<tr>
<td></td>
<td>(0.242)</td>
<td>(0.007)</td>
<td>(0.484)</td>
</tr>
<tr>
<td>Commuting time squared</td>
<td>-0.1572*</td>
<td>-0.2141</td>
<td>-0.1502*</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.021)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>Last monthly wage</td>
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<td>0.0003</td>
<td>0.0042</td>
</tr>
<tr>
<td></td>
<td>(0.436)</td>
<td>(0.421)</td>
<td>(0.060)</td>
</tr>
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<td>-0.0313*</td>
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</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.002)</td>
<td>(0.483)</td>
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<tr>
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<td>0.0022</td>
<td>-0.0111</td>
</tr>
<tr>
<td></td>
<td>(0.439)</td>
<td>(0.436)</td>
<td>(0.293)</td>
</tr>
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<td></td>
<td>(0.460)</td>
<td>(0.483)</td>
<td>(0.285)</td>
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<td>(0.017)</td>
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<td></td>
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<td>(0.000)</td>
<td></td>
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<td></td>
<td>(0.189)</td>
<td>(0.397)</td>
<td>(0.320)</td>
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<tr>
<td><strong>Interaction of log unemployment at workplace with</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commuting time</td>
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<td>0.0855</td>
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<td>(0.349)</td>
<td>(0.023)</td>
<td>(0.217)</td>
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<td></td>
<td>(0.015)</td>
<td></td>
<td>(0.015)</td>
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<td>(0.288)</td>
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<td>(0.081)</td>
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<td>(0.492)</td>
<td>(0.487)</td>
<td>(0.149)</td>
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<td>-0.0009</td>
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<td>(0.159)</td>
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<td>(0.165)</td>
<td>(0.189)</td>
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<td>Male</td>
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<td>-0.3069*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.003)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>3.8573*</td>
<td>3.6910*</td>
<td>3.8007*</td>
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<td></td>
<td>(0.000)</td>
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Notes: Numbers in parentheses are p-values.
Table 4
Logistic regression of receipt of reimbursement

<table>
<thead>
<tr>
<th>Variable</th>
<th>All</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Women</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Men</th>
<th>Model 1</th>
<th>Model 2</th>
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<tbody>
<tr>
<td><strong>Main effects</strong></td>
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<tr>
<td>Commuting time</td>
<td>0.2548</td>
<td>0.6268</td>
<td>1.6692</td>
<td>4.7338</td>
<td>-0.6737</td>
<td>-0.1338</td>
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<td></td>
<td>(0.782)</td>
<td>(0.81)</td>
<td>(0.253)</td>
<td>(0.329)</td>
<td>(0.579)</td>
<td>(0.968)</td>
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</tr>
<tr>
<td>Commuting time squared</td>
<td>0.1438</td>
<td>-1.1379</td>
<td>0.1064</td>
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</tr>
<tr>
<td></td>
<td>(0.89)</td>
<td>(0.545)</td>
<td>(0.937)</td>
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<td></td>
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</tr>
<tr>
<td>Last monthly wage</td>
<td>-0.0106</td>
<td>-0.0096</td>
<td>0.0345</td>
<td>0.039</td>
<td>0.0012</td>
<td>0.0011</td>
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<tr>
<td></td>
<td>(0.536)</td>
<td>(0.579)</td>
<td>(0.395)</td>
<td>(0.341)</td>
<td>(0.959)</td>
<td>(0.962)</td>
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<td>Unemployment rate at place of residence</td>
<td>0.6213*</td>
<td>0.5956*</td>
<td>1.0679*</td>
<td>1.0099*</td>
<td>0.5116*</td>
<td>0.5015*</td>
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<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
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<tr>
<td>Log unemployment rate at place of work</td>
<td>-3.9507*</td>
<td>-4.2657</td>
<td>0.2036</td>
<td>1.4248</td>
<td>-4.13</td>
<td>-4.3302</td>
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<tr>
<td></td>
<td>(0.029)</td>
<td>(0.067)</td>
<td>(0.953)</td>
<td>(0.763)</td>
<td>(0.103)</td>
<td>(0.159)</td>
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<td>Gross monthly wage</td>
<td>0.009</td>
<td>0.0095</td>
<td>0.0472*</td>
<td>0.05*</td>
<td>-0.0059</td>
<td>-0.0059</td>
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<td></td>
<td>(0.123)</td>
<td>(0.106)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.448)</td>
<td>(0.452)</td>
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<tr>
<td><strong>Interaction of log unemployment at workplace with</strong> Commuting time</td>
<td>2.7301*</td>
<td>4.2519</td>
<td>1.0587</td>
<td>-0.8962</td>
<td>3.9504*</td>
<td>5.0329</td>
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<td></td>
<td>(0.032)</td>
<td>(0.245)</td>
<td>(0.581)</td>
<td>(0.897)</td>
<td>(0.02)</td>
<td>(0.276)</td>
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<tr>
<td>Commuting time squared</td>
<td>-1.1209</td>
<td>0.5465</td>
<td>-0.9616</td>
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<tr>
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<td>(0.461)</td>
<td>(0.845)</td>
<td>(0.623)</td>
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<tr>
<td>Last monthly wage</td>
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<td>0.015</td>
<td>-0.0553</td>
<td>-0.0612</td>
<td>0.0095</td>
<td>0.0095</td>
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<td></td>
<td>(0.500)</td>
<td>(0.540)</td>
<td>(0.340)</td>
<td>(0.295)</td>
<td>(0.757)</td>
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<tr>
<td>Unemployment rate at place of residence</td>
<td>-0.4298*</td>
<td>-0.4003*</td>
<td>-0.8071*</td>
<td>-0.7468*</td>
<td>-0.3655*</td>
<td>-0.3488*</td>
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<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.011)</td>
<td>(0.017)</td>
<td>(0.018)</td>
<td>(0.02)</td>
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<tr>
<td>Constant</td>
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<td>-1.5652</td>
<td>-6.6813*</td>
<td>-8.373*</td>
<td>-0.1575</td>
<td>-0.6072</td>
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<td>(0.405)</td>
<td>(0.368)</td>
<td>(0.014)</td>
<td>(0.022)</td>
<td>(0.935)</td>
<td>(0.792)</td>
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