Labor Market Competition, Wages and Worker Mobility *

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Abstract

I study an integration of local labor markets which made it easier for French border commuters to get a job in the high-wage Swiss labor market. The research design compares how wages and employment of non-movers evolve in treated labor markets relative to a matched control group of labor markets in other parts of France. The results show that low-skill wages rise by 1.6 percent and low-skill employment by around 3 percent after the reform. Further evidence indicates that the integration reduced firms' monopsony power in low-skill labor markets that are less spatially integrated than high-skill labor markets.

Keywords: wages, job search, monopsony, outside options, commuting
JEL classification: J08, J21, J31, J42, J60, R23

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1. Introduction

Job mobility not only helps workers moving up the job ladder, but theory predicts that the ability to change jobs can affect the labor market as a whole.[1] Even though barriers to worker mobility are widespread, their equilibrium effects are empirically not well understood.[2]

In the present paper I study how the removal of barriers to the geographic mobility of cross-border workers affected local labor markets in France. I exploit a reform in 1998 which made it easier for French residents to find a job in neighboring Switzerland as a cross-border commuter. While one could commute already before, Swiss firms no longer had to first look for a suitable Swiss worker after the integration. As a result, French residents in the border region gained access to around 60 percent more employers whose wages were twice as high as the wages in France.

After documenting that more people, and particularly high-skill workers, start commuting from France to Switzerland soon after the integration is announced, I study the effects on French labor markets using a difference-in-differences research design. The design compares treated border regions with a matched set of control regions in other parts of France. The identification assumption is that wages and employment in the treated and the control regions would have evolved on parallel trends in absence of the market integration.

I find that average wages of employees in the French border region rise by around 1.7 percent and overall employment increases by 1 to 3 percent within three years after the market integration. The higher wages stem from low- and mid-skill workers. As wages of high-skill workers do not change, the skill premium among employees in the border region declines. The higher employment stems mainly from low-skill workers. High-skill employment increases by a similar magnitude but the effect is imprecisely estimated. Analyzing various subsamples of firms and workers separately, I show that the wage gains are not driven by any particular sector, but instead wages rise in all sectors. In contrast, employment increases in the tradable sector while the point estimates are close to zero or negative in other sectors. Low-skill wages grow more at larger and more productive employers.

The effects are consistent with a model of on-the-job search where workers' job finding rate depends on how far away from their residence they look for jobs. The labor market integration makes it easier for French workers to find a job nearby and increases competition for them. The effect is strongest for low-skill workers: Because they search for jobs very locally, the reform increases their job finding rate relatively more than for the more mobile high-skill workers.

Various facts support this interpretation. I first show, exploiting productivity shocks to the firm after netting out industry-wide shocks and controlling for skill-specific sorting to firms, that the wages of high-skill workers respond more strongly to changes in productivity at the firm than the wages of low-skill workers. In a model with on-the-job search, this means that low-skill workers find jobs less easily.[3] I then

[1]See Topel and Ward (1992) and (Burdett and Mortensen, 1998).

[2]See for instance The Economist (2019), Starr et al. (2019), U.S. Treasury (2016) and Davis and Haltiwanger (2014).

[3]In particular, when a firm becomes more productive, it wants to expand. In order to achieve a certain size, the firm needs to raise wages more when workers find other jobs more easily.

show that low-skill workers are less geographically mobile: When starting a new job, low-skill workers move to jobs that are closer to their current residence than high-skill workers. As a result, the labor market integration increases the pool of potential employers primarily for low-skill workers. I document that closest to the French-Swiss border, the local labor market for low-skill residents triples in size, while it less than doubles for high-skill workers. As the competition for workers increases, firms need to raise wages to keep their workers. The wage gains are higher at larger firms because they have initially more market power. In particular, as they face less competition from other employers before the reform, the wages they pay are further away from the marginal product than the wages of less productive firms. This allows them to raise wages more in response to the tougher competition from Swiss employers.

Investigating the employment adjustment, I find that low-skill employment increases because fewer employed workers become unemployed.[4] The additional supply of low-skill workers is absorbed in the tradable sector where firms face a more elastic demand and changes in quantity have a smaller effect on the marginal revenue product (Harasztosi and Lindner, 2019).[5] High-skill employment does not shrink because highly educated workers emigrate less from the border region to other parts of France. As they are more mobile, they respond most strongly to the increased amenity value of working in the French border region. The amenity is the option value of getting a high-wage Swiss job in the future (Harris and Todaro, 1970).

The main findings are robust to including additional controls and to using an alternative matching strategy. Since I measure regional wage growth from wage growth of individual workers, the effects do not stem from compositional changes in the level of unobserved worker quality. Moreover, other competing channels cannot explain all the findings. First, it is possible that the integration increased the demand for local non-tradable services because of the high wages that commuters earn in Switzerland but likely spend back at their place of residence. Such a mechanism is however implausible because employment does not increase in the non-tradable sector. Second, the reduction in the skill premium does not stem from the higher supply of high-skill workers, and neither from technological change that increases the productivity of low-skill workers.

The present paper contributes to three strands of the literature. First, it documents that removing barriers to geographic worker mobility improves the labor market outcomes of workers because it makes labor markets more competitive. In particular, because workers search very locally for jobs (Le Barbanchon et al., 2020; Manning and Petrongolo, 2017), having the option to work at a larger number of high-paying employers increases employer competition in the labor market and thus reduces monopsony power. The findings suggest that local economic policies that improve local access to jobs, such as commuting infrastructure, can have similar pro-competitive effects in the labor market. Relative to studies on employer mar-

Workers who find jobs more easily thus get a larger fraction of the surplus at the firm (Manning, 2011).

[4]This is consistent for instance with evidence in Manning (2003, Chapter 4.5)

[5]It is also consistent with a search model where firms make positive profits and the marginal product of labor is constant, so that firms are always willing to expand.

ket power arising from mobility restrictions such as visa policies and non-compete agreements,[6] I document that non-movers benefit from the ability to change jobs not only in terms of wages, but likely also in terms of employment.

Second, the paper analyzes how outside options and employer competition affect the labor market and assesses which type of model the evidence is most consistent with. While existing work uses individual variation (Caldwell and Danieli, 2021; Jäger et al., 2020; Caldwell and Harmon, 2018), I assess the effects of an aggregate shock to workers' outside options. I can therefore study employment effects and heterogeneous impacts across employers.[7] The results support models of oligopsonistic competition where firms interact strategically with each other when setting wages. A change in the structure of the labor market then impacts the wage-setting power of firms. In model with on-the-job search, the labor market integration increases the arrival rate of job offers and reduces the monopsony power of incumbent employers. In a model of horizontal job differentiation where workers' utility only depends on the wage and the commuting distance (Bhaskar et al., 2002; Boal et al., 1997), the labor market integration provides more close substitutes to workers that have stronger preferences for short commutes.[8]

Third, the paper uses a commuting policy to study the effects of removing barriers to worker mobility. It is related to three existing studies. The empirical strategy is similar to Dustmann et al. (2017) who exploit a policy in Germany. Beerli et al. (2021) exploit the same policy as the present paper to study the effects on the Swiss labor market. While the latter studies focus on the effects of immigration, contemporaneous work by Bütikofer et al. (2020) studies an integration of local labor markets where residents of Malmö in Southern Sweden gained access to the large labor market in the Danish capital city Copenhagen. Among Malmö residents, the integration increases overall employment and total earnings, which accrue from working in either Sweden or Denmark. Moreover, wage inequality within and across households increases because men are more likely to commute to Denmark than women. The present paper estimates a different treatment effect of labor market expansions. In particular, because many jobs become available to workers who search for jobs most locally, my paper documents a labor market competition channel.[9]

[6] For visa policies see Wang (2020), Hunt and Xie (2019) and Naidu et al. (2016), for non-compete agreements see Balasubramanian et al. (2020) and Lipsitz and Starr (2020), and for no-poach agreements see Gibson (2020).

[7] Green et al. (2019) also exploit an aggregate shock, but they use the employment rate as a control for channels other than their bargaining channel.

[8] Other models of job differentiation assume that firms are strategically small and so the labor market integration does not impact their power to set wages (Lamadon et al., 2019; Card et al., 2018).

[9] This is because parts of the French-Swiss border share a common urban area. In contrast, the bridge between Malmö and Copenhagen is around 10km long, where there are no jobs available. I find that 10km from the Swiss border the gains for workers who search most locally decays to almost 0.

2. Conceptual framework

This section describes the framework through which I study the effects of the market integration. For a wide class of monopsony models, the wage of worker g depends on her outside option b_g and her marginal product at firm j, p_{jg}. ε_g measures the degree of competition in the labor market. The wage is then

$$w_{jg} = \frac{1}{1+\varepsilon_g} b_g + \frac{\varepsilon_g}{1+\varepsilon_g} p_{jg}. \tag{2.1}$$

In a perfectly competitive labor market, $\varepsilon_g \to \infty$ and workers earn their marginal product. Because the inverse labor supply curve to individual firms is flat, lowering the wage even slightly makes all employees move to other firms. If the labor market is imperfectly competitive, however, $0 < \varepsilon_g < \infty$ and some workers will stay at the firm even when it lowers the wage.

Two common types of models of imperfectly competitive labor markts are a search model (Burdett and Mortensen, 1998) and a model with job differentiation as in Card et al. (2018). Both models assume that firms pay a unique wage to all its employees – at least within a skill group – and that worker types are perfect substitutes.[10] In the model with on-the-job search, workers are unable to move to better-paying firms because they cannot immediately find open positions at other firms. The market is more competitive when ε_g is higher and workers find other jobs more easily, making it harder for firms to retain workers at low wages.[11] In the model with job differentiation, workers are unwilling to move to better-paying firms because idiosyncratic tastes make them particularly like working at a specific firm. The market is more competitive when ε_g is higher because workers' taste shocks are less dispersed and workers have weaker preferences for specific employers.

The labor market integration can impact wages through two different channels. In a search model, the market integration makes it easier for workers to find a job across the border which raises ε_g. In a model with horizontal employer differentiation, in contrast, the market integration adds more employers with high wages, which can be thought of as increasing b_g. As preferences do not change, however, ε_g does not change and therefore firms' monopsony power is constant.[12] It is an empirical question through which channel the labor market integration operates. If competition in the labor market rises, wages should rise more at more productive firms.

[10]The model in Card et al. (2018) can be extended to include imperfect substitutability, see their paper for details.

[11]Note that in the search model, each firm pays a different wage. When firms are homogenous, which firm pays which wage is indeterminate. When firms are heterogeneous, the productivity distribution pins down the firm wage distribution (Bontemps et al., 2000; Burdett and Mortensen, 1998). but the expected wage is given by equation (2.1).

[12]The key reason for this is the absence of strategic interactions in the labor market because firms are strategically small as is assumed in Card et al. (2018) and the papers that build on it. For instance, if workers only care about a finite number of firm characteristics (Bhaskar et al., 2002; Boal et al., 1997), then the market integration also increases the competition for workers among firms because there are more and more closely substitutable employers in the labor market (also see Berry and Pakes (2007) for a discussion in Industrial Organization).

3. Background and main data

This section describes how wages are set in France, the data I use and the policy experiment I analyze.

3.1. Wage setting in France

Wages are set at three different levels. The government defines a national minimum wage. Bargaining at the industry level between employers and trade unions defines minimum wages at the industry-occupation level.[13] In 1992 these agreements covered around 90% of workers. Since the agreements only define wage floors, individual employers keep considerable room to pay higher wages. As a result an important fraction of wages are set at the company-level (OECD, 2004, p. 151), either through bargaining with unions or through individualized pay rises. For instance, 75 percent of large firms (above 50 employees) granted their workers individualized pay rises in the year 1998 (Barrat et al., 2007). As the French labor market is similarly decentralized as the German or the Dutch market, studies have found wage dispersion across employers and that employer competition is important in determining French wages Cahuc et al. (2006); Abowd et al. (1999).

3.2. Main data: Full-count worker records

The analysis uses a matched employer-employee dataset from France provided by the Statistical Office (INSEE). The data contain annual social security declarations filed by employers covering all workers, excluding the self-employed. I use the vintage called *DADS postes* (DADS = "Déclarations annuelles des données sociales"). The data report employment spells between individuals and establishments.[14] Data on spells report total salary, total hours worked, gender, age, occupational category, municipality of work and residence, the start and end date, as well as an indicator whether it is the individual's main spell in that year.[15] If the worker was employed at the same firm in the previous year, information on wages and hours from that year are also available. If the worker was employed at another firm in the previous year, the information on the preceding spell is not available, however. I keep workers that are between 15 and 64 years old. I drop apprentices, interns and workers in the agricultural sector. I also drop workers with missing data on occupation or place of work.

I classify workers into skill groups based on their two-digit occupational classification[16] similar to Combes et al. (2012) and Cahuc et al. (2006).[17] High-skill

[13] The majority of these agreements is at the national level.

[14] E.g., if an individual is employed at two different establishments, there are two spells.

[15] The definition is provided by INSEE and based on the spell's duration and total compensation.

[16] There was a major revision of occupational classifications in 2002, but the 2-digit variable used for the skill assignment ("socioprofessional category") is reported with almost no change until 2008. It changes in 2002 for some managers, but both their old and their new two-digit socioprofessional category lie in the high-skill group.

[17] I pool skill groups 2 and 3 from Cahuc et al. (2006).

occupations are managers, executives, scientists, engineers, lawyers. Mid-skill occupations are technicians, foremen, skilled blue collar workers and administrative employees. Low-skill occupations are unskilled blue and white collar workers (craft, manufacturing, sales clerks). Local labor markets are defined by INSEE. There are 297 units in France and their average size and commuting patterns are comparable to counties in the United States.

Using these data, I build a yearly dataset of wage growth and employment at the skill × labor market cell. To measure employment, I count all workers in their main employment spell when they are employed on June 30 in each year. It includes also part-time workers because the definition of part-time employment changes during the sampling period.[18] To measure aggregate growth of hourly wages, I proceed in three steps. First, I residualize wages with respect to gender, age and year. Second, I calculate individual wage growth as the change in the log hourly wage between two consecutive years. Doing so controls for individual-specific heterogeneity, which is important because the labor market integration could directly change the composition of workers through changes in labor supply. Third, I aggregate the individual wage growth at the cell level which I then cumulate across years.[19] For instance, the outcome in 2002 is the sum of the average individual wage growth in the cell for the years 1999 to 2002. Because I observe workers' wages in the previous year only if they stayed at their main employer, I focus on firm stayers. While doing so prevents me from studying the effects on wages of newly hired workers, firm stayers represent around 70 percent of all employees in two consecutive years.

Besides the worker records, I use a number of other data sets from France and Switzerland which I describe in Appendix A.2.

3.3. The integration of local labor markets

In 1998, Switzerland and the EU announced a set of bilateral agreements to facilitate factor mobility.[20] One of the agreements gave citizens the freedom to seek work and settle in the parties' labor markets. Because the EU allows cross-border commuting across its internal borders, local labor markets along the Swiss border became integrated and hiring restrictions were removed.

Before the reform, cross-border commuting was only possible between from municipalities in the so-called "border region", which was defined in a contract in 1946. I call this set the border municipalities. The French border municipalities are depicted by the navy blue area in Figure 1b. The following general rules were symmetric for French and Swiss commuters. Commuters had to return to their residence every day, their work permits were valid for one year, and changing work location or profession needed to be authorized. The specific rules on how to issue work permits depended on the country (Swiss Federation, 1986); Swiss firms could only hire a worker from across the border when they could not find a suitable worker in Switzerland.

[18] I find similar effects for employment and hours which assures me that the employment effects are not driven by more part-time work.

[19] Because individual growth rates exhibit large tails I winsorize them at the first and 99th percentile.

[20] See table A.9 for an overview.

The reform gradually removed the restrictions. Permits became valid for five years and weekly instead of daily commuting became possible, but cross-border commuters could not work outside border municipalities before 2007. Even though the treaties specified that the restrictions be removed gradually starting in 2002, it is plausible that the reform had an immediate impact on the French labor markets soon after it was announced in late 1998. I discuss this in more detail in section 3.4.

Appendix Section A.1.2 provides details on the taxation and social security coverage of cross-border commuters in Switzerland before and after the labor market integration. While it became mandatory for cross-border commuters to register with the Swiss health insurance, there were no changes in terms of unemployment insurance, pension systems and taxation.[21] Moreover, 98 percent of cross-border commuters were not controlled when crossing the border.

The institutional setting makes it unlikely that the integration of local labor markets was a result of special interests in the French border region to Switzerland. It was Switzerland that asked for negotiations in the mid-1990s during which the EU's position was defined by general principles. On several occasions the European Commission stated that the agreements had to comply with existing European norms (Bundesrat, 1999; van den Broek, 1996; European Commission, 1995), and the integration of local labor markets was a consequence of that more general rule.

3.4. Large wage differences attract more commuters

In this section I summarise the main results from comparing wages in France and Switzerland at the time of the labor market integration, and its impact on commuting. Details can be found in Appendix section B.

Figure 1a shows the nominal wages in the labor markets on both sides of the border in 1998. For all French labor markets at the border, the next labor market in Switzerland has a higher average wage. Across all labor markets in the border area, Swiss wages are around twice as high. Compared to French wages, they were twice as high for workers with a tertiary education and around 80 percent higher for workers with a mandatory education.

Insert Figure 1 about here.

Using data on the presence of commuters in Switzerland, I show that more French residents start commuting to Switzerland within the first two years after the reform was announced.[22] Together with anecdotal evidence that French residents in the border region were aware of the reform in late 1999,[23] it is thus plausible that

[21] Taxation of commuter is based on older treaties between Switzerland and France. French commuters pay taxes in France, unless they work in Geneva.

[22] Swiss commuters in France are less well documented. In 2000 0.03% of the Swiss labor force in the border region worked in France (Federal Statistical Office, 2000). Appendix B.4 suggests that for French citizens commuting to Switzerland is more important than migrating to Switzerland.

[23] The Swiss newspaper article from November 1999 by Merckling (1999) shows that French residents, mayors and real estate agents were aware of the reform at the time. The likely reason for why commuting increases immediately after announcing the reform is that Swiss authorities started handling permit applications more leniently (Beerli et al., 2021).

reform was common knowledge and that the French labor market adjusts around the same time.

I further document that while many new commuters were highly educated, some less educated workers also accepted jobs in Switzerland. The majority of new commuters lived and worked in the French border region before accepting a job in Switzerland.

4. Empirical design

4.1. Estimating the effect of the labor market integration

To estimate the effect of the labor market integration, I define labor markets that are at most a distance $\bar{d}$ away from the French-Swiss border as potentially affected by the market integration and thus in the treatment group. It includes, on the one hand, eligible labor markets that contain at least one border municipality as defined in the agreement. It includes, on the other hand, also areas that could be affected through ripple effects across labor markets: Because of commuting linkages, local labor markets overlap spatially and a shock in one area can have spillover effects on areas close by (Nimczik, 2020; Monte et al., 2018; Manning and Petrongolo, 2017). To consider such spillovers in the estimation, I define $\bar{d} = 84$ kilometers as the width of a belt drawn around the French-Swiss border. The distance is defined by the municipality in the eligible labor markets that is furthest away from Switzerland. The resulting set of 22 treated labor markets is shown in figure 1b. The eligible labor markets are in red and the spillover labor markets are in green.[24]

Insert Figure 3 about here.

The econometric model compares how outcome y in labor market i for skill group g changes from 1998 to year τ in treatment and control areas in a difference-in-difference manner:

$$\Delta y^g_{i\tau} = \alpha^g_\tau + \beta^g_\tau treat_i + \upsilon^g_{i\tau},\ \forall \tau \neq 1998 \tag{4.1}$$

with

$$\Delta y^g_{i\tau} = y^g_{i\tau} - y^g_{i1998}$$

First differences absorb time-constant heterogeneity at the level of the labor market $\times$ skill group level.[25] α^g_τ accounts for a skill-specific time trend that is constant across all labor markets. The coefficients of interest are β^g_τ which estimate the effect of the labor market integration on workers with skill g for different years. υ^g_{it} is an error term orthogonal to the treatment assignment and possibly correlated across

[24] The treated labor markets lie within a 96-minutes car drive from the next French-Swiss border crossing. The median commute in France in 2004 was 12 minutes. The treated labor markets therefore lie within ten times the median commute which is how far Manning and Petrongolo (2017) estimate the ripple effects go. Data on the location of border crossings have been kindly provided by Henneberger and Ziegler (2011).

[25] I estimate the model in first differences because the wage outcome is already differenced.

space. The hypothesis that $\beta_\tau^g = 0$ for $\tau < 1998$ allows me to test for pre-existing trends between the treatment and control areas before the labor market integration. Failing to reject this hypothesis will support the identification assumption of parallel trends in absence of the labor market integration.

Since the treatment is perfectly correlated within department,[26] I cluster the standard errors at the level of the departement (Abadie et al., 2017). There are 27 clusters in the matched sample and I calculate standard errors using the small-sample correction provided by Imbens and Kolesar (2016). They show that the approach has good coverage rates even in small samples with heterogeneous cluster sizes, and it is simple to compute. For robustness I also estimate bootstrapped p-values using the wild cluster bootstrap (Cameron et al., 2008).

4.2. Matching to find a suitable control group

Equation (4.1) compares the evolution of outcomes in affected areas with non-affected ones. Because the labor market integration was not randomly assigned across labor markets, differences between the treatment and control group may bias the estimated effect. One reason are differing labor market dynamics as wages in the control area could be growing slower than wages in the treatment area already before 1998. Another reason is that labor markets may have different sectorial structures which could therefore be exposed to different time-varying shocks. In both cases the regression in equation (4.1) would wrongly attribute differences in outcomes to the labor market integration when in reality they are driven by other factors.

I define the control areas as follows. To minimize the risk that spillovers across areas contaminate the control group, I only consider as potential controls labor markets that are at least 150 kilometers away from the Swiss border. To find suitable control units that are as similar as possible to the treated labor markets I use Mahalanobis matching. It is relatively robust in different settings, in particular in small samples, but the set of included covariates should not be too large (Stuart, 2010; Zhao, 2004). I therefore include a limited set of covariates that I believe impact potential outcomes after 1998.[27]

I match on the cumulative growth of residual wages of firm stayers for the three skill groups between 1995 and 1998 to account for different labor market dynamics before the labor market integration. I match on the following covariates in the cross-section in 1998 to account for other unobserved heterogeneity that could affect wage growth after 1998: employment shares of four sectors (tradable, non-tradable, construction, other), and employment shares of three skill groups. Accounting for differences in the industry structure is important because industries may react differently to the market integration. For instance, when competition for labor increases, firms that sell to a local consumer base may be better able to raise prices and pay their workers more (Harasztosi and Lindner, 2019). Accounting for the distribution of employment across skill groups is important because macroeconomic shock could affect different skill groups differently. I also match on the share of

[26] A *département* is a subnational administrative unit. When a labor market lies in more than one department, I assign it the department where it has the largest employment share in 1998.

[27] I have also experimented with adding more variables but the overall match quality worsens.

residents that live and work in the same labor market to account for heterogeneous local labor supply elasticities across locations which can affect how the labor market integration affects the local economies (Monte et al., 2018). I call it the own commuting share. I loosely call the full set of variables as covariates even though some of them are pre-existing trends in outcomes.

To assess balance, I compare the overlap in covariate distributions between the treatment and the control group using three measures.[28] First, normalized differences between treatment and control measure the position of the distributions, relative to the population standard deviation. Second, log ratios of standard deviations between treatment and control measure the dispersion of the distributions. Third, the fraction of treated (control) units that lies in the tails of the values of the control (treatment) units measures how well treatment and control areas overlap in the tails. In particular, it measures the probability mass of the treated units that lies outside the 0.025 and 0.975 quantiles of the distribution of the control units, and vice versa. Intuitively it is more difficult to impute the potential outcome for those units because there are not many in the control (treatment) group. For reference, in a randomized experiment this number should be 0.05 in expectation, meaning that 5% of units have covariate values that make imputing missing potential outcomes difficult.

