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natives and cross-border
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Wage differentials between natives and cross-border workers within and across establishments*

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Abstract

Luxembourg has a very unusual labor market, with only 29% of Luxembourgish nationals. The remaining workforce is composed of immigrants (27%) and cross-border workers (44%) who live in one of the three surrounding countries which are France, Germany and Belgium. Research on economic outcomes of immigrants has been a major focus of labor market research in many countries, but the cross-border population has only attracted scarce attention. Even though this topic is of limited relevance in most countries at the national level, similar situations as in Luxembourg can be found in regional and local labor markets in most other countries, around major cities for example. In this paper we use the example of Luxembourg to investigate the determinants of the wage gap between natives and cross-border workers. We first analyze whether this specific commuting workforce is concerned, like the non-national population in many other labor markets, by segregation into low-wage firms. We then use a matched employer-employee dataset to investigate the role that firm-specific characteristics play in determining the wage gap. This approach opens interesting perspectives for expanding the literature on the native-immigrants wage gap.

Keywords: wage gap, cross-border labor market, segregation, multilevel modeling. JEL codes: R23, J31, J61, J71

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1 Introduction

Situated in the heart of Europe, Luxembourg is one of the smallest countries of the European Union, surrounded by France, Germany and Belgium. Over the past three decades, there has been a significant increase in the numbers of workers from these countries crossing the border and working in Luxembourg, from 17 000 in 1985 (10% of the total workforce) to 150 000 in 2010 (44%). Short commuting distances, unrestricted border crossings, an ever improving information flow through networking, a high job creation rate, and comparatively high wages in Luxembourg explain the massive inflow of cross-border workers to Luxembourg,

An interesting anomaly in this labour market is that the cross-border workers (CBW) have lower wages than natives living in Luxembourg. This wage gap was first documented, for men, by Langers (1997) using the 1995 Structure of Earnings Survey who estimated the difference at around 9% in favor of natives. Lejealle (2001) confirmed these results in her study, for both men and women. Using administrative data, Brosius (2005) showed that the gap was larger for cross-border workers from France than for those from Belgium and Germany.

In this paper we extend the previous research by looking at different determinants of this wage gap. It is important to understand whether this wage gap originates from differences in human capital, in segregation of cross-border workers into low-paying occupations, industries or firms, or rather due to firm-specific characteristics determining the within-firm wage gap between natives and commuters. The findings for Luxembourg should be useful for understanding differences in other comparable labor markets (for example in Switzerland) or, more importantly, in regional and local labor markets in many other countries.

The paper follows previous international research that has mainly focused on the determinants of the racial wage gap. Occupational segregation of non-natives has been documented abundantly (Ragan & Tremblay (1988), Sorensen (1989), Hirsch & Schumacher (1992), Grodsky & Pager (2001), Huffman (2004), Hirsch & Macpherson (2004)) and can also be expected to contribute to the wage differences in Luxembourg. This initial literature which has often been limited by the absence of the percentage of immigrants in other dimensions than the one defined by occupations, has been extended by the availability of matched employer-employee datasets (Abowd et al. (1999), Haltiwanger et al. (1999), Hellerstein & Neumark (2005), Hamermesh (2008)). It was shown that segregation into specific industries and establishments contributes to our understanding of the racial wage gap (Groschen (1991), Davis & Haltiwanger (1991), Levy & Murnane (1992), Kramarz et al. (1996)). We will investigate the commuter wage gap along these lines by constructing industry and establishment composition variables using a matched employer-employee dataset for Luxembourg. We hereby follow the more recent literature that has used various matched (mostly US) datasets to stress the importance of investigating the role of the share of minorities at the industry and firm-level (Bayard et al. (1999b), Carrington & Troske (1998), Aydemir & Skuterud (2008), Hellerstein & Neumark (2008), Simon et al. (2008)). Concerning the more specific population of cross-border workers, (Müller & Ramirez, 2009) show that in Switzerland about a third of the wage gap between Swiss workers and commuters can be explained by firm-level segregation. For Luxembourg, no evidence exists as of yet.

