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Being a long distance out-commuter or home employee in a rather peripheral region evidence of a German federal state

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Abstract Many firms in Germany are short of qualified workers, whereby East German regions are particularly affected because of the out-migration to West Germany after the reunification. This gives rise to an important debate for regional policy as the shortage of workers is a major challenge for each region and firm. In this context, out-commuters—workers who commute to work in another region—become an important group of employees to potentially satisfy local labour needs. In this study, we take a closer look at out-commuters in a particular eastern German region—the Federal State Mecklenburg-Vorpommern (MV)—and address the question whether out-commuters are a selective group of individuals working in e.g. occupations or industries that are rarely needed for labour market requirements in MV. Further, we focus on the wage differential between out-commuters and workers who are living and working in MV (home employees). The determination of the factors that explain this wage gap can provide new insights and a deeper understanding of the labour market in MV. This can provide a basis to work out potential strategies to attract the group of out-commuters for a workplace in MV to reduce the complained labour shortage. The derived evidence suggests that only few out-commuters can be recalled, as the labour demand in MV and the respective wage level are too low and the economic structure is too weak to sufficiently gain back out-commuters. Especially females suffer from the job-market weakness in MV.

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1 Introduction

Within countries, inter-regional commuting is increasing in the EU (European Commission 2017; DGB 2016), i.e. workers leave the region of residence and commute to another region for job related reasons. For example, in Germany the number of workers leaving their communities to work increased from 14.9 million in 2010 to 19.3 million in 2018, which is nearly half of the German labour force. Such inter-regional commuting can lead not only to personal, environmental and societal changes, like lower life satisfaction and increased congestion (Frey and Stutzer 2007; Wang 2001). It also results in a loss of workforce for the region of out-commuting. This outflow of labour can be particularly serious for regions that claim a shortage of labour.

One of these regions is East Germany. After the German re-unification in 1991, East Germany was characterised by high unemployment, low wages and less growth perspectives compared to the western parts (Blien et al. 2016). As a result, especially, young people out-migrated from East Germany (Kröll and Niebuhr 2008; Fuchs-Schündeln and Schündeln 2009). Although, economic conditions in East Germany have improved and outmigration reached balanced levels (Nadler and Wesling 2003), there is still a large number of workers commuting out of eastern German regions to the West. Outmigration from East Germany and a low birth rate in the 1990th have left its mark: the age structure is characterised by a higher proportion of elderly people, resulting in a shortage of young workers (Schwengler and Hirschenauer 2015). This is already asserted by Burkard (2010) and showing in an analysis of the IAB-Establishment Panel: firms in East Germany were unable to fill 33% of training positions in the training year 2014/2015 (Dummert et al. 2019)—which can be attributed to a shortage of applicants. This situation gives rise to an important debate for regional policy and policy makers as the shortage of workers can be seen as a major challenge to regional development and social welfare. In this context, out-commuters—workers who commute to work in another region—become an important group of employees to satisfy local labour needs as they are already available in the particular “home” region. The win-back of this workforce can reduce local labor shortages.

Generally, commuting between different regions might be the result of strategic choices that balance housing and living costs, family, wage differentials, employment opportunities as well as job accessibility and job availability (Bunel and Tovar 2014; Eliasson et al. 2003; Reggiani et al. 2011; Bergantino and Madio 2018). This could be especially important for workers commuting between regions that differ in labour market conditions, like East and West Germany. In particular, regarding wages and

unemployment¹, the differences to West Germany are still visible (Brenke 2014). People living in East Germany are consequently disadvantaged in many respects: (i) they face lower wages, (ii) working conditions are not comparable (work council, career possibilities), and (iii) they face higher unemployment resulting in fewer job opportunities (Blien et al. 2010). Such factors push workers to cross regional borders (van Ham et al. 2001; Reggiani et al. 2011), either by migration or commuting.

However, migration flows between the East and West are currently balanced, but both out-commuting (commuting from East to West Germany) and the distances workers commute are increasing. This increase in long-distance commuting can be seen as a reason for the decrease in inter-regional migration decisions (Green et al. 1999; Lundholm et al. 2004). The lower migration propensity can be explained by the fact that individuals who live for a long period in the same place develop social networks, have families and children as well as home ownership. Their attachment to this region is therefore very strong, which is why they decide to commute and not to migrate. This is also further enhanced by the improvements in infrastructure and the information and communication technology (Sandow and Westin 2010) that makes it easier for employees to cover long distances and cross regional borders.

From the MV employer perspective, who claim labour-shortages, it is important to understand why people commute out and face the costs of long-distance commuting. The aim of this study is therefore to investigate factors—individual, job-related and establishment characteristics—that distinguish the group of long-distance out-commuters from the group of workers who live and work within the same region (home employees). A qualification-related mismatch results, if we find that both groups, out-commuters and home employees differ in terms of individual and firm characteristics. If both groups are however more identical, it would be easier for policy measures to win back the group of out-commuters. Additionally, as theory and empirical evidence show that wages are a main factor for long-distance commuting (van Ommeren and Fosgerau 2009; Brueckner 2000; Manning 2003; Green et al. 2019), we pay particular attention on the wage differential between the group of out-commuters and home employees (Bergantino and Madio 2018). Our study provides new insights and a deeper understanding of the labour market conditions in East Germany and the issue of out-commuting and show what regions with worse labour market conditions can do to attract back the skilled workers who are working outside their residence region. In particular, if the payments of both regions are not competitive a win-back campaign is potentially less successful.

For this study, we consider a particular region of East Germany, namely Mecklenburg-Vorpommern (MV). Although Wicht et al. (2020) discuss, why functional regions might be superior in the analysis above administrative regions, our research topic of a win-back-campaign is bounded to the administrative borders of MV. MV is not only characterised by workers leaving their regions for job related reasons but is also still worse to the west in terms of economic conditions, like the wage level and labour market opportunities (Blien et al. 2016). In addition, MV offers a particularly

¹ Although the unemployment rate has fallen significantly in East Germany in recent years, it is still higher than in West Germany (Granato et al. 2009). Moreover, the decline is in particular due to the falling number of workers in the east—more and more workers in East Germany are retiring.



Fig. 1 Out-commuting flows from MV to other federal states (main destinations)

good basis for investigation, since it is located at the boarder to West Germany and provides workers a good opportunity living in MV and working in West Germany. Close to the western parts of MV is the metropolitan area of Hamburg, which has good labour market opportunities as well. In general, MV has a high proportion of peripheral regions with low population densities. In the West of MV there is the capital city Schwerin, with almost 100,000 inhabitants, surrounded by rather peripheral regions. Kropp and Schwengler (2017) show, that the western parts of MV may be assigned to the functional labour market of Hamburg. Rostock as a harbour city is the largest city with about 245,000 inhabitants. Stralsund, Greifswald, Neubrandenburg and Wismar are other cities with about 30–70,000 inhabitants and are spread all over the federal state. In total, about 1.6 Mio people live currently in MV and the population density is less than 70 people per square kilometre including the cities (about 35 excluding cities). MV is characterized by an aging society—the proportion of elderly people is relatively higher compared to other regions and Federal States. According to Bode et al. (2023) productivity growth might be low and thus, future perspectives in MV not as good as in more prosperous regions. Currently, there is one in-commuter relative to approximately 4.5 out-commuters and thus, commuting flows are not balanced. In-commuters are usually not highly skilled, and interestingly, the proportion of youngsters is relatively higher. An overview of out-commuting flows to various destinations is provided in Fig. 1. For example, 17% of out-commuters from MV commute to Hamburg, while 10.1% work in Berlin.

