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D5.2 Interaction of the Austrian and the Hungarian labour markets

WP5 Migration and impact on skills and inequality

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Summary

The report investigates how a large-scale out□ow of workers a□ect the reaming workforce. The article uses Hungarian administrative social security data on the opening of the Austrian labor market to Hungarian workers as a natural experiment. It finds that the opening of the Austrian border increased wages by 1 percent and decreased employment by 5 percent in the close neighborhood of the Hungarian side of the border. It also shows that the out□ow of workers slightly decreased the quality of the remaining workforce in Hungary. Furthermore, the report shows that Austrian labor demand shocks have a positive impact on Hungarian wages as the increase of vacancies in Austria increases the wages on the Hungarian side of the border.

The labor market effects of worker outflow: Evidence from Hungary*

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Abstract

We investigate how a large-scale outflow of workers affect the reaming workforce. We use Hungarian administrative social security data on the opening of the Austrian labor market to Hungarian workers as a natural experiment. We find that the opening of the Austrian border increased wages by 1 percent and decreased employment by 5 percent in the close neighborhood of the Hungarian side of the border. We also show that the outflow of workers slightly decreased the quality of the remaining workforce in Hungary. Furthermore, we show that Austrian labor demand shocks have a positive impact on Hungarian wages as the increase of vacancies in Austria increases the wages on the Hungarian side of the border.

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1 Introduction

One of the most influential and politically debated policy of the European Union is the free movement of labor. In accordance with the free movement of labor, any citizen of the European Union has the right to work in any member state of the EU. After the EU enlargement in 2004, this policy helped the citizens of new member states to look for a job in Western Europe. As a consequence, more than 6 million workers from the new member states moved to old member states (Eurostat, 2021), and more than two million people are employed as a posted worker or commute on a daily basis between countries (Kuosmanen and Meriläinen, 2022). This large-scale mobility has a strong effect on public opinion and political competition as well. Most notably, mobility was a central question in the campaign leading up to the Brexit referendum (Dennison and Geddes, 2018). Besides, many old member states used transitional arrangements after 2004 which aimed to decrease labor mobility between countries. For example, Austria and Germany restricted the work rights of citizens from the new member states for an additional seven years after the EU enlargement.

This paper investigates the effect of the border opening from the perspective of a new member state. Namely, we investigate how the opening of the Austrian border affected the Hungarian labor market. We implement a difference-in-difference estimation strategy and compare the wage and employment dynamics of micro-regions close to and farther away from the Austrian border. Our identification assumption is that workers close to the border are more likely to commute to work in Austria, and therefore, the opening of the border had a stronger effect on the labor market close to the border compared to more distant areas. We have two important contributions to the literature. First, we investigate how much the increased mobility of the workforce changes the composition of the remaining workers. Second, we investigate whether Austrian labor demand shocks affect wages on the Hungarian side of the border.

We use a Hungarian administrative linked employer-employee database which covers 50 percent of the Hungarian population between 2003 and 2017. We define a worker to live close to the border if her home address or work address is within 30 or 60 minutes driving distance to the border, and estimate employment and wage dynamics before and after the opening of the border. Furthermore, the database contains information on employers. Therefore, we can estimate the earning potential of every worker using the method of Abowd et al. (1999). Then, we use individual worker fixed effects from the AKM estimates to measure selectivity in worker mobility as in Dostie et al. (2021).

We start the empirical investigation by showing that the composition of workers close to the border and in areas farther away was similar before the opening of the border, just like wage and employment growth. Then, we show that the opening of the Austrian border

increased wages by approximately 1 percent. This positive wage effect is still apparent if we control for unobserved heterogeneity by including individual and firm fixed effects. At the same time, employment decreased by 5 percent compared to areas farther away from the border. These results suggest that Hungarian labor supply decreased because of the border opening. The implied elasticity of labor demand is approximately 0.2, which is similar to the findings of Borjas (2003).

Next, we show that the composition of workforce worsened after the opening of the border. The average worker fixed effect decreased by 0.4-0.9 percent after the opening of the border which implies that workers who had a larger than average earning potential were more likely to leave employment.

Finally, we provide evidence that the growth of Austrian labor demand has a positive effect on Hungarian wages. For this purpose, we show that vacancy postings in Austria increase wages of the same occupations in Hungary. However, this positive effect is apparent only within 30 minutes distance from the border. This result suggests that Austrian vacancy postings affect mostly workers who commute between Austria and Hungary.

We contribute to the debate on the relationship between immigration and the labor market. Previous results found mixed evidence on how immigration affects wages in the target country of migration. In his seminal paper Borjas (2003) showed a negative effect, while Ottaviano and Peri (2012) found a positive effect of immigration on native wages. Stoyanov and Zubanov (2012); Card (2012) and Dustmann et al. (2016) pointed out that the estimated effect of immigration crucially depends on the underlying assumptions, namely on substitutability between different types of workers. These identification assumptions can lead to opposing results even in the case of narrowly defined immigration events (Card, 1990; Borjas, 2017; Peri and Yasenov, 2019). In the case of Austria, Scmieder and Weber (2020) found that the inflow of workers from the new member states increased the wages of native workers and decreased the wages of other immigrant workers. They also show that immigration did not have a negative impact on native workers' employment; instead, firm creation increased. A small but growing strand of the literature investigates the effects of emigration on the host country. These papers usually make use of the liberalization of working rights in the border region of a neighboring country (Dodini et al., 2022; Illing, 2023). For example, Hafner (2021) found that the opening of the Swiss labor market increased wages in the French border region, while Dicarlo (2022) showed that the opening had an adverse effect on wages in the Italian border region. Dicarlo (2022) argued that the opening of the border negatively effected the selectivity of the workforce and firm creation in the Italian border region. We add to the literature by investigating a new member state and systematically investigating the selectivity of workforce. We also find evidence for negative selectivity, even though the positive wage

effect of a decreasing labor supply predominates over the wage effect of worker selectivity.

The rest of the paper is structured as follows. Section 2 provides a description of the institutional context. Section 3 introduces the databases and presents basic descriptive statistics. Section 4 outlines the estimation strategy, while Section 5 discusses the results. Finally, Section 6 concludes the paper.