Another source of the cross-border wage gap could be the wage policies of firms and the potential wage gap that can exist within firms. This approach has been used by Grodsky & Pager (2001) to investigate the racial wage gap in the United States. They use a multilevel model to investigate the inequality within jobs rather than between jobs. Huffman (2004) also uses a multilevel estimation approach combined with a more detailed definition of jobs as defined by local occupation-industry cells. This research focused on within-job differences in wages, with jobs being defined by occupation variables. To the best of our knowledge, no paper has analyzed the immigrant-native wage gap at the level of firms themselves rather than occupations as just presented. It could

however be that firms have very specific wage setting policies and that these, reflected by measurable establishment-level characteristics, could help us to better understand whether and why, within some firms, the wage penalty for cross-border workers is higher than in others. The impact of various firm characteristics on the wage structure has already been documented by Cardoso (1999, 2000) and Stephan & Gerlach (2005) in a non-discrimination framework as well as Heinze & Wolf (2010) for the analysis of the gender wage gap.

To summarize, several factors might contribute to the cross-border worker wage gap found in Luxembourg. First, cross-border workers might have lower levels of productivity related skills, such as education or on-the-job experience, and thus earn less than their native counterparts. Alternatively, after controlling for such differences, a remaining gap might result from labour market discrimination on the part of employers. Such discrimination could reflect the preferences of Luxembourgish employers, employees, or even customers, or alternatively be in the form of statistical discrimination (Becker 1957, Arrow 1972). Second, cross border workers might be more heavily represented in lower paid occupations or sectors of the economy. This segregation might simply reflect again the skill mix of cross-border workers or their employment preferences, or result from labour market discrimination in the form of occupational “crowding.” Lastly, cross-border workers may be more heavily concentrated in lower paying firms across the sectors. This could result from cross-border workers having relatively little bargaining power relative to native workers, or to cross-border workers having lower reservation wages than natives. If reservation wages are determined in part by the alternative wages in the home country, or by the degree of social networks and other sources of information about relative wages in Luxembourg, then cross-border workers would be expected to have lower reservation wages. This effect might increase with the proportion of cross-border workers employed in a firm.

We use a matched employer-employee dataset that allows us to investigate the between- and within-plant variations in wages, controlling for standard human capital variables, to investigate the sources of the wage gap between nationals and cross-border workers in Luxembourg. The results indicate that the segregation of the workforce at the establishment level has a significant effect on the native/cross-border wage differential, with cross-border workers more highly represented in low-paying firms. In addition, we find that the pay gap between national and cross-border workers is larger within firms that employ greater shares of cross-border workers.

The paper is outlined as follows. In section 2 we describe the matched employer-employee dataset and give some descriptive statistics about the cross-border and native workers, highlighting the non-random sorting of cross-border workers into firms. Section 3 gives evidence that this nonrandom sorting leads to segregation of cross-border workers into low paying firms and that this explains part of the overall wage gap. Section 4 takes the analysis to the firm level to show that the wage gap between Luxembourgish nationals and cross-border workers varies from one firm to another and looks at firm-specific factors explaining this variation. Section 5 concludes.

2 Data and descriptive evidence

The European Structure of Earnings Survey (SES) 2002 is a national representative survey of private-sector establishments in Luxembourg with at least 10 employees. It covers the following economic activities (NACE C-K): construction, wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods, hotels and restaurants, transport, storage and communications, financial intermediation, real estate, renting and business activities. A two-stage mixed sampling scheme has been applied with an activity- stratified probability sampling of establishments, followed by a sampling of employees by the employer. Firms of at least 10 employees were selected from the official business register and employees were selected by the human resource manager of each firm through a proportional-to-size sampling scheme and according

to rules fixed by the common survey design in all European countries. The dataset for Luxembourg covers 1328 establishments and 28246 employees. In the sample, the number of observations within each establishment (i.e. the number of sampled employees) ranges from a minimum of 3 to a maximum of 487 with an average of 21 employees per firm. Sampling weights render the data representative of the total number of 3140 firms and 168000 employees for the specified economic activities and firm sizes in 2002.