Our study contributes to the literature in several ways. First, we contribute to the literature on inter-regional commuting and analyse individual and firm characteristics that cause individuals to live in one region and work in another region (Castelli and Parenti 2020; Parenti and Tealdi 2019; Sandow and Westin 2010). By adopting probit regressions, we work out characteristics in a multivariate setting, which significantly differ between the groups under investigation. Second, our study adds to the literature on long-distance commuting by examining commuting between extensive labour markets rather than focusing only on commuting within cities, as is usually the case in the literature (Andersson et al. 2018). Third, we determine individual and firm-specific characteristics that explain the wage gap between the group of out-commuters and home employees by showing how the wage setting differs between the region of migration and emigration (Bergantino and Madio 2018). In order to identify the determinants that explain the wage gap, we resort to the decomposition technique introduced by Oaxaca (1973) and Blinder (1973). Forth, we make use of a vast data basis provided by the Institute for Employment Research, the Integrated Employment Biographies, IEB. This data basis covers all individuals working subject to social security contributions and represents a comprehensive source of individual as well as firm information. Last, due to the distinction between men and women we reveal gender-specific differences in individual and firm-specific characteristics which explain out-commuting and wage disparities.

In fact, our results indicate different reasons why women and men commute long distances and cross regional borders. While men commute out for higher wages and better career opportunities, the results for women indicate that they commute out to avoid unemployment. MV has not only weak labour market conditions, but especially for women there is not even a demand for labour and thus it is rather difficult to attract back the group of out-commuters. However, as the individuals do not out-migrate, there must be additional unobserved factors (related to migration costs) that keep individuals living in MV.

The remaining paper is structured as follows. Section 2 provides insights into long-distance commuting and related literature. Section 3 discusses the empirical design, describes the data and the methodological approach. The descriptive analysis is shown in Sect. 4, while Sect. 5 reports the results of the probit model and the Oaxaca-Blinder decomposition. Finally, Sect. 6 concludes.

2 Related literature

Whenever the place of work differs from the place of residence, commuting is necessary when remote work is not applicable. Commuting is hence an elementary, time-consuming part of most workers' day and an important requirement to match employees and employers. Commuting can occur in a wide-ranging regional setting as workers can cross regional borders and commute long-distances leading workers to reach an even more distant labour market. Labor market conditions, the housing market as well as individual and job characteristics are important determinants of long-distance commuting.

In particular, the standard urban theory implies a negative relationship between urban density and commuting distances: people living in sparsely populated labor markets commute longer than those in urbanized areas as urban areas are denoted the centre of employment opportunities (Rouwendal and Nijkamp 2004). Since land prices decrease gradually from the centre to rural areas and housing is limited in the centre, workers are faced with a trade-off between living in the centre and paying higher rents or living outside where rents are lower, but commuting ways are longer. In this context, literature on housing market characteristics find that high housing prices increase long-distance commuting in-flows because of their deterrent effect on in-migration (Muellbauer and Cameron 1998). The reason is that regions with high wage levels attract workers, but high housing prices in these regions cause workers to live outside. This in turn leads to inter-regional long-distance commuting. Housing prices, especially in rural regions such as in MV are significantly lower than in the neighbouring larger cities in western Germany such as in Hamburg. This can make commuting a more attractive way than migration into these regions (Muellbauer and Cameron 1998). For example, for the UK, Bergantino and Madio (2018) explain the inter-regional commuting behaviour caused by regional wage differentials. In this sense, Renkow and Hoover (2002) show that longer commutes are traded for lower housing prices in rural areas, which increases long-distance commuting between these two kinds of regions (Andersson et al. 2018, Zax 1991). In addition, Andersson et al. (2018) shows that the number of those long-distance commuters who travel more than 100km from rural to urban areas rises.

Gender plays also a fundamental role on commuting patterns: men commute longer than women (Sang et al. 2011; Gimenez-Nadal et al. 2022). Women earn less than men (MacDonald 1999) what makes commuting long distances less attractive according to the willingness-to-commute literature (Le Barbanchon et al. 2021; Dauth and Haller 2020). Females work more frequently in occupations that are geographically more evenly distributed (Halfacree 1995; Hanson and Pratt 1995), leading to smaller commuting distances. Women's commuting patterns are also constrained by household and family involvements (Gimenez-Nadal and Molina 2016). In addition, commuting distance increases for full-time workers (McQuaid and Chen 2012) and females are more often engaged in part-time work, which is lower paid. Again, as a result commuting distance is lower.

Age is another important determinant of commuting decisions; however, the relationship is not entirely evident. While older workers have longer working experience, which would lower the willingness to accept longer commuting distances (Booth et al. 1999), older workers are home-owners or have family obligations that could increase the propensity to commute (van Ham et al. 2001).

Another common finding is that commuting increase with the education level: more educated workers are more mobile. They have to search longer for jobs because their job market is concentrated to a limited number of locations (especially to larger centres) and are thus not evenly distributed across space (Börsch-Supan 1990; Sandow 2008). In this context Huber (2014) derives theoretical arguments of the impact of individual education on being a commuter or home employee and provides empirical evidence that out-commuters are better skilled. According to Dargay and Clark (2012) high educated workers earn better than low skilled workers

which makes it more profitable for them to commute longer distances. High earning households have preferences for larger living space, so they choose to live in the suburbs where housing prices and rents are cheaper and accept longer commuting ways (Brueckner 2000).

However, when out-commuters work in distinct regional labor markets, differences in wages may be driven by differences in productivity, caused by differences in firm, industrial and occupational structure. This is confirmed by several studies explicitly showing that individual wages are affected by firm characteristics (Brixy et al. 2022; Schmid 2023; Dostie et al. 2020; Brunow and Jost 2022).

The literature review provides theoretical and empirically justified arguments for long-distance commuting. The complexity of mobility choices depends on sociodemographic characteristics, such as age and gender, education attainment, job characteristics and the occupation, labour market aspects, wages, firm productivity, among others. With MV being a rather rural region in Germany with relatively poor labour market conditions, it offers a good object of study to foresee potential future problems regarding labour supply in MV and East Germany.

3 Empirical design

3.1 Data and sample

In this study, we use the Integrated Employment Biographies (IEB, version V13.01.01-190111) provided by the Institute for Employment Research (IAB) of the Federal Employment Agency in Germany. This data basis results from the administrative process of the German Social Security System and is highly reliable. The data covers individuals working subject to social security contributions, self-employed and civil servants are excluded. It can be aggregated to any higher level of aggregation, such as firm and region because of unique identifiers.