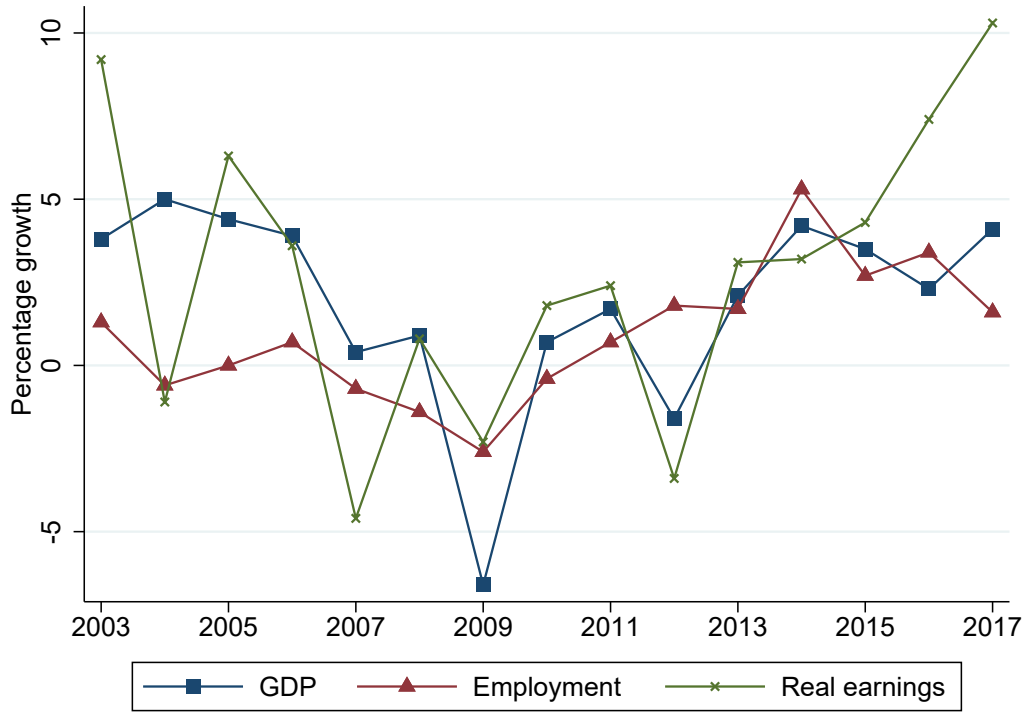
2 Institutional context

Hungary entered the European Union on 1 May 2004 with 9 other Central European countries. The accession improved the welfare of the new member states, however, Hungarian citizens had to face several travel and work restrictions even after entering the EU. The reason is that each old member state could introduce transitional arrangements restricting the work opportunities of citizens of the new member states. In the case of Austria, Hungarian citizens could work there before 2004 if they had received a permit from the Public Employment Service indicating that no other worker of the same qualification was available for the job in the European Economic Area. Austria opened up its labor market to Hungarian workers gradually between 2004 and 2011. During the transitory period, only low-educated workers needed a permit, and workers from the new member states had priority over non-EU workers. After 1 May 2011, all work restrictions were abolished and Hungarian workers had the same work opportunities as Austrian citizens(Chaloupek and Peyrl, 2016). These work restrictions were an effective obstacle as the number of Hungarian workers stagnated around 20 thousand between 2004 and 2011. Since then, the number of Hungarian workers increased linearly and reached 100 thousand at the start of the Covid pandemic (Reizer, 2020). 40 thousand of these workers were daily commuters, while the rest had temporary or permanent residence in Austria. The most important sectors are hospitality and catering, manufacturing, wholesale and retail (Reizer, 2020).

Labor market institutions in Hungary are similar to those in Anglo-Saxon countries. Wage bargaining takes place at individual level and it is relatively easy to lay off workers (Tonin, 2009). The share of union members is low and sectoral agreements are rare (Neumann, 2006).

The growth of the economy and real wages were stable until 2007. The Great recession hit Hungary severely, and decreased growth even until 2012. Since then, both the GDP and real wages started to grow again. In contrast to this, the level of employment stagnated until 2011 and was increasing fast afterwards (Figure 1).

Figure 1: Macroeconomic environment



Data source: https://kti.krtk.hu/wp-content/uploads/2021/06/hlm-2020.pdf, page 229

3 Data

We use two data sources for the empirical analysis. The main data source is the administrative linked employer-employee database of the Centre for Economic and Regional Studies. The database covers a 50 percent random sample of the Hungarian population between 2003 and 2017 (Sebők, 2019). The database contains information on employment status, occupation and income at a monthly frequency. If a worker had more jobs, we keep only the job which provided the largest monthly salary. The database also contains anonimized firm identifiers as well as the balance sheet and income statement of the employing firms.