Figure 2 presents normalized differences and log ratios of standard deviations of the covariates used for matching. The x-axis denotes the value of the measure and the y-axis denotes the variables. The left panel shows the normalized differences and the right panel shows the log ratio of standard deviations. In each panel, the red dots show the compare the treatment group and all potential controls. The green triangles compare the treatment group and the matched control group. The red dots indicate that there is considerable imbalance in the overall sample. Treated areas have more employment in the tradable sector and a higher own commuting share. Wages grow less in the treatment group than in the pool of potential controls before the market integration. Some covariates are also substantially less dispersed in the treatment group than in the potential control areas, most notably the share of high-skill workers, the wage growth and the own-commuting share. This suggests that treated labor markets are more homogenous than the potential control areas. The green dots indicate that the matching strategy improves balance for most covariates. Normalized differences shrink in all but two cases. The variability of covariates also shrinks considerably, implying that covariates are more similarly distributed in both the treated and the control areas.

Insert Figure 2 about here.

Table 1 presents more detailed numbers for the sample before and after matching. For each variable panel A compares the treated units to all potential control units, and panel B compares them to the matched control units. The first four columns show the means and standard deviations of the variables by treatment status. The last four columns show the different overlap measures. Columns (5) and (6) contain

[28]The measures are preferable to t-statistics because they are invariant to sample size (Imbens and Rubin, 2015).

the same information as Figure 2, and columns (7) and (8) show the overlap measures in the tail of the distributions. The second-last row in each panel measures the multivariate distance between the covariates of the treated and control units. It is the variance-weighted distance between covariate means of treated and controls. The matching reduces the distance from 1.19 to 0.22, suggesting that the matching strategy reaches a reasonable balance in the covariates between the treatment and control labor markets.[29] As the covariates are less dispersed in the treated than in the control group, a substantial fraction of control units lies outside the tails of the distribution of the treated units before matching (panel A, column (7)). The matching brings the tails of the control units closer to the treated units (panel B, column (7)).

Insert Table 1 about here.

4.3. Identifying assumptions

First, I assume that the matched control areas are not affected by the labor market integration. The assumption is violated if input or output markets could transmit the local shock to the rest of the French economy.

Second, I assume that only the agreement on cross-border commuting had a differential impact on French border regions, relative to other regions in France. Table A.9 shows the content of the agreements, the changes and their effects if known. The main reason why it is plausible to assume that the other agreements impact all French labor markets in the same way is that transporting people is more costly than transporting goods (Monte et al., 2018). It implies that the effect of the labor market integration decays much more quickly across space than any effects of the other agreements. To support this claim, I exploit the fact that one of the reforms, which lowered the fixed cost of trade, only applied to some tradable sectors.[30] When studying the effects of the labor market integration only on workers in the tradable sector unaffected by that reform, I find similar results as with the full sample of workers.

Third, I assume that French border regions were not differentially exposed to French nation-wide policies around 1998. The assumption is violated if for instance the French government increases the minimum wage and French-Swiss border regions employ more workers at the minimum wage than the control regions. Similarly, the French government announced a reform to reduce the hours worked per week from 39 hours to 35 hours (Askenazy, 2013). Firms with 20 employees or more had to comply by the year 2000, and early compliers received tax cuts. The law wanted to increase the hourly wages of workers by lowering hours worked per week but keeping monthly wages constant. In robustness checks I control for the regions' exposure to changes in the minimum wage and to the workweek reform and the results remain unaffected.

[29] I am not aware of benchmarks for these measures, but Imbens and Rubin (2015) refer to substantial imbalance for a sample with multivariate distance of 1.78, and to excellent balance for a sample with multivariate distance of 0.44.

[30] Tariffs between Switzerland and the EU had been abandoned already in 1972.

5. Main results

5.1. Effect on wage growth and employment

Figure 4 presents the main effect of the labor market integration on wage growth of firm stayers. Figure 5 shows the effect of the market integration on log employment. The error bars are 95 percent confidence intervals using standard errors corrected for clustering at the département level. Table 2 contains detailed results on wages and employment for the short- and medium run. I define the short-run effect as the effect in year 1999 and the medium run effect as the effect in year 2001. For inference, the table shows the standard errors using the Imbens and Kolesar (2016) correction in parentheses, and wild-cluster bootstrapped standard errors (Cameron et al., 2008) in brackets. Significance levels using the two methods closely align with each other.

Insert Figure 4 about here.

Panel 4a shows the average effect across all skill groups. The regressions for the years 1995 to 1997 do not indicate any pre-existing differential trend in wage growth in the treatment group. This is by construction as I match on these trends. Wages start increasing in 1999 and by 2001 they have grown 1.7% more in the treatment region. The effect remains on the level until 2003 and is statistically significant, but the standard errors grow over time. Panels 4b to 4d show the estimated treatment effects by skill group. All cases suggest that treatment and control groups are on parallel trends before 1998. There is no effect on wages of high-skill workers, and the point estimate turns negative towards the end of the sample period. In contrast wages of mid- and low-skill workers grow significantly after 1998. The point estimates are similar for both groups and range between 1.7 percent for low-skill workers and 2.1 percent for mid-skill workers, but they are statistically indistinguishable from each other.

Insert Figure 5 about here.

Turning to the employment effects, panel 5a shows that overall employment increases by 1.4 percent in the short-run, and by 2.8 percent in the medium run. The effect is, however, imprecisely estimated. The remaining panels show that it is low-skill employment that increases significantly in the short-run but again becomes imprecise after the year 2000, while the magnitude of the point estimate remains similar throughout the sample period.

Insert Table 2 about here.

5.2. Robustness

To explore the robustness of the main results I conduct several additional exercises. To control for the exposure to national minimum wage changes and to the workweek reduction, I include two additional controls in the regressions. In particular, I control for the share of workers at the minimum wage in 1998. If the government increases the legal minimum wage, these workers would be the most affected by the change. To control for the exposure to the change in workweek legislation I include the share of employees in large firms in 1998 in the regressions. This is a valid control for exposure to the workweek reduction if large firms did react more quickly to the reform than small firms. Table 3 shows that the wage effects are very similar when controlling for these two policies (column (6)) as in the baseline (column (5)) for all skill groups. The employment effect is also robust to including these controls (table 4, column (1) and (2)). Because I do not directly match on the level of wages, I include them as controls and report the results in the remaining columns of tables 3 and 4. In columns (3) and (7) I control for the average residual log hourly wage. The estimated medium-run average wage effect drops from 0.017 to 0.012 but remains statistically significant at the 10 percent confidence level. It also drops for the medium and low-skill workers but remains significant at conventional levels. The employment effects, if anything, slightly increase when controlling for average wages at baseline and remains significant. In columns (4) and (8) I control for skill-specific residual log hourly wages in the labor market, and the estimated wage and employment effects are close to the baseline effects.

Because I match labor markets only on a few covariates, I show in Appendix D.1 that the main results are robust to including a range of additional controls in the regressions. The controls, all measured at baseline, are the education structure of the population, employment shares by skill, and employer characteristics such as capital per worker and value added per worker as well as the firm size distribution.

Insert Table 3 about here.

Insert Table 4 about here.

Other agreements accompanied the labor market integration. A trade reform reduced the fixed cost of trade in some manufacturing sectors by 0.5 to 1 percent of the annual product value, and it has been documented that the reform increased imports of affected goods to Switzerland (Hälg, 2015). To assess whether this increased trade can explain the positive wage and employment effects in the tradable sector, I compare the estimated wage and employment effects on French border regions in tradable industries that were not affected by the trade reform with the baseline effects and the effects in the tradable industries as a whole. The results for the year 2001 are in table 5. Columns (1) and (4) present the baseline estimates for wages and employment, respectively, columns (2) and (5) the effect on tradable industries as a whole, and columns (3) and (6) on tradable industries not affected by the trade reform. Column (3) shows that the wage effects for both mid- and low-skill workers are very similar to the baseline effects and even a bit larger than the effect on tradable industries as a whole, and they remain statistically significant. Similarly, in column (6) we see that if anything, employment grew even more in the industries unaffected by the trade reform compared to the overall effects, even though the effects are imprecisely estimated. The results suggest that the simultaneous reduction in trade cost do not explain the positive employment and wage effects.

Insert Table 5 about here.

Further, as an alternative matching strategy, I use entropy balancing (Hainmueller, 2012). It is a re-weighting estimator which creates weights across all potential control units so as to perfectly balance the first and second moment of the covariate distribution.[31] I use the weights as regression weights in equation (4.1). Appendix C.2 provides further details on the matching approach. Figure D.19 shows the estimated effects for the baseline sample with a solid line and points and for the entropy balanced sample with a dashed line and triangles. In general the magnitude and the precision of the wage effects are similar when using either of the two approaches. For low-skill workers, there is an insignificant pre-existing positive trend in wage grwoth, and the estimated effect of the market integration on low-skill wages is less precise than the effect with the baseline matching strategy. The employment effects, however, differ more between the two samples. First, entropy balancing does not find a positive employment effect overall. Second, while it finds a positive effect on low-skill employment of a similar magnitude and precision as the baseline matching strategy does in the year 1999, the estimated effects decline afterwards and even become negative. As discussed in Appendix C.2, this is likely because entropy balancing fails to pick up some unobserved heterogeneity which is responsible for the differing employment effects, while the baseline matching strategy does capture it.

5.3. Effect on worker flows

Even though more people started commuting to Switzerland, the labor market integration increased employment in the French sending regions. To understand how local employment adjusts along different margins, I study the effect of the labor market integration on the following worker flows: in- and out-migration between the sampled regions and other parts of France, flows between employment and unemployment as well as employment and inactivity. The only data set that has information on all these flows is the Labor Force Survey. It is limited in size and only reports the previous department of residence. I therefore conduct the analysis at the level of the department, which gives me eight treated labor markets and 70 potential control units.[32]

[31] I do not use synthetic controls because the three pre-treatment period are insufficient to find appropriate weights.

[32] Similar to the main empirical analysis, I drop departments in a buffer zone that lie close to the treated area to minimize spillovers from the treated to the control regions.

With these limitations in mind, I find in Appendix section D.2 that for highly educated workers the labor market integration affects primarily the migration decision. From 1998 to 2002, highly educated people stay longer in the border region and move less to other parts of France. I do not find any significant impact on outflows of less educated workers, nor any significant impact on inflows of any worker. For workers with only a mandatory education, I find fewer outflows from employment to unemployment in response to the reform.

6. Interpretation

The preceding analysis shows that the labor market integration increased both wages and employment. The present section argues that the findings can be interpreted through the lens of a job search model where the labor market integration increases the job finding rate and therefore competition in the labor market.

6.1. Competition and worker mobility

First I assess the pass-through of productivity growth to incumbent wages in the French labor market, following Card et al. (2018). The idea is based on equation (2.1) where workers in more competitive markets earn a larger share of the marginal product. Thus, in a model with on-the-job search, heterogeneous firms and with a linear production technology, changes in firm productivity affect wages of workers with a higher supply elasticity more strongly (see Appendix E for a model based on Bontemps et al. (2000)). In particular, when a firm becomes more productive it wants to expand and hire more workers, which means it has to raise wages. In a more competitive market workers find new jobs more easily, and therefore the firm needs to raise the wage more than in less competitive markets in order to obtain a certain level of employment.

Among French single-establishment firms from 1995 to 2003, I estimate the following regressions for each skill group g separately:

$$\Delta w_{gijt} = \beta_g \Delta p_{ijt} + \gamma_{gi} + \gamma_{gjt} + u_{gijt} \tag{6.1}$$

where i identifies the firm and j the four-digit industry of the firm. w_{gijt} is the average wage growth of incumbent workers between year $t-1$ and t that stay at the firm, Δp_{ijt} is the change in log value added per worker between $t-1$ and t, and u_{gijt} is an unobserved, time-varying shock at the firm level. Workers in markets with lower search frictions benefit more strongly from changes in firm productivity and therefore have a higher estimated β_g. The regression controls for a firm-skill fixed effect γ_{gi} and an industry-time fixed effect γ_{gjt}. The firm-skill fixed effect accounts for differential sorting of workers to firms. If high-skill workers sort into firms that share more of the rents with their employees, failing to account for a firm-specific effect would wrongly assign this sorting to labor market competition. The industry-time effect accounts for time-varying productivity shocks at the industry level that also raise wages as they, for instance, raise the demand for all workers in the same industry and therefore increase labor market tightness independently of the performance of the individual firm. The coefficient β_g is therefore estimated from within-firm variation in deviations from industry-wide productivity growth. Two problems with estimating models of that form are measurement error in the explanatory variable and endogeneity. Measurement error in the financial variables biases the estimated elasticity towards zero. I follow Card et al. (2018) and use the growth of sales at the firm in a slightly larger time period, between $t-2$ and t, as an instrument for changes in productivity. The idea is that if measurement error in the longer time period is uncorrelated with measurement error in the shorter time period, then the change in sales in the longer time period can be used as an instrument for the change in value added per worker. While the approach, at least partially, overcomes measurement error, it does not solve issues related to endogeneity and reverse causality. For instance, if a firm adopts a technology that raises the productivity of high-skill workers, the regression wrongly attributes this to a pass-through of productivity while in reality the worker has become more productive.

Table 6 shows the estimated elasticities for all skill groups using OLS and IV. The standard errors clustered at the firm level are in parentheses. Using OLS, I find that the elasticity of incumbent wages to firm-level productivity shocks is 0.021 for workers in high-skill occupations and 0.017 for low-skill workers. The differences are economically and statistically small. As expected, when using the instrumental variables, the estimated elasticities increase. In particular, a 10 percent increase in firm productivity raises incumbent high-skill wages by 0.6 percent and low-skill wages by 0.34 percent, and the estimates are statistically different from each other. This is consistent with French high-skill workers capturing a higher share of firm-level rents as estimated by Cahuc et al. (2006). The estimated magnitudes fall into the lower part of the range of 0.05 to 0.15 reported in Card et al. (2018) who summarise existing work, but they are similar to the estimates that Card et al. (2018) obtain themselves with Portuguese data. The results suggest that high-skill workers face fewer job search frictions, which allows them to extract a larger share of the rents at the firm than mid- and low-skill workers.

Insert Table 6 about here.

A potential reason for higher search frictions among low- and mid-skill workers is worker mobility. If they search for jobs across a smaller geographic area, they find fewer jobs which implies more wage-setting power to employers. To assess this possibility, I first study whether high-skill workers search for jobs in more distant labor markets. Among workers in the *DADS panel* who voluntarily change jobs, I calculate the geographical distance between the workers' municipality of residence at the end of the first job and the municipality of work of the second job.[33] I classify a worker as a migrant if she changes her municipality of residence between the two jobs.

[33]See Appendix A.2 for more details. Distances are calculated between municipalities' centroids. French municipalities are very small and correspond to a radius of 2 kilometers on average (Combes et al., 2019).

I am interested in the following three outcomes that capture the different margins along which workers' job search behavior can differ: distance when keeping the residence, probability of migrating, and distance when migrating. For outcome y at the level of worker i in skill group g and age group a in labor market m in year t, I estimate forms of the following regression:

$$y_{igamt} = \sum_g \gamma_g \text{skill}_{ig} + \sum_a \phi_a \text{agegrp}_{ia} + \theta \text{female}_i + \alpha_m + \alpha_t + e_{igamt} \tag{6.2}$$

where skill_{ig} is an indicator for one of the three skill groups, and agegrp_{ia} is an indicator for one of three age groups (below 30, 30 to 49, above 49).[34] The parameters γ_g, ϕ_a and θ estimate group-specific differences in job search behavior of employed workers. α_z and α_t are fixed effects for local labor market of residence and last year of the ending spell, respectively.[35] I cluster standard errors at the labor market of residence during the ending spell. Distances are measured in $\ln(meters)$.[36]

Table 7 presents the results for the three outcomes. The baseline category are male high-skill workers between 30 and 49 years old. Columns (1) to (3) document differences in the search radius when the worker keeps her current municipality of residence. The workers in the baseline category accept jobs that are on average 60km away from their current place of residence. Both low- and mid-skill workers accept jobs that are on average substantially closer to their place of residence. In particular, low- and mid-skill workers accept jobs that are on average only 16km and 36km away from their place of residence, respectively. Women also accept jobs that are much closer to their current residence, which is more pronounced still for women in low-skill jobs. The differences across age groups are not significant. Columns (4) to (6) report the estimated differences in the probability of migrating to the new job. While on average 16 percent of the baseline group do so, low-skill workers do so only in 10 percent of job changes. Moreover, young workers migrate more when changing jobs. Columns (7) to (9) report the estimated differences in the search radius when changing the municipality of residence. The baseline group accepts jobs that are on average 200km away from the current place of residence, while low-skill workers accept jobs that are 50km away from their current residence. The pattern is similar for mid-skill workers. Again, women migrate shorter distances when voluntarily changing jobs, but among younger workers, they tend to move further than men.

The reported results are consistent with other work on demographic differences in job search and geographic mobility.[37] Compared to existing work, the documented gender difference in the probability and distance to migrate is novel and perhaps suprising if households tend to move together. A likely reason is that I only consider workers who change jobs with only a short intervening spell of non-employment. If couples move together, but women are more likely to move residence with their

[34] I consider age and gender to paint a fuller picture of demographic differences in geographic mobility of employed workers and because existing work documents gender differences.

[35] I drop observations from the treated labor markets after 1998 to avoid potential confounding, but doing so is not material to the results.

[36] Meters are set to 1 if the worker accepts a job in the municpality where she lives.

[37] See Amior (2021) and Balgova (2020) for educational differences in migration, Le Barbanchon et al. (2020) for gender differences in commuting preferences of unemployed workers, and Caldwell and Danieli (2021) for differences in distance more generally.

partner and search for a job only in the new location, they will not be captured by the regressions above.[38]

More generally, the results in this section indicate that low- and mid-skill workers search for jobs much more locally than high-skill workers. The larger spatial labor market of high-skill workers makes their labor market more competitive and allows them to extract a larger share of firms' rents.

Insert Table 7 about here.

6.2. The increase in labor market competition

Since low-skill employees face a smaller geographic labor market, I now study whether they benefitted disproportionately from the new Swiss employment opportunities that became available, making their labor markets more competitive.

6.2.1. A larger labor market

First, I calculate the increase in the size of the labor market for each French employee living in a French border municipality in 1998. The increase is the number of newly available Swiss firms at which a worker can work relative to the current number of firms in France from which a worker could receive a job offer. The number of currently available potential employers is a weighted average of all establishments within the search radius for migration and for commuting, weighted by the respective probabilities of changing residence when changing the job. I predict the search radius and migration probabilities from a regression model similar to equation (6.2).[39] The number of newly available potential employers are all Swiss establishments that lie within each worker's predicted search radius and are in a Swiss municipality where cross-border commuters are allowed to work.[40]

The reform increases the size of the labor market relatively more for workers that migrate less and that, conditional on migrating, migrate shorter distances, because they disproportionately benefit from the Swiss jobs nearby. Moreover, workers that accept longer commutes do not necessarily benefit more because only Swiss jobs within 10km from the border became available to French residents. The constraint is thus binding for workers who typically accept jobs that are more than 10km away from their current place of residence.[41]

Figure 6a shows the average increase across individuals by skill group and by distance from the next border crossing to Switzerland. In municipalities closest to the border, low-skill workers gain access to twice as many additional firms as they

[38] This scenario does not invalidate the interpretation that women's job search behavior is more constrained than men's since they are less likely to accept a job far away without their partner having a job offer, too.

[39] See Appendix section D.6 for more details.

[40] I take the number of Swiss establishments from the business registry, see Appendix A.2 for details.

[41] This is not crucial for the patterns documented below. Even though the gain increases for high-skill workers, closest to the border the gain is still largest for low-skill workers.

currently have in France. Since their search radius is relatively small, however, the labor market does not grow for residents that live 30km or more from the border. For high-skill workers, the size of the labor market roughly doubles immediately at the border, and the spatial decay is smaller. The bump in the line around 20km from the next border crossing is the French labor market around Evian, lying along the lake of Geneva opposite the Swiss city of Lausanne. The labor market is relatively closer to Lausanne than it is to a border crossing on land.[42] Figure 6b plots the cumulative distribution function of the increase in the size of the labor market by skill, gender and by distance from the border. I group municipalities that are up to 40km from the border into four groups such that each group has the same number of residents. The group are municipalities from 1 to 8 km from the border, 8 to 16, 16 to 26 and 26 to 40km. The top row refers to female workers, the bottom row to male workers. Among male workers that live up to 8km from the border, the majority of low-skill workers gain more employers than high-skill workers. At the third quatile, the increase in the number of potential employers is around 1.5 the size of the current labor market, which is 50 percent higher than the relative increase for high-skill workers. Moving further away from the border, the gains decline for low-skill workers, with the aforementioned exception. Among female workers, the gains in the municipalities closest to the border are similar as for men, and in particular the gains are larger for low-skill women than for high-skill women. The right tail is larger for low-skill women than for low-skill men, indicating that the highest gains of potential employers accrued to the former.

This section indicates that the labor market integration increased the size of the labor market particularly for workers who are less mobile, but only immediately at the border. This gives rise to two further predictions. First, the increase in labor market competition implies that low-skill wages should rise more at more productive employers, as predicted by a simple search model. Second, the increase should be larger in magnitude in labor markets immediately at the border. I test these hypotheses in turn.

6.2.2. Heterogeneous wage effects by establishment size

I assess whether larger employers raise the wages more after the labor market integration. Since the size of the local labor market appears to be important, in particular for low-skill workers, the relevant measure of size needs to be relative to other employers in the same labor market. I therefore classify employers by their position in the employer size distribution in their local labor market and assess differential wage effects on employers in the lower and in the upper quintile of the establishment size distribution in 1998. I use establishment size as a proxy for productivity because of data limitations and because of its theoretical appeal. In particular, a search model predicts that more productive firms are endogenously larger because they can pay higher wages and therefore attract more workers.[43]

[42] Today, the boat connection between Lausanne and Evian is an important route for many cross-border commuters.

[43] The data limitation is that I cannot measure labor productivity at the plant level. Only 7 percent of low-skill workers work in highly productive single-establishment firms in the treated region, which prevents me from estimating differential effects on low-skill workers in high and

Figure 7 shows the estimated effect of the labor market integration on wage growth in large and small establishments. While the patterns are similar both for low- and for mid-skill workers, they are more pronounced for low-skill workers. In particular, by 2001 low-skill wages in large establishments have grown by 2 percent in large firms, while the estimated effect is not statistically distinguishable from zero in small establishments.

Insert Figure 7 about here.

These results are consistent with models of oligopsonistic competition where more productive firms have more wage-setting power. For instance, in a model with on-the-job search and firm heterogeneity, more productive firms face less competition from other firms which allows them to pay wages that are further away from the marginal product than in less productive firms. As the labor market integration increases the job finding rate of workers, more productive firms have more room to raise wages than less productive ones.[44]

6.2.3. Heterogeneous wage effects by distance from the border

Lastly, I study whether the wage effects differ by how far away the labor market is from the Swiss border. Doing so not only tests the prediction that the impact should be stronger immediately at the border, but it also tests whether there are spillovers across labor markets. To investigate this channel, I estimate the effects of the labor market integration on eligible labor markets and spillover labor markets as defined in section 4.1. In particular, I modify regression equation (4.1) as follows:

$$\Delta y^g_{i\tau} = \alpha^g_{\tau,elig} + \alpha^g_{\tau,spillover} + \beta^g_{\tau,elig} treat_{i,elig} + \beta^g_{\tau,spillover} treat_{i,spillover} + v^g_{i\tau},\ \forall \tau \neq 1998 \tag{6.3}$$

where $\alpha^g_{\tau,elig}$ accounts for a skill-specific time trend among the treated, eligible labor markets and their respective matched control labor markets. Similarly, $\alpha^g_{\tau,spillover}$ accounts for a skill-specific time trend among the treated, spillover labor markets and their respective matched control units. $\beta^g_{\tau,elig}$ estimates the effect of the labor market integration on eligible labor markets, and $\beta^g_{\tau,spillover}$ the effect on spillover labor markets. Since the shock is very local, I expect $\beta^g_{\tau,elig} > \beta^g_{\tau,spillover}$, while $\beta^g_{\tau,spillover} = 0$ would suggest that there are no spillovers to neighoring labor markets.