The sample comprises all individuals who live in MV at some moment in time since 1999, as the place of residence is collected since then. However, in the analysis we restrict to the day of September 15, 2017². Additionally, we draw a 10% sample of all individuals working in the destination regions of the out-commuters. Although the analysis builds on a cross-section of individuals, we make use of the entire individual labour market biographies to construct measures of the individual performance in the past, such as job-changing behaviour and unemployment periods. These measures control for unobserved heterogeneity in part.

Further, we perform two proven data corrections: the first one corrects the education-related variable following the procedure suggested by Fitzenberger et al. (2005). For the second one we follow Card et al. (2013) and use an imputation method that overcomes the truncation of wages top-coded at the social security contribution ceiling. From the sample we exclude individuals with unknown education (i.e. missing information) and individuals working in so called “mini-jobs”. These are jobs with-

² The reference day is chosen to balance seasonal frictions (summer-winter employment levels) and because most of young individuals start their apprenticeship and are not potentially registered as unemployed.

out social security contributions and earnings of up to 400€ per month. We restrict the sample to German employees only, because less than 2% of all employees are foreigners, of which 90% out-commute. We exclude 10,592 foreigners because of their specificity.

The group of out-commuters comprises all employees living in MV and working outside MV and commute at least 34 kilometres, which corresponds to a travel time of 30 minutes. We exclude the group of out-commuting workers with commuting time up to 30 minutes (approx. 8000 cases, 11% of all out-commuters). We find that 75% of all home employees commute up to 30 minutes. Therefore, we assume that commuting times up to 30 minutes are acceptable and that each out-commuter with commuting times up to 30 minutes would accept a job offer within MV immediately. Additionally, individuals from outside MV may have relocate into MV because of lower housing costs and became in that way an out-commuter in MV. The 30 minutes/34 kilometres restriction is further comparable to other studies, e.g. Sandow and Westin (2010) who investigate long-distance commuting in sparsely populated areas in Sweden. This long-distance out-commuters we further refer to out-commuters.

After data preparation, the data set comprises 485,673 home employees and another 58,554 out-commuters.

3.2 The comparison groups in detail

This study has two objectives. First, the study aims to identify characteristics that increase the likelihood that workers are living in MV and out-commute. Second, we are interested in the explanation of the wage gap between the group of out-commuters and different reference groups.

For this purpose, we compare the group of out-commuters with the group of home employees. In addition, we compare the group of out-commuters to a group of home employees with commuting distances up to 34 kilometres (long-distance home commuters). Out-commuters and long-distance home commuters should be similar regarding commuting costs and thus after theory rather similar regarding their characteristics. In particular, if there are insignificant differences between these two long-distance commuting groups, it would indicate less job opportunities within MV, leading to the need to out-commute in order to avoid unemployment. If there are still significant differences, it indicates a mismatch, that their qualification is not requested in MV.

Lastly, we compare out-commuters with those workers in the destination region. This shows if the group of out-commuters is similar in their characteristics compared to workers in the destination region and give additional insights into push and pull factors of out-commuting.

3.3 Variables

There are two variables which are subject of our investigation. The first one is the binary variable of being an out-commuter or home/destination employee. The second variable is the wage an employee earns.

Table 1 Explanatory Variables

	Characteristics
Occupations	Indicator for 36 distinct occupations (based on the classification of occupations 2010 KldB2010, equiv. to ISCO-08; excluding military services)
Tasks	Indicator for unskilled labour—skilled labour (reference)—specialists/experts
Leading responsibility	Indicator for supervision responsibility Indicator for leading responsibility (reference: neither of both)
Vocational training	Indicator for no vocational training—vocational training (reference)—university degree Indicator for working as foreman (German Meister/Polier) (Additional training)
Firm characteristics	Firm size (indicators for number of employees) Proportion of human capital and females
Industry	Indicator for industry (NACE, 2-digit)
Individual age	Age (indicators for 5 age groups)
Full-time	Indicator for full-time or part-time
Unemployment	Indicators representing the share of time spent in unemployment (<5% reference, 5% < 10%, 10% < 25%, < 25%)
Experience	Duration at the current employer (firm experience) Average employment duration at different employers (work experience)
Regional indicators	5 labour market region indicators measured at the place of residence (based on Eckey et al., 2006)

To explain the variables of interest we consider the characteristics as reported in Table 1, and that have been identified in previous studies (see Sect. 2).

3.4 Methodological approach

The choice of a reference day Although a Panel data set would be preferred to capture unobserved heterogeneity, structural changes at the firm level and, as a consequence, at the labour market lead to differences in coefficients when time passes by. Such time-related heterogeneity makes interpretation difficult. Especially in the wage analysis, changing parameters make an interpretation impossible, that disentangles the effect of structural changes from the potential different distributions of characteristics between the comparison groups. For this reason, we consider a cross-section. The September 15 is chosen, because at this date usually school and apprenticeship leavers are in employment and seasonal effects are not as pronounced.

Who is an out-commuter? We use a Probit model to identify significant group differences of characteristics that increase the likelihood that workers out-commute. As suggested by existing literature, we consider women and men separately.

What explains the wage gap? To explain the wage difference between the group of out-commutes and home (destination) employees we use the Oaxaca-Blinder decomposition (OB-decomposition) according to Jones and Kelley (1984). The estimation relies on the Mincerian earnings function as a theoretical workhorse for

the wage setting on the labour market. To perform the OB-decomposition, for both groups—out-commuters and home-employees—a separate wage equation is estimated by OLS. The OB-decomposition splits the wage differential into an explained part consisting of differences in endowments, an unexplained part consisting of differences in coefficients and an interaction term. The endowment effect states: *How much more/less would a home/destination employee earn adjusting the average endowment (i.e. the average x-values) to the level of the out-commuter.* Differences in endowments therefore indicate an unequal distribution of characteristics and would thus indicate a mismatch for out-commuters. There qualification/characteristics are not as frequent demanded in MV. The coefficient effect indicates differences in the slopes of the estimated Mincerian wage equations. The interpretation of the coefficient effect is as follows: *How much would an average home/destination employee earn more/less adjusting the coefficient to the level of the out-commuters.* We relate these different returns to characteristics as structural differences in payment schemes. Employers in MV might become more competitive, when returns to characteristics are treaded in a way as for out-commuters. Lastly, the interaction effect considers the simultaneous adjustment of differences in endowments and coefficients. Concerning the interpretation, we adjust the wage levels of home-employees to the level of out-commuters. This is a matter of choice and does not bias results in any respect. From a policy perspective, it provides insights on potential, required wage increases to become competitive with other regions; at least with payment levels of out-commuters.

4 Descriptive analysis

According to Table 2 the number of out-commuters is more than twice as high for males than for females. Comparing female and male long-distance home employees it can also be observed a larger number of males. Thus, men commute longer distances than women. Various studies confirm this gender specific commuting pattern (Dargay and Clark 2012; McQuaid and Chen 2012; Gimenez-Nadal et al. 2022).