The SES dataset presents four main advantages. First, it covers the main economic activities in Luxembourg: in 2002, they account for 73% of GNP and occupy 70% of the total labor force. Second, and contrary to most other databases available in Luxembourg, it collects data for both resident employees and cross-border commuters. The sample is composed of 49% cross-border workers, 23% national workers and 28% immigrants (i.e. non Luxembourgish residents). Third, the dataset provides detailed information on the level and structure of employees' remuneration but also on employees' demographic characteristics and the characteristics of their job (in particular, age, education level, sex, nationality, tenure in the establishment, occupation, type of contract, industry, establishment size). Fourth, data was collected both at the employee level but also at the establishment level, allowing us to derive valuable information about the composition of the workforce in each establishment, most importantly the share of cross-border and Luxembourgish nationals in the workforce. Given the sampling procedure of the SES, these shares risk to be rough measures of the real firm composition. Table A1, in the appendix, shows however that the sample values are almost identical to those derived from comparable exhaustive administrative records on employees and firms of the corresponding sampling population.

Hourly wages are calculated by dividing the total gross earnings of October 2002 (excluding earnings related to overtime and special payments for shift work) by the corresponding number of hours worked. In 2002, the overall wage gap between cross-border workers and Luxembourgish residents is of 25 log points in favor of the latter (table 1). Wage dispersion is higher for Luxembourgish nationals than for cross-border workers.

Some of these wage differences could be explained by differences in human capital and job specific variables, as can be seen from table 1. Compared to the Luxembourgish nationals, cross-border workers are younger (average age of 37 vs. 40 for LUX), and a greater portion of cross-border workers are working in the construction and service sectors (real estate, renting and business activities) whereas the Luxembourgish nationals are overrepresented in the transportation and finance sectors. A lower proportion of CBW are present in very large firms of more than 500 employees (31% compared to 44% for LUX), they have considerably less tenure in their current job (5 years on average, compared to 12 years for LUX) and only half of them are working in white-collar jobs (compared to 68% for LUX). They are overrepresented in manual occupations such as plant and machine operators and assemblers, as well as craft and related trades workers, whereas a relatively high share of Luxembourgish nationals (33%) occupies positions as clerks. They do however have higher education levels (23% have higher degrees than A-levels compared to 11% for LUX) which could contribute to a reduction of the extent of the wage gap.

Table 1. Descriptive statistics by origin (percentages, except for wages and tenure)