Figure 8 shows the estimated effects for low and mid-skill workers. The positive wage effects among low-skill workers stem indeed primarily from wage gains in the labor markets directly at the border to Switzerland. Wages increase by around 2 percent by 2001. While not significantly different, the point estimate for the spillover labor market is below 1 percent and imprecisely estimated. The effects are more

low labor productivity firms. Nevertheless, in Appendix section D.4 I report the results from different measures of firm size and productivity. Figure D.20 shows the estimated effect of the labor market integration on wage growth acros all workers, and figure D.21 shows heterogeneity in wage growth for low- and mid-skill workers in establishments of different absolute size.

[44] The fact that wages grow more at larger firm does not impliy that these firms also become larger. For instance, it depends on how the wages of new hires respond to the market integration, and on how quickly workers can reallocate to other firms that offer higher wages.

similar across labor markets for mid-skill workers, even though the point estimate for the directly affected labor markets is larger than the point estimate for the spillover labor markets.

Insert Figure 8 about here.

The results are thus consistent with the very local direct impact of the increase in employment opportunities, but they also suggest that there are non-negligible spillovers to neighboring labor markets. Comparing directly impacted labor markets with neighbors can thus underestimate the true effect of the policy. The reason why the spillover effect is relatively smaller among low-skill workers than among mid-skill workers could be the fact that low-skill workers search for jobs in smaller areas than mid-skill workers, which dampens the ripple effect for low-skill workers.[45]

6.3. Alternative explanations

I now turn to a set of competing explanations of the observed effects.

6.3.1. Demand effect through higher earnings from Switzerland: Wage and employment effects across industries

It is possible that the high wages in Switzerland feed back into a demand shock for non-tradables in the local French economy. For instance, new commuters may go more to the restaurant or buy newer and larger houses. As a result, one might expect the wage and employment effects to be stemming from increases in in either the non-tradable service sector or in the construction sector. To test this hypothesis, I study the wage and employment effects across industries. Local non-tradable services are classified as in Mian and Sufi (2014), while the tradable sector is defined as in Combes et al. (2012) and contains manufacturing as well as business services such as law firms. The remaining sectors are split into construction and "other" of which wholesale trade is an important part.

Table 8 provides all point estimates for wages and employment for the year 2001. Columns (1) and (6) contain the baseline average effects when pooling all workers, and the remaining columns present the results by different industries. Wages grow in all industries. In 2001, the point estimate in the tradable and non-tradable sector is 0.015 (se 0.007 and 0.009 respectively) and very close to the baseline estimate of 0.017. In construction, wages raise substantially more by 0.043 (se 0.016), while it is smaller and not significant in other sectors. Looking at different skill groups gives a very similar picture. Low-skill wages rise by a similar magnitude in the tradable sector as in the baseline, and they are also larger in the construction sector. In contrast to the wage effects, the employment effects are concentrated in the tradable sector where, by 2001, overall employment increases by 4.8 percent while the overall effect is 2.8 percent. In contrast, employment effects in other industries are smaller, not distinguishable from zero and negative for construction. High- and low-skill

[45] Appendix D.5 shows that the low-skill employment effects are also driven by higher employment immediately at the border, particularly in the tradable sector (see also section 6.3).

employment also rises in tradable industries, but the point estimate in the medium run is more imprecise.

Insert Table 8 about here.

In conclusion, the fact that employment increases in the tradable sector and wages rise in all sectors is not consistent with demand spillovers from new commuters.

6.3.2. Other explanations

Appendix D.7 shows that the results are not consistent with three further explanations.

Relative supply and relative wages The labor market integration reduced the skill premium in the border area and raised employment of low- and possibly high-skill workers. In the canonical model with perfectly competitive market where skill groups are imperfect substitutes the reduction in the skill premium could be explained by an increase in the relative supply of high-skill workers (Katz and Murphy, 1992). The results, however, show that relative supply of high and low-skill workers did not change after the reform.

Higher worker productivity If employers expect low-skill workers to become more abundant after the market integration, they may invest in technologies that make low-skill workers more productive (Acemoglu, 2002). This could raise low-skill wages even if the market is perfectly competitive. The results from estimating production functions at the firm level suggest, however, that the low-skill workers did not become more productive after the reform.

Bargaining A bargaining model could also explain the positive wage effects because of better outside options for workers. It would, however, not predict a positive employment effect since workers' improved outside options reduces the job creation of firms and lowers employment (Beaudry et al., 2018, 2012).

7. Conclusion

Restrictions to worker mobility can make employers imperfect substitutes for workers. This constrains workers' access to good outside options and increases monopsony power of employers.

Using a quasi-experiment I study the effects of removing barriers to geographic worker mobility. The integration of local labor markets between France and Switzerland provides plausibly exogenous variation in French workers' access to good jobs. The results suggest that the policy increased wages and employment of non-movers because of higher competition among employers in the labor market. Several additional facts support the interpretation that the market integration lowered monopsony power, particularly in low-skill labor markets that are less spatially integrated than high-skill labor markets.

The findings have important implications both for labor market policy and for understanding the sources of monopsony power in the labor market. Removing barriers to worker mobility can make labor markets more competitive and improve the labor market outcomes even of non-movers. Examples of barriers to mobility include employer-sponsored health insurance, non-compete agreements or intransferable pension rights. The paper shows evidence consistent with models of oligopsonistic competition in the labor market where changes in the market structure impact the wage-setting power of firms. Understanding better the sources of monopsony power in the labor market and assessing policies that reduce it remain important areas for future research.

References

Abadie, A., Athey, S., Imbens, G., and Wooldridge, J. (2017). When should you adjust standard errors for clustering? *Working paper.*

Abowd, J. M., Kramarz, F., and Margolis, D. N. (1999). High wage workers and high wage firms. *Econometrica*, 67(2):251–333.

Acemoglu, D. (2002). Directed technical change. *Review of Economic Studies*, 69(4):781–809.

Ackerberg, D. A., Caves, K., and Frazer, G. (2015). Identification properties of recent production function estimators. *Econometrica*, 83(6):2411–2451.

Aeschlimann, J. (2004). EU - Der Blocher-Effekt. Facts.

Amior, M. (2021). Education and geographic mobility: The role of the job surplus.

Askenazy, P. (2013). Working time regulation in France from 1996 to 2012. *Cambridge Journal of Economics*, 37(2):323–347.

Balasubramanian, N., Chang, J. W., Sakakibara, M., Sivadasan, J., and Starr, E. P. (2020). Locked in? the enforceability of covenants not to compete and the careers of high-tech workers. *Journal of Human Resources.*

Balgova, M. (2020). Leaping into the unknown? the role of job search in migration decisions.

Barrat, O., Chaput, H., Naboulet, A., and Wolff, L. (2007). Wage bargaining and compensation practices in France: An overview. In *Proceedings of the conference Négociations salariales, emploi, politique économique et monétaire, Banque de France, Paris.*

Beaudry, P., Green, D., and Sand, B. (2012). Does industrial composition matter for wages? A test of search and bargaining theory. *Econometrica*, 80(3):1063–1104.

Beaudry, P., Green, D. A., and Sand, B. M. (2018). In search of labor demand. *American Economic Review*, 108(9):2714–57.

Beerli, A., Ruffner, J., Siegenthaler, M., and Peri, G. (2021). The abolition of immigration restrictions and the performance of firms and workers: Evidence from switzerland. *American Economic Review*, 111(3):976–1012.

Bello, P. and Galasso, V. (2016). Old before their time: The role of employers in retirement decisions. Working Paper.

Berry, S. and Pakes, A. (2007). The pure characteristics demand model. *International Economic Review*, 48(4):1193–1225.

Bhaskar, V., Manning, A., and To, T. (2002). Oligopsony and monopsonistic competition in labor markets. *Journal of Economic Perspectives*, 16(2):155–174.

Bischoff, J. (1997). Verschärfte italienische grenzkontrollen. Neue Zuercher Zeitung.

Boal, W. M., Ransom, M. R., et al. (1997). Monopsony in the labor market. *Journal of Eonomic Literature*, 35(1):86–112.

Bontemps, C., Robin, J.-M., and Van den Berg, G. J. (1999). An empirical equilibrium job search model with search on the job and heterogeneous workers and firms. *International Economic Review*, 40(4):1039–1074.

Bontemps, C., Robin, J.-M., and Van den Berg, G. J. (2000). Equilibrium search with continuous productivity dispersion: Theory and nonparametric estimation. *International Economic Review*, 41(2):305–358.

Bundesrat (1999). Botschaft zur Genehmigung der sektoriellen Abkommen zwischen der Schweiz und der EG. Legal report.

Burdett, K. and Mortensen, D. T. (1998). Wage differentials, employer size, and unemployment. *International Economic Review*, 39(2):257–273.

Bütikofer, A., Loken, K. V., and Willen, A. (2020). Building bridges and widening gaps. wage gains and equity concerns of labor market expansions. *Working Paper*.

Cahuc, P., Postel-Vinay, F., and Robin, J.-M. (2006). Wage bargaining with on-the-job search: Theory and evidence. *Econometrica*, 74(2):323–364.

Caldwell, S. and Danieli, O. (2021). Outside options in the labor market. *Working Paper*.

Caldwell, S. and Harmon, N. (2018). Outside options, bargaining, and wages: Evidence from coworker networks. *Working Paper*.

Cameron, A. C., Gelbach, J. B., and Miller, D. L. (2008). Bootstrap-based improvements for inference with clustered errors. *Review of Economics and Statistics*, 90(3):414–427.

Card, D., Cardoso, A. R., Heining, J., and Kline, P. (2018). Firms and labor market inequality: Evidence and some theory. *Journal of Labor Economics*, 36(S1):S13–S70.

Combes, P.-P., Duranton, G., and Gobillon, L. (2019). The costs of agglomeration: House and land prices in French cities. *Review of Economic Studies*, 86(4):1556–1589.

Combes, P.-P., Duranton, G., Gobillon, L., Puga, D., and Roux, S. (2012). The productivity advantages of large cities: Distinguishing agglomeration from firm selection. *Econometrica*, 80(6):2543–2594.

Davis, S. J. and Haltiwanger, J. (2014). Labor market fluidity and economic performance. *NBER Working Paper*.

Di Giovanni, J., Levchenko, A. A., and Mejean, I. (2014). Firms, destinations, and aggregate fluctuations. *Econometrica*, 82(4):1303–1340.

Dustmann, C., Schönberg, U., and Stuhler, J. (2017). Labor supply shocks, native wages, and the adjustment of local employment. *Quarterly Journal of Economics*, 132(1):435–483.

Eckstein, Z. and Van den Berg, G. J. (2007). Empirical labor search: A survey. *Journal of Econometrics*, 136(2):531–564.

Eckstein, Z. and Wolpin, K. I. (1990). Estimating a market equilibrium search model from panel data on individuals. *Econometrica*, 58(4):783–808.

Eidgenösisches Aussendepartement (EDA) (2016). Die Schweiz und die Europäische Union.

Engbom, N. and Moser, C. (2018). Earnings inequality and the minimum wage: Evidence from brazil. *Working Paper*, 7:18–50.

European Commission (1995). Press release 95-118.

European Commission (2006). Regulation (EC) No 562/2006 of the European Parliament and of the Council of 15 March 2006 establishing a Community Code on the rules governing the movement of persons across borders (Schengen Borders Code).

European Council (2004). Verordnung (EWG) Nr. 1408/71 des Rates vom 14. Juni 1971 zur Anwendung der Systeme der sozialen Sicherheit auf Arbeitnehmer und Selbstständige sowie deren Familienangehörige, die innerhalb der Gemeinschaft zu- und abwandern. Legal text.

European Union and Swiss Government (1999). Abkommen zwischen der Schweizerischen Eidgenossenschaft einerseits und der Europäischen Gemeinschaft und ihren Mitgliedstaaten andererseits über die Freizügigkeit. Legal text.

Federal Statistical Office (2000). Population census. Data set.

Federal Statistical Office (2017a). Grenzgängerstatistik. Data set.

Federal Statistical Office (2017b). Lohnstrukturerhebung 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014. Data set.

Federal Statistical Office (2019). Ständige ausländische Wohnbevölkerung nach Staatsangehörigkeit, 1980-2018. Data set.

French and Swiss Government (1966). Abkommen zwischen der Schweiz und Frankreich zur Vermeidung der Doppelbesteuerung auf dem Gebiet der Steuern vom Einkommen und vom Vermögen und zur Vermeidung von Steuerbetrug und Steuerflucht. Legal text.

French and Swiss Government (1975). Abkommen zwischen der Schweizerischen Eidgenossenschaft und der Französischen Republik über Soziale Sicherheit. Legal text.

French and Swiss Government (1978). Abkommen zwischen der Schweizerischen Eidgenossenschaftund der Republik Frankreich über die Arbeitslosenversicherung. Legal text.

French and Swiss Government (1983). Accord entre le gouvernement de la république francaise et le conseil fédéral suisse relatif à l'imposition des rémunerations des travailleurs frontaliers. Legal text.

Gibson, M. (2020). Employer market power in silicon valley. Technical report, Working Paper.

Gopinath, G., Kalemli-Özcan, Ş., Karabarbounis, L., and Villegas-Sanchez, C. (2017). Capital allocation and productivity in south europe. *Quarterly Journal of Economics*, 132(4):1915–1967.

Green, D. A., Morissette, R., Sand, B. M., and Snoddy, I. (2019). Economy-wide spillovers from booms: Long-distance commuting and the spread of wage effects. *Journal of Labor Economics*, 37(S2):S643–S687.

Hainmueller, J. (2012). Entropy balancing for causal effects: A multivariate reweighting method to produce balanced samples in observational studies. *Political Analysis*, 20(1):25–46.

Harasztosi, P. and Lindner, A. (2019). Who pays for the minimum wage? *American Economic Review*, 109(8):2693–2727.

Harris, J. R. and Todaro, M. P. (1970). Migration, unemployment and development: a two-sector analysis. *American Economic Review*, 60(1):126–142.

Henneberger, F. and Ziegler, A. (2011). Evaluation der Wirksamkeit der flankierenden Massnahmen zur Personenfreizügigkeit - Teil 2: Überprüfung von Lohndruck aufgrund der Personenfreizügigkeit. *FAA Discussion paper*, 125.

Hoffmann, F. and Shi, S. (2016). Burdett–Mortensen model of on-the-job search with two sectors. *Review of Economic Dynamics*, 19:108–134.

Hunt, J. and Xie, B. (2019). How restricted is the job mobility of skilled temporary work visa holders. *Journal of Policy Analysis and Management*, 38(1):41–64.

Hälg, F. (2015). *Technische Handelshemmnisse und die Gewinner tieferer Marktbarrieren*, chapter 4, pages 113–132. In Schellenbauer and Schwarz (2015).

Imbens, G. and Kolesar, M. (2016). Robust standard errors in small samples: Some practical advice. *Review of Economics and Statistics*, 98(4):701–712.

Imbens, G. W. and Rubin, D. B. (2015). *Causal inference in statistics, social, and biomedical sciences.* Cambridge University Press.

Jäger, S., Schoefer, B., Young, S., and Zweimüller, J. (2020). Wages and the value of nonemployment. *Quarterly Journal of Economics*, 135(4):1905–1963.

Katz, L. F. and Murphy, K. M. (1992). Changes in relative wages, 1963–1987: Supply and demand factors. *Quarterly Journal of Economics*, 107(1):35–78.

Kislig, B. (2004). Verschärfte Grenzkontrollen - Deutschland zieht die Schlinge zu. Berner Zeitung.

Lamadon, T., Mogstad, M., and Setzler, B. (2019). Imperfect competition, compensating differentials and rent sharing in the US labor market. *NBER Working Paper*.

Le Barbanchon, T., Rathelot, R., and Roulet, A. (2020). Gender differences in job search: Trading off commute against wage. *Quarterly Journal of Economics*, 136(1):381–426.

Levinsohn, J. and Petrin, A. (2003). Estimating production functions using inputs to control for unobservables. *Review of Economic Studies*, 70(2):317–341.

Lipsitz, M. and Starr, E. (2020). Low-wage workers and the enforceability of non-compete agreements. *Management Science*.

Manning, A. (2003). *Monopsony in motion: Imperfect competition in labor markets*. Princeton University Press.

Manning, A. (2011). Imperfect competition in the labor market. In *Handbook of Labor Economics*, volume 4, pages 973–1041.

Manning, A. and Petrongolo, B. (2017). How local are labor markets? Evidence from a spatial job search model. *American Economic Review*, 107(10):2877–2907.

Merckling, N. (1999). Ce que les bilatérales changeront pour le commun des mortels des deux cotés de la frontière. Le Temps.

Mian, A. and Sufi, A. (2014). What explains the 2007–2009 drop in employment? *Econometrica*, 82(6):2197–2223.

Monte, F., Redding, S., and Rossi-Hansberg, E. (2018). Commuting, migration and local employment elasticities. *American Economic Review*, 108(12):3855–90.

Moscarini, G. and Postel-Vinay, F. (2013). Stochastic search equilibrium. *Review of Economic Studies*, 80(4):1545–1581.

Naidu, S., Nyarko, Y., and Wang, S.-Y. (2016). Monopsony power in migrant labor markets: evidence from the united arab emirates. *Journal of Political Economy*, 124(6):1735–1792.

Nimczik, J. S. (2020). Job mobility networks and data-driven labor markets. *Working Paper*.

OECD (2004). Employment outlook 2004.

Olley, S. and Pakes, A. (1996). The dynamics of productivity in the telecommunications equipment industry. *Econometrica*, 64(6):1263–1297.

Oster, E. (2019). Unobservable selection and coefficient stability: Theory and evidence. *Journal of Business & Economic Statistics*, 37(2):187–204.

Polinsky, A. M. and Shavell, S. (2007). *Handbook of Law and Economics*, volume 2.

Saameli, D. (2002). Gegen ein leichtfertiges Ja. St. Galler Tagblatt.

Schellenbauer, P. and Schwarz, G., editors (2015). *Bilateralismus – was sonst*. Verlag Neue Zürcher Zeitung.

Staatsekretariat für Wirtschaft (SECO) (2008). Die Bilateralen I zwischen der Schweiz und der EU: Eine Zwischenbilanz. *Die Volkswirtschaft*, 81(11).

Starr, E., Prescott, J. J., and Bishara, N. (2019). Noncompetes in the US labor force. *Working Paper*.

Stuart, E. A. (2010). Matching methods for causal inference: A review and a look forward. *Statistical Science: a review journal of the Institute of Mathematical Statistics*, 25(1):1.

Swiss Federation (1946). Accord entre la suisse et la france relatif à la circulation frontalière.

Swiss Federation (1986). Verordnung über die Begrenzung der Zahl der Ausländer. Legal text.

Swiss Federation (1995). Verordnung über die Krankenversicherung. Legal text.

The Economist (2019). Another French president tries pension reform.

Topel, R. H. and Ward, M. P. (1992). Job mobility and the careers of young men. *Quarterly Journal of Economics*, 107(2):439–479.

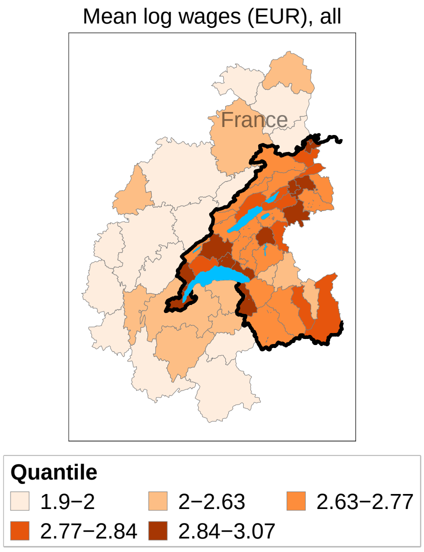
U.S. Treasury (2016). Non-compete contracts: Economic effects and policy implications.

van den Broek, H. (1996). Switzerland and the European Union. Address at the Swiss-Dutch Chamber of Commerce.

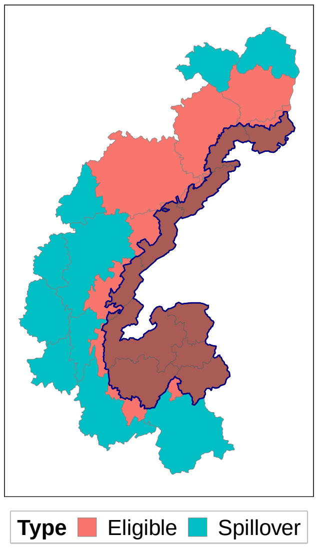
Wang, X. (2020). US permanent residency, job mobility, and earnings. *Journal of Labor Economics*.

Zhao, Z. (2004). Using matching to estimate treatment effects: Data requirements, matching metrics, and monte carlo evidence. *Review of Economics and Statistics*, 86(1):91–107.

8. Figures and Tables



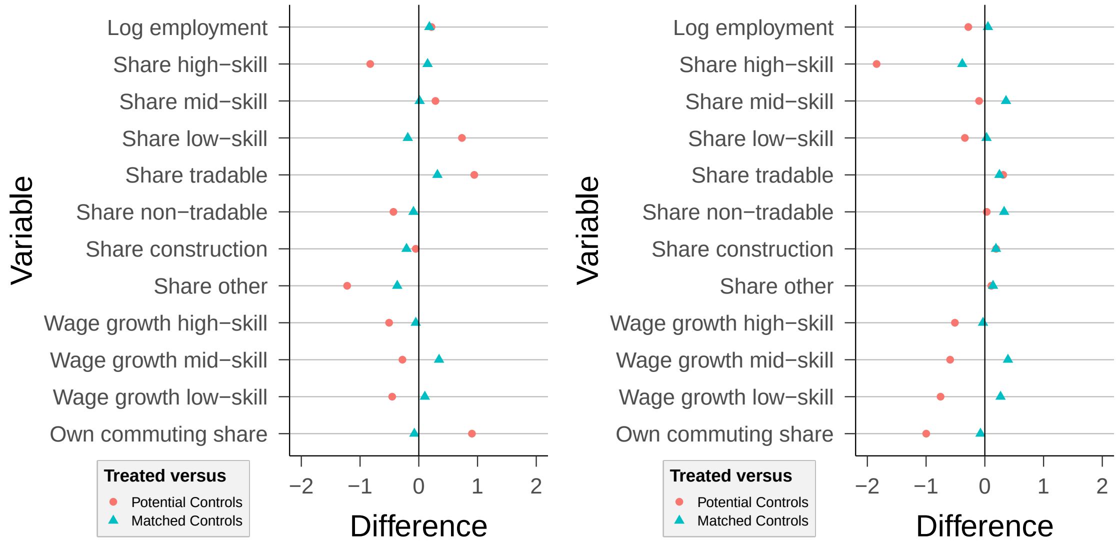
(a) Wages in 1998



(b) French border municipalities and treated labor markets

Figure 1: The Swiss and French labor markets around the border

Notes: Panel 1b shows French the municipalities and labor markets along the Swiss-French border. The navy blue area are the French border municipalities. Labor markets are colored by whether they are directly exposed to the market integration (red) by having at least one municipality in the border region, or by being affected by spillovers (green). Figure 1a shows the average log wages in labor markets in France and Switzerland in 1998. The colors refer to quantiles of the labor markets in the sample. *Data: DADS, SESS.*



(a) Normalized Diff.

(b) Log Ratio of S.D.

Figure 2: Balance before and after matching

Notes: The figure shows the normalized differences and log ratio of standard deviations between the treatment group and the control group for each variable as indicated on the y-axis. Normalized differences are the differences in means between the treated and the control units, normalized with respect to the standard deviations of the treated and control units. Controls are all potential controls for the red dots and the matched controls for the green diamonds. The variables refer to: log employment, employment share of workers in high, mid and low-skill occupations, employment share in tradable, non-tradable construction and other sector, all in 1998. Wage growth for high, mid and low-skill is cumulative residual wage growth of firm stayers in two consecutive years from 1995 to 1998. Own commuting share is the share of employees in the labor market that also live in that market in 1998. See the Table 1 and text for details.