Considering the age structure of home-employees and out-commuters in Table 2, shows slightly higher proportions of older workers among male out commuters. In contrast, female out-commuters are slightly younger. The age structure of long-distance home employees is comparable to the age structure of home employees. In addition, the comparison of out-commuters with destination employees shows that male out-commutes are older, while female out-commuters are younger.

Out-commuting might be a result of a job-characteristics mismatch at the labour market. Table 2 therefore shows the distribution according to tasks. Indeed, there are relative more employees working as specialists and experts among male and female out-commuters, indicating a specific brain drain. However, for women we also observe a slightly higher share for unskilled labour.

Further, Table 2 reveals substantial wage differences between home employees and out-commuters: gross daily wages are about 28 € higher (approximately 840 € monthly) for males. For females, wages of out-commuters are higher, but with about 12 € (357 € monthly), less lucrative for out-commuting when subtracting commut-

Table 2 Age distribution, task level and median wages

	Home employees		Out-commuters		Long-distance home employees		Destination employees	
	Women	Men	Women	Men	Women	Men	Women	Men
<i>Age structure %</i>								
<25 years	5.6	7.3	7.1	3.6	7.9	7.47	5.2	5.5
25–34 years	18.7	21.7	23.4	18.1	20.1	20.8	20.5	22.9
35–44 years	20.3	21.7	21.7	21.6	20.3	21.3	21.0	22.3
45–54 years	29.2	26.0	25.9	30.3	27.7	26.7	31.0	28.9
>= 55 years	26.4	23.3	21.9	26.5	24.0	23.8	22.2	20.4
<i>Task levels %</i>								
Unskilled labour	14.0	12.5	15.2	8.9	13.2	10.5	13.8	11.6
Skilled labour	64.4	66.6	57.3	61.3	61.1	65.1	63.2	57.0
Specialists/experts	21.6	20.9	27.5	29.9	25.7	24.5	23.0	31.4
<i>Median wage (€/day)</i>								
<25 years	36.3	33.5	36.2	42.8	34.4	34.1	70.0	79.4
25–34 years	61.8	70.5	77.0	92.0	68.6	75.4	83.8	100.8
35–44 years	64.1	76.3	80.7	105.1	74.6	82.2	74.0	114.8
45–54 years	69.2	78.9	81.6	109.9	78.9	86.5	76.4	121.0
>= 55 years	70.1	78.6	80.1	104.7	82.0	86.2	74.1	115.3
<i>Median wage (€/day)</i>								
Unskilled labour	47.56	59.2	46	70.3	45.4	59.0	50.3	76.5
Skilled labour	62.44	70.9	73.06	92.2	69.0	74.8	74.5	100.9
Specialists/experts	103.04	117.9	115.44	153.4	105.8	122.4	110.6	159.1
<i>Median wage (€/day)</i>	64.7	73.8	76.6	101.6	72.5	80.0	77.1	110.8
<i>N</i>	252,591	233,082	16,523	42,031	36,082	48,560	1,143,825	1,268,436

Source: IEB version V13.01.01-190111, own calculation

ing costs. In addition, out-commuting is beneficial for better skilled. Surprisingly, out-commuting unskilled females earn even 5€ less per day. In comparison with long-distance home commuters, out-commuting males earn still substantially more. For females, there is a benefit as well but less pronounced. Sandow and Westin (2010) confirm such findings by considering long distance commuters in Sweden. Comparing the wage of out-commuters with the wage of destination employees, male commuters earn about 10€ less, depending on the age group, for out-commuting females' wages are slightly higher.

The descriptive results show first evidence of group differences in characteristics and especially between men and women out-commuting seems more lucrative for

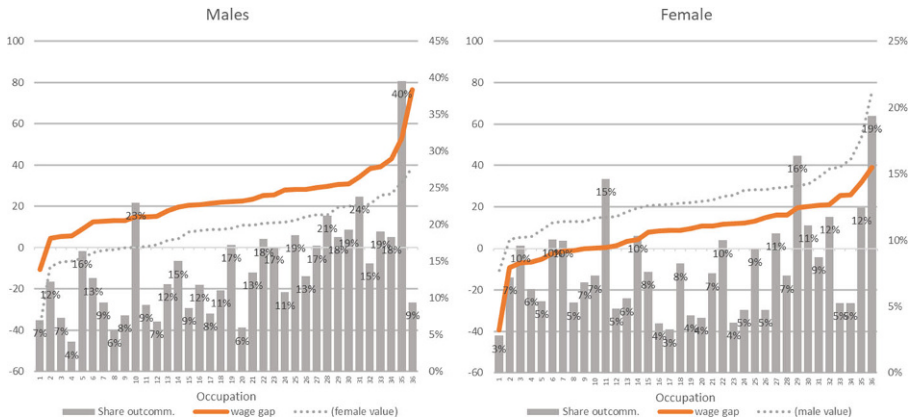


Fig. 2 Wage gap and out-commuting shares by occupations (list of occupations see Table 8)

males as they benefit even more from higher wages. The results show that wages in MV are lower even for those workers who commute long distances in MV.

Figure 2 shows the wage gap between both group's home-employees and out-commuters (orange line, left y-axis) and the proportion of employees within each occupation who out-commute (grey bars, right y-axis), separated by 36 occupations (labels are provided in Table 8) and gender. To give an example: for males, the out-commuting share of more than 40% is in mining occupations. In this occupation employed out-commuting males earn 53 € per day more compared to home-employees. It is worth mentioning, that for about 19% of all out-commuting females, the median gross daily wage differential is negative. These females out-commute and receive less wages compared to female home-employees in the same occupation. They have to pay twice: first, lower wages and second, more time and travel costs that they spend for mobility.

5 Multivariate regression results

5.1 Who is an out-commuter?

Table 3 presents the estimates of the probit model to identify group differences between out-commuters and home/destination employees separated by gender. Within each block, the first column considers differences between out-commuters and home employees. The second column shows differences between out-commuters and long-distance home employees, while the third column reveals the results comparing out-commuters with employees in the destination region. In each estimation, all coefficients are jointly significant. Because we are not interested in the magnitude to become an out-commuter but in the differences in characteristics between both groups, we only interpret the signs of the estimates.