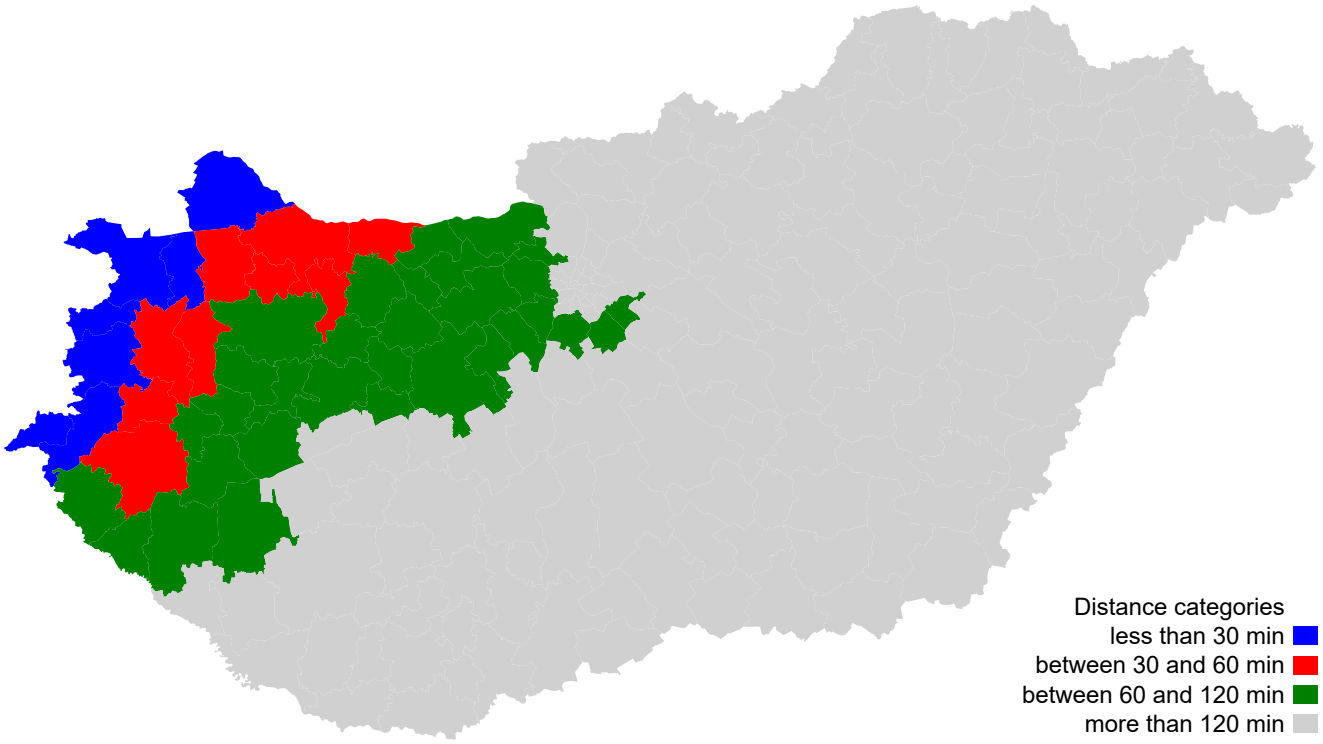
We make two samples for the analysis. In the first sample, we include every worker who was aged between 18 and 60 in the year of observation, and had a full-time job in a recorded and observed occupation with a monthly salary reaching the minimum wage. In the restricted sample, we consider only workers aged between 25 and 40 in 2002. The reason for this is that these workers most likely finished education until 2002 and were still in their prime working age (between 40 and 55) in the last observed year, i.e. in 2017. Therefore, the restricted sample enables us to estimate the effect of the border opening on a sample of individuals that does not change over time.

The database also contains information on the NUTS4 microregion of the individuals' home address and of the registered address of the firms. The Hungarian address register is not able to keep a perfect record of the actual place of residence. This means that many people move within the country or emigrate while keeping their previous official address in Hungary. That is why, we are not able to perfectly identify those workers who emigrate to Austria[1]. To improve the precision of residence information, we use the microregion of the firm if the address of an individual and the employer firm is in a different microregion, and the firm is active in the manufacturing sector. Note that, we cannot use the address defined with this method in the services sector where firms have multiple sites (e.g. retail chains) because we only observe the location of their registered address.

In the analysis, we compute the distance between the microregions and the Austrian border as the average driving distance between the respective municipalities of the microregion and the closest Austrian border crossing. Then, ee define three distinct distance categories for the analysis: i. the distance is less than 30 minutes, ii. the distance is between 30 and 60 minutes, and iii. the distance is the between 60 and 120 minutes. We consider the distance groups below 60 minutes as treated regions, while we use the microregions where the distance is between 60 and 120 minutes as control groups. Figure 2 illustrates the microregions used in the empirical analysis.

[1] This problem makes impossible the merging Hungarian and Austrian social security data with the current dataset as well.

Figure 2: Hungarian microregions by distance to the Austrian border

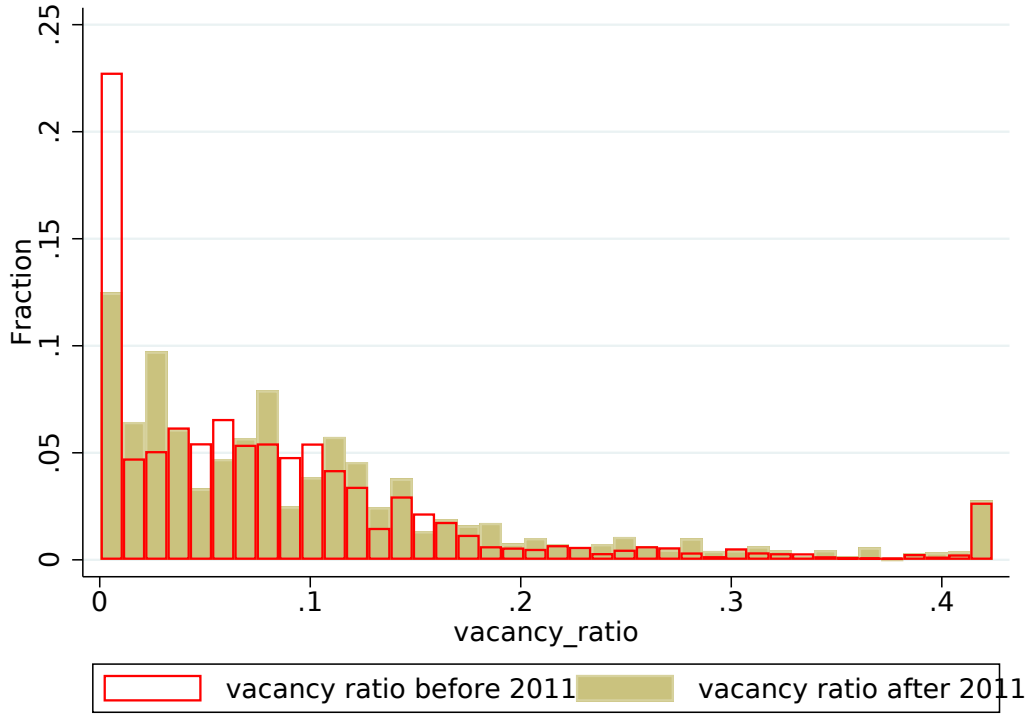


We aggregate individual-level wage and employment data at the level of occupations for every distance category. In particular, we compute the total amount of working days for every occupation and distance category by year, and calculate the average daily wages weighted by working days. As a result, we get a balanced panel between 2003 and 2017 which we can compare directly with Austrian vacancy data.