	Lux	CBW	CBW Fr	CBW Bel	CBW Ger	Immi	Allemployees
Age							
25 or less	0.09	0.10	0.12	0.10	0.08	0.10	0.10
26-30	0.12	0.16	0.16	0.16	0.15	0.15	0.15
31-35	0.13	0.19	0.19	0.20	0.17	0.19	0.17
36-40	0.16	0.19	0.18	0.19	0.21	0.18	0.18
41-50	0.33	0.26	0.25	0.25	0.30	0.26	0.28
51 or more	0.17	0.10	0.10	0.10	0.10	0.12	0.12
gender=male	0.61	0.68	0.65	0.70	0.71	0.62	0.64
Education							
ISCED1	0.11	0.08	0.10	0.06	0.07	0.24	0.13
ISCED2	0.12	0.11	0.12	0.09	0.09	0.18	0.13
ISCED3	0.57	0.52	0.52	0.45	0.59	0.34	0.48
ISCED4	0.11	0.18	0.17	0.24	0.14	0.10	0.14
ISCED5	0.08	0.11	0.09	0.15	0.10	0.13	0.11
ISCED6	0.01	0.01	0.00	0.01	0.01	0.01	0.01
economic activity							
Manufacturing	0.15	0.17	0.18	0.16	0.17	0.10	0.15
Construction	0.05	0.13	0.11	0.13	0.19	0.21	0.13
wholesale and retail trade	0.12	0.13	0.14	0.14	0.10	0.10	0.12
hotels/restaurants	0.01	0.03	0.05	0.02	0.01	0.06	0.04
Transport	0.16	0.09	0.07	0.07	0.15	0.07	0.10
Finance	0.18	0.17	0.13	0.22	0.19	0.16	0.17
business activities	0.08	0.19	0.24	0.18	0.08	0.18	0.16
establishment size							
10-49 employees	0.24	0.27	0.24	0.28	0.31	0.31	0.27
50-249 employees	0.24	0.35	0.35	0.34	0.36	0.30	0.31
250-499 employees	0.11	0.14	0.14	0.11	0.18	0.13	0.13
500-999 employees	0.08	0.11	0.13	0.10	0.09	0.11	0.10
1000+ employees	0.33	0.13	0.14	0.17	0.06	0.14	0.18
job type							
part-time job	0.18	0.13	0.14	0.12	0.12	0.16	0.15
tenure in current job (years)	11.92 (10.56)	5.66 (6.55)	5.47 (6.37)	6.76 (7.46)	4.87 (5.62)	6.37 (7.32)	7.38 (8.32)
Occupation							
elementary occupation	0.08	0.07	0.10	0.04	0.04	0.20	0.11
plant and machine operators and assemblers	0.08	0.13	0.11	0.14	0.15	0.09	0.11
craft and related trades workers	0.13	0.20	0.21	0.15	0.23	0.21	0.19
service workers and shop and market sales workers	0.08	0.11	0.14	0.08	0.06	0.10	0.10
Clerks	0.23	0.15	0.14	0.16	0.17	0.11	0.16
technicians and associate professionals	0.23	0.18	0.16	0.19	0.21	0.13	0.18
Professionals	0.10	0.12	0.10	0.16	0.10	0.09	0.10
legislators, senior officials and managers	0.07	0.04	0.03	0.07	0.04	0.06	0.05
workforce composition							
share of cross-border workers in establishment	0.28	0.66	0.66	0.64	0.69	0.36	0.49
share of natives in establishment	0.53	0.14	0.13	0.16	0.15	0.17	0.25
share of immigrants in establishment	0.19	0.19	0.21	0.19	0.16	0.47	0.26
N	7478	15302	7854	3909	3539	8310	31090

SES 2006; weighted data; standard deviations are in parentheses.

LUX = luxembourgish nationals, IMMI = immigrants, CBW=cross-border workers.

Table 2 shows the distributions of workers across establishments, industries and occupations, where we find that cross-border workers are non-randomly sorted across establishments. The average cross-border worker is working in an establishment with 66% of commuters, 14% of Luxembourgish nationals and 20% of immigrants. This is clearly above the overall distribution of 49%, 24% and 28%.² A similar regrouping by origin can be seen for the Luxembourgish nationals who work in establishments dominated by Luxembourgish workers (52%) and for immigrants who are employed by establishments with mainly other immigrants (49%). As can be seen in table 2, this segregation by origin is much less pronounced at the industry and occupation levels than at the establishment level.

Table 2. Nonrandom sorting by origin (2006)

establishment	CBW	Lux	Immi	Total
%CBW	0.66	0.28	0.36	0.49
%Luxembourgish	0.14	0.53	0.17	0.25
%immigrants	0.19	0.19	0.47	0.26
Observations	15302	7478	8310	31329
industry	CBW	Luxembourgish	immigrants	total
%CBW	0.51	0.46	0.49	0.49
%Luxembourgish	0.22	0.31	0.21	0.24
%immigrants	0.27	0.23	0.30	0.27
Observations	15302	7478	8310	31329
occupation	CBW	Luxembourgish	immigrants	total
%CBW	0.50	0.49	0.47	0.49
%Luxembourgish	0.24	0.26	0.23	0.24
%immigrants	0.26	0.25	0.30	0.27
Observations	15302	7478	8310	31329