The results show that out-commuters are relatively older than home-employees. Younger workers—men and women—are less likely to be out-commuters. This holds

Table 3 Probit regression on being an out-commuter

Comparison group to out-commuters	Men			Women		
	Home employees (I)	Long dist. home empl. (II)	Destination employee (III)	Home employees (I)	Long dist. home empl. (II)	Destination employee (III)
Individual characteristics						
Age 16–24	–0.737*** (0.019)	–0.662*** (0.026)	0.849*** (0.018)	–0.385*** (0.023)	–0.405*** (0.033)	1.112*** (0.023)
Age 25–34	–0.177*** (0.010)	–0.128*** (0.014)	–0.020* (0.012)	–0.079*** (0.013)	–0.040** (0.019)	0.004 (0.016)
Age 45–54	0.139*** (0.009)	0.077*** (0.013)	0.105*** (0.011)	0.052*** (0.012)	–0.001 (0.018)	0.007 (0.016)
Age 55–64	0.175*** (0.010)	0.099*** (0.013)	0.159*** (0.012)	0.084*** (0.013)	0.035* (0.019)	0.071*** (0.017)
Unskilled labour	–0.086*** (0.013)	0.005 (0.018)	0.239*** (0.020)	0.109*** (0.015)	0.175*** (0.023)	0.258*** (0.026)
Specialist/expert	0.126*** (0.013)	0.071*** (0.018)	0.287*** (0.022)	0.139*** (0.016)	0.144*** (0.023)	0.221*** (0.032)
<i>No vocational training</i>						
<i>Employees working as ...</i>						
... unskilled labour	0.235*** (0.025)	0.238*** (0.036)	–0.537*** (0.039)	0.170*** (0.029)	0.113*** (0.041)	–0.485*** (0.047)
... skilled labour	0.011 (0.016)	0.071*** (0.022)	0.096*** (0.023)	0.006 (0.021)	0.035 (0.030)	0.000 (0.034)
... specialist/expert	0.086** (0.034)	0.169*** (0.048)	0.564*** (0.043)	0.168*** (0.045)	0.299*** (0.066)	0.113 (0.083)
<i>University degree holders working as ...</i>						
... unskilled labour	0.286*** (0.085)	0.344*** (0.128)	2.773*** (0.027)	0.092 (0.084)	0.117 (0.125)	2.486*** (0.031)
... skilled labour	0.119*** (0.023)	0.061** (0.031)	3.076*** (0.013)	0.031 (0.022)	0.003 (0.031)	2.397*** (0.018)
... specialist/expert	–0.173*** (0.014)	–0.152*** (0.018)	1.757*** (0.020)	–0.107*** (0.018)	–0.176*** (0.025)	1.377*** (0.029)
Full-time	–0.060*** (0.013)	0.046** (0.018)	–0.162*** (0.015)	–0.039*** (0.009)	–0.003 (0.013)	–0.133*** (0.012)
Additional training	0.070 (0.075)	0.080 (0.107)	– (–)	0.054 (0.096)	0.008 (0.141)	– (–)
Leadership responsibility	–0.038** (0.019)	–0.001 (0.026)	–0.111*** (0.018)	–0.047* (0.028)	0.098** (0.040)	–0.098*** (0.032)
Supervision responsibility	0.130*** (0.021)	0.100*** (0.029)	–0.254*** (0.022)	0.025 (0.035)	0.072 (0.051)	–0.143*** (0.041)
Dummy unemployed 5<10%	–0.098*** (0.010)	–0.059*** (0.014)	0.216*** (0.013)	–0.110*** (0.013)	–0.103*** (0.020)	0.231*** (0.017)

Table 3 (Continued)

Comparison group to out-commuters	Men			Women		
	Home employees (I)	Long dist. home empl. (II)	Destination employee (III)	Home employees (I)	Long dist. home empl. (II)	Destination employee (III)
Dummy unemployed 10–<25%	–0.227*** (0.010)	–0.178*** (0.014)	0.321*** (0.013)	–0.232*** (0.013)	–0.208*** (0.019)	0.412*** (0.017)
Dummy unemployed 25% and more	–0.517*** (0.013)	–0.395*** (0.018)	0.488*** (0.017)	–0.428*** (0.016)	–0.376*** (0.023)	0.761*** (0.020)
Log(firm experience)	–0.061*** (0.004)	0.006 (0.005)	–0.315*** (0.005)	–0.085*** (0.005)	–0.009 (0.007)	–0.382*** (0.006)
Log(work experience)	–0.256*** (0.006)	–0.179*** (0.009)	0.268*** (0.007)	–0.243*** (0.008)	–0.193*** (0.012)	0.461*** (0.010)
Firm characteristics						
Firm size 10–49 employees	0.283*** (0.010)	0.090*** (0.015)	0.200*** (0.014)	0.156*** (0.013)	0.022 (0.020)	0.149*** (0.017)
Firm size 50–249 employees	0.621*** (0.011)	0.314*** (0.015)	0.310*** (0.014)	0.469*** (0.013)	0.234*** (0.020)	0.310*** (0.017)
Firm size 250+ employees	0.948*** (0.012)	0.702*** (0.017)	0.255*** (0.015)	0.789*** (0.015)	0.610*** (0.022)	0.327*** (0.018)
Proportion females in firm	–0.923*** (0.021)	–0.726*** (0.029)	–0.687*** (0.026)	–0.245*** (0.023)	–0.251*** (0.033)	0.283*** (0.029)
Proportion high-skilled in firm	0.747*** (0.018)	0.659*** (0.024)	–0.059*** (0.019)	0.214*** (0.021)	0.089*** (0.030)	–0.219*** (0.025)
Constant	–1.559*** (0.042)	–0.495*** (0.061)	–2.466*** (0.089)	–1.422*** (0.071)	–0.420*** (0.107)	–3.084*** (0.136)
N	275,113	90,591	1,285,833	269,114	52,605	1,129,683
Pseudo R ²	0.139	0.090	0.632	0.118	0.091	0.557

Note: Robust Standard errors in (). Level of significance: * 1%, ** 5%, ***10%. Source: IEB version V13.01.01-190111, own calculation. Labour Market Region FE, Industry FE, Occupation FE included

for the comparison with the group of long-distance home employees and destination employees. Since the economic conditions have improved in the last years and due to the fear of labour shortages, the necessity for young individuals to leave MV is reduced (Nadler and Wesling 2003; Schwengler and Hirschenauer 2015; Burkard 2010).

Table 3 reports relevant results considering the task levels. The presented parameters relate to the reference group of individuals holding a vocational training degree (interaction effects will be discussed next): relative to skilled labour, the proportion of specialists/experts is higher among male and female out-commuters compared to home and destination employees. Female out-commuters are more frequently working in unskilled labour positions compared to all three comparison groups.

Going into detail, the interaction effect with the vocational-degree background reveals the following pattern: men and women without a vocational training de-

gree out-commute more often compared to home employees. Further, high-skilled male out-commuters are more frequently employed as unskilled or skilled labour compared to home and long-distance home employees. This indicates downward mobility to jobs that do not require such high formal qualification. In comparison with the destination employees, the large and positive coefficients consolidate this picture of downward mobility for males and females.

Commuting long distances is costly and therefore only profitable for those working in full-time (McQuaid and Chen 2012). Our results confirm this picture as out-commuters are more frequently full-time employed relative to part-time work. However, in comparison with long-distance home employees however male out-commuters work more frequently part-time.

The fraction of taking a supervision position is higher for male out-commuters but in comparison with the destination employees, supervision positions are relative less frequent.

Considering measures of the employment biography, shows that in comparison with home employees male and female out-commuters are less often unemployed, and compared to destination employees they are on average more often unemployed. Home employees are on average longer employed at their current employer compared to out-commuters. As a result, the average employment duration within firms is highest for female and male home employees and lowest for destination employees. Out-commuters are somewhere in between, indicating a more dynamic labour market outside MV.