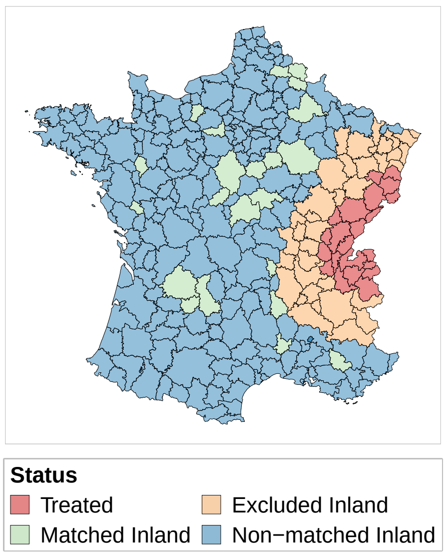
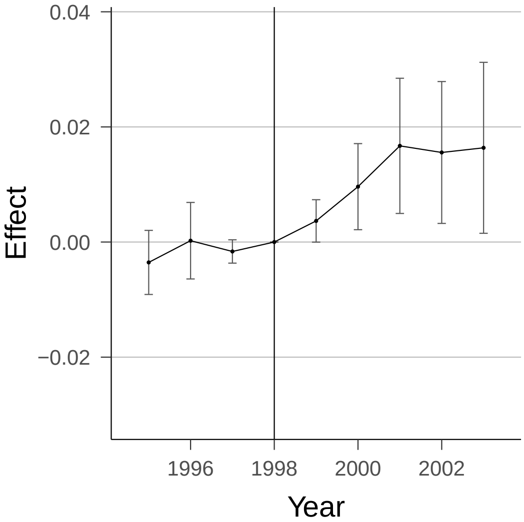
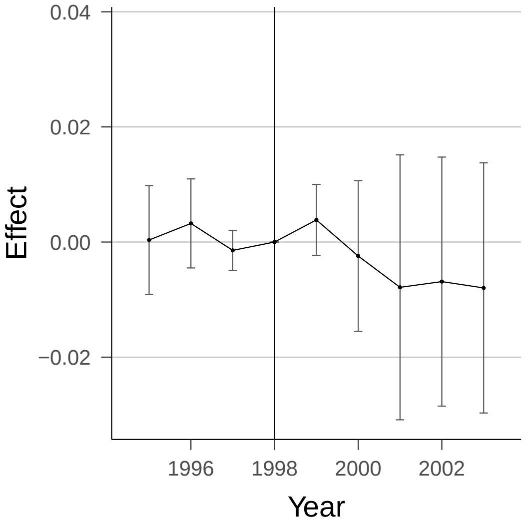


Figure 3: Labor markets in France by matching status

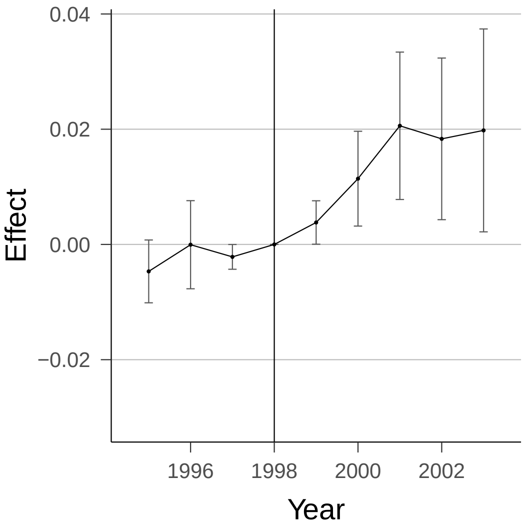
Notes: The figure shows all labor markets in France and their matching status. *Border Region* are the treated labor markets. *Excluded Inland* are those not included for the matching strategy. *Matched Inland* and *Non-matched Inland* are the labor markets selected and not selected in the matching procedure. Details: see text.



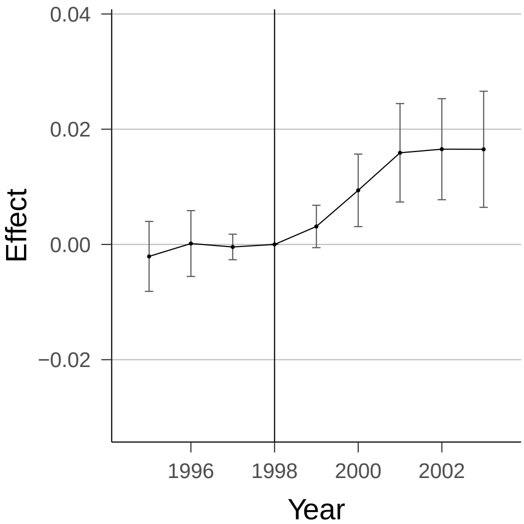
(a) All workers



(b) High-skill occupations



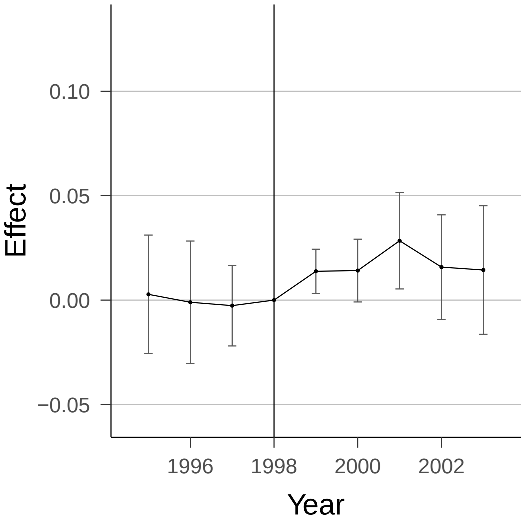
(c) Mid-skill occupations



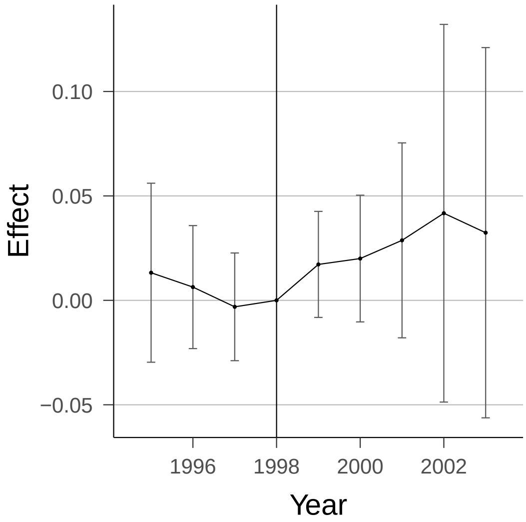
(d) Low-skill occupations

Figure 4: Main effects on wage growth of firm stayers

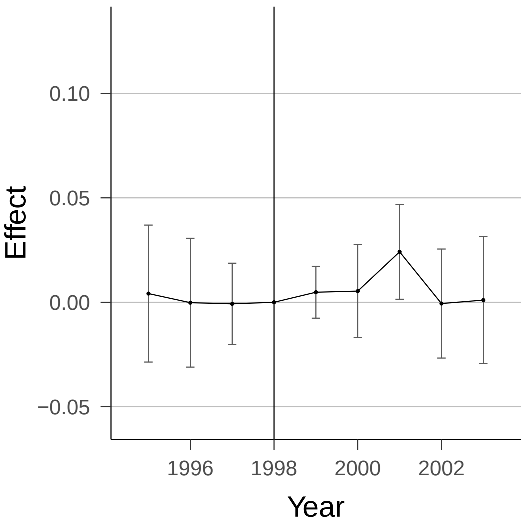
Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on cumulative growth in hourly wages of firm stayers relative to 1998. Regressions are weighted by cell-specific employment in 1998. Hourly wages are residualized for gender and age. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*



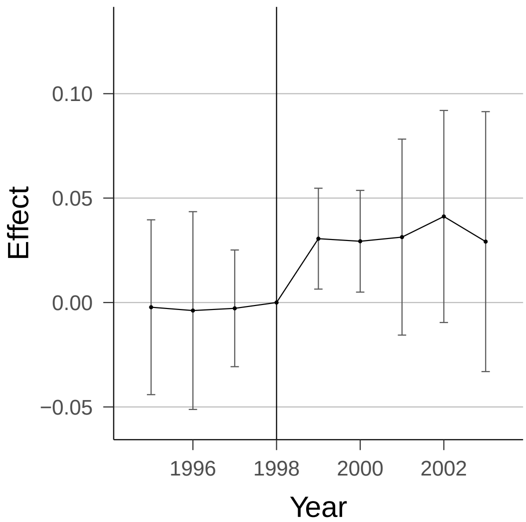
(a) All workers



(b) High-skill occupations



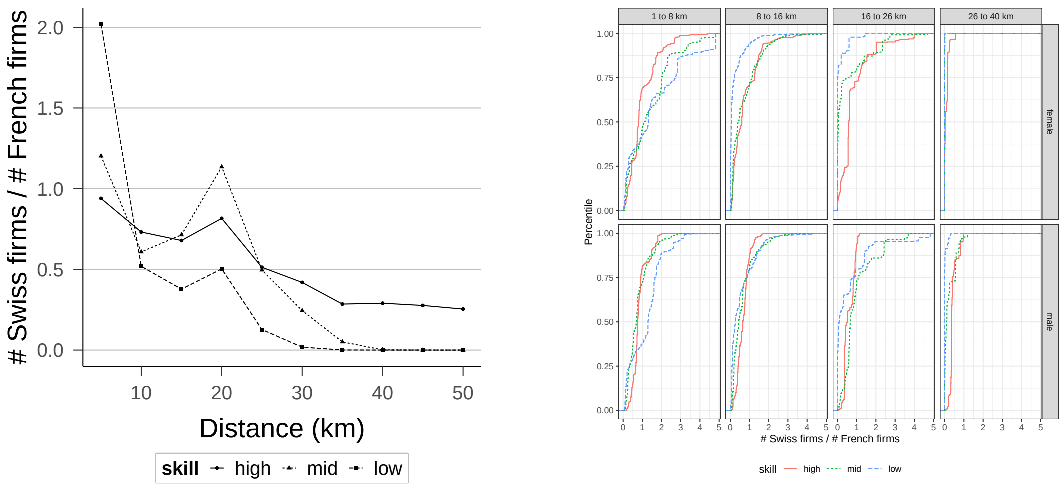
(c) Mid-skill occupations



(d) Low-skill occupations

Figure 5: Main effects on total employment

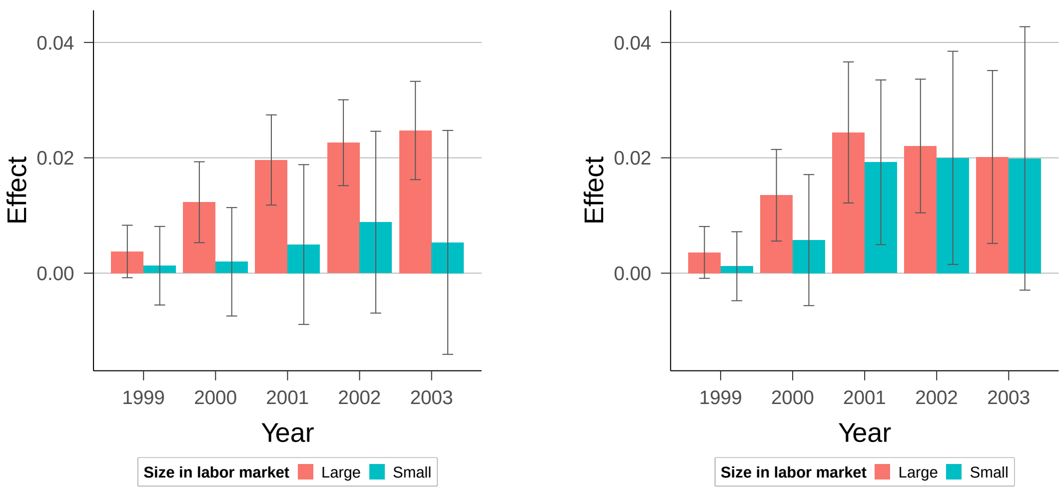
Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on total employment. Regressions are weighted by cell-specific employment in 1998. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*



(a) Average (b) Distribution

Figure 6: The increase of the number of potential employers across space

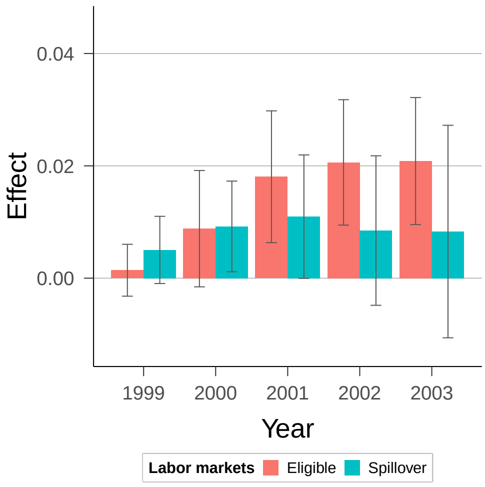
Notes: The figure shows the number of Swiss employers within workers' search radius relative to the number of French employers currently in a workers' search radius. Panel 6a shows the average by skill across bins of 5km from the next Swiss border crossing. Panel 6b shows the cumulative density functions by skill and gender across four bins of distance from the next border crossing, equalizing the total population in each distance bin. For the latter panel, the increase in the number of employers is winsorized at the 99.5th percentile to make the figure more readable. See text for details. *Data: DADS.*



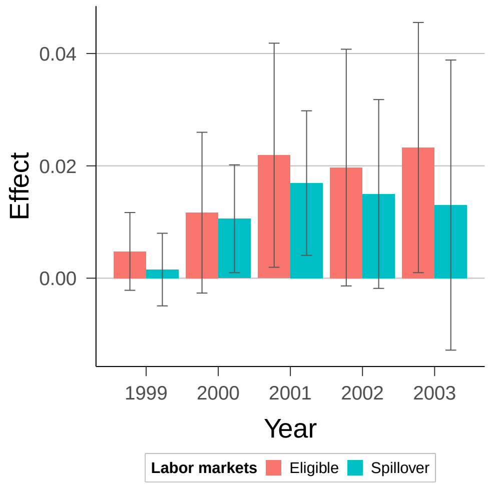
(a) Low-skill workers (b) Mid-skill workers

Figure 7: Wage effects by relative establishment size

Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on wages in large and small establishments. Large (small) establishments are establishments in the upper (lower) quintile of the labor market-specific size distribution in 1998. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*



(a) Low-skill workers



(b) Mid-skill workers

Figure 8: Wage effects by labor market types

Notes: The figure shows annual estimates of the treatment effect in equation (6.3) on wages by labor market. Eligible labor markets are those where the residents of at least one municipality become eligible to commute to Switzerland. Spillover labor markets are the remaining labor markets. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*

Table 1: Balance before and after matching

	Controls		Treated		Overlap measures			
	Mean (1)	(S.D.) (2)	Mean (3)	(S.D.) (4)	Nor Dif (5)	Log ratio SD (6)	pi c (7)	pi t (8)
Panel A. Controls: All								
Log employment	10.53	(1.05)	10.74	(0.79)	0.22	−0.28	0.13	0.00
Share high-skill	0.14	(0.08)	0.10	(0.01)	−0.83	−1.84	0.30	0.00
Share mid-skill	0.61	(0.04)	0.62	(0.04)	0.28	−0.10	0.07	0.00
Share low-skill	0.24	(0.06)	0.28	(0.04)	0.73	−0.34	0.12	0.00
Share tradable	0.40	(0.08)	0.50	(0.11)	0.94	0.31	0.05	0.18
Share non-tradable	0.13	(0.03)	0.12	(0.03)	−0.43	0.03	0.10	0.14
Share construction	0.11	(0.02)	0.10	(0.02)	−0.05	0.19	0.06	0.14
Share other	0.36	(0.06)	0.28	(0.07)	−1.22	0.11	0.08	0.14
Wage growth high-skill	0.07	(0.02)	0.06	(0.01)	−0.51	−0.51	0.12	0.00
Wage growth mid-skill	0.07	(0.02)	0.07	(0.01)	−0.28	−0.59	0.17	0.00
Wage growth low-skill	0.07	(0.02)	0.06	(0.01)	−0.45	−0.75	0.23	0.00
Own commuting share	0.74	(0.15)	0.85	(0.06)	0.90	−1.00	0.15	0.05
Multivariate distance					1.18			
N	238.00		22.00					
Panel B. Controls: Matched								
Log employment	10.57	(0.75)	10.74	(0.79)	0.18	0.05	0.05	0.05
Share high-skill	0.09	(0.02)	0.10	(0.01)	0.15	−0.38	0.18	0.09
Share mid-skill	0.62	(0.03)	0.62	(0.04)	0.01	0.36	0.00	0.14
Share low-skill	0.29	(0.04)	0.28	(0.04)	−0.19	0.03	0.00	0.14
Share tradable	0.47	(0.09)	0.50	(0.11)	0.32	0.25	0.00	0.14
Share non-tradable	0.12	(0.02)	0.12	(0.03)	−0.09	0.33	0.05	0.14
Share construction	0.11	(0.02)	0.10	(0.02)	−0.21	0.19	0.09	0.00
Share other	0.31	(0.06)	0.28	(0.07)	−0.37	0.14	0.05	0.09
Wage growth high-skill	0.06	(0.02)	0.06	(0.01)	−0.05	−0.03	0.05	0.05
Wage growth mid-skill	0.06	(0.01)	0.07	(0.01)	0.34	0.39	0.00	0.18
Wage growth low-skill	0.06	(0.01)	0.06	(0.01)	0.10	0.27	0.00	0.18
Own commuting share	0.86	(0.06)	0.85	(0.06)	−0.08	−0.07	0.09	0.00
Multivariate distance					0.22			
N	22.00		22.00					

Notes: The Table shows balancing statistics between treatment and control for two samples. In Panel A controls are all potential controls. In Panel B controls are the matched controls. The overlap measures are: normalized differences, log ratios of standard deviations, and pi for control and treated units. Normalized differences use the population standard deviation in the full sample in the denominator. pi measures the probability mass of units of the treatment (control) group that lie outside the interval between the 0.025th and 0.975th quantile of the control (treatment) group. The multivariate distance is the variance-weighted difference between the vector of means for the treated and for the control group. See Section 4.2 for details.

Table 2: Main effects on wages and employment

	Wages		Employment	
	1998–1999	1998–2001	1998–1999	1998–2001
	(1)	(2)	(3)	(4)
Panel A: All				
beta	0.004	0.017	0.014	0.028
	(0.002)	(0.006)	(0.005)	(0.012)
	[0.092]	[0.021]	[0.034]	[0.022]
N	44	44	44	44
R-squared	0.097	0.284	0.146	0.175
Panel B: High-skill				
beta	0.004	-0.008	0.017	0.029
	(0.003)	(0.012)	(0.013)	(0.024)
	[0.237]	[0.545]	[0.232]	[0.278]
N	44	44	44	44
R-squared	0.057	0.023	0.072	0.075
Panel C: Mid-skill				
beta	0.004	0.021	0.005	0.024
	(0.002)	(0.007)	(0.006)	(0.012)
	[0.084]	[0.01]	[0.452]	[0.051]
N	44	44	44	44
R-squared	0.081	0.329	0.009	0.08
Panel D: Low-skill				
beta	0.003	0.016	0.031	0.031
	(0.002)	(0.004)	(0.012)	(0.024)
	[0.129]	[0.008]	[0.032]	[0.215]
N	44	44	44	44
R-squared	0.069	0.259	0.122	0.058

Notes: Standard errors robust to clustering at the department level are in parentheses, and wild-cluster bootstrapped p-values in brackets. The columns present results from estimating equation (4.1) for different years. Wages are the cumulative residual wage growth since 1998. Employment is the change in aggregate log employment. Regressions are weighted by skill-specific employment in 1998. Details: see text. *Data: DADS.*

Table 3: Robustness of main effects: Wages

	Wages: 1998–1999				**Wages: 1998–2001**			
	Baseline (1)	National Policies (2)	Avg. wages (3)	Avg. wages, by skill (4)	Baseline (5)	National Policies (6)	Avg. wages (7)	Avg. wages, by skill (8)
Panel A: All								
beta	0.004	0.004	0.002	0.004	0.017	0.016	0.012	0.014
	(0.002)	(0.002)	(0.002)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)
	[0.092]	[0.065]	[0.284]	[0.088]	[0.021]	[0.028]	[0.056]	[0.052]
N	44	44	44	44	44	44	44	44
R-squared	0.097	0.213	0.158	0.251	0.284	0.312	0.427	0.444
Panel B: High-skill								
beta	0.004	0.004	0.002	0.003	-0.008	-0.01	-0.017	-0.023
	(0.003)	(0.003)	(0.003)	(0.003)	(0.012)	(0.012)	(0.01)	(0.012)
	[0.237]	[0.232]	[0.52]	[0.337]	[0.545]	[0.494]	[0.217]	[0.246]
N	44	44	44	44	44	44	44	44
R-squared	0.057	0.124	0.149	0.152	0.023	0.056	0.212	0.303
Panel C: Mid-skill								
beta	0.004	0.004	0.003	0.005	0.021	0.02	0.017	0.019
	(0.002)	(0.002)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)
	[0.084]	[0.083]	[0.247]	[0.075]	[0.01]	[0.016]	[0.016]	[0.026]
N	44	44	44	44	44	44	44	44
R-squared	0.081	0.137	0.096	0.205	0.329	0.343	0.395	0.411
Panel D: Low-skill								
beta	0.003	0.003	0.001	0.003	0.016	0.016	0.011	0.015
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
	[0.129]	[0.04]	[0.454]	[0.094]	[0.008]	[0.001]	[0.012]	[0.002]
N	44	44	44	44	44	44	44	44
R-squared	0.069	0.256	0.181	0.248	0.259	0.375	0.383	0.49

Notes: Standard errors robust to clustering at the department level are in parentheses, and wild-cluster bootstrapped p-values in brackets. The columns present results from estimating equation (4.1) for different years. *Baseline* is the main specificion *National policies* controls for exposure to minimum wage changes, *Average wages* controls for average residual log wages in 1998, *Average wages, by skill* controls for for skill-specific residual log wages in 1998. Wages are the cumulative residual wage growth since 1998. Employment is the change in aggregate log employment. Regressions are weighted by skill-specific employment in 1998. Details: see text. *Data: DADS.*

Table 4: Robustness of main effects: Employment

	Employment: 1998–1999				**Employment: 1998–2001**			
	Baseline (1)	National Policies (2)	Avg. wages (3)	Avg. wages, by skill (4)	Baseline (5)	National Policies (6)	Avg. wages (7)	Avg. wages, by skill (8)
Panel A: All								
beta	0.014	0.013	0.016	0.017	0.028	0.028	0.033	0.037
	(0.005)	(0.006)	(0.006)	(0.007)	(0.012)	(0.012)	(0.012)	(0.016)
	[0.034]	[0.049]	[0.047]	[0.07]	[0.022]	[0.03]	[0.021]	[0.063]
N	44	44	44	44	44	44	44	44
R-squared	0.146	0.182	0.167	0.224	0.175	0.187	0.203	0.245
Panel B: High-skill								
beta	0.017	0.014	0.01	0.019	0.029	0.025	0.017	0.036
	(0.013)	(0.014)	(0.015)	(0.019)	(0.024)	(0.024)	(0.028)	(0.03)
	[0.232]	[0.339]	[0.572]	[0.476]	[0.278]	[0.343]	[0.597]	[0.323]
N	44	44	44	44	44	44	44	44
R-squared	0.072	0.218	0.163	0.216	0.075	0.249	0.163	0.256
Panel C: Mid-skill								
beta	0.005	0.006	0.009	0.012	0.024	0.027	0.033	0.037
	(0.006)	(0.006)	(0.007)	(0.008)	(0.012)	(0.011)	(0.013)	(0.014)
	[0.452]	[0.377]	[0.232]	[0.218]	[0.051]	[0.02]	[0.018]	[0.037]
N	44	44	44	44	44	44	44	44
R-squared	0.009	0.015	0.044	0.11	0.08	0.112	0.135	0.177
Panel D: Low-skill								
beta	0.031	0.027	0.035	0.027	0.031	0.027	0.041	0.038
	(0.012)	(0.011)	(0.014)	(0.013)	(0.024)	(0.025)	(0.022)	(0.032)
	[0.032]	[0.038]	[0.038]	[0.081]	[0.215]	[0.366]	[0.124]	[0.389]
N	44	44	44	44	44	44	44	44
R-squared	0.122	0.225	0.135	0.189	0.058	0.095	0.082	0.112