Note: weighted statistics reported

Another way to describe this sorting of cross-border workers into cross-border dominant firms would be to look at the distribution of firms with respect to the share of CBW they employ. In the absence of any sorting (i.e. random sorting), each firm should employ the same share of a specific type of workforce (the overall share). Carrington & Troske (1997) have pointed out, however, that differences in the share of a minority group from one establishment to another can occur even if sorting is random (especially in small firms). In order to control for this, we follow Aydemir & Skuterud (2008) by comparing the variance between establishments of the share of CBW to the expected variance under the null hypothesis of random sorting. We do this first by randomly re-sorting the CBW status across our observations, preserving the overall share of CBW in the economy and also preserving the establishment-size distribution of our sample. We then calculate the variance of the CBW share between establishments. From 1000 replications, we get the 99% confidence interval of [0.020 - 0.025], meaning that in 99% of the samples the between-establishment variance of the share of CBW lies between 0.020 and 0.025. In our SES2002 sample, the between-

²These concentrations vary only marginally for subgroups of cross-border workers (young, old, female, male, education levels, etc.). Statistics for these subgroups are not presented here but are available from the authors upon request.

establishment variance of the share of CBW is 0.099. This variance clearly lies outside of the 99% confidence interval for random sorting. We can therefore conclude that cross-border workers are non-randomly distributed across establishments. This is also confirmed by the index of dissimilarity Duncan & Duncan (1955) which takes a value of 0.503 in our sample, largely situated above the 99% confidence interval of [0.147 - 0.164] which we obtain by randomly distributing the cross-border workers over the given firm-size structure of our sample, again with a 1000 replications. This measure indicates that 50 percent of the CBW workforce would need to change establishments in order to have an equal distribution with nationals.

3 Between-establishment wage differences

We now analyze whether this nonrandom sorting of CBW could explain part of the origin-specific wage gap. This would be the case if commuters were systematically sorted into low-paying establishments. To verify this, we follow Bayard et al. (1999a, 2003) and estimate a wage regression that controls for differences in human capital characteristics and differences in the proportion of cross-border workers in industries, occupations and establishments (equation (1)).

$$\begin{aligned}
 w_i = & \alpha + \beta_1 CBW \\
 & + \beta_2 IND\%CBW + \beta_3 OCC\%CBW + \beta_4 EST\%CBW \\
 & + \beta_5 IND\%IMMI + \beta_6 OCC\%IMMI + \beta_7 EST\%IMMI \\
 & + \beta_8 X_i + E_i
 \end{aligned} \tag{1}$$

where w is the log hourly wage, CBW is a dummy variable equal to one if the worker is a cross-border worker, IND stands for industry, OCC for occupation and EST for establishment, so that $IND\%CBW$ is the proportion of cross-border workers in the industry and $OCC\%IMMI$ is the proportion of immigrants in the occupation. X is a vector of control variables for human capital variables and job characteristics.²

We estimate this wage regression on a pooled sample of Luxembourgish and cross-border workers to get the coefficients β_1 to β_7 (table 3, column 2). An Oaxaca (1973) type decomposition, imposing the restriction that the coefficients are the same for both groups of workers, is then obtained which expresses the overall wage gap between Lux and CBW as follows:

$$\begin{aligned}
 & \beta_1 + \beta_2(IND\%CBW_{CBW} - IND\%CBW_{Lux}) \\
 & + \beta_3^1(OCC\%CBW_{CBW} - OCC\%CBW_{Lux}) \\
 & + \beta_4^1(EST\%CBW_{CBW} - EST\%CBW_{Lux}) \\
 & + \beta_5^1(IND\%IMMI_{CBW} - IND\%IMMI_{Lux}) \\
 & + \beta_6^1(OCC\%IMMI_{CBW} - OCC\%IMMI_{Lux}) \\
 & + \beta_7^1(EST\%IMMI_{CBW} - EST\%IMMI_{Lux}) \\
 & + \beta_8^1(X_{CBW} - X_{Lux})
 \end{aligned} \tag{2}$$

where we multiply the coefficient estimates from (1) with the differences in the share of cross-border workers that the two groups are exposed to at the industry, occupation and

²Variables included are those from table 1, apart from firm, occupation and industry variables that are now covered by the proportion variables.

establishment levels.