Regarding the firm characteristics, out-commuters of both genders are more frequently employed in larger firms irrespective of the comparison group. Compared to home employees out-commuters work in firms with a higher fraction of high-skilled employees. However, the evidence suggests a brain-drain and downward mobility of high-skilled. Therefore, it is not surprising that out-commuters work in firms with a lower share of high-skilled workers in comparison with destination employees.

5.2 On the monetary benefits of out-commuting

A first overview of the results of the OB-decomposition is provided in Table 4. Male out-commuters earn on average 36.4% (26.7%) more than home employees (long-distance home employees). Male out-commuters, however, earn about 8.3% less compared to employees in the destination region. For females, the results show less pronounced wage differentials. Female out-commuters earn about 11.2% more relative to all home employees. There is no difference compared to long-distance home commuters. Relative to females in the destination region, out-commuters earn 2.9% less. With respect to the economic magnitude, a 1% wage increase accounts for approximately 0.74€ for males and 0.65€ for females in gross daily income (about 22.20€ for males and 19.50€ for females per month).

The endowment effect is positive for out-commuting males and insignificant for females, in comparison to home employees. This confirms especially for males the findings of the probit model of group differences in favour of the out-commuters. Interestingly, the coefficient effect is positive for females and males, indicating that returns on endowments are better evaluated outside MV. In comparison with

Table 4 Evaluation of the Oaxaca-Blinder decomposition

Comparison group	Men			Women		
	Home empl.	Long dist. home empl.	Destination employee	Home empl.	Long dist. home empl.	Destination employee
Difference	1.364*** (0.013)	1.267*** (0.008)	0.917*** (0.002)	1.112*** (0.036)	1.049 (0.040)	0.971*** (0.005)
Endowments	1.131*** (0.008)	1.084*** (0.007)	0.934*** (0.002)	1.021 (0.024)	0.973 (0.028)	1.024*** (0.004)
Coefficients	1.173*** (0.004)	1.141*** (0.002)	0.967*** (0.003)	1.054*** (0.009)	1.044*** (0.009)	0.990 (0.009)
Interaction	1.028*** (0.005)	1.024*** (0.002)	1.016*** (0.003)	1.034*** (0.010)	1.032*** (0.006)	0.957*** (0.008)
N	275,113	90,591	1,290,760	269,114	52,605	1,144,523
N out-commuter	42,031	42,031	41,959	16,523	16,523	16,506

Note: Cluster robust s.e. at labor-market-region level in (), * 0.1, ** 0.05, *** 0.01; all control variables included

destination employees, males show a slightly disadvantageous effect of 3.3%; for females the coefficient effect is insignificant.

Endowment effect Table 5 reports the endowment effect in detail. The effect of the difference in the occupational mix is very tiny. This aspect is important as it reveals that after controlling for other characteristics, the average wage differential is not caused by the unequal occupational mix. Compared to destination employees, both men and women experience a wage disadvantage of about 1%, depending on the occupational group. Thus, out-commuters work in occupations which are paid less compared to destination employees.

The probit model reveals a relative higher proportion of specialists/experts among out-commuters compared to home and destination employees, which makes it less surprising that adjusting the task structure of home employees to the level of out-commuters is leading to a wage increase of about 1.8% for men, and 0.6% for women. However, although the share of specialist/experts is higher among out-commuters, there is no positive wage effect in comparison to destination employees.

Little or no wage effects can be found adjusting leadership responsibility and vocational training information.

Moreover, we find no significant effect of labour market experience related variables for males but a significant negative effect of almost 3.1% for females. Although out-commuting females are less frequent unemployed, show shorter firm tenure and are on average more frequently job-changers, they earn less. This indicates that especially for female's firm tenure is honoured in MV.

Because out-commuters are slightly older compared to home employees, higher wages are paid supporting to the Mincerian wage equation. Thus, wages are higher for out-commuters. For females such age-related effect is not observed.

Table 5 Detailed results of the endowment effect

Comparison group	Men			Women		
	Home empl.	Long dist. home empl.	Destination employee	Home empl.	Long dist. home empl.	Destination employee
Occupations	1.001 (0.001)	1.001 (0.002)	0.992*** (0.000)	0.990** (0.004)	0.988** (0.005)	0.989*** (0.001)
Tasks	1.018*** (0.004)	1.011*** (0.004)	1.000 (0.000)	1.006*** (0.001)	1.000 (0.001)	1.002*** (0.001)
Leadership responsibility	1.002*** (0.000)	1.001*** (0.000)	1.000 (0.000)	1.001*** (0.001)	1.001* (0.000)	1.003*** (0.000)
Full-time	1.020*** (0.002)	1.008*** (0.001)	1.012*** (0.001)	1.018*** (0.002)	1.007*** (0.003)	1.047*** (0.002)
Age	1.017*** (0.002)	1.020*** (0.002)	1.004*** (0.000)	0.996 (0.004)	1.004 (0.004)	0.997*** (0.000)
Vocational training	1.013*** (0.003)	1.007*** (0.002)	0.995*** (0.000)	0.996** (0.002)	0.991*** (0.002)	1.002*** (0.001)
Unemployment	1.007*** (0.001)	1.006*** (0.002)	0.983*** (0.000)	1.005 (0.005)	1.002 (0.005)	0.985*** (0.000)
Experience	0.992* (0.005)	1.005 (0.005)	0.970*** (0.000)	0.969*** (0.009)	0.985 (0.010)	0.963*** (0.001)
Firm characteristics	1.044*** (0.005)	1.023*** (0.003)	1.002*** (0.001)	1.047*** (0.004)	1.011*** (0.003)	1.035*** (0.001)
Industry	1.008*** (0.003)	0.999 (0.002)	0.988*** (0.000)	0.988*** (0.004)	0.981*** (0.004)	0.989*** (0.001)

Note: Cluster robust s.e. at labor-market-region level in (), * 0.1, ** 0.05, *** 0.01; all control variables and regional indicators included

There is also a substance wage increase of about 2% for men and women caused by full-time work.

Regarding firm characteristics, the results show that they are associated with a substantive wage increase of about 4.4% for males and 4.7% for females. Especially the employment size of firms in MV is smaller and firms employ less human capital.

Lastly, there are small industry-related effects for males in favour for out-commuters. Contrary, out-commuting females work in industries that pay less.

Coefficient effect The coefficient effect relates to differences in the parameters of characteristics on the effect on wages. Thus, potentially structural differences in the wage setting can be identified. The results of the coefficient effect are provided in Table 6. Small values would indicate a rather equal wage setting and evaluation among MV employers and firms employing out-commuters outside MV. However, this is rarely the case. In particular, compared to home employees for male and female out-commuter's tasks outside MV are evaluated better, which may be due to the observed brain drain.