Notes: Standard errors robust to clustering at the department level are in parentheses, and wild-cluster bootstrapped p-values in brackets. The columns present results from estimating equation (4.1) for different years. *Baseline* is the main specificion *National policies* controls for exposure to minimum wage changes, *Average wages* controls for average residual log wages in 1998, *Average wages, by skill* controls for for skill-specific residual log wages in 1998. Wages are the cumulative residual wage growth since 1998. Employment is the change in aggregate log employment. Regressions are weighted by skill-specific employment in 1998. Details: see text. *Data: DADS.*

Table 5: Main effects, dropping sectors with trade reform

Outcome:	**Wages, 1998–2001**			**Employment, 1998–2001**		
	Baseline	Tradable	Tradable w/o trade reform	Baseline	Tradable	Tradable w/o trade reform
	(1)	(2)	(3)	(4)	(5)	(6)
A: All						
beta	0.017	0.015	0.018	0.028	0.048	0.051
	(0.006)	(0.007)	(0.008)	(0.012)	(0.022)	(0.031)
	[0.021]	[0.053]	[0.02]	[0.022]	[0.058]	[0.166]
N	44	44	44	44	44	44
R-squared	0.284	0.147	0.138	0.175	0.144	0.11
B: Mid						
beta	0.021	0.02	0.019	0.024	0.031	0.036
	(0.007)	(0.008)	(0.009)	(0.012)	(0.022)	(0.025)
	[0.01]	[0.026]	[0.024]	[0.051]	[0.184]	[0.202]
N	44	44	44	44	44	44
R-squared	0.329	0.188	0.108	0.08	0.043	0.053
C: Low						
beta	0.016	0.014	0.019	0.031	0.078	0.089
	(0.004)	(0.007)	(0.005)	(0.024)	(0.042)	(0.06)
	[0.008]	[0.077]	[0.001]	[0.215]	[0.081]	[0.191]
N	44	44	44	44	44	44
R-squared	0.259	0.086	0.214	0.058	0.118	0.093

Notes: Standard errors clustered at the department level are in parentheses, and wild-cluster bootstrapped p-values in brackets. The columns present results on wage growth and employment in year 2001 . Regressions are weighted by cell-specific employment in 1998. Columns (1) and (4) are the baseline with the complete sample, Columns (2) and (4) only include the tradable sector, and Columns (3) and (6) only include tradable industries not affected by the reduction in the fixed cost of trade. Tradable sector is defined as in Combes et al. (2012) and includes manufacturing and business services. Four-digit sectors affected by the trade reform are taken from Bello and Galasso (2016). See text for details. *Data: DADS.*

Table 6: Wages and productivity

Outcome: Wage growth	**High-skill**		**Mid-skill**		**Low-skill**	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
Productivity growth	0.021	0.06	0.019	0.041	0.017	0.034
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)
N (firm x year)	1657432	1657432	3722567	3722567	2411195	2411195
R-squared	0.292	0.284	0.24	0.235	0.277	0.275
First stage coefficient		0.362		0.363		0.377
		(0.004)		(0.003)		(0.004)
Firm FE	Y	Y	Y	Y	Y	Y
Industry-time FE	Y	Y	Y	Y	Y	Y

Notes: Regressions of incumbent wage growth on firm productivity growth. Standard errors clustered by firm in parentheses. The unit of observation is the firm-skill group-year, and regressions are weighted by the number of firm stayers in that cell. The sample includes firms with non-zero stayers in two consecutive and complete balance sheet information in the two preceding years. Financial variables are winsorized at the 1% and 99% level in each year. The instrument is sales growth per worker in the previous two years. OLS = Ordinary Least Squares, IV = Instrumental variables. *Data: DADS Postes, Ficus.*

Table 7: French employees' job search radius

	ln(Commuting distance)			P(migrate)			ln(Migration distance)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Low	−1.39	−1.25	−1.38	−0.06	−0.07	−0.06	−1.42	−1.50	−1.41
	(0.13)	(0.18)	(0.13)	(0.01)	(0.01)	(0.01)	(0.18)	(0.18)	(0.18)
Mid	−0.53	−0.49	−0.53	−0.04	−0.04	−0.04	−0.88	−1.01	−0.88
	(0.11)	(0.15)	(0.11)	(0.01)	(0.01)	(0.01)	(0.18)	(0.17)	(0.18)
Female	−0.76	−0.52	−0.81	−0.01	−0.03	−0.03	−0.40	−0.81	−0.72
	(0.06)	(0.18)	(0.08)	(0.01)	(0.01)	(0.01)	(0.09)	(0.25)	(0.15)
Age > 49	−0.23	−0.23	−0.19	−0.07	−0.07	−0.07	−0.21	−0.21	0.02
	(0.11)	(0.11)	(0.11)	(0.01)	(0.01)	(0.01)	(0.24)	(0.24)	(0.26)
Age < 30	−0.02	−0.03	−0.08	0.10	0.10	0.09	0.23	0.22	0.06
	(0.05)	(0.05)	(0.06)	(0.01)	(0.01)	(0.01)	(0.09)	(0.09)	(0.10)
Low × female		−0.41			0.03			0.38	
		(0.19)			(0.01)			(0.26)	
Mid × female		−0.20			0.01			0.51	
		(0.17)			(0.01)			(0.26)	
(Age > 49) × female			−0.14			0.03			−0.88
			(0.21)			(0.01)			(0.58)
(Age < 30) × female			0.15			0.04			0.53
			(0.09)			(0.01)			(0.17)
Mean for omitted category	60.19	60.19	60.19	0.16	0.16	0.16	202.93	202.93	202.93
N	33064	33064	33064	39451	39451	39451	6387	6387	6387
R^2 (full model)	0.07	0.07	0.07	0.04	0.04	0.04	0.08	0.08	0.08
R^2 (proj model)	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02

Notes: Standard errors robust to clustering at the commuting zone of former residence are in parentheses. All regressions include fixed effects for year and commuting zone of former residence. For the commuting and migration distance, the dependent variables are in ln(*meters*). If a worker accepts a job in her municipality of residence, *meters* is set to 1. The omitted group are high-skill males that are 30 to 49 years old. The means for commuting and migration distance of the omitted group are in kilometers. See text for details. *Data: DADS Panel.*

Table 8: Main effects by sector

	Wages: 1998–2001					Employment: 1998–2001				
	Baseline (1)	Tradable (2)	Non-Tradable (3)	Cons-truction (4)	Other (5)	Baseline (6)	Tradable (7)	Non-Tradable (8)	Cons-truction (9)	Other (10)
A: All										
beta	0.017	0.015	0.015	0.043	0.008	0.028	0.048	0.011	-0.01	0.02
	(0.006)	(0.007)	(0.009)	(0.016)	(0.006)	(0.012)	(0.022)	(0.014)	(0.019)	(0.016)
	[0.021]	[0.053]	[0.128]	[0.019]	[0.223]	[0.022]	[0.058]	[0.452]	[0.593]	[0.251]
N	44	44	44	44	44	44	44	44	44	44
R-squared	0.284	0.147	0.092	0.308	0.07	0.175	0.144	0.019	0.01	0.048
B: High										
beta	-0.008	-0.018	-0.002	0.016	-0.005	0.029	0.058	-0.002	0.033	-0.004
	(0.012)	(0.02)	(0.008)	(0.017)	(0.009)	(0.024)	(0.022)	(0.023)	(0.023)	(0.045)
	[0.545]	[0.446]	[0.823]	[0.377]	[0.677]	[0.278]	[0.011]	[0.922]	[0.15]	[0.954]
N	44	44	44	44	44	44	44	44	44	44
R-squared	0.023	0.037	0.001	0.047	0.015	0.075	0.172	0	0.042	0.001
C: Mid										
beta	0.021	0.02	0.01	0.048	0.01	0.024	0.031	0.041	-0.01	0.027
	(0.007)	(0.008)	(0.01)	(0.017)	(0.005)	(0.012)	(0.022)	(0.025)	(0.019)	(0.012)
	[0.01]	[0.026]	[0.341]	[0.013]	[0.083]	[0.051]	[0.184]	[0.159]	[0.6]	[0.068]
N	44	44	44	44	44	44	44	44	44	44
R-squared	0.329	0.188	0.035	0.32	0.115	0.08	0.043	0.073	0.01	0.094
D: Low										
beta	0.016	0.014	0.022	0.031	0.009	0.031	0.078	-0.005	-0.014	-0.024
	(0.004)	(0.007)	(0.009)	(0.016)	(0.008)	(0.024)	(0.042)	(0.02)	(0.044)	(0.033)
	[0.008]	[0.077]	[0.057]	[0.069]	[0.246]	[0.215]	[0.081]	[0.8]	[0.758]	[0.531]
N	44	44	44	44	44	44	44	44	44	44
R-squared	0.259	0.086	0.152	0.177	0.046	0.058	0.118	0.003	0.002	0.017

Notes: Standard errors clustered at the department level are in parentheses, and wild-cluster bootstrapped p-values in brackets. The columns present results on wage growth and employment in year 2001 . Regressions are weighted by cell-specific employment in 1998. *Baseline* is the baseline regression with all sectors, *Tradable* are tradable sectors, *Non-tradable* are local non-tradable services, *Construction* are construction industries, *Other* are other industries. Tradable sectors are classified as in Combes et al. (2012) and include manufacturing and business services. Non-tradable, construction and other sectors are classified as in Mian and Sufi (2014). See text for details. *Data: DADS.*

Online Appendix

Appendix A Institutional Setting and Data

A.1 Details on the bilateral treaties

A.1.1 All agreements

The agreements between Switzerland and the European Union from 1999 cover a range of areas. Table A.9 shows for each agreement the relevant change and its effects if they are known.

Table A.9: The content of the bilateral treaties between Switzerland and the EU.

Agreement	Change	Effects
Free movement of people	Access to labor markets without restrictions	Expansion of local labor markets
Mutual recognition agreement	lower administrative costs for approval of products for some manufacturing sectors	Cost savings of 0.5 –1 % of product value per year. Corresponds to less than 0.2% of trade volume between EU and Switzerland. Increased mostly imports to Switzerland at the intensive margin
Land traffic	Higher weight limit on carriages, tax on alp-crossing transport	By 2006, accumulated reduction in cost for transports between Switzerland and EU of 8.3%
Air traffic	More competitive pressure for airlines	More and cheaper connections from Geneva Airport
Public procurement	Swiss purchasers (municipalities, utilities, rail, airports, local traffic) need to tender internationally	Unknown (10% of bidders for municipal purchases were foreign)

Notes: The treaties on cooperation on research and on agriculture were excluded from the table. *Sources: Eidgenösisches Aussendepartement (EDA) (2016), Hälg (2015), Staatsekretariat für Wirtschaft (SECO) (2008).*

A.1.2 Other regulations for cross-border commuters

The labor market agreement made it easier for French residents to get a job in Switzerland as a border commuter. There was only a change in health insurance coverage, while taxation, unemployment insurance and the way pensions are calculated did not change with the bilateral agreements between the EU and Switzerland.

Taxation The bilateral agreements explicitly do not touch the existing accords on double taxation between Switzerland and other member states of the European Union (European Union and Swiss Government, 1999, Article 21). This also includes the definition of a cross-border commuter for tax purposes. The treaty on double taxation between France and Switzerland from 1966 makes it possible that the earnings of French residents in Switzerland can be taxed in Switzerland (French and Swiss Government, 1966). This is the case in Geneva, where the canton of Geneva transfers 3.5 percent of the gross earnings of French commuters in Geneva to French authorities. In contrast, other Swiss cantons close to the French border do not tax the earnings of French border commuters (French and Swiss Government, 1983).[46] In particular, French residents that work in these cantons pay their taxes in France, and the French authorities transfer 4.5 percent of the gross earnings of border commuters to Switzerland.

Unemployment insurance French residents that work in Switzerland contribute to the Swiss unemployment insurance both before and after the bilateral treaties with the EU. Until 2009, Switzerland transferred the contributions of French commuters employed in Switzerland to France. Unemployment benefits are paid by the system of the country of residence, except for short-time work where the country of work is responsible. Employment spells in Switzerland and France count equally towards the calculation of how long the worker receives unemployment benefits and this was also the case before 1999 (French and Swiss Government, 1978).

Health insurance With the bilateral treaties it becomes mandatory for cross-border commuters to register with the Swiss health insurance system, and they can choose whether they want to be treated either in the country of residence or in the country of work. Before 1999, cross-border commuters could voluntarily register with the Swiss health insurance system (Bundesrat, 1999; Swiss Federation, 1995).

Pensions Contributions to pension schemes in each countries are derived from the relative contributions to the system in either countries, both before 1999 (French and Swiss Government, 1975, Article 18) and thereafter (European Council, 2004, Article 46 2a).

Border controls During the sample period, the Swiss border was an external border to the Schengen area. While traffic that crosses external Schengen borders is subject to border controls, “cross-border commuters who are well-known to the border guards are subject to only random checks” (European Commission, 2006). Anecdotal evidence suggests that border guards on both sides of the Swiss border had a similar practice until Switzerland joined the Schengen area in 2008. In particular, around two percent of cross-border commuters were checked by Swiss guards (Aeschlimann, 2004), and their peers across the border were similarly lenient (Kislig, 2004; Saameli, 2002; Bischoff, 1997).

A.2 Data

Where necessary, I harmonize educational levels in France and Switzerland with the ISCED-1997 classification. I classify industries as follows. Tradable industries are all manufacturing sectors and business services as in Combes et al. (2012). Construction and non-tradable industries are defined as in Mian and Sufi (2014). The remaining industries are classified as “other”.

[46] The cantons are: Bern, Solothurn, Basel-Stadt, Basel-Landschaft, Vaud, Valais, Neuchâtel, Jura.

A.2.1 Additional Data from France

Balance sheets from tax records In part of the main analysis, I combine the worker data data with firm-level balance sheet data drawn from the *FICUS*. The data contain annual information on the total wage bill, the book value of capital, sales, material use as well as other observables such as the municipality of the headquarters, a unique firm identifier and the five-digit industry of economic activity (NACE classification). The data are quasi-exhaustive and exclude very small firms with annual sales of less than 80'300 Euros[47] as well as finance and insurance companies. The data cleaning and preparation follows Gopinath et al. (2017), and nominal variables are deflated at the two-digit industry level with deflators from EU-KLEMS. On the one hand I use the data at the firm level to estimate production functions and rent-sharing regressions. On the other hand I calculate separate outcomes at the labor market $\times$ year level where I aggregate the firm-level variables. The data are only available at the taxable unit, so that I cannot measure balance sheets at the plant of multi-establishment firms.

Labor Force Survey The survey, covering the years 1994 to 2002, is a rotating panel of the French residential population. The survey samples individuals at the place of residence in March of three consecutive years. In each interview they report their labor market status for each of the 12 preceding months. I calculate, based on the individual responses, flows between employment statuses at the level of the French department, which is the smallest proxy for local labor markets available (the survey does not report where the person works, and I assume she works in the department she lives). The data set allows me to identify cross-border commuters by their country of work. I define a worker as a new border commuters as an individual that has a job in Switzerland in year t but not in year $t-1$.

Panel subsample of the DADS The data set follows a four percent subsample of individuals in the DADS over time and provides additional demographic information. I use the data to calculate wages by education group in France and to calculate how far away from their residence employed workers search for new jobs. For this, I focus on workers that change between two main jobs as classified by INSEE where the new job starts less than 31 days after the old job ended. I then calculate the distance between the municipality of residence during the last year of the old job and the municipality of work during the first year of the new job.

A.2.2 Data from Switzerland

The Swiss Earnings Structure Survey is provided by (Federal Statistical Office, 2017b). It is a biennual firm-level survey on wages and employment. The survey is stratifed by geography, industry and firm size class. Firms are sampled based on the business registry. The data report the hourly wage of each employee in each firm along with demographic information and with sample weights that reflect non-response and whether the firm chose to report the data only on a fraction of the

[47]This threshold is from 2010, but only changes marginally over time (Di Giovanni et al., 2014).

employees. I calculate average hourly wages by education group and labor market after winsorising the data at the 1 and 99 percent level. The data is available through a data contract with the Federal Statistical Office.

Data on commuters: Grenzängerstatistik It is the most accurate data source on the cross-border commuters in Swiss municipalities.[48] It reports, since 1996 and at a quarterly frequency, the number of cross-border commuters by municipality of work and gender. The data are based on commuting permits issued by Switzerland and other administrative ans survey data. The reported counts are estimates and the data are available online (Federal Statistical Office, 2017a).

Business registry It is a survey of all businesses in the non-agricultural sector and is used as a base for various official statistics. I obtained counts of employment and establishments by industry and municipality in 1998 in a private exchange from the Federal Statistical Office.

[48]The data from the Earnings Structure Survey do not report the municipality of work, while the Grenzängerstatistik does.

Appendix B Wage differences and commuting patterns

This section describes the labor markets along the border in 1998 and describes the outflow of French commuters to Swiss jobs in response to the labor market integration. It does so for for three education groups separately: compulsory education or less, secondary education, and tertiary education. The grouping of workers differs from the main analysis, where I group workers by occupation, for two reasons. First, it allows a comparison of wages on both sides of the border. Second, since the occupation is not defined for non-employed workers, it allows to assess transitions between labor market statuses.

B.1 Wage differences between France and Switzerland by education

Figure B.9 depicts large wage differences between France and Switzerland in 1998. The figure plots the average nominal log wage in Euros for three education groups in the Swiss and the French parts of the border region. French wages are in red and Swiss wages are in green. Wages for highly educated workers were around 3 log points in Switzerland and a bit more than 2 log points in France, implying that average wages for high-skill workers were more than twice as high in Switzerland than they were in France. The wage differences for less-educated workers were smaller. For workers with mandatory education, the Swiss wages were still around 80 percent higher than French wages.

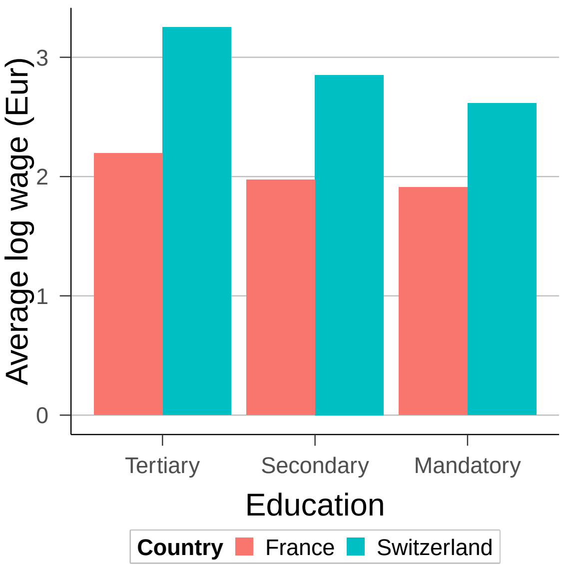


Figure B.9: Average wages in the French-Swiss border area in 1998

Notes: The figure shows average wages by education group in the labor markets along the border. *Data: DADS Panel, Federal Statistical Office (2017b).*

B.2 The impact on commuting from France

I now study how the labor market integration impacted commuting flows from France to Switzerland. I do so by estimating the impact of the reform on commuters in Switzerland because Swiss data are better suited for this analysis than French data as they are both precise and geographically finely disaggregated.[49] The data report the number of commuters for each Swiss municipality each year. This allows me to study in detail the evolution of commuting flows in the municipalities where French workers are eligible to work.

I compare the evolution of commuters in Swiss border municipalities with non-border municipalities in the rest of Switzerland. I focus on border municipalities that are close to the French border where French border commuters are likely to work.[50] [51] Following closely Beerli et al. (2021), I estimate the following regression

$$y_{it} = \alpha_i + \alpha_t + \sum_{\tau \neq 1998} \beta_\tau \text{border\_municipality}_i \times 1[t = \tau] + \varepsilon_{it} \tag{B.1}$$

where y_{it} is the number of commuters in municipality i in year t relative to total employment in the municipality in 1998. $\text{border\_municipality}_i$ is an indicator for whether the municipality is a border municipality. α_i are municipality fixed effects that absorb any permanent differences between the number of commuters in the two groups, and α_t is a time fixed effect. I weight the regressions by total employment in the municipality in 1998.

Figure B.10 shows the estimated coefficients with corresponding 95 percent confidence intervals, suing standard errors clustered at the commuting zone level. While there are no pre-existing trends in the number of commuters before the labor market integration is announced 1998, the figure shows that commuting increases soon thereafter. In the year 2000, the fraction of commuters is already 0.8 percentage points (se: 0.23) higher in terms of baseline employment than in 1998. The trend continues until the end of the sample period in 2003 when the increase reaches around 3 percentage points.

[49]The French Labor Force Survey, in contrast, is by construction based on a smaller sample size. Using these data, I find similar qualitative patterns as documented in figure B.11a.

[50]The data do not report where the commuter lives.

[51]The border municipalities are those defined by the treaty that are in the cantons along the French border: Vaud, Geneva, Jura, Valais, Neuchâtel, Fribourg, Solothurn and Bern (I get similar results when also including Basel-Stadt and Baselland, but there it is less clear whether the registered commuters live in Germany or in France). The control municipalities are municipalities in the rest of Switzerland which were not defined as border municipalities by the treaties.

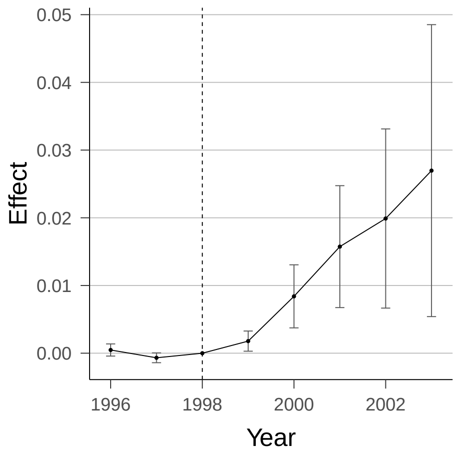


Figure B.10: Commuting flows from France to Switzerland

Notes: The Figure shows estimated impacts from estimating equation (B.1). The coefficients estimate the impact of the labor market integration on the presence of French commuters in Switzerland relative to employment in the municipality in 1998. The error bars are calculated from standard errors clustered at the commuting zone level. *Data: BFS.*

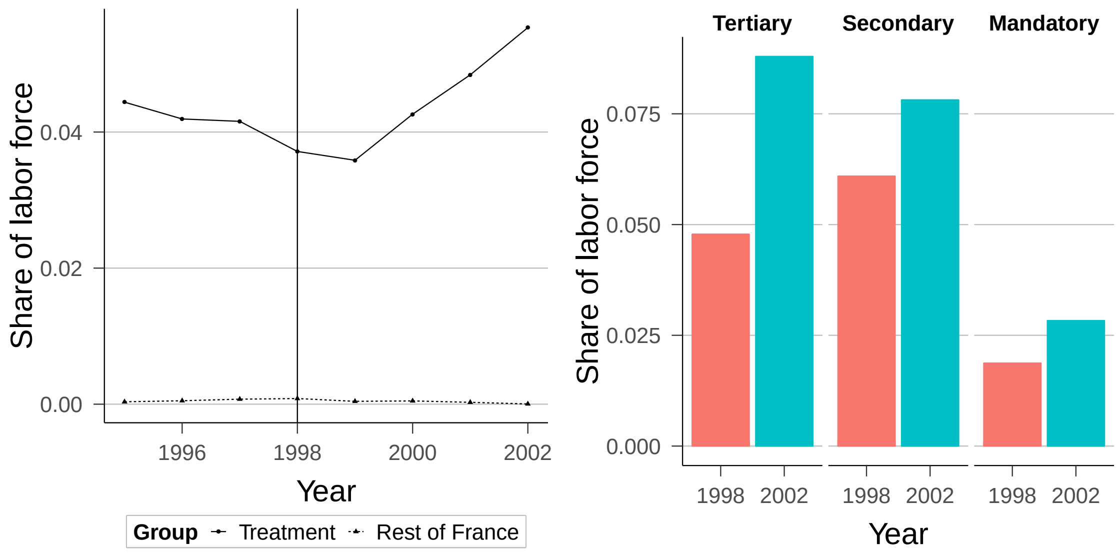
B.3 The composition of commuters: Employees in high-skill professions reacted the most strongly

To further understand who are the workers that commute to Switzerland, I use data from the French Labor Force Survey. For treated and non-treated French labor markets, figure B.11a shows the share of the labor force that commutes to Switzerland for 1993 to 2002. There are no border commuters from the control area. In the treatment area the share of commuters to Switzerland decreases from above 4% in 1993 to below 4% in 1998. The trend reverses after 1999[52] and in 2002 almost 6% of the labor force commute to Switzerland.[53]

Figure B.11b plots the same number for the three education groups in 1998 and 2002. The red bars refer to 1999, the green bars to 2002. Workers of all types start commuting more, suggesting that the market integration raised employment opportunities for all workers. There is, however, a strong education gradient. Many new commuters are highly educated; the share of cross-border commuters of the high-skill labor force increases from below five percent to more than eight percent in 2002.