Table 3. Wage decomposition with establishment wage effects

	Coefficient estimate (1)	Coefficient estimate (2)	Mean Difference CBW-Lux (3)	Absolute Contribution (4)=(2)x(3)	Relative contribution (5)
CBW	-0.244 (0.024)	-0.053 (0.008)	1.00	-0.053	0.217
%CBW industry		-0.580 (0.128)	0.050	-0.029	0.119
%CBW occupation		-1.251 (0.115)	0.014	-0.017	0.070
%CBW establishment		-0.236 (0.043)	0.378	-0.089	0.365
%immi industry		-0.090 (0.081)	0.037	-0.003	0.012
%immi occupation		-1.536 (0.091)	0.010	-0.015	0.061
%immi establishment		-0.237 (0.055)	0.008	-0.002	0.008

Note: Weighted data. Only cross-border workers and Luxembourgish nationals are included. The number of observations is 20611 for model (1) which is the model with only CBW and no control variables (reference wage gap). The number of observations is 20058 for the pooled model (2) with control variables as presented in table 1 without industry, occupation and establishment variables which are now accounted for by the proportion variables. Standard errors of regression estimates are reported in parentheses; all standard errors are adjusted for non-independence of residuals within establishments. Oaxaca command in Stata.

The overall wage gap to be decomposed is presented in column 1 of table 3 as the coefficient estimate for the cross-border dummy from a pooled regression on LUX and CBW only (excluding immigrants) with no control variables. The wages of CBW are about 25% lower than those of Luxembourgish natives. Column 2 shows the estimated coefficients, again from a pooled model, but this time including controls for human capital and job characteristics and furthermore adding our variables of segregation. The coefficient on the CBW dummy is the unexplained part of the model: 6% of the overall wage gap can neither be explained by human capital variables nor by segregation variables. Wages are lower in industries, occupations and establishments with higher shares of cross-border workers (coefficients on %CBW). These effects concern both cross-border workers and Luxembourgish nationals and it is the mean difference in these variables (column 3) that will weight this overall effect in a way to determine the contribution of each variable to the overall wage gap to be explained. Column 4 shows the weight of each variable in the decomposition and column 5 the relative contribution to the overall gap. The sorting of cross-border workers into establishments with a high concentration of cross-border workers explains 37% of the overall wage gap between CBW and LUX. Sorting of cross-border workers into industries and occupations with a high proportion of other cross-border workers accounts for only about 8% of this overall gap. About 11% of the wage gap is explained by a higher concentration of cross-border workers into industries, establishments and most importantly occupations with a high presence of immigrants, and 16% is accounted for by differences in human capital and job attributes (not shown in table 3).

4 Within-establishment wage differences

Next to segregation, the wage policy of firms could explain part of the remaining wage gap. We now go beyond the individual level analysis and take into account the two-level employer-employee structure of our data by applying multilevel models.

4.1 Multilevel modeling strategy

We estimate the following linear wage regression:

$$w_{ij} = \beta_{0j} + \beta_{1j}CBW_{ij} + \beta_{2j}IMMI_{ij} + \beta_3X_{3ij} + \dots + \beta_KX_{Kij} + r_{ij} \quad (3)$$

where w_{ij} is the logarithm of the wage of worker i in establishment j , β_{0j} is the intercept at the worker level - it shows that average wages are lower in some establishments (which can be a source for the wage gap if commuters are concentrated in these establishments), β_{1j} is the regression coefficient of the cross-border dummy variable CBW , which represents the average wage difference between cross-border workers and Luxembourgish nationals (the reference group) in establishment j ; $IMMI$ is a dummy variable equal to 1 if the worker is an immigrant; worker characteristics and job attributes are controlled for by $K-2$ variables X_{3ij} to X_{Kij} , with their respective coefficients β_3 to β_K ; r_{ij} is a worker-level error term assumed to be normally distributed with zero mean and variance σ^2 . In order to avoid any endogeneity due to cluster-level confounding, we include cluster means of all covariates in the specification (Mundlak (1978), (Rabe-Hesketh & Skrondal, 2008, p. 115)).