Table 6 Detailed results of the Coefficient Effect

Comparison group	Men			Women		
	Home empl.	Long dist. home empl.	Destination employee	Home empl.	Long dist. home empl.	Destination employee
Occupations	1.001 (0.017)	1.042*** (0.013)	0.962** (0.016)	0.989 (0.022)	1.029 (0.023)	1.080*** (0.019)
Tasks	1.045*** (0.002)	1.016* (0.009)	1.005 (0.006)	1.065** (0.031)	1.036 (0.028)	1.008 (0.010)
Leadership responsibility	0.999 (0.001)	0.999* (0.001)	0.999* (0.001)	1.000 (0.000)	0.999 (0.001)	0.999* (0.001)
Full-time	1.095*** (0.029)	1.112*** (0.030)	1.011* (0.007)	1.074*** (0.010)	1.077*** (0.015)	0.977*** (0.004)
Age	1.087*** (0.017)	1.057*** (0.020)	1.426*** (0.013)	1.090*** (0.025)	1.067*** (0.024)	1.453*** (0.023)
Vocational training	0.882*** (0.005)	0.863*** (0.014)	1.121*** (0.007)	0.930*** (0.025)	0.864*** (0.021)	1.181*** (0.013)
Unemployment	0.997 (0.002)	1.001 (0.001)	1.011*** (0.001)	0.999 (0.004)	0.999 (0.005)	0.994*** (0.002)
Experience	0.993** (0.003)	0.987*** (0.003)	1.010*** (0.004)	1.009* (0.005)	0.992 (0.008)	1.024*** (0.007)
Firm characteristics	1.037*** (0.005)	1.090*** (0.010)	0.978*** (0.006)	0.933*** (0.013)	0.963*** (0.014)	0.941*** (0.015)
Industry	1.054* (0.033)	1.065* (0.039)	1.038*** (0.014)	1.039 (0.026)	1.037 (0.028)	1.042*** (0.010)
Constant	0.970 (0.059)	0.924 (0.045)	0.681** (0.111)	0.956 (0.092)	1.019 (0.101)	0.793 (0.322)

Note: Cluster robust s.e. at labor-market-region level in (), * 0.1, ** 0.05, *** 0.01; all control variables and regional indicators included

Further, working full-time outside MV provides about 9.5% higher wages for males and 7.4% higher wages for females.

There are also substantive age effects—the associated returns are much higher outside MV—compared to home, long-distance home and destination employees.

For education related variables, the coefficient effect is not in favour of out-commuting. However, for the relative wage dispersion, it is the case that unskilled workers in MV suffer a higher wage loss than skilled workers in MV; consequently, the coefficient effect is in favour of home-employees. Thus, unskilled out commuting might be seen as a chance to improve the wage position. Finally, we argue that outside MV formal qualification is of less importance and thus employers not necessarily pay relatively less for unskilled (as is the case within MV).

Regarding the firm characteristics, a different picture emerges for males and females: for males, the returns are higher, relative to home-employees and for females the coefficient effect is negative. Compared to destination employees, respective firm effects are smaller for men and women.

Interaction effect The interaction effect captures the joint change in endowments and coefficients. The results are provided in the appendix (Table 7). Although some effects are significant from a statistical point of view, their magnitude is rather small from an economic point of view.

5.3 Discussion

The results so far indicate a certain brain drain of better skilled people out of MV and obviously a lack of more advanced jobs in MV. This becomes obvious comparing out-commuters with long distance home employees. Although both face similar commuting costs, out-commuters are different. In particular, we find a higher likelihood of being an out-commuter and working as specialist/experts compared to long-distance home employees. The lack of advanced jobs in MV is also confirmed as we find that high-skilled males are more frequently employed as unskilled or skilled labour compared not only to home but also to destination employees. Thus, such better skilled out-commuters tend to work overqualified outside MV, which indicates a brain drain. This could be a reaction to a weak labour market in MV that does not provide enough employment opportunities especially for high-skilled workers. Further, the results provide evidence of a qualification related spatial mismatch as the results show that out-commuters work in larger firms with a higher fraction of high-skilled workers compared to home employees, but in comparison with destination employees, out-commuters work in firms with a lower share of high-skilled workers. However, out-commuting is an individual choice. Those, who accept jobs outside MV under their individual qualification may be still satisfied, although they work overeducated, they still earn more—which is confirmed in the OB-decomposition—and potentially these higher wages compensate the potential disadvantage of working overqualified.

In addition, the results imply that individuals out-commute to prevent unemployment—what especially affects women. In particular, we find that although women work in unskilled jobs with lower wages, they commute out and face higher commuting costs—comparing out-commuters with home and long-distance home employees. Further, the results show that employers in MV more frequently request formal qualification also for tasks, that not necessarily need formal qualification—for men and women. Thus, workers without formal qualification have to commute out to might prevent long-lasting unemployment. Interestingly, considering the comparison with the destination region the fraction of individuals without formal qualification working in unskilled tasks is higher among the destination employees. Again, here the demand for unskilled labour is given and out-commuters are more frequently recognized as a resource of labour.

Further, the results indicate weak career opportunities in MV: we not only find a lack of supervision and leadership positions in MV but out-commuters also more frequently change firms. Jobs in MV potentially may not allow for carrier opportunities and therefore, those who want to pursuer carrier must commute out—which affects men in particular.

With respects to potential labour shortage there should also be an increase in full-time jobs as we find that out-commuters are more likely to work in part-time

compared to long-distance home employees. However, we find that out-commuters are typically older. Therefore, we expect a decline in out-commuting flows in the future when these workers retire.

Regarding the wage gap, we find that out-commuters earn higher wages than home and long-distance home employees, which is especially the case for men. This wage difference is explained by a higher proportion of specialists/experts, older workers, workers in full-time jobs and by the fact that out-commuters more often work in larger firms which employ more human capital. Therefore, potential gains of increasing returns to scale and benefits of human-capital-intensive production are missing in MV, leading to lower wages. Thus, firms outside MV are relatively more productive.

In addition, there are significant differences in coefficients indicating that the wage setting behaviour outside MV honours full-time work, task levels and age relatively more. This indicates that male and female out-commuters must be a specific, valuable group for example regarding human capital that explains the substantive higher wages, although we provide evidence of over-qualification of out-commuters.

Comparing out-commuters with destination employees, the wage dispersion between different educational levels is higher between the out-commuters and smaller among destination employees. There is obviously a “fading” effect, i.e., employers outside MV do not differentiate as strongly between the different skill levels as is the case in MV. For males and females, the wage spread is larger outside MV, i.e. the coefficients of the occupational indicators differ significantly. Thus, firms within MV set wages more equally among occupations whereas the wage spread is larger outside MV. For females, the results additionally indicate that they select themselves into less productive firms outside MV which might indicate again a reaction to avoid unemployment in MV.

5.4 Robustness checks

Several modifications underpin the robustness of our findings. In particular, we identify out-commuters as workers with commuting times between (i) 30 and 60 minutes, (ii) 30 and 90 minutes and (iii) more than 90 minutes. The results are in line with the findings presented so far, only the magnitude slightly differs.

To better understand the potential skill-mismatch, especially for the high-educated individuals, the analysis is performed by the different task levels separately, which supports the previous findings. Especially for males working as specialists and experts, we find supportive evidence of the skill-mismatch.