The second data source is the vacancy register of the Austrian public employment service ('Arbeitsmarktservice', AMS). The purpose of the AMS is to administer unemployment insurance payments and to help unemployed people to find a job. As part of this, the AMS collects vacancy postings and helps in matching them with the unemployed. According to Mueller et al. (2018), the AMS contains 60 percent of the total number of vacancy postings in Austria. The database records the required occupation (4-digit ISCO), the municipality of the workplace and the starting date of the job for every vacancy posting. We drop vacancies where the workplace is at more than 60 minutes driving distance from the Hungarian border or the vacancy is posted for apprentices. Then, we aggregate the number of vacancies by year and 4-digit occupational category. An important measurement issue is that vacancy postings are distinct events while we measure Hungarian wages as a yearly average. To make the two measure comparable, we define a vacancy as 1 in occupation o in year t if the vacancy was open for 12 months. As a consequence, if a vacancy was withdrawn or filled in after 3 months,

we code the vacancy as 1/4. Finally, we take into account that some occupations are more populous than other, so the number of jobs and the number vacancies are larger as well. For this purpose, we take the ratio of Austrian vacancies and the number of workers by occupation. We show the histogram of vacancy ratios before and after the opening of the Austrian labor market in Figure 3.

Figure 3: Distribution of vacancy ratios before and after the opening of the Austrian labor market



3.1 Descriptive statistics

Table 1 shows the most important descriptive statistics for the distance categories. In Columns (1)(3) we present the variables for the first observed year 2003, while the last three columns show average values for 2017. Since we are interested in the effect of the border opening on total employment and wages, we restrict attention to workers who either worked or were registered unemployed.

The first row shows that the share of men is slightly above 50 percent, but we cannot see any large difference across distance categories. In the second row, we show the share of workers whose current address is in distance category i, while their first observed address was not in district i[2]. For example, Column (1) shows that the movement of workers increased

[2]We consider a worker as a mover if she originally lived more than 120 minutes away from the border, and

the population of the district at a distance of less than 30 minutes from the border by 1 percentage point. This share increased by up to 18.6 percentage points until 2017. The share of incoming workers was slightly larger, but had similar magnitudes in the other distance categories. These numbers suggest that approximately 1 percent of the population changes address between district categories each year.

The wages were also approximately the same in every district category in 2013. The average wage was 2 percent lower in the closest district category than in the categories farther away. Similarly, the average worker fixed effects are close to zero in every district category. This suggests that workers are neither positively nor negatively selected compared to the national-level average. Firm fixed effects are also close to zero in every district category. We see the largest average firm fixed effects in the district category where the average distance is between 30 and 60 minutes. Still, here, the average firm fixed effects are only 3 percentage points larger than in the other two district categories.

Finally, Appendix shows the descriptive statistics for the sample aged between 26 and 40 age in 2003. The main characteristics of this subsample are similar to the full sample, except for two notable differences. First, the average age of this subsample increases over time, while the measure of mobility is somewhat lower. Both differences come from the fact that we fixed the cohorts in the restricted sample.

Table 1: Descriptive statistics

	Distance categories in 2003			Distance categories in 2017		
	30<	Between 30-60	60<	30<	Between 30-60	60<
Share of men (%)	50.5	53.5	52.0	51.6	53.7	52.9
Mobility[a] (%)	1.0	1.1	1.3	18.6	19.3	20.9
Age	38.2	38.1	38.1	38.8	39.0	39.1
	(38.1)	(38.1)	(38.1)	(38.8)	(38.9)	(39.0)
Average wage (log)	5.02	5.04	5.04	5.40	5.43	5.43
	(4.84)	(4.86)	(4.88)	(5.33)	(5.45)	(5.52)
Individual FE[b]	-0.006	-0.007	0.004	-0.041	-0.042	-0.029
	(0.379)	(0.389)	(0.396)	(0.324)	(0.337)	(0.352)
Firm FE[b]	0.012	0.044	0.013	0.025	0.052	0.016
	(0.302)	(0.315)	(0.339)	(0.307)	(0.323)	(0.331)
Observations	68057	92025	271287	64400	87291	290298

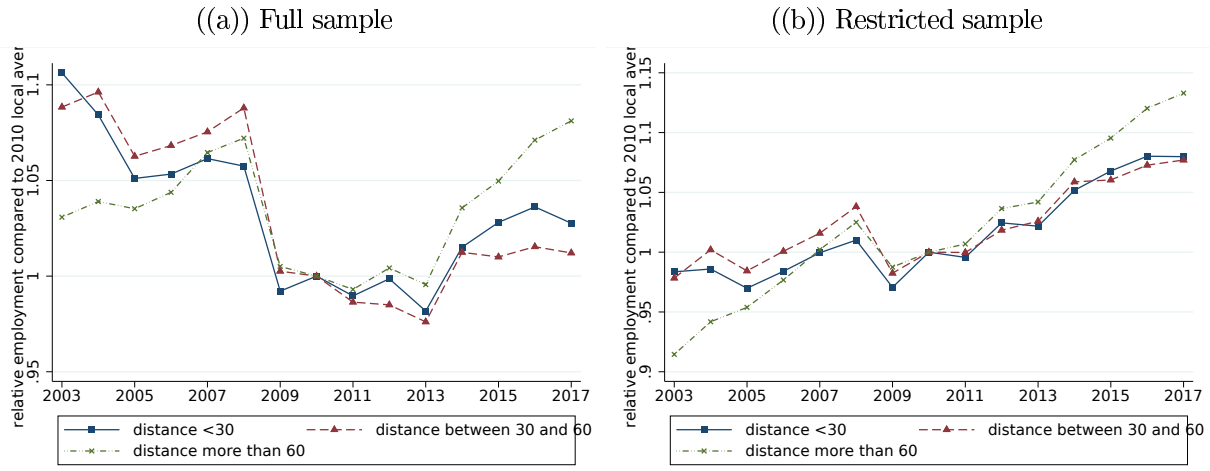
[a]The share of individuals whose first observed district category was different from the current district category. [b]The individual and firm fixed effects are the average values of AKM fixed effects.

As the next step, we show the evaluation of main variables of interest. For this purpose, we show the growth of employment between 2003 and 2017. Figure 4 calculates the total

subsequently moved closer than 120 minutes.

working days in every distance category. To facilitate the comparison between locations, we normalized employment in 2010 to 1 in every district. Figure 4a shows that employment was approximately 10 percent higher in every district before the Great Recession between 2005 and 2008. As opposed to this, the level of employment started to diverge after 2011. Most notably, total employment grew slower close to the Austrian border compared to microregions farther away. The growth of employment was steady after 2013 in the microregions at a distance of more than 60 minutes to the border, while the growth of employment stopped in closer microregions. This figure provides suggestive evidence that the opening of the Austrian labor market had a negative effect on employment in the Hungarian border region. The restricted sample in Figure 4b displays a similar pattern. The only exception is that relative employment before the Great Recession was not as high as in the full sample.