[52]It does not reverse in 1999 because the survey is conducted in March 1999 and the market integration was only announced in December 1998.

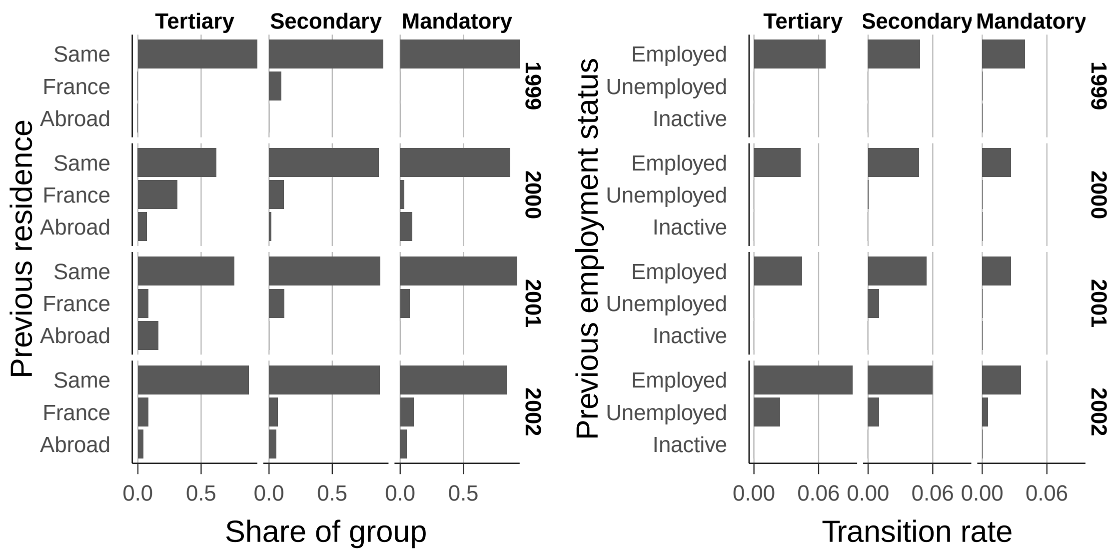
[53]Swiss commuters in France are less well documented. In 2000 0.03% of the Swiss labor force in the border region worked in France (Federal Statistical Office, 2000). Appendix B.4 suggests that for French citizens commuting to Switzerland is more important than migrating to Switzerland.



(a) All (b) By education

Figure B.11: Commuters to Switzerland as share of labor force

Notes: The Figures show the number of residents that work in Switzerland as share of the total labor force. The solid line in panel B.11a refers to the treated region, the dashed line to the matched control areas. Panel B.11b shows the share for three education groups in 1998 and 2002 in the treatment region. *Data: LFS.*



(a) Residential origin (b) Transitions by labor market status

Figure B.12: Previous place of residence and labor market status of new border commuters

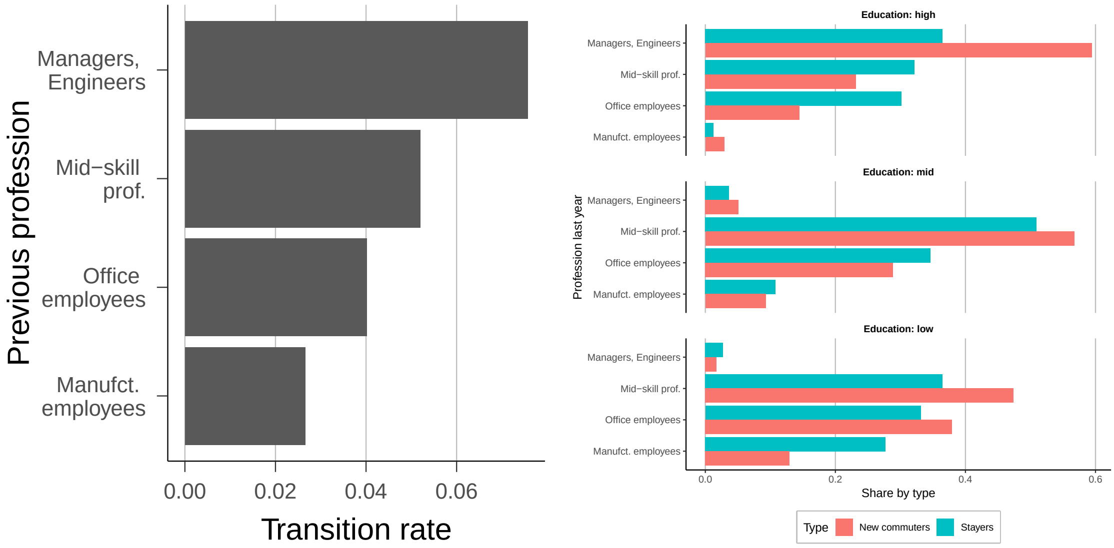
Notes: The data refer to the treatment region. In both panels rows refer to years and columns refer to education groups. Panel B.12a shows where the new border commuters came from geographically: whether they lived in the same area, in other parts of France or abroad in the previous year. Panel B.12b shows transition rates for people that previously lived in the area by labor force status: Employed, Unemployed, Inactive. *Data: LFS.*

To understand better which workers responded to the newly available jobs, I study the transitions of workers from France to Switzerland. In the Labor Force

Survey I identify new cross-border commuters that worked in Switzerland in year t but worked in France in year $t-1$. Figure B.12 shows that the new commuters were primarily workers that lived and worked in the border area in the previous year. Figures B.12a and B.12b consider education groups (columns) and years (rows) separately. Figure B.12a shows that roughly 75 percent of new border commuters already lived in the border area in the year before they accepted a job in Switzerland. This holds across all education groups and across most years. An exception is the year 2000 when almost 50 percent of new border commuters with a tertiary education did not live in the border area before they accepted a job in Switzerland. Figure B.12b zooms further into the group of new border commuters that already lived in the border area in the previous year. It presents transition rates out of employment, unemployment and inactivity to Switzerland, again for the three education groups and each year separately.[54] The majority of those new border commuters did have a job in the border area in the previous year. In each year between four and eight percent of highly educated employees accepted a new job in Switzerland. The number decreases by education as around 2.5 percent of workers with mandatory education accepted a new job in Switzerland. In contrast Swiss firms did not hire any French commuters from inactivity and very few from unemployment.

I present some more evidence on new commuters by the previous occupation they previously held. For four groups of occupation, I calculate average transition rates from 1999 to 2002. The sample contains new commuters that leave their jobs in the French border area to work in Switzerland. Figure B.13a shows that the highest outflow was from high-skill occupations such as mangers and engineers. Almost seven percent of those workers left their jobs in France to work in Switzerland. The number is smaller for less skill-intensive professions. Four percent of office employees and a bit more than two percent of manufacturing employees transitioned to Switzerland. The data further suggest that new commuters were positively selected on occupation in each education group. I compare new commuters with stayers in their old job, e.g. in the year before the new commuters leave to Switzerland. Figure B.13b plots the distribution of workers across occupations within education groups both for stayers and for new commuters. 60 percent of new commuters with tertiary education worked in managerial or engineering professions before they accepted a job from Switzerland compared to less than 40 percent of workers with the same education that did not start commuting. Similarly, for workers with secondary and mandatory education, new commuters tend to be drawn from more skill-intensive occupations than stayers, although the patterns are less stark.

[54] If a worker is employed in France in the previous year and employed in Switzerland in the current year, but has an intermittent unemployment spell bin between, she is classified as a transition from unemployment.



(a) Transition rate by profession (b) Stayers and new commuters

Figure B.13: New commuters and their previous profession

Notes: The data refer to the treatment region. In both panels "Mid-skill prof." are middle-skill occupations such as qualified production workers and technicians and "Manufct. employees" are employees in manufacturing. New border commuters are residents in France that work in Switzerland in the current year but did not do so in the previous year. Panel B.13a plots the average transition rates 1999 to 2002 by occupation. Panel B.13b shows, by education, the distribution of all stayers and new commuters across their last occupation from 1999 to 2002. Stayers are workers that remain employed in France in two consecutive years. *Data: LFS.*

In conclusion, the evidence shows that, in terms of wages, all French workers could potentially benefit from working in Switzerland. While workers of all education groups accepted more jobs in Switzerland after the market integration, most of new commuters were highly educated. They lived and worked in the border area before starting a new job in Switzerland. The largest outflow was from managerial and engineering professions.

B.4 Migration and commuting from France

The agreement on worker mobility opened the Swiss labor market not only for border commuters, but also for residential migration to Switzerland. To assess the relative importance of commuting and migration for French citizens, I would ideally compare the number of French commuters in Switzerland to the number of French citizens residing in Switzerland. Data restrictions do not allow me to do this because I do not have information on the citizenship of commuters before 2002. Yet, since commuters tend to minimize the time spent commuting, the number of commuters in Switzerland close to the French border is a good proxy for commuters that reside in France. I therefore compare the number of French citizens that are registered in Switzerland (Federal Statistical Office, 2019) with the number of commuters in municipalities close to the French-Swiss border. These are all Swiss municipalities that are at most 22.6km from the next border crossing to France. 22.6km is the median distance to the next border crossing to France for all Swiss municipalities whose closest border crossing is to France as compared to other countries. The data indicate that commuting to Switzerland is more important for French citizens than migrating. In 1998, there are almost 80'000 commuters from France in Switzerland, while there are less than 60'000 permanent residents from France. After the labor market integration, the number of commuters grows substantially to above 90'000, while the number of permanent residents keeps increasing at a rate comparable to the rate before 1998.

Appendix C Treatment group and matching

The border municipalities were all French municipalities that are within 10km from the French-Swiss border as well as the municipalities in Haute Savoie and Pays Gex. They were defined in an earlier treaty between France and Switzerland from 1946 that regulated the mobility of residents in the border area (Swiss Federation, 1946).

C.1 Defining the treated labor markets

Labor markets consist of municipalities. Denote the municipalities of labor market i as j_i, $j_i \in \{1, ...J_i\}$. Define the set of border municipalities B_F. A labor market i is eligible if $\{j_i\}_{j=1}^{J_i} \cap B_F \neq \emptyset$, e.g., if at least one municipality is a border municipality. This gives 12 eligible labor markets and denote this set as L_E. Assign to each labor market the distance between the municipality that is furthest away from the next Swiss border crossing, formally $d_i = \max_{j \in J_i}\{dist_{j_i,Switz}\}$. Then define $\bar{d} = \max_{i \in L_E}\{d_i\}$ and a labor market is in the treatment group if $d_i \leq \bar{d}$. In the present case I have $\bar{d} = 84km$.

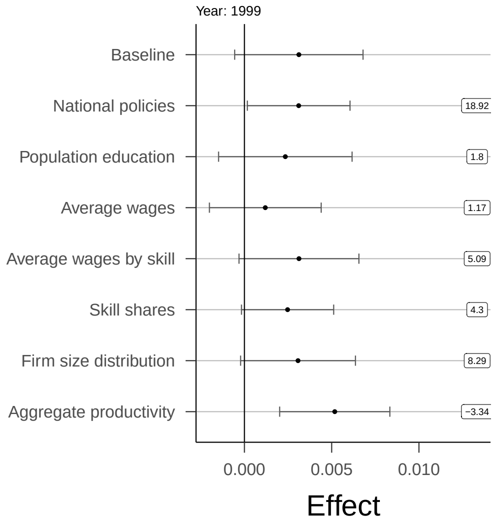
C.2 Entropy balancing

Entropy balancing calibrates weights for control units in order to achieve overlap in the first and second moments of the covariate distributions between the treated and the control units (Hainmueller, 2012). The method requires setting a balancing constraint m so that the difference of (weighted) means and variances between the treatment and the control group are at most m. I use $m = 0.0001$. Further, I define base weights according to the relative size of each labor market because the baseline estimation also uses the size of the labor market as regression weights. I then match on the following variables: Employment in 1998 and its growth rate since 1995, wage growth from 1995 to 1998, the own-commuting share, employment structure by skill and sector, the education structure of the population, and the employment share of establishments with more than 49 employees. Moreover, I drop the Paris labor market from the pool of potential control units. The matching algorithm does not converge without doing so, most likely because the labor market is an outlier for some of the covariates.

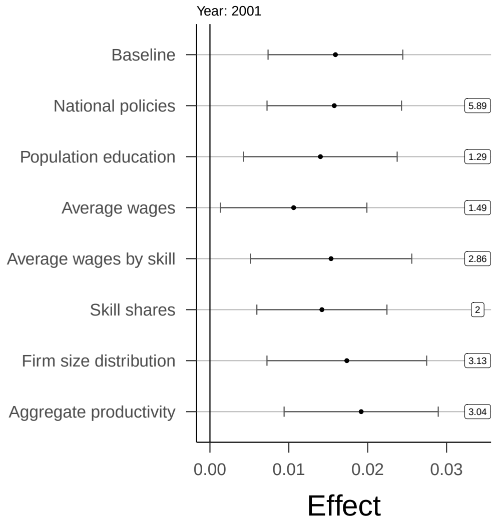
Appendix D Additional Results

D.1 Robustness of main results with more controls

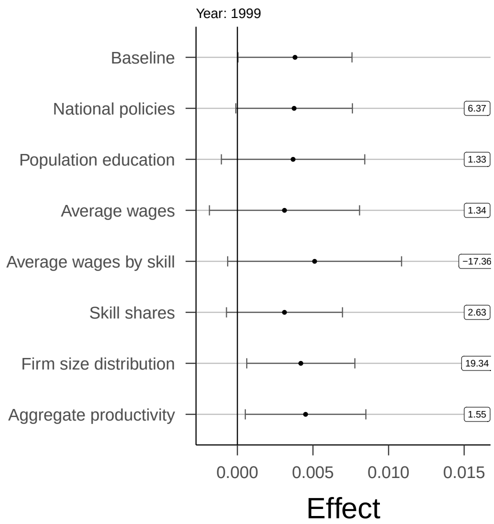
Figure D.14 shows the estimated medium-run wage effects on low- and mid-skill occupations when including some more controls. The controls are skill shares at baseline, the employment share of different firm size groups, and financial variables such as capital and value added per worker. Including these controls does not alter the estimated effects of the market integration. As pointed out by Oster (2019), coefficient movements should be assessed together with movements in the variation explained by additional controls. The boxes on the right-hand side of the panels in figure D.14 contain the calculated amount of unobservable selection necessary to drive the estimated effect of the market integration to zero, assuming unobservables explain an additional 30 percent of the variation in the outcome compared to the regression with the controls. In all cases, this statistic lies above 1, implying that the amount of unobservable selection would have to be stronger than the amount of observable selection in order to make the wage effects disappear. Figure D.15 shows the respective estimates for the effect on employment of low and mid-skill workers. As with the main results, the employment effect for mid-skill workers is less precise in 2001, but the estimated magnitude of the effect changes little across the set of controls included.



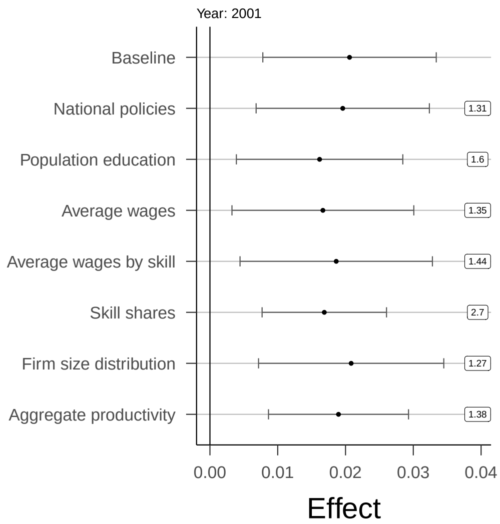
(a) Low-skill occupations, 1999



(b) Low-skill occupations, 2001



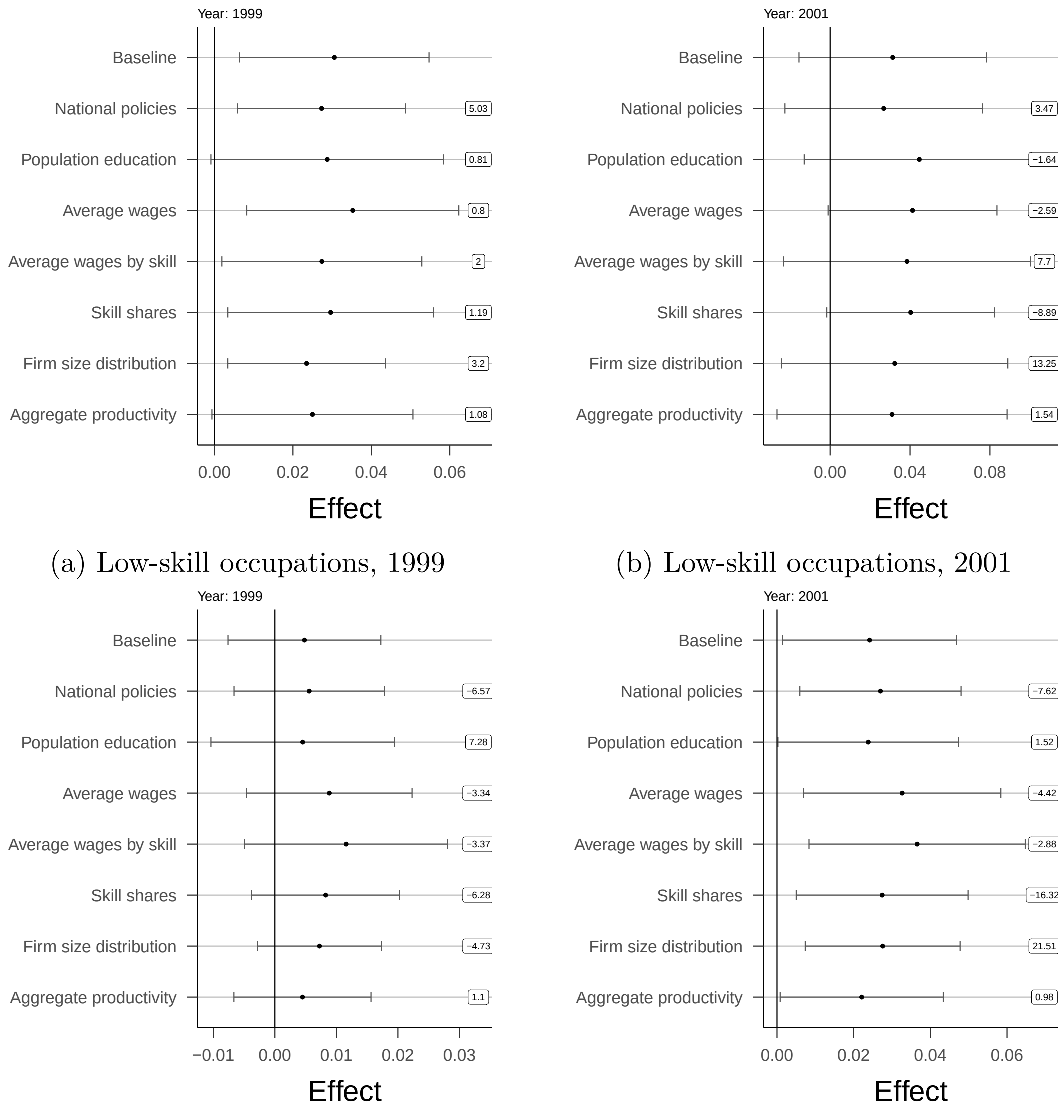
(c) Mid-skill occupations, 1999



(d) Mid-skill occupations, 2001

Figure D.14: Wage effects for firm stayers when including more controls

Notes: The Figure shows estimates of the treatment effect in equation (4.1) on cumulative growth in hourly wages of firm stayers relative to 1998. Units are weighted by their skill-specific employment in 1998. *Baseline* shows the baseline effect, *National policies* controls for exposure to minimum wage rises and to the change in workweek legislation, *Population education* controls for population shares of three education groups, *Average wages* and *Average wages by skill* controls for log wages on average overall and by skill group, respectively. *Skill shares* controls for skill-specific employment shares, *Firm size distribution* controls for employment shares by establishment size, *Aggregate productivity* controls for value added and capital per worker. The number in the box on the right of the error bars shows the amount of unobservable selection compared to observable selection necessary to drive the estimated effect to zero (Oster, 2019). See the text for details. *Data: DADS, Ficus.*



(a) Low-skill occupations, 1999

(b) Low-skill occupations, 2001

(c) Mid-skill occupations, 1999

(d) Mid-skill occupations, 2001

Figure D.15: Employment effects when including more controls

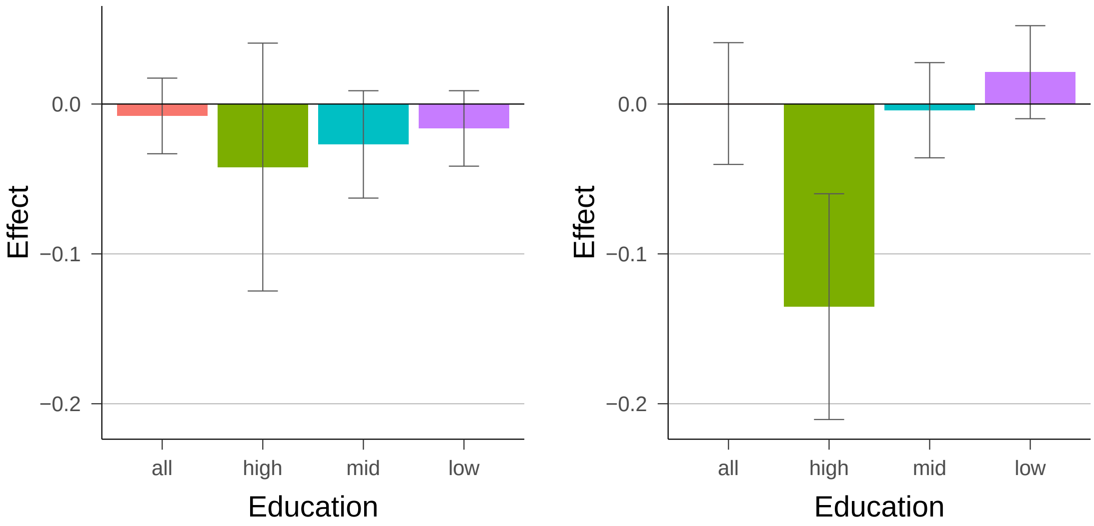
Notes: The Figure shows estimates of the treatment effect in equation (4.1) on employment relative to 1998. Units are weighted by their skill-specific employment in 1998. *Baseline* shows the baseline effect, *National policies* controls for exposure to minimum wage rises and to the change in workweek legislation, *Population education* controls for population shares of three education groups, *Firm size distribution* controls for employment shares by establishment size, *Aggregate productivity* controls for value added and capital per worker. The number in the box on the right of the error bars shows the amount of unobservable selection compared to observable selection necessary to drive the estimated effect to zero (Oster, 2019). See the text for details. *Data: DADS, Ficus.*

D.2 Effect on worker flows

I calculate worker flows as the cumulative transitions between labor force status in two consecutive years since 1998. To interpret the flow as a flow rate, I normalize the flows by the number of employees in 1998. I group workers by education as in Section B.