The relative wage gap might also be explained by differences in housing prices³; especially, when commuting is the chosen alternative instead of migration into the region outside MV. For out-commuters, the ratio of average housing prices at the workplace and the place of residence is expected to be higher. We tested several specifications on the impact of housing-prices on the wage gap, i.e. the ratio of prices at workplace and at home, just the prices at workplace and finally at the place

³ Housing prices are included as the regional median basic rent (excluding heating costs) (Mense et al. 2019; Mense 2021).

of residence. First, the ratio was always insignificant, although in favour for the out-commuters. Second, considering the endowment effect, the housing price was positive for out-commuters, indicating that especially out-commuters earn higher wages caused by higher housing prices at the workplace. This provides a general evidence that employers take local housing prices in their wage setting into account, irrespective of the regions, where their employees live. The coefficient effect was insignificant. Third, when adding simply housing prices of the place of residence, no endowment effect became significant. However, the coefficient effect becomes significant and in favour of individuals living and working in MV. Because the coefficients are identified by within-group comparison, obviously an extra Euro of housing prices in MV raises individual wages within MV stronger compared to outside MV. However, because MV is very peripheral with low housing costs in the rural areas but relative higher prices in the towns and cities, obviously, also employers compensate for such differences. Outside MV the differences are smaller and then, a coefficient effect in favour of MV employees results.

6 Conclusion

In this study, we consider out-commuters from a particular eastern German region, MV, and compare them with employees within MV and the destination region. We analyse individual, job-related and firm characteristics that increase the likelihood that men and women to cross regional borders by commuting long distances and take a closer look at factors that explain the wage gap between both groups. These findings can be important against the background that regions in East Germany are complaining about labour shortage especially in the course of the aging population that will retire in the next years (Kröll and Niebuhr 2008). Policy measures which aim to employ current out-commuters within MV could be a smart way to compensate labour shortages.

Our findings show that especially high-skilled, older workers, and men and women working in larger firms out-commute. For women we additionally show a higher share of women working in unskilled labour. We conclude therefore that less job opportunities, less labour demand—especially for women—are the key factors why workers live in MV and commute in other regions to work.

Regarding the wage gap between out-commuters and home employees we find that especially males benefit from out-commuting as they earn about 37% more than home employees. This can be explained by differences in the age structure, task levels and firm characteristics. Moreover, we show that the wage setting behaviour outside MV honours full-time work, tasks and leadership responsibilities more. Additionally, the returns of firm characteristics are larger for out-commuters. Thus, firms outside MV are relatively more productive.

This brings us to the conclusion: if employers and policy makers within MV want to gain back out-commuters, such that they provide their work capacity within MV, structural changes at the labour market have to occur first. Especially job opportunities for high-skilled individuals are not enough, leading currently to brain drain. Females partly out-commute and accept even lower wages to avoid unemployment.

Employers have to rethink their wage setting behaviour in general to become competitive with the wage setting of firms outside MV. Lastly, the firm productivity is relatively lower within MV, indicating structural differences and lead at least to the relative lower labour demand for highly skilled individuals. Thus, to make MV more attractive for individuals, significant economic improvements have to be done. Without improvements the employment of out-commuters in MV may be go along with a welfare loss as wages (and thus tax revenues) are expected to be lower. Lastly, although MV offers different leisure opportunities, especially nature-related, such improvements are required not just to gain back out-commuters to work within MV but also to be an attractive region for in-commuting or immigration as well. We suspect that our results can be partly transferred to other East German regions, which face similar problems.

7 Appendix

Table 7 Detailed results of the Interaction Effect

Comparison group	Men		Comparison group	Women		Comparison group
	Home empl.	Long dist. home empl.		Home empl.	Long dist. home empl.	
Occupations	0.996** (0.001)	0.999 (0.001)	0.990*** (0.002)	1.005** (0.002)	1.006** (0.003)	0.986** (0.007)
Tasks	1.007*** (0.001)	1.002 (0.002)	1.005*** (0.001)	0.998 (0.003)	0.996 (0.003)	0.995*** (0.001)
Leading responsibility	1.001 (0.001)	0.999 (0.001)	1.000 (0.000)	1.001 (0.001)	1.000 (0.000)	1.001** (0.001)
Full-time	1.000* (0.000)	1.000* (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)	1.000 (0.000)
Age	1.005*** (0.002)	1.003*** (0.001)	1.000* (0.000)	1.010*** (0.002)	1.003** (0.001)	0.995*** (0.001)
Vocational training	1.007*** (0.001)	1.004*** (0.001)	1.004*** (0.000)	0.996*** (0.001)	1.000 (0.001)	0.991*** (0.001)
Unemployment	0.996*** (0.001)	0.997*** (0.000)	1.003*** (0.000)	1.001** (0.001)	1.003*** (0.001)	0.999 (0.000)
Experience	1.001** (0.000)	1.001*** (0.000)	1.005*** (0.001)	1.001 (0.001)	1.000 (0.000)	0.995*** (0.001)
Firm characteristics	1.000 (0.000)	1.000 (0.001)	0.999 (0.001)	0.998 (0.001)	1.001 (0.001)	0.996* (0.002)
	1.016*** (0.005)	1.014*** (0.004)	1.006*** (0.001)	1.008** (0.004)	1.013*** (0.002)	0.992*** (0.001)

Note: Cluster robust s.e. at labor-market-region level in (), * 0.1, ** 0.05, *** 0.01; all control variables and regional indicators included

Table 8 Labels for occupations as presented in Fig. 2

1	Occupations in teaching and training
2	Occupations in cleaning services
3	Occupations in tourism, hotels and restaurants
4	Occupations in agriculture, forestry, and farming
5	Occupations in safety and health protection, security and surveillance
6	Occupations in the performing arts and entertainment
7	Occupations in law and public administration
8	Occupations in education and social work, housekeeping, and theology
9	Occupations in gardening and floristry
10	Drivers and operators of vehicles and transport equipment
11	Occupations in plastic-making and -processing, and wood-working and -processing
12	Occupations in non-medical healthcare, body care, wellness and medical technicians
13	Occupations in building services engineering and technical building services
14	Occupations in metal-making and -working, and in metal construction
15	Occupations in textile- and leather-making and -processing
16	Occupations in paper-making and -processing, printing, and in technical media design
17	Medical and health care occupations
18	Occupations in interior construction
19	Occupations in traffic and logistics (without vehicle driving)
20	Occupations in food-production and -processing
21	Occupations in product design, artisan craftwork, fine arts and the making of musical instruments
22	Occupations in mechatronics, energy electronics and electrical engineering
23	Occupations in technical research and development, construction, and production planning and scheduling
24	Sales occupations in retail trade
25	Occupations in business management and organisation
26	Occupations in geology, geography and environmental protection
27	Occupations in building construction above and below ground
28	Occupations in computer science, information and communication technology
29	Occupations in mathematics, biology, chemistry and physics
30	Occupations in production and processing of raw materials, glass- and ceramic-making and -processing
31	Occupations in construction scheduling, architecture and surveying
32	Occupations in in philology, literature, humanities, social sciences, and economics
33	Technical occupations in machine-building and automotive industry
34	Occupations in financial services, accounting and tax consultancy
35	Occupations in purchasing, sales and trading
36	Occupations in advertising and marketing, in commercial and editorial media design

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