Figure 4: Evaluation of employment compared to 2010



We can expect that some workers may move to Western Hungary to fill in the jobs left behind by workers who start to work in Austria. We consider a worker as a mover within country if her current microregion is different in the current year compared to her microregion of the first observed year. Then, we plot the cumulative share of net migration by year and district. For example, if a worker entered the database in 2005 in the closest district and moved to the second closest district in 2007, we add 1 to net migration in the second closest district and subtract 1 from net migration in the closest district. Obviously, this measure means that cumulative migration in 2003 was 0 in every district. Then, we divide the net migration measure by the total population of the district to make the districts comparable.

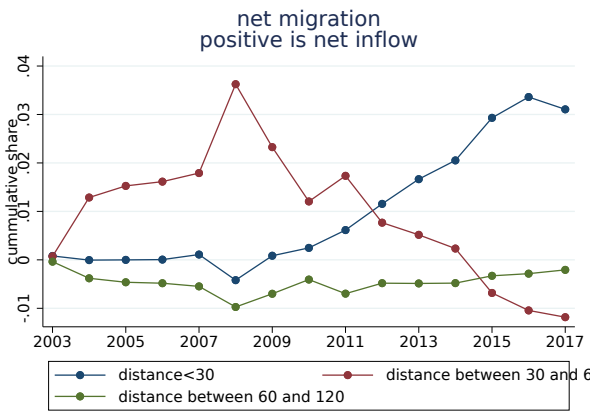
The results are summarized in Figure 5. Panel (a) shows that the microregions between 30 and 60 minutes had a positive inflow of workers until 2008. 0.04 means that in 2008 migration increased the amount of workers by 4 percentage points compared to 2003. In contrast to

this, net migration was close to zero in the other two districts. However, this trend changed after the full opening of the Austrian labor market in 2011. The amount of new workers started to increase fast in the close proximity of the Austrian border, while a quick decrease began in regions within 30 to 60 minutes from the border. However, net migration can be partially driven by the change of workforce. For that reason, it is important to compute the net migration measures on the subsample which is fixed over the whole period. The corresponding results on Panel (b) show qualitatively similar patterns. Net migration was increasing in microregions within 30 to 60 minutes before the Great Recession. However, the increase was not as large as in the case of the full sample. At the same time, net migration turned to be strongly positive in the close proximity of the border after the opening of the Austrian labor market.

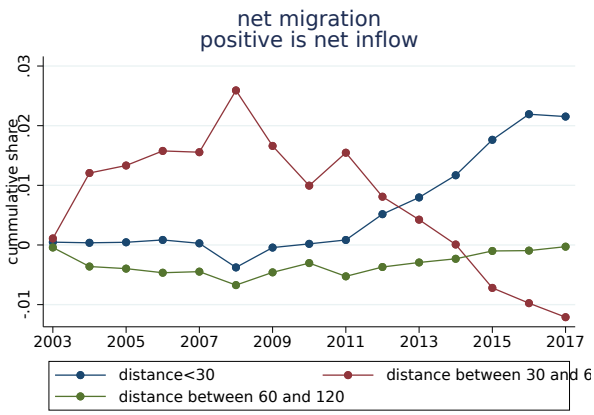
To sum up, the results suggest that the opening of the Austrian labor market induced within-country mobility, and some workers moved to Western Hungary to replace workers who had left the country.

Figure 5: Evaluation of net mobility compared to 2010

((a)) Full sample



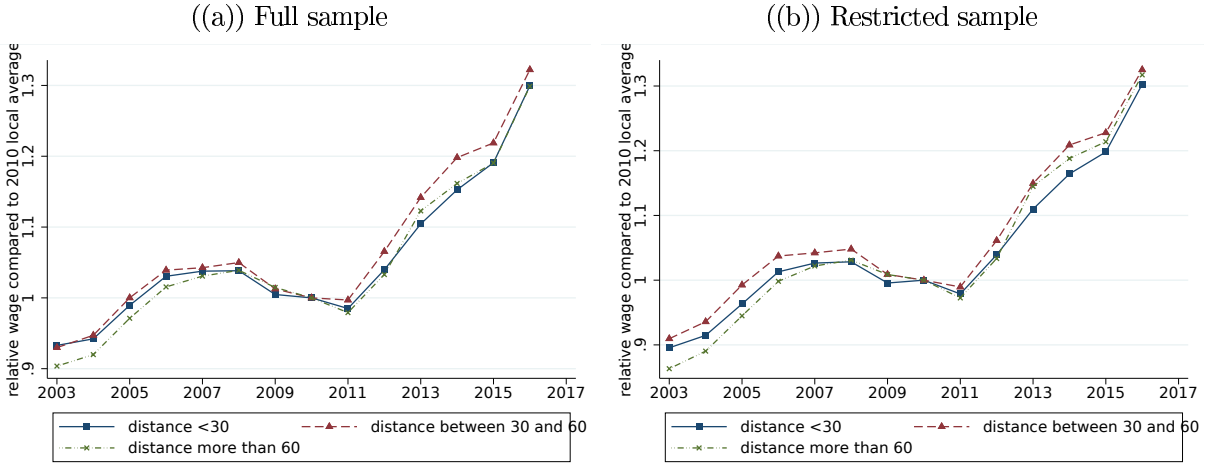
((b)) Restricted sample



Finally, we investigate wages in Figure 6. Here, we compute the average daily real wage deflated by the consumer price index for every distance category and year. Then, we normalize real wages to 1 in every distance category for 2010 to facilitate the comparison across districts. The results show that wage growth was slow in every distance category before the Great Recession, but started to increase fast after 2011. In the last six observed years, real wages increased by more than 30 percent which implies a fast real wage growth everywhere. We do not see any significant difference across distance categories either in the full sample (Panel A) or in the restricted sample (Panel B). A possible explanation for this fact is that the occupational composition of the workforce changed differently across districts. We investigate

this possibility in the next sections.