To find a set of suitable control areas for the analysis, I also use a matching strategy. Yet, because of the smaller sample size, I use a separate matching for each outcome and for each education group separately. I match on log employment in 1998, mean log wages in 1998 and in 1995, as well as on the flow rate under consideration from 1995 to 1998.

To assess the migration margins, I first study whether more people move from other parts in France to live and work in the border region. Second, I study whether fewer people that previously lived and worked in the border region migrate to other parts of France. Figure D.16 shows that the labor market integration only affected the migration decisions of the highly educated workers. In particular, fewer of them leave the treated area after 1998 and the estimated effect corresponds to more than 10 percent of employment in 1998.

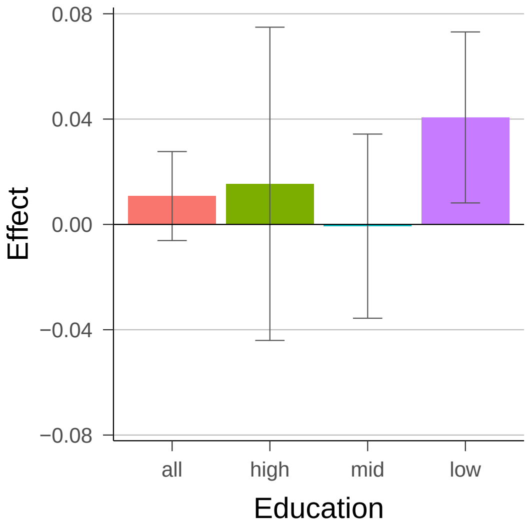


(a) In-migration (b) Out-migration

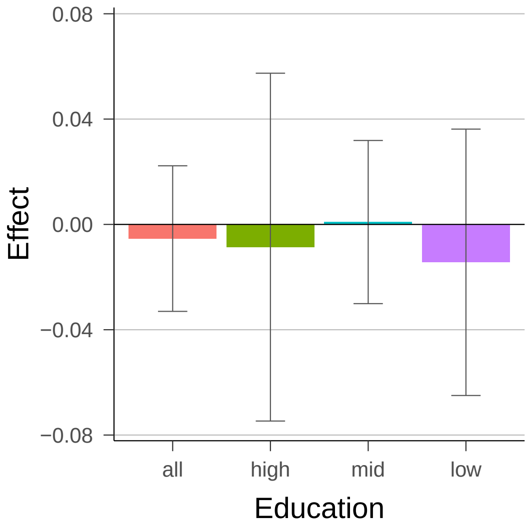
Figure D.16: Migration between the sampled areas and the rest of France.

Notes: The figures show the estimated effect of the labor market integration on the cumulative in-migration rate from 1998 to 2002 in panel D.16a and the cumulative out-migration rate from 1998 to 2002 in panel D.16b. Error bars correspond to 95% confidence intervals using standard errors robust to heteroskedasticity.
The results refer to models of the form of equation 4.1 at the department level. Control units are matched separately for each outcome and education group. In-migrants are workers that live and work in one of the sampled departments and did not live in the same department in the previous year. Out-migrants are workers that lived and worked in one of the sampled department in the previous year and now live in another department. The education groups are: pooled (all), tertiary (high), secondary (mid) and mandatory (low). *Data: LFS.*

Next, I study the effect on worker flows into employment from either non-participation or unemployment. I first calculate the net flows into employment from non-participation and unemployment, respectively. To be specific, the net inflows from unemployment to employment are the gross flows from unemployment to employment minus the gross flows from employment to unemployment. The results in figure D.17 show that the labor market integration increased the net inflows for workers with low education into employment by 4 percent of their baseline employment. In contrast, there is no effect on the inflows from non-participation. Figure D.18 further splits up the net flows from unemployment to employment into the gross flows from unemployment to employment and vice versa and it suggests that the main driver behind the increase in low-skill employment are reduced transitions of low-skill workers to unemployment.



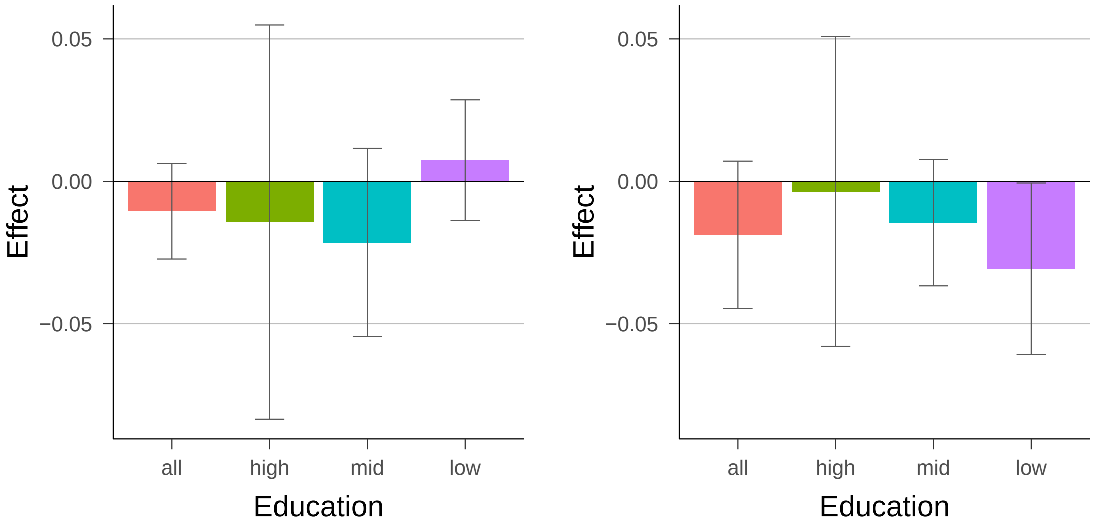
(a) Net inflows from unemployment



(b) Net inflows from non-participation

Figure D.17: Net flows into employment from non-participation and unemployment.

Notes: The figures show the estimated effect of the labor market integration on the cumulative net inflows into employment between 1998 and 2002 from unemployment in panel D.17a and from non-participation in panel D.17b. Error bars correspond to 95% confidence intervals using standard errors robust to heteroskedasticity.
The results refer to models of the form of equation 4.1 at the department level. Control units are matched separately for each outcome and education group. The numbers underlying the measures use all workers that lived in the same departments in two consecutive years. Net inflows from unemployment are gross inflows of workers from unemployment to employment minus the gross outflows from employment into unemployment between two years. Net inflows from non-participation are gross inflows of workers from non-participation to employment minus the gross inflows from employment into non-participation between two years. The education groups are: pooled (all), tertiary (high), secondary (mid) and mandatory (low). *Data: LFS.*

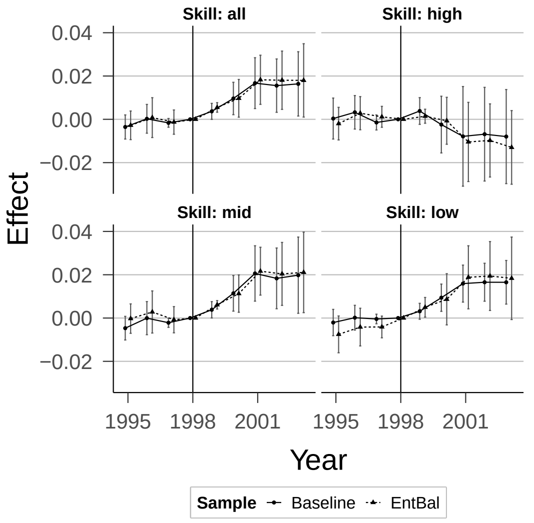


(a) Gross flows from unemployment to employment (b) Gross flows from employment to unemployment

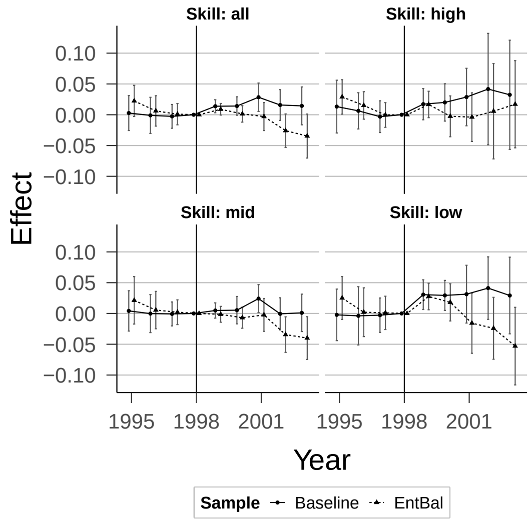
Figure D.18: Gross flows between unemployment and employment.

Notes: The figures show the estimated effect of the labor market integration on the cumulative gross flows from unemployment to employment between 1998 and 2002 in panel D.17a and from employment to unemployment in panel D.17b. Error bars correspond to 95% confidence intervals using standard errors robust to heteroskedasticity. The results refer to models of the form of equation 4.1 at the department level. Control units are matched separately for each outcome and education group. The numbers underlying the measures use all workers that lived in the same department in two consecutive years. The education groups are: pooled (all), tertiary (high), secondary (mid) and mandatory (low). *Data: LFS.*

D.3 Entropy balancing



(a) Wages



(b) Employment

Figure D.19: Main effects with different matching strategy

Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on employment and wages. There are two samples. "Baseline" refers to the main matched sample used in the text, "EntBal" uses Entropy Balancing following Hainmueller (2012). Results from the baseline have a solid line and a dot, results from the entropy balancing have a dashed line and a diamond. Baseline weights units by their skill-specific employment in 1998. Entropy Balancing weights the control units by the entropy weights, and the treated units by unity. Hourly wages are residualized for gender and age. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See Section 5.1 for details. *Data: DADS.*

Why do the results on employment differ between the baseline matching and the entropy balancing? The results in figure D.19 show that the estimated treatment effects for employment differ between the baseline matching strategy and the entropy balancing, even though the short-run effect on employment of low-skill workers is similar. The most probable explanation for this is that the entropy balancing does not capture some unobserved heterogeneity among the treated labor markets that drives parts of the employment adjustment. In particular, the regression results when using the weights from entropy balancing are not robust to including more covariates, while the main results with the baseline matching strategy are. For instance, controlling for the industry structure at baseline drives the estimated effect on low-skill employment in 2003 from -0.05 to 0. In contrast, controlling for baseline industry structure in the main specification does little to the magnitude and precision of the wage and employment effects, and they also survive the test proposed by Oster (2019).

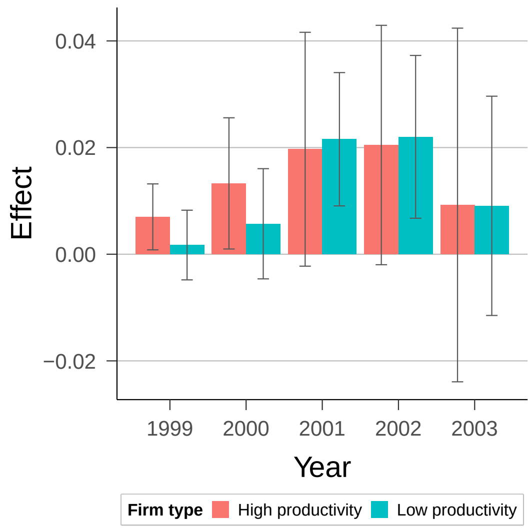
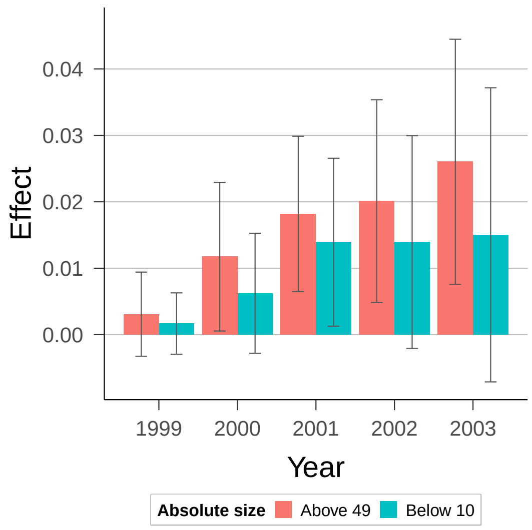


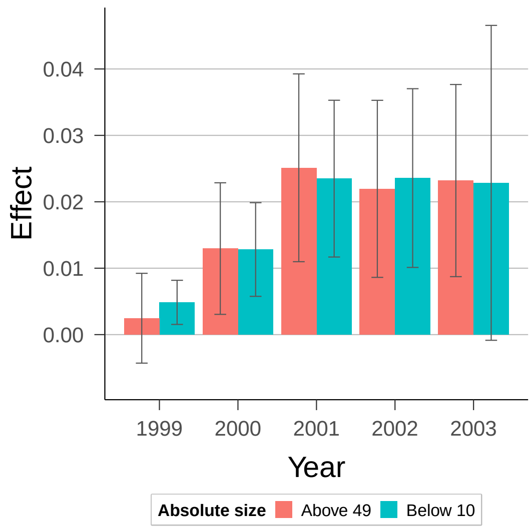
Figure D.20: Wage effects by firm productivity

Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on wages in high and low productivity firms with a single establishment. Regressions are weighted by employment in 1998. High-productivity (low-productivity) firms are firms in the upper (lower) quintile of the labor market-specific productivity distribution. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS, Ficus.*

D.4 Heterogeneous wage effects by productivity and absolute firm size



(a) Low-skill workers

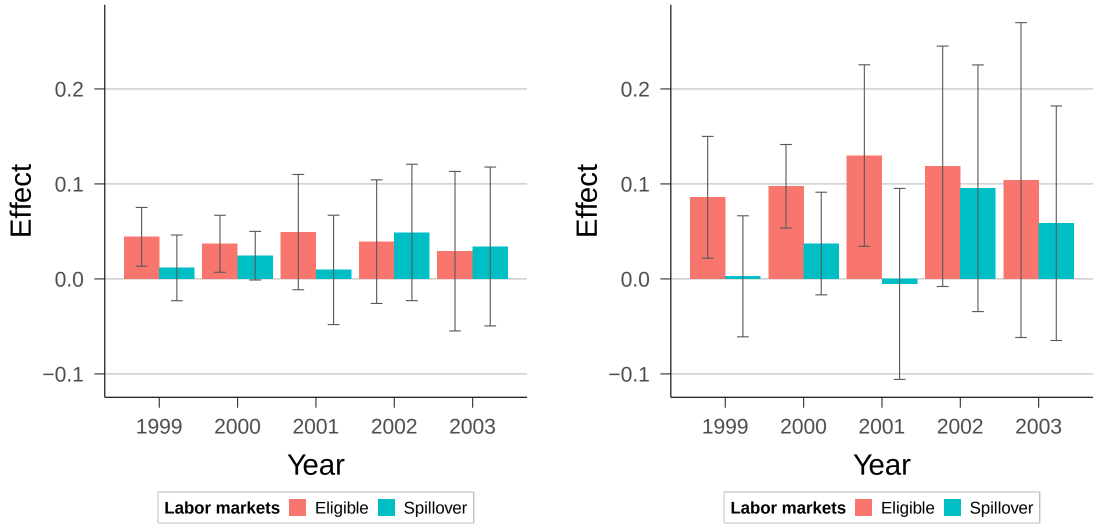


(b) Mid-skill workers

Figure D.21: Wage effects by absolute establishment size

Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on wages in establishments with less than 10 and in establishments with more than 49 employees in 1998. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*

D.5 Employment effect by distance from the border



(a) All sectors

(b) Tradable sector

Figure D.22: Low-skill employment effects by distance from the border

Notes: The Figure shows annual estimates of the treatment effect in equation (6.3) on low-skill employment by labor market. Eligible labor markets are those where the residents of at least one municipality become eligible to commute to Switzerland. Spillover labor markets are the remaining labor markets. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*

D.6 Worker mobility and the increase in the size of the local labor market

I estimate worker mobility in each cell defined by skill g, age group a and gender $f \in \{0,1\}$ and thus estimate the following regressions for the three outcomes at the level of worker i:

$$y_{iga} = \sum_g \sum_a \gamma_{agf}(\text{skill}_{ig} \times \text{agegrp}_{ia} \times \text{female}_i) + e_{iga} \tag{D.1}$$

skill_{ig} is an indicator for one of the three skill groups, agegrp_{ia} is an indicator for one of three age groups (below 30, 30 to 49, above 49), and f indicates whether the coefficient is specific to men or women. The outcomes are the commuting and migrating distance respectively. For the migration rate I use a logistic regression because I predict out of sample and need the predictions to be bounded between 0 and 1.

I then calculate the increase in the size of the local labor market induced by the labor market integration. Consider French workers who reside in the French border municipalities B_F. The increase in employment opportunities depends on the number of existing establishments in France and Switzerland and on the search radius of French workers.[55] First, I use the estimated models of worker mobility to

[55] I focus on establishments rather than jobs for two reasons. First, in textbook search models

predict the individual migration probability $\widehat{p^m_{ig}}$, the search radius for commuting $\widehat{d^c_{ig}}$ and for migrating $\widehat{d^m_{ig}}$ for each worker i in skill group g that lives in municipality $j(i)$ in B_F (I omit gender and age subscripts for simplicity). Second, I calculate the relative increase in the number of potential employers as follows

$$\%\Delta_{ij(i)g} = \frac{(1-\widehat{p^m_{ig}})\sum_s n_s 1\left(d_{j(i),s} \leq \widehat{d^c_{ig}} \;\&\; s \in B_S\right)}{(1-\widehat{p^m_{ig}})\sum_f n_f 1(d_{j(i),f} \leq \widehat{d^c_{ig}}) + \widehat{p^m_{ig}}\sum_f n_f 1(d_{j(i),f} \leq \widehat{d^m_{ig}})}, \forall j(i) \in B_F \tag{D.2}$$

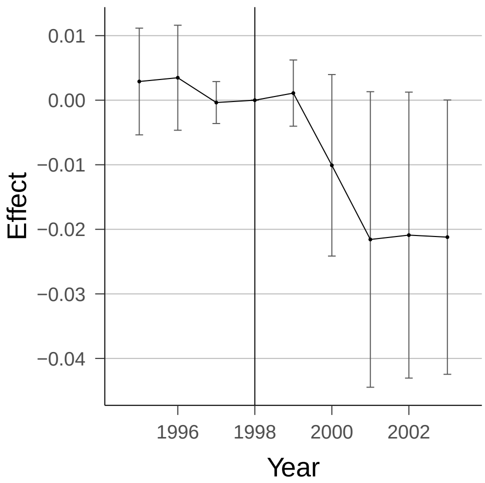
where $1(expr)$ is an indicator function which is 1 if $expr$ is true and 0 otherwise. Consider first the denominator. It measures the size of the labor market that worker i currently faces, and it depends on the geographic mobility of her demographic group. In particular, with probability $1-\widehat{p^m_{ig}}$ the worker does not move and can then work at any firm in a municipality that is at most $\widehat{d^c_{ig}}$ away from her current residence. n_f is the number of establishments in French municipality f. With probability $\widehat{p^m_{ig}}$ the worker moves to another municipality in mainland France and can work at any firm within the typical search radius for migrating, $\widehat{d^m_{ig}}$. In the numerator, n_s is the number of establishments in Swiss municipality s, and $d_{j(i),s}$ is the commuting distance between worker i's home municipality $j(i)$ and municipality s. Municipality s has to additionally lie in the set of Swiss border municipalities B_S.

D.7 Alternative mechanisms

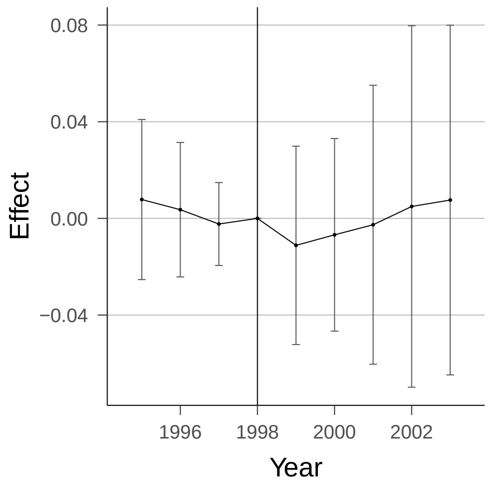
D.7.1 Relative supply and relative wages

The market integration reduced the skill premium in the border area and raised employment of low- and possibly high-skill workers. In a perfectly competitive market where skill groups are imperfect substitutes the reduction in the skill premium could be explained by an increase in the relative supply of high-skill workers. To assess this possibility, I estimate the effect of the market integration on relative supply and relative prices of workers. In particular, I calculate the change in relative supply as $log\frac{L_{h\tau}}{L_{u\tau}} - log\frac{L_{h1998}}{L_{u1998}}$ and the change in relative prices as $\Delta w_{s\tau} - \Delta w_{u\tau}$ where $\Delta w_{g\tau}$ is the cumulative growth in residual wages from 1998 to τ of skill group g. Figure D.23 presents the time pattern of the effect on the two outcomes with 95 percent confidence bands around the point estimates. Panel D.23a shows the drop in the skill premium of around 2 percent in the medium run after the market integration. In contrast, panel D.23b shows that relative supply of high-skill workers did not increase in the same period. This evidence suggests that the drop in the skill premium cannot be explained by a model where high-skill and low-skill workers are imperfect substitutes and an increase in the relative supply of high-skill workers.

Burdett and Mortensen (1998), the firm is the relevant decision maker on the labor demand side and its size depends on its productivity and on workers' job finding rate. Second, the data from Switzerland and France are not comparable to each other and not disaggregate enough for a more detailed description of (the change in) outside options as for instance in Caldwell and Danieli (2021).



(a) Effect on relative wages



(b) Effect on relative supply

Figure D.23: Effect on relative wages and relative supply

Notes: The figure shows annual estimates of the treatment effect in equation (4.1) on relative supply and relative wages in the border area. Relative wages is the difference in cumulative wage growth since 1998 between high- and low-skill workers. Relative supply is the change in the log ratio of high- versus low-skill supply. Regressions are weighted by total employment in 1998. The error bars show the 95% intervals around the point estimate using standard errors clustered at the level of departements. See text for details. *Data: DADS.*

D.7.2 Higher worker productivity

I investigate whether the labor market integration made low-skill workers more productive and estimate output elasticities with a Cobb-Douglas production function for firms in the treated and control areas.[56] A firm j in sector s and located in labor market i at time t produces value added y with capital and three labor inputs:

$$y_{jits} = \alpha + x'_{jit}\delta \tag{D.3}$$

where x'_{jit} is a vector of prodution inputs capital and three skill types (high, mid, low-skill): $x'_{jit} = (k_{jit}, h_{jit}, m_{jit}, l_{jit})'$. I interact all inputs with treatment and time indicators and estimate the following production function:

$$\begin{aligned} y_{jits} =& x'_{jit}\delta_0 + post_t \times treat_i \times x'_{jit}\beta_1 + post_t \times x'_{jit}\delta_1 + \\ & treat_t \times x'_{jit}\delta_2 + post_t \times treat_i + \alpha_i + \alpha_t + \alpha_s + u_{jits} \end{aligned} \tag{D.4}$$

where α_i, α_t and α_s account for labor-market, time and two-digit sector fixed effects. u_{jits} is an unobserved productivity shifter. $post_t$ indicates the period after 1998, $treat_i$ indicates treatment labor markets. δ_0 estimates the production function parameters from 1995 to 1998, δ_1 estimates how technology changes after 1998. δ_2 estimates the permanent technological difference between the treatment and the

[56] An obvious concern is the endogeneity of inputs (Olley and Pakes, 1996). As far as I am aware existing methods that account for this (Ackerberg et al., 2015; Levinsohn and Petrin, 2003; Olley and Pakes, 1996) are not well suited for more than one or two proxy variables. My specification has four state variables and thus requires four proxy variables.

control region. β_1 is the main coefficient of interest and estimates whether the technology changes differentially in the treatment region than in the control region after 1998. If the marginal product of workers increases after 1998 the elements in β_1 should be positive. I cluster the standard errors at the level of departements.