The coefficients β_3 to β_K are supposed not to vary from one establishment to another; they are modeled as fixed effects. However, the intercept β_{0j} and the origin-specific effects β_{1j} and β_{2j} are allowed to vary across establishments and are therefore modeled as random. In a first set of models, these random coefficients are the outcome of the following establishment-level equations:

$$b_{0j} = g_{00} + u_{0j} \quad (4)$$

$$b_{1j} = g_{10} + u_{1j} \quad (5)$$

$$b_{2j} = g_{20} + u_{2j} \quad (6)$$

where the g are constant terms and u are establishment-level error terms assumed to be normally distributed.

In a second step, these establishment-level equations are augmented with establishment-specific variables (constant within establishments) that allow us to estimate the effect of establishment-specific characteristics on the wage gap between cross-border workers and Luxembourgish nationals. In that case, the random coefficients are modeled as follows:

$$b_{0j} = g_{00} + d_{01}Z_{1j} + \dots + d_{0m}Z_{mj} + u_{0j} \quad (7)$$

$$b_{1j} = g_{10} + d_{11}Z_{1j} + \dots + d_{1m}Z_{mj} + u_{1j} \quad (8)$$

$$b_{2j} = g_{20} + d_{21}Z_{1j} + \dots + d_{2m}Z_{mj} + u_{2j} \quad (9)$$

where the g are constant terms, Z are establishment constant variables and u are establishment-level error terms assumed to be normally distributed. The Z -variables allow us to analyze the effect, on the wage gap, of industry variables, firm size and the composition of the work-force measured by the share of cross-border workers, the share of highly educated workers or the proportion of young and men.

4.2 Accounting for the variation of within-establishment wage gaps

Estimation of model (3) with sub-conditions (4)-(6) shows that the within-establishment wage gap is not the same in each establishment (table 4). Its point estimate of 5.1% has an associated variance component of 0.003 that is statistically significant. This means that 95% of the realizations of the random variable CBW are expected to lie in the range $[-0.051 \pm 1.96 \times \sqrt{0.003}] = [-0.158 ; 0.056]$. This range is quite large, highlighting also the fact that, in some establishments at least, cross-border workers earn more than Luxembourgish nationals, once human capital differences and sorting effects have been taken into account. The objective now is to determine the establishment-specific factors that can explain part of this within-establishment wage gap variation.

Table 4. Multilevel model estimates of the wage gap

	Wage gap	Variance Components
CBW	-0.051 (0.005)	0.003 (0.001)
Variance of intercept		0.018 (0.001)
Variance of residual		0.037 (0.000)

Note: standard deviations in parentheses. A dummy variable for immigrants has been included (co-efficient not reported here), so that the reference group is constituted by the Luxembourgish nationals. Human capital and job controls: education in 7 categories, age in 6 categories, tenure in 6 categories, gender, part time job, type of contract, occupation in 8 categories. Standard errors in parentheses; N = 27428 employees, 1307 establishments.

This model is now augmented as in (7)-(9) by introducing establishment-constant variables concerning different industries (7 classes), establishment sizes (4 classes), and compositional indicators (share of cross-border workers, share of higher educated workers (A-levels and more), share of men and share of younger workers (less than 30 years old)). These Z-variables can have an effect, both on the intercept of the model (differences in the level of wages between establishments both for cross-border workers and Luxembourgish nationals) and on the cross-border coefficient through cross-level interactions. It is this second impact that we are interested in because it helps us to better understand the remaining unexplained within-establishment wage gap.