Figure 6: Evaluation of wages compared to 2010



4 Estimation strategy

We use a difference-in-difference strategy to estimate the effect of the border opening on the labor market. For this purpose, we run the following regression:

$$Y_{iodt} = \beta_1 \mathbb{1}\{\nu_d == 1\} * After_t + \beta_2 \mathbb{1}\{\nu_d == 2\} * After_t + \beta_3 X_{it} + \nu_d + \nu_o + \nu_i + \nu_t + \epsilon_{odt} \quad (1)$$

where the dependent variable is the log-wage of worker i at year o at distance category d at year t. The explanatory variables are dummy variables taking the value of 1 if the distance to the border is less than 30 minutes ($\mathbb{1}\{\nu_d == 1\}$) or between 30 and 60 minutes ($\mathbb{1}\{\nu_d == 2\}$), and a dummy variable indicating that the year of observation is after 2011 ($After_t$) when the Austrian labor market was fully opened to Hungarian workers. In this regression, workers living between 60 to 120 minutes from the border serve as a control group. We control for individual characteristics such as age and gender, and for year (ν_t), district (ν_d) and occupation (ν_o) fixed effect. In the most demanding specification, we also control for individual fixed effect (ν_i) to get rid of the effect of changing worker composition. The main variables of interest are β_1 and β_2 which are positive if the border opening had a positive effect on wages near the border.

Since the effect of the border opening on employment or worker selectivity cannot be estimated using an individual-level regression, we aggregate employment at the level of occupation and run the following regression:

$$Y_{odt} = \beta_1 \mathbb{1}\{\nu_d == 1\} * After_t + \beta_2 \mathbb{1}\{\nu_d == 2\} * After_t + \nu_d + \nu_o + \nu_t + \epsilon_{odt} \quad (2)$$

where the dependent variable is log-employment or the average worker-level fixed effect from the AKM model in occupation o in distance category d at year t. As in the wage regression, we use a difference-in-difference strategy. The main variables of interest are β_1 and β_2 which show whether employment and worker selectivity changed after the border opening. We control for year (ν_t), district (ν_d) and occupation (ν_o) fixed effect. Finally, in the most demanding specification, we include occupation-year fixed effect which controls the possibility that the relative wages in a specific occupation change over time. We weight the regressions with the number of workdays in every occupation-district-year category to make the sample representative for the working population.

As the final step, we estimate whether vacancies in Austria have an effect on wages in Hungary. For this purpose, we run the following regression:

$$Log(wage)_{odt} = \beta_1 Vac_{odt} * After_t + \beta_2 Vac_{odt} + \nu_o + \nu_t + \epsilon_{odt} \quad (3)$$

where the dependent variable is the average wage in occupation o at distance category d at year t. Vac_{odt} denotes the amount of vacancies in Austria at one hour driving distance to the border divided by the number of workers in occupation o at distance category d at year t in Hungary. Just like in Equation (2), we control for year (ν_t) and occupation (ν_o) fixed effects. The variable of interest is β_1 which is negative if Austrian vacancies increase the wages close to the border in Hungary. Here, we are interested in whether Austrian vacancies have a wage effect only in the close neighborhood of the border or even over a larger distance. That is why first we restrict attention to microregions within 30 minutes distance to the border and then expand the distance of interest up to 60 minutes driving distance.

5 Results

We start presenting the results by investigating the effect of the border opening on wages in Table 2. Column (1) shows that wages within 30 minutes distance to the Austrian border increased by 0.5 percent (s.e. 0.1 percent) after the opening of the border. The increase was slightly larger in the distance category between 30 and 60 minutes, where growth was 1 percent (s.e. 0.1 percent). The point estimates increase by up to 1.3 percent in both distance categories if we control for firm fixed effects in Column (2). Still, it is possible that the composition of workers changed after the border opening because of selective migration. We take this possibility into account in Column (3), where we control for individual fixed effect. The results show that wages increased by 0.7 percent in the closest district category, while

they increased by 1.3 percent in the distance category where the driving distance was between 30 and 60 minutes.

In Column (4)(6), we restrict attention to workers who were between age 25 and 40 in 2003, so they are prime-age workers until 2017, the last observed year. The table shows that wages increased in the restricted sample by 11.3 percent after the border opening if we control for firm fixed effects. If we control for firm and worker fixed effects, too, the estimated effect of the border opening decreases down to 0.6-1 percent. This point estimates are similar to the results using the full sample.

Table 2: The effect of the border opening on wages

	Full sample			Restricted sample		
	(1)	(3)	(3)	(4)	(5)	(6)
AfterX(distance<30)	0.005***	0.013***	0.007***	0.003	0.013***	0.006***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
AfterX(30<distance<60)	0.010***	0.013***	0.013***	-0.003	0.010***	0.010***
	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
Constant	11.773***	11.432***	11.446***	12.035***	11.431***	11.419***
	(0.002)	(0.003)	(0.003)	(0.009)	(0.005)	(0.004)
Indiv FE		Yes	Yes		Yes	Yes
Firm FE			Yes			Yes
Observations	53,659,053	52,931,471	63,875,189	27,511,779	27,165,273	32,704,376
R-squared	0.292	0.855	0.901	0.286	0.852	0.904

As the second step of the analysis, we define four occupational categories to estimate the effect of border opening on wage inequality. For this purpose, we define a separate category for managers (managers - ISCO 1), for occupations with college requirements (professionals - ISCO 2), for occupations with secondary school requirement (skilled jobs - ISCO 3-7) and jobs without schooling requirements (unskilled jobs ISCO 8-9). Then, we estimate the effect of border opening on wages by occupation groups. The results presented in Table 3 show that the border opening had heterogeneous effects across educational groups. According to Column (1), the wages relatively decreased among managers and professionals at the close neighborhood of the border if we do not control for composition effect compared to managers living further from the border. In contrast to this, the wages at unskilled jobs increased with 4 percent after the opening compared to further regions. Column (2) reveals that these raw differences are driven by composition effect. If we control for selectivity using individual fixed effects then we find that wages increased with 1-2 percent in every occupational category after the border opening except occupations with college requirement. We find similar patterns if we restrict attention to those worker who where between 25 and 40 in 2003. The results show in

these restricted sample that the wage growth was the largest among managers (approximately 4 percent) while the wages grew by 1 percent in skilled and unskilled jobs. Finally, we find that wages decreased with one percentage point among professionals if we take into account firm and individual fixed effects.