Table D.10: The effect of the market integration on technology

	All	Tradable	Non-tradable	Construction	Other
	(1)	(2)	(3)	(4)	(5)
Intercept	1.738	1.666	2.205	2.228	2.35
	(0.018)	(0.027)	(0.049)	(0.044)	(0.103)
k	0.205	0.171	0.268	0.149	0.19
	(0.006)	(0.008)	(0.01)	(0.008)	(0.008)
h	0.215	0.248	0.169	0.232	0.225
	(0.008)	(0.012)	(0.01)	(0.015)	(0.011)
m	0.358	0.373	0.267	0.442	0.378
	(0.007)	(0.012)	(0.012)	(0.012)	(0.012)
l	0.131	0.152	0.16	0.106	0.111
	(0.004)	(0.007)	(0.005)	(0.004)	(0.008)
k x post x treat	0.003	0.008	0.021	0.011	-0.005
	(0.006)	(0.01)	(0.011)	(0.014)	(0.016)
h x post x treat	-0.005	-0.015	0.008	-0.012	-0.005
	(0.007)	(0.014)	(0.013)	(0.015)	(0.013)
m x post x treat	0.012	0.005	0	0.001	0.027
	(0.008)	(0.015)	(0.012)	(0.014)	(0.013)
l x post x treat	-0.006	-0.007	0.004	-0.012	-0.013
	(0.003)	(0.006)	(0.009)	(0.007)	(0.011)
N (firm x year)	181287	67224	41911	31632	40520
R-squared	0.852	0.881	0.758	0.873	0.812

Notes: Results from estimating equation (D.4). Standard errors clustered at the department level are in parentheses. The columns refer to sectors: (1) – All sectors, (2) – Tradable sector, (3) – Non-tradable sectors, (4) – Construction sector (5) – Other sectors. The coefficients are: K – capital, H – high-skill labor, M – mid-skill labor, L – low-skill labor and the double-interaction with treatment status and year after 1998. Single-interactions with treatment and with post are not reported for brevity. The number of observations refer to firm-year observations. Sample: single-establishment firms with positive inputs and outputs. See text for details. *Data: Ficus.*

Table D.10 presents the results. For brevity I only report the estimated δ_0 and β_1. Column (1) uses the firms from all sectors. The coefficients on the labor inputs interacted with time and treatment are all statistically insignificant. The point estimate is negative and small for high-skill (-0.005, se 0.007) and low-skill workers (-0.006, se 0.003), and positive and larger for mid-skill workers (estimate 0.012, se 0.008). The remaining columns present similar results separately for firms in the tradable, non-tradable, construction and for firms in other sectors. Thus, even if the point estimate is positive for mid-skill workers, the results are inconsistent with higher wages for both mid- and low-skill workers.

Appendix E Search model

In this section I describe a simple equilibrium framework with heterogeneous firms and workers based on Bontemps et al. (2000) and Engbom and Moser (2018). I show how wages and the allocation of workers across firms and space adjust when employed workers receive more job offers.

E.1 Workers and firms

French workers live forever and maximize their expected lifetime income. They belong to a skill group $\theta \in \Theta$ and only search within this market. They discount future income at rate ρ and can be employed or unemployed. When unemployed they receive flow utility b_θ and receive new job offers at rate λ^u_θ. When employed they receive wage flow w and receive offers for new jobs at rate λ^e_θ. They are laid off at rate δ_θ. Job offers from French and Swiss firms are drawn randomly from the distribution $F_\theta(w)$ on the support $[\underline{w}_\theta, \overline{w}_\theta]$. Workers know the distribution of job offers and take it as given. Denote the legal minimum wage w_{min}.[57]

The value function for an unemployed worker is

$$\rho W_\theta = b_\theta + \lambda^u_\theta \int_{\underline{w}_\theta}^{\overline{w}_\theta} \max\{S_\theta, W_\theta\} dF_\theta(w)$$

and the value function for an employed worker is

$$\rho S_\theta = w + \delta_\theta [W_\theta - S_\theta] + \lambda^e_\theta \int_{w}^{\overline{w}_\theta} [S_\theta(x) - S_\theta(w)] dF_\theta(x)$$

Unemployed workers follow a reservation wage strategy and accept any job that offers at least ϕ_θ:

$$\phi_\theta = b_\theta + (\kappa^u_\theta - \kappa^e_\theta) \int_{\phi_\theta}^{\overline{w}_\theta} \frac{\overline{F}_\theta(x)}{\beta + 1 + \kappa^e_\theta \overline{F}_\theta(x)} \tag{E.1}$$

where $\kappa^j_\theta = \lambda^j_\theta / \delta_\theta$ for $j = \{u, e\}$, $\beta_\theta = \rho/\delta_\theta$, and $\overline{F}_\theta(x) = 1 - F_\theta(x)$. This implies that there is no wage below ϕ_θ. In a steady-state, flows into unemployment equal flows out of unemployment, and the unemplomyent rate is $u_\theta = \frac{1}{1+\kappa^u_\theta}$. Unemployment is lower when unemployed workers find jobs more quickly.

The model assumes that workers do not search in markets of other skill types, and that job offers from France and Switzerland arrive at the same rate. These strong assumptions are necessary to keep the model tractable. For instance a model where workers receive job offers from two competing regions at different rates would complicate the exposition without giving many more insights. Hoffmann and Shi (2016) analyze a model of this kind and their simulation evidence yields similar predictions as the ones derived here.

To keep the model as simple as possible I also abstract from worker heterogeneity within segments. Worker heterogeneity is more important to explain unemployment

[57] I abstract from minimum wages at the skill level. If they exist, they lie above the legal minimum wage. Also see the discussion in Section 3.1

durations (Eckstein and Van den Berg, 2007; Bontemps et al., 1999; Eckstein and Wolpin, 1990) and less crucial for the effect of search frictions on the job on wages.

I further assume that wages are set unilaterally by firms as opposed to wage bargaining: Employer and worker cannot renegotiate wages of an on-going employment spell. The first reason why I make this assumption is that it is much simpler to incorporate search on the job in posting models as opposed to bargaining models (Manning, 2003, p. 996), and on-the-job search is an important feature of the setting I study. The second reason is that the search model nests the competitive model as a special case when the contact rate for employed workers tends to infinity and the highest-productivity firm is the representative firm in the market.

Firms in France or Switzerland produce with labor from the three worker types that are perfect substitutes:

$$y(p, \{l_\theta\}_{\theta \in \Theta}) = p \sum_{\theta} l_\theta \tag{E.2}$$

The distribution of firm productivities is $\Gamma(p)$. Having heterogeneous firms helps to interpret the wage differentials across the border documented below: The average Swiss firm is more productive than the average French firm. In reality wages in Switzerland may be higher because of exchange rate differentials but this does not alter the incentives of French firms and workers.

I assume that workers of all types are equally productive at the same firm. The assumption implies that wages in the same firm differ across worker types only because search frictions differ. Allowing worker productivity to vary by segment does not change the comparative statics.

Because the production function is linear, the firm maximizes profit flows π_θ for each type separately. As a result, each segment of the labor market is a version of the model of Bontemps et al. (2000) and can be studied in isolation. $K_\theta(p)$ are the (possibly multiple) wages of a firm with productivity p in market θ that maximize profits:

$$K_\theta(p) = \underset{w}{\operatorname{argmax}}\{\pi_\theta(p, w) | \max\{\phi_\theta, w_{min}\} \leq w \leq p\} \tag{E.3}$$

with

$$\pi_\theta(p, w) = (p - w) l_\theta(w).$$

It follows that the lowest firm type in market θ is $\underline{p}_\theta = \max\{\phi_\theta, w_{min}\}$ as any firm below would make losses. Changes in the minimum wage or in the reservation wage may affect the entry threshold for firms.

With on the job search, firms take into account the wages paid at other firms. The decision resolves a trade off between profit per worker and firm size (Burdett and Mortensen, 1998): A higher wage attracts more workers and keeps them longer at the firm but doing so decreases profits per worker. When the productivity distribution is continuous the productivity rank pins down the pay rank of the firm.[58] Loosely speaking, if two firms pay the same wage but their productivities differ by ϵ, the more productive firm is better off by offering an $\frac{\epsilon}{2}$ higher wage. Total profits increase

[58] See Bontemps et al. (2000) for a proof. Firms play mixed strategies when they are homogenous (Burdett and Mortensen, 1998).

because it poaches more workers from the other firm which more than offsets the lower profits per workers. It also follows that there is only one optimal wage for each firm type, and that more productive firms pay higher wages and are larger. Firm heterogeneity also implies that more productive firms have more monopsony power: even though on-the-job search induces rent sharing between firms and workers, it is limited at high-productivity firms because they face less competition from other firms.

E.2 Equilibrium effects of an increase in labor market competition

To simplify the comparative statics I make two further assumptions. I assume that the minimum wage is always binding in all segments of the labor market which implies that the productivity threshold for firm entry is fixed. As a result, the labor market integration does not affect entry and exit of firms.

I also assume that the market integration primarily affects the job finding rate of employed workers (κ_θ^e), but not unemployed workers (κ_θ^u). The assumption ensures that the reservation wage remains below the minimum wage.

The data are consistent with the implications of the assumptions. The minimum wage is binding in all segments of the labor market in 1998 in the treatment region. The descriptive analysis in the paper suggests further that the policy primarily affected the job finding rate of employed workers and not of the unemployed.

I also assume a uniform distribution of firm productivities but this is merely to derive closed-form comparative statics.

Proposition 1. *Assume $\phi_\theta < w_{min}$ $\forall\theta$ and $\Gamma(p) \sim U[\underline{p}, \overline{p}]$. Then an increase in the contact rate κ_θ^e*

1. *increases the wages at all firms except the lowest-productivity one. The effect is stronger at more productive firms and weaker in more competitive markets. In perfectly competitive markets the effect tends to* 0*.*

2. *has an ambiguous effect on firm size. The sign of the effect depends on a unique threshold of firm productivities. More productive firms expand and less productive firms shrink. The treshold is higher in more competitive markets.*

See Appendix E.3 for details and a proof.

Because workers receive more job offers, all firms pay higher wages (except the least productive one) to prevent too many workers from quitting. More productive firms increase wages more because they can attract many more workers than less productive ones. From the workers' point of view, receiving more job offers increases bargaining power which allows them to extract more rents from their employer. Because rents are higher at more productive firms, wages increase more at those employers. This heterogeneity contrasts with bargaining models where bargaining power is fixed which shuts down the rent-sharing channel of an increase in degree of labor market competition. Moreover, as wages lie closer to the marginal product in more competitive markets, a further increase in the contact rate has a smaller effect on wages.

Because more productive firms increase their wages more, they attract more workers in the new equilibrium. They poach from less productive firms that do not increase wages as much. Because the less productive firms cannot hire more unemployed workers, they become smaller. On aggregate, workers reallocate to more productive firms. In a more competitive market the monopsony power of less productive firms is already low and they have less room to increase wages. In contrast, the most productive firms still enjoy more market power and a further increase in the contact rate makes them increase the wages further, attracting even more workers. In a perfectly competitive market there is no worker mobility because all workers are already at the most productive firm.

Consider two labor market segments that are initially differently competitive. Assuming that there are more productive firms in Switzerland than in France, the reallocation of workers to more productive firms makes more workers flow to Switzerland in the more competitive segment. In the less competitive segment, the threshold for a positive employment effect is lower and so some productive firms in France also become larger. Wages increase more in the less competitive segment.[59]

The comparative statics study two steady-states where the contact rate for employed workers varies. The model assumes that wages cannot increase at the current employer and is therefore silent on transitional dynamics between steady-states. One can circumvent this problem by assuming an equal-treatment constraint for firms (Moscarini and Postel-Vinay, 2013): firms have to pay the same wage to all their employees in a given market θ, be it new hires from unemployment, new hires from other firms, or incumbent workers.

E.3 Derivations

This Section derives the labor market equilibrium from the previous section in detail and largely follows Bontemps et al. (2000). The segmentation by skill type is based on Engbom and Moser (2018).

E.3.1 Worker flows

In any market θ, there are N_θ active firms M_θ active workers of which U_θ are unemployed. Let $G_\theta(w)$ denote the fraction of employed workers in skill group θ that earn at most wage w. In a steady state, the number of workers earning at most wage w does not change over time: there are as many unemployed workers that find jobs paying at most w as there are workers leaving the same jobs because of layoffs or because they find a higher-paying job. Formally we have

$$\lambda_\theta^u U_\theta F_\theta(w) = [\delta_\theta + \lambda_\theta^e \overline{F}_\theta(w)](M_\theta - U_\theta)G_\theta(w) \tag{E.4}$$

Solving this equation at $w = \overline{w}_\theta$ gives the unemployment rate $u_\theta = \frac{1}{1+\kappa_\theta^u}$. With this result, one can also show that the observed wage distribution relates to the offer

[59]The present search framework also predicts wage gains in Switzerland. The prediction is also present in Hoffmann and Shi (2016): a higher cross-regional job finding rate increases wages in both regions even when the contact rate within region remains constant.

distribution as follows: $G_\theta(w) = \frac{F_\theta(w)}{1+\kappa_\theta^e \overline{F}_\theta(w)}$. The more quickly workers climb the job ladder, the more employment is concentrated among higher-paying firms.

E.3.2 Firms

Since workers meet firms at random, the average firm size for firms paying wages in the interval $[w, w+\epsilon]$, where $\epsilon \to 0$ is

$$l_\theta(w) = \frac{M_\theta - U_\theta}{N_\theta}\frac{dG_\theta(w)}{dF_\theta(w)} = \frac{M_\theta - U_\theta}{N_\theta}\frac{1+\kappa_\theta^e}{[1+\kappa_\theta^e \overline{F}_\theta(w)]^2} \tag{E.5}$$

where $\frac{dG_\theta(w)}{dw}$ was taken from the relation above. As in the model with homogenous firms, high-wage employers are larger because they can attract more workers and fear less poaching from other firms.

Firms maximize profit flows $\pi_\theta(p,w) = (p-w)l_\theta(w)$. $\underline{p}_\theta$ is the productivity threshold for active firms and profits are negative for any $p < \underline{p}_\theta$. Denote the distribution of active firms by $\Gamma_\theta(p)$ which is the probability of being a firm of at most productivity p conditional on being active in the market:

$$\Gamma_\theta(p) = \frac{\Gamma_0(p) - \Gamma_0(\underline{p}_\theta)}{\overline{\Gamma_0}(\underline{p}_\theta)} \tag{E.6}$$

The number of active firms is therefore $N_\theta = N_0\overline{\Gamma_0}(\underline{p}_\theta)$, e.g. the number of all possibly active firms multiplied by the fraction of firms above the threshold productivity.

The optimal strategy of a firm with productivity p maximizes profits subject to the wage constraint:

$$K_\theta(p) = \underset{w}{\operatorname{argmax}}\{\pi_\theta(p,w) | \max\{\phi_\theta, w_{min}\} \leq w \leq p\} \tag{E.7}$$

where

$$\pi_\theta(p, w_\theta) = (1+\kappa_\theta^e)\frac{M_\theta - U_\theta}{N_0\overline{\Gamma_0}(\underline{p})}\frac{p-w}{[1+\kappa_\theta^e \overline{F}_\theta(w)]^2} \tag{E.8}$$

follows from equations (E.5) and (E.6). For future reference, define $A_\theta \equiv (1+\kappa_\theta^e)\frac{M_\theta - U_\theta}{N_0\overline{\Gamma_0}(\underline{p}_\theta)}$ and therefore $\pi_\theta(p,w_\theta) = A_\theta\frac{p-w_\theta}{[1+\kappa_\theta^e \overline{F}_\theta(w_\theta)]^2}$.

Because firms are indifferent between all strategies that solve (E.7), define $F_\theta(.;p)$ as the probability distribution of firm type p over all optimal strategies. Thus the overall wage distribution in the economy is $F_\theta(.) = \int F_\theta(.;p)d\Gamma_\theta(p)$

E.3.3 Market equilibrium

An equilibrium is a set $(\phi_\theta, \underline{p}_\theta, \{F_\theta(.;p), p > \underline{p}_\theta\})$ such that

1. The distribution of wage offers is $F_\theta(.) = \int F_\theta(.;p)d\Gamma_\theta(p)$.
2. Only firms with at least productivity $\underline{p}_\theta$ are active and their distribution is given by (E.6).
3. ϕ_θ satisfies (E.1).

4. $F_\theta(., p)$ is a distribution over all strategies that satisfy (E.7).

Bontemps et al. (2000, Proposition 3) show that there exists a wage function $K_\theta(p)$ such that the wage distribution reflects the productivity distribution, if this distribution is continuous. Firms play pure strategies because only one strategy is optimal for a given type. As a result, firms with higher productivity pay higher wages, the wage distribution is continuous and $\underline{w}_\theta = \max\{\phi_\theta, w_{min}\}$.

The first-order condition of a firm of type p is $\frac{\partial \pi_\theta(p, w_\theta)}{\partial w_\theta} = 0 \Leftrightarrow -l_\theta(w) + (p - w)l'_\theta(w) = 0$ which results in

$$-[1 + \kappa^e_\theta \overline{F}_\theta(w)] + 2\kappa^e_\theta f_\theta(w)(p - w) = 0 \tag{E.9}$$

Firms with the lowest productivity pay the lowest wages: $K(\underline{p}_\theta) = \underline{w}_\theta$.

Consider the marginal increase of profits for a marginal increase in productivity, $\frac{\partial \pi_\theta[K_\theta(p)]}{\partial p}$:

$$\begin{aligned}\frac{\partial}{\partial p}[p - K_\theta(p)]l_\theta[K_\theta(p)] = &\overbrace{l_\theta[K_\theta(p)]}^{\text{output incumbents}} - \overbrace{l_\theta[K_\theta(p)]K'_\theta(p)}^{\text{wage incumbents}} + \\ &\overbrace{pl'_\theta[K_\theta(p)]K'_\theta(p)}^{\text{output new hires}} - \overbrace{K_\theta(p)l'_\theta[K_\theta(p)]K'_\theta(p)}^{\text{wage new hires}}\end{aligned} \tag{E.10}$$

which simplifies to

$$\pi'_\theta(p) = l_\theta[K_\theta(p)] \tag{E.11}$$

This follows because when a firm increases productivity, its wage increases. The optimal wage equalizes marginal labor cost with marginal profits. Labor cost increase because of higher wages for incumbent workers and because of new hires that are attracted by the higher wage. The new hires increase output further. The three last terms exactly offset each other, and the marginal profit is just the marginal increase in output from the incumbent workers.

The marginal profit in (E.11) is a differential equation with initial condition $\pi_\theta(\underline{p}) = (\underline{p}_\theta - \underline{w}_\theta)l_\theta(\underline{w}_\theta)$. Therefore

$$\pi_\theta(p) = (\underline{p}_\theta - \underline{w}_\theta)l_\theta(\underline{w}_\theta) + \int_{\underline{p}}^{p} l_\theta[K_\theta(x)]dx \tag{E.12}$$

and since $\overline{F}_\theta[K_\theta(x)] = \overline{\Gamma_\theta}(x)$, we have $l_\theta[K_\theta(x)] = \frac{A_\theta}{[1+\kappa^e_\theta \overline{\Gamma_\theta}(x)]^2}$, and using $\underline{p}_\theta = \underline{w}_\theta$:

$$\pi_\theta(p) = A_\theta \int_{\underline{w}_\theta}^{p} \frac{1}{[1 + \kappa^e_\theta \overline{\Gamma_\theta}(x)]^2} dx \tag{E.13}$$

Using $\pi_\theta(p) = [p - K_\theta(p)]l_\theta[K_\theta(p)]$, rearrange for $K_\theta(p)$, substitute (E.13) for profits and (E.5) for the firm size and use $F_\theta(x) = \Gamma_\theta(x)$ gives the wage as a function of the distribution of productivity, the contact rate, firms' productivity and the reservation wage:

$$K_\theta(p) = p - [1 + \kappa^e_\theta \overline{\Gamma_\theta}(p)]^2 \int_{\underline{w}_\theta}^{p} \frac{1}{[1 + \kappa^e_\theta \overline{\Gamma_\theta}(x)]^2} dx \tag{E.14}$$

The number of equilibria depends on the parameters of the model. The equilibrium exists for $\overline{p} < \infty$ (see Bontemps et al. (2000) for details). The interdependence of the reservation wage ϕ_θ and the threshold productivity $\underline{p}_\theta$ makes the model non-recursive.

E.3.4 Equilibrium with uniform productivity and proof of proposition

Assume now that firm productivity is distributed uniformly on the interval $[\underline{p}, \overline{p}]$. The assumption allows me to derive closed-form solutions for the equilibrium wage function and assess comparative statics. Also assume that the minimum wage is binding in all markets: $\phi_\theta < w_{min}\ \forall\theta$ and $\underline{p}_\theta \equiv \underline{p}\ \forall\theta$. The assumptions imply that the entry threshold does not change when the contact rate for employed worker changes. Since the entry threshold is constant across markets, we also have $N_\theta \equiv N\ \forall\theta$.

The wage offered by a firm with productivity p is then

$$K_\theta(p) = p - \frac{(\overline{p} - \underline{p})(p - \underline{p}) + \kappa^e_\theta(\overline{p} - p)(p - \underline{p})}{(1 + \kappa^e_\theta)(\overline{p} - \underline{p})} \tag{E.15}$$

I first show that a reduction in the search friction on the job (an increase in the contact rate for employed workers) workers increases the wages at all firms except the with the lowest productivity, which after simplifying and collecting terms yields

$$\frac{\partial K(p)}{\partial \kappa^e_\theta} = \frac{(p - \underline{p})^2}{(1 + \kappa^e_\theta)^2(\overline{p} - \underline{p})} \geq 0 \tag{E.16}$$

As the numerator is increasing in p and the denominator is increasing in κ^e_θ, we have $\frac{\partial^2 K(p)}{\partial \kappa^e_\theta \partial p} > 0$ and $\frac{\partial^2 K(p)}{\partial \kappa^e_\theta \partial \kappa^e_\theta} \leq 0$, and $\lim_{\kappa^e_\theta \to \infty}(\frac{\partial}{\partial \kappa^e_\theta} K(p)) = 0$. ■

Now consider how the employment of a firm with productivity p responds to a reduction in search frictions on the job.

$$\frac{\partial l_\theta[K_\theta(p)]}{\partial \kappa^e_\theta} = \frac{M_\theta - U_\theta}{N} \frac{[1 + \kappa^e_\theta \overline{\Gamma}(p)]^2 - 2(1 + \kappa^e_\theta)[1 + \kappa^e_\theta \overline{\Gamma}(p)]\overline{\Gamma}(p)}{[1 + \kappa^e_\theta \overline{\Gamma}(p)]^4} \tag{E.17}$$

Simplifying yields

$$\frac{\partial l_\theta[K_\theta(p)]}{\partial \kappa^e_\theta} = \frac{M_\theta - U_\theta}{N} \frac{1 - \overline{\Gamma}(p)(2 + \kappa_\theta)}{[1 + \kappa^e_\theta \overline{\Gamma}(p)]^3} \tag{E.18}$$

The sign of the effect only depends on $1 - \overline{\Gamma}(p)(2 + \kappa_\theta)$, and all the remaining terms are positive. Because $\overline{\Gamma}(p)$ is monotonically decreasing in p, there exists a unique threshold $\underline{\tau}^l_\theta$ above which the term is positive:

$$\frac{\partial l_\theta[K_\theta(p)]}{\partial \kappa^e_\theta} \Leftrightarrow p > \overline{p} - \frac{\overline{p} - \underline{p}}{(2 + \kappa^e_\theta)} \equiv \underline{\tau}^l_\theta.$$

The threshold $\underline{\tau}^l_\theta$ is increasing κ^e_θ. ■