The wage gap within establishments does not vary from one industry to another (table 5). It does however change with respect to other establishment characteristics. First, firms pay lower wages to commuters than to Luxembourgish nationals when the share of cross-border workers in the establishment increases. This could reflect the existence of a substitution effect, with cross-border workers having lower bargaining power in firms where wage competition is higher (with the underlying hypothesis of a higher wage competition due to lower reservation wages for commuters). The widening of the wage gap could then be due to a certain complementarity between the two types of workforce, the nationals thereby being excluded from the ongoing wage competition. The wage gap further increases in establishments that have a higher share of higher educated employees (more than A-level) and establishments with a higher proportion of younger employees (less than 30 years old). These, again, are situations in which wage competition can be expected to be high and/or where the wage policy of establishments could be expected to integrate the lower reservation wages of

commuters.

	effect of Z on the wage gap		standard error
construction (ref)	-		-
manufacturing	-0.019		(0.019)
wholesale and retail trade	0.001		(0.019)
hotels/restaurants	-0.027		(0.032)
transport	-0.018		(0.024)
finance	-0.019		(0.023)
real estate, renting and business activities	-0.026		(0.023)
share CBW	-0.053	*	(0.029)
share immi	-0.030		(0.034)
share A-level and more	-0.066	**	(0.026)
share men	0.034		(0.027)
share less than 30 years	-0.071	*	(0.036)
firm size 10-49 (ref)	-		-
firm size 50-249	-0.001		(0.012)
firm size 250-499	0.012		(0.019)
firm size 500+	0.052	**	(0.019)

Note: *** signifies statistically different from zero at the 1% level or better; ** at the 5% level or better; * at the 10% level or better.

5 Conclusion

Daily commuters are present on many labor markets, be it at the national level (Luxembourg, Switzerland) or at the regional level (most countries with smaller borders regions) or even the local level (big cities with respect to surrounding areas). This commuting workforce could have different reservation wages or could be exposed to discriminatory pressures which could in turn lead to wage gaps between nationals and cross-border workers. Most of the wage determination literature has ignored this population, focusing almost exclusively on the population of immigrants who represent a much higher share of the labor force in most countries. From a regional labor market point of view, it is however interesting to analyze whether the only fact that a person crosses a border to go to work can have an impact on his/her wage. This could give us new insights into the sources of wage gaps between nationals and non-nationals in a more general framework.

We use the 2002 Structure of Earnings Survey for Luxembourg, a country where the commuters make up about half of the private-sector workforce. We find that the overall wage gap in favor of Luxembourgish nationals can mainly be explained by human capital differences and sorting of cross-border workers in lower-paying establishments but about a quarter of the initial wage gap cannot be accounted for by between-establishment differences. It is within firms that we turn to find potential sources of this remaining wage gap. Multilevel models allow us to disentangle these remaining differences by allowing us to estimate the impact of establishment-specific characteristics on wages. We find that the share of commuters in the establishment, as well as the proportion of younger employees and higher educated employees puts some downward pressure on wages of commuters compared to those of nationals. At this stage, the data does not allow us to attribute this effect to either a discriminatory behavior of employers or alternatively to a wage bargaining strategy of commuters consisting in lowering their reservation wage in situations of high wage competition. This should be investigated more carefully in future work. Also, it will be necessary to have a closer look at the population of commuters with respect to their country of residence. In Luxembourg, cross-border workers can reside in one of three surrounding countries, and it could be expected that the sources of wage gaps could vary from one country of origin to another.

6 Appendix

Table A1. Comparison of the SES2002 sample and an exhaustive administrative dataset (IGSS) (percentages)

		IGSS	SES 2002
share of commuters in firm	less than 33%	37	32
	33% to 66%	31	32
	more than 66%	32	36
share of immigrants in firm	less than 33%	60	62
	33% to 66%	26	24
	more than 66%	14	14
share of Luxembourgish in firm	less than 33%	77	74
	33% to 66%	18	19
	more than 66%	5	7
share of young (<30 years) in firm	less than 33%	69	66
	33% to 66%	30	30
	more than 66%	1	4
share of older (>45 years) in firm	less than 33%	84	81
	33% to 66%	16	19
	more than 66%	0	0
share of men in firm	less than 33%	13	12
	33% to 66%	26	29
	more than 66%	61	59
N		3140	1328

Note: weighted statistics reported for SES

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