Table 3: The effect of the border opening on wages - by occupational categories

	Full sample			Restricted sample		
	(1)	(3)	(3)	(4)	(5)	(6)
AfterX(distance<30)X	-0.021**	0.027***	0.030***	-0.012	0.040***	0.039***
managers	(0.008)	(0.005)	(0.004)	(0.010)	(0.006)	(0.005)
AfterX(distance<30)X	-0.086***	-0.011**	-0.003	-0.068***	-0.036***	-0.012***
professionals	(0.005)	(0.004)	(0.003)	(0.007)	(0.006)	(0.003)
AfterX(distance<30)X	0.000	0.013***	0.011***	-0.001	0.014***	0.008***
skilled jobs	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
AfterX(distance<30)X	0.044***	0.016***	-0.002	0.032***	0.017***	-0.001
Unskiled jobs	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
AfterX(30<distance<60)	0.007	0.020***	0.038***	0.017*	0.027***	0.046***
Xmanagers	(0.007)	(0.005)	(0.003)	(0.009)	(0.006)	(0.004)
AfterX(30<distance<60)	-0.080***	0.000	-0.000	-0.089***	-0.027***	-0.015***
Xprofessionals	(0.004)	(0.004)	(0.002)	(0.006)	(0.005)	(0.003)
AfterX(30<distance<60)*	0.012***	0.014***	0.014***	0.000	0.011***	0.010***
Xskilled jobs	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.001)
AfterX(30<distance<60)	0.041***	0.016***	0.013***	0.026***	0.016***	0.011***
Xunskilled jobs	(0.002)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)
Constant	11.787***	11.429***	11.447***	11.935***	11.427***	11.419***
	(0.002)	(0.003)	(0.003)	(0.007)	(0.005)	(0.004)
Indiv FE		Yes	Yes		Yes	Yes
Firm FE			Yes			Yes
Observations	52,952,234	52,931,471	63,875,189	27,172,105	27,165,273	32,704,376
R-squared	0.482	0.854	0.902	0.480	0.852	0.904

Note:

The most natural explanation for the positive wage effect of the border opening is that some Hungarian workers close to the Austrian border actually started to work in Austria, which decreased labor supply. To test this hypothesis, we estimate the effect of the border opening on employment in the close neighborhood of the Austrian border in Table 4. Column (1) shows that there are no employment changes if we consider only the raw differences. In contrast to this, employment decreased significantly close the border if we take into account the occupational composition in Column (2). According to this specification, employment decreased by 5.9 percent (s.e. 1.5 percent) within 30 minutes distance from the border and by 6.5 percent (s.e. 1.3 percent) in microregions where the distance to the border is between 30

to 60 minutes. Even though this point estimate is a bit larger than the estimated effect for the closest distance category, the two point estimates are statistically not significantly different from each other. The point estimates are one percent lower, but significantly not different from Column (2) if we control for occupationXyear fixed effects to filter out occupation-level demand and supply shocks in Column (3). Finally, the employment effect of border crossing is similar if we restrict attention to cohorts who were prime-age workers through all observed years in Columns (4)(6). The point estimates are very close to the full sample (the difference is less than 0.3 percentage point) and they are not significantly different from each other.

Table 4: The effect of the border opening on employment

	Full sample			Restricted sample		
	(1)	(3)	(4)	(4)	(5)	(6)
AfterX(distance<30)	0.014	-0.059***	-0.046***	0.005	-0.061***	-0.051***
	(0.080)	(0.014)	(0.013)	(0.080)	(0.015)	(0.013)
AfterX(30<distance<60)	0.008	-0.065***	-0.057***	-0.001	-0.065***	-0.056***
	(0.071)	(0.013)	(0.011)	(0.071)	(0.013)	(0.012)
Constant	13.740***	13.608***	13.607***	13.051***	12.934***	12.933***
	(0.017)	(0.003)	(0.003)	(0.017)	(0.003)	(0.003)
Occupation FE		Yes	Yes		Yes	Yes
OccupationXyear FE			Yes			Yes
Observations	10,586	10,541	10,514	10,399	10,354	10,279
R-squared	0.152	0.973	0.986	0.157	0.971	0.985

As the next step of the analysis, we investigate the effect of the border opening on worker selectivity in Table (4). The selectivity of workers can improve (worsen) if workers whose earning potential is below (above) the mean earning potential are more likely to exit their job or start to work in Austria. In Table (4), the dependent variable is the average individual fixed effects form the AKM model in occupation o at year t at distance category d, while the explanatory variables are the same as in Table (3). Column (2) shows that the average worker fixed effect at 30 minutes driving distance to the border decreased by 0.5 percent (s.e. 0.2 percent) after the border opening. These point estimates mean that wages decreased by 0.5 percent after the opening in the closest distance category because the selectivity of workers became worse. According to the point estimates, the estimated effect of the border opening does not change if we filter out occupation-specific shocks using occupationXyear fixed effects.

One possible explanation for negative selectivity is the changing cohort composition. For example, it is possible that young workers entering the labor market after 2003 had a slightly lower ability than the new cohorts at other regions for some unobserved reasons. We use the restricted sample to filter out this mechanism since we cannot control for individual fixed

effects in these regressions[3]. The results in Columns (4)(6) show that average wages in the restricted sample decreased by 0.80.9 percent in the close neighborhood of the border because of changing worker composition. The border opening had a small negative effect on worker selectivity also in the distance category between 30 to 60 minutes. Here, wages decreased by 0.4 percent after the border opening.

Table 5: The effect of the border opening on worker selectivity

	Full sample			Restricted sample		
	(1)	(2)	(3)	(4)	(5)	(6)
AfterX(distance<30)	0.000	-0.005**	-0.007***	-0.005	-0.008***	-0.009***
	(0.013)	(0.002)	(0.002)	(0.014)	(0.002)	(0.002)
AfterX(30<distance<60)	0.004	-0.001	-0.002*	-0.005	-0.004**	-0.004**
	(0.011)	(0.002)	(0.001)	(0.012)	(0.002)	(0.002)
Constant	-0.013***	-0.010***	-0.009***	10,396	10,351	10,275
	(0.003)	(0.000)	(0.000)	0.002	0.979	0.988
Occupation FE		Yes	Yes		Yes	Yes
OccupationXyear FE			Yes			Yes
Observations	10,584	10,539	10,512	10,396	10,351	10,275
R-squared	0.004	0.976	0.991	0.002	0.979	0.988

As the final step of the analysis, we investigate the effect of Austrian vacancies after the border opening on Hungarian wages. We expect that Austrian vacancies increase Hungarian wages as the more vacant positions there are in Austria, the better outside option Hungarian workers may have. The results presented in Column (1) of Table 6 support this hypothesis. The average wage increases by 0.63 percent in the distance category within less than 30 minutes to the border if the ratio of vacancies increases by 10 percent. In contrast to this, we do not find evidence that Austrian vacancies increase wages in the whole area at less than 60 minutes distance to the border (Column (2)). Furthermore, we find a positive effect of Austrian vacancies on Hungarian wages only in the 30-minute distance category if we estimate a separate parameter for the distance categories. Finally, we do not find evidence that vacancies significantly increase wages if we restrict attention to the cohort observed over the whole time period. A possible explanation for this is that young workers entering the labor market after 2003 are more willing to work in Austria, and therefore, their wages react more strongly to Austrian vacancies.

[3]Note: This measure of worker selectivity is perfectly collinear with individual fixed effects.

Table 6: The effect of Austrian vacancies on Hungarian wages

	Full sample			Restricted sample		
	(1)	(2)	(3)	(4)	(5)	(6)
	Dist.<30	Dist.<60	Dist.<60	Dist.<30	Dist.<60	Dist.<60
VacancyXafter	0.063**	0.026		0.010	-0.011	
	(0.026)	(0.028)		(0.014)	(0.015)	
VacancyXafter<(dist.30)			0.069**			0.010
			(0.034)			(0.019)
VacancyXafterX(30<dist<60)			-0.016			-0.033*
			(0.034)			(0.019)
vacancy_ratio	0.105**	-0.333***	-0.341***	0.115***	-0.132***	-0.138***
	(0.050)	(0.045)	(0.045)	(0.025)	(0.023)	(0.023)
Constant	11.960***	12.037***	12.038***	11.977***	12.070***	12.071***
	(0.005)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)
Observations	2,193	4,427	4,427	2,163	4,369	4,369
R-squared	0.979	0.961	0.961	0.977	0.955	0.955

6 Conclusion

This paper investigated the effect of the opening of the Austrian border on the Hungarian border region. We make use of the fact that the Austrian labor market was fully opened to Hungarian workers only seven years after Hungary's accession to the European Union. This delay in the opening of the border enables us to differentiate the effect of the border opening from the accession of Hungary to the EU.

We used a Hungarian linked employer-employee database to show that the wages of workers within 60 minutes distance from the border increased by 1 percent compared to the wages of workers living between 60 and 120 minutes driving distance to the border. The estimated wage effect remains significantly positive even if we control for unobserved heterogeneity in worker composition. At the same time, employment in the Austrian border region decreased by 5 percent. This implies that the elasticity of labor demand is around 20 percent.

We have two additional contributions to the literature in addition to investigating the employment and wage effects of the border opening. First, we investigated the effect of the border opening on the selectivity of the workforce. We found that the average earning potential of workers decreased by one percent in the close neighborhood of the border. Second, we provided evidence that Austrian vacancies increase wages in Hungary. More specifically, a 10 percent increase in the vacancy to employment ratio increases wages in the Hungarian border region by 0.6 percent. However, this positive effect is apparent only within 30 minutes distance from the border.

To sum up, we found evidence that the opening of the Austrian labor market increased

wages and decreased employment in the Hungarian border region. This implies that the free movement of labor in the European Union significantly decreased labor supply in Hungary. Even though this policy is a cornerstone of the EU, which helped millions of workers to find a better job, policy makers have to pay attention to mitigating the negative side effects of the policy. One of the side effects is decreasing labor supply and potentially increasing labor shortage in the new member states. Consequently, policies which aim to increase labor supply and help inactive workers to enter the labor market have an increasing importance.

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Appendix

The estimation of individual earning potential

We estimate individual earning potential by following Abowd et al. (1999) and estimating

$$log(wage)_{ijt} = \beta_1 X_{it} + \nu_i + \nu_j + \nu_t + \epsilon_{odt} \tag{4}$$

where the dependent variable is the wage of worker i in year t. We consider the job which provided the largest amount of income in year t. Then, we divide this wage by the number of working days to get a daily wage. We restrict attention to workers who worked full-time and earn more than the minimum wage. The explanatory variables are occupation fixed effects, age^2 and age^3 as in Card et al. (2013). In this model, the firm fixed effects (ν_j) show the firm-specific wage premium of individuals, while the individual fixed effects (ν_i) show the earning potential of workers. We use these individual fixed effects to proxy the selectivity of workers.

In the estimation of AKM fixed effects, it is crucial that we observe as much firm change as possible. If the number of firm changes is not sufficient, the variance of individual fixed effects is overestimated, the variance of firm fixed effects is underestimated, and we observe a spurious negative correlation between individual and firm fixed effects(Bonhomme et al., 2023). To avoid this problem, we extend the estimation sample of the AKM model as much as possible. That is why we include every year between 2003 and 2017, and even locations which are at more than 120 minutes driving distance from the border. The remaining empirical issues are described in detail by Boza (2022).

Table 7: Descriptive statistics - restricted sample

	Distance categories in 2003			Distance categories in 2017		
	1	2	3	1	2	3
Share of men (%)	53.7	56.7	55.2	49.4	51.6	51.0
Mobility (%)	1.3	1.4	1.7	14.9	15.9	20.3
Age	32.1	32.1	32.3	46.0	45.9	45.9
	(32.1)	(32.1)	(32.2)	(45.9)	(45.8)	(45.8)
Average wage (log)	5.01	5.05	5.03	5.42	5.45	5.45
	(4.83)	(4.87)	(4.88)	(5.38)	(5.51)	(5.60)
Individual FE	-0.018	-0.005	-0.00	-0.036	-0.031	-0.013
	(0.366)	(0.383)	(0.386)	(0.363)	(0.376)	(0.392)
Firm FE	0.003	0.046	0.007	0.005	0.031	-0.00
	(0.322)	(0.338)	(0.355)	(0.304)	(0.319)	(0.333)
Observations	30655	41705	125002	33934	46375	156325

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