Labor Market Competition, Wages and Worker Mobility *

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Abstract

Using a quasi-experiment I study the effects of removing barriers to worker mobility. In 1998 French border-commuters gained access to the Swiss labor market where nominal wages were twice as high. The labor market integration increased the number of – primarily highly skilled – commuters from France to Switzerland. I study the effect of the integration on French labor markets using a difference-in-differences research design. For this, I compare treated labor markets in the French border region with a matched control group of labor markets in other parts of France. The integration increases overall wages and employment in France, but disproportionately so for low-skill workers. This is despite the fact that they were seemingly less affected by the policy change. A model of monopsonistic competition can explain this result. When it becomes easier to work in Switzerland, workers' outside options increase and workers find more employers close by than before. Intuitively, the inverse labor supply curve to individual French firms shifts inward and becomes more elastic at the same time. This change increases wages and employment for workers with initially more inelastic supply curves, which empirically are the less mobile low skilled workers. Hence, this paper suggests that enhancing labor mobility may induce pro-competitive effects that reduce firms' market power and result in welfare gains to labor.

Keywords: wages, job search, monopsony, outside options

JEL classification: J31, J42, J64, R23

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1. Introduction

The rate at which workers change jobs in the United States has decreased by one third from 1991 to 2013 (Davis and Haltiwanger, 2014). While this may reflect that people are happy with their jobs, it can also be cause for concern: If more mobile workers have more and better outside options, low worker mobility may depress wage growth.

Using a quasi-experiment I study the effects of removing barriers to worker mobility. Local labor markets between France and Switzerland were integrated in 1998. The market integration gave French border commuters better access to jobs in neighboring Switzerland where average wages were twice as high. It attracted more commuters from France to Switzerland. From 1998 to 2003 the share of border commuters in the labor force of French border areas increased from below 4 percent to almost 6 percent of the labor force. Many of the new commuters had a tertiary education. They previously worked in the French border area in high-skill professions as managers or engineers, for instance. Between five and eight percent of employees in these professions left their jobs in France to work in Switzerland every year.

I study the effects of the market integration on French labor markets using a difference-in-differences design. The design compares treated labor markets in the French-Swiss border area with a matched set of control areas in other parts of France. The design assumes that without the labor market integration, wages and employment in the treated and the control labor markets would have grown at the same rate. The absence of pre-existing trends before the integration supports this assumption. The design further assumes that no other event impacted treated labor markets differently from the control labor markets. In particular, it assumes that the remaining agreements that became active at the same time affected all French labor markets in the same way. To support this claim, I show that the results are very similar when focusing on a small set of manufacturing sectors which were not affected by other agreements. Moreover, to abstract from compositional changes in the workforce, I measure wage growth as the average change in log hourly residual wages of workers that stay at the same plant in two consecutive years. I have to make this sample restriction because the data do not allow me to follow workers across firms.

The labor market integration raises both wages and employment. Wages rise by around 1.6% after five years. The effect corresponds to a bit less than a year's average wage growth before the integration. Employment increases by 3% in the first two years after the integration. The magnitude remains similar thereafter but the estimated effect becomes more imprecise. These improved labor market outcomes, in particular the wage gains, come from gains at the bottom of the skill distribution. Wages rise both for low- and mid-skill workers by around 2%. Wages of high-skill workers do not change. Employment rises because low- and high-skill employment increase. While the magnitudes are similar, it is significant only for the low-skill workers.

The estimated effects are robust to several additional checks. Because the matching relies on a small number of covariates, I include more unmatched covariates in the regression and the results do not change. One of the agreements that accompanied the market integration reduced the fixed cost of trade in some manufacturing sectors. If firms close to Switzerland were more or less affected than firms in other parts for France, this could invalidate my interpretation. Yet, when focusing on tradable industries exempt from the trade policy, I find quantitatively similar but more imprecise effects. In addition, France also changed the working hours legislation around the same time (Goux et al., 2014) and this could have affected different regions differently. Controlling for the exposure to this reform, however, does not change the results.

The large scale of the administrative data allows for analyzing various subsamples of firms and workers separately to better understand the average treatment effects. The wage gains are not driven by any particular sector, but instead wages rise in all sectors by a similar magnitude. In contrast, employment increases in the tradable sector while the point estimates are close to zero or negative in other sectors. Wages grow more quickly at highly productive firms and increase at unproductive firms only later. Similarly, wages rise in firms with more than 50 employees and do not change in small firms with less than ten employees. The effect on low-skill employment exhibits a remarkably similar pattern: the observed increase in low-skill employment stems from large firms employing more low-skill workers. In contrast, small firms employ significantly fewer low-skill workers. This increasing heterogeneity across firms is a potential explanation for why the overall wage and employment effect becomes more imprecise over time.

Both the average treatment effects as well as the heterogeneity across sectors and firms are consistent with a mechanism where the labor market integration increases workers' outside options and makes the labor market more competitive. This implies that the labor market is imperfectly competitive to start with. In several models of the labor market, the wage of a worker is a weighted average between her outside option and her marginal product (Manning, 2011):

$$w_{ij} = \frac{1}{1+\varepsilon_i} b_i + \frac{\varepsilon_i}{1+\varepsilon_i} p_{ij}$$

where i indicates the worker type, j the firm, b_i is the value of the outside option, p_{ij} the marginal product of worker i at firm j, and ε_i is the elasticity of labor supply of worker type i to firm j. In a perfectly competitive market, each firm is a price taker. This means that the inverse labor supply curve to the individual firm is flat: a slightly lower wage will move away all workers from that firm to other firms. This can be represented by $\varepsilon_i \to \infty$. In imperfectly competitive markets $0 < \varepsilon_i < \infty$, eg the slope of the inverse labor supply curve to the individual firm is not flat but slopes upward, and the firm can lower the wage without losing all its employees. As a result, the employer has some monopsony power and hires fewer workers at a lower wage than in a competitive equilibrium. There are different reasons for market imperfections, and prominent examples include search frictions (Burdett and Mortensen, 1998; Bontemps et al., 2000) and workplace differentiation

(Bhaskar et al., 2002; Boal et al., 1997; Card et al., 2018).

Through the lens of this simple equation, the labor market integration both increases workers' outside option b_i and the elasticity of labor supply to individual firms ε_i. This means that the inverse labor supply curve to individual firms shifts inwards and becomes flatter. The change in the outside option raises wages more for worker types with a lower supply elasticity. To support this claim, I show that wage growth of incumbent workers is more strongly associated with firm-level productivity growth for high-skill workers than for low-skill workers. I do this with regressions similar to Card et al. (2018). One reason for this is that high-skill workers face a larger labor market than low-skill workers. High-skill workers are more mobile geographically both in terms of average commuting distance and in terms of internal migration rates. This suggests that they have a larger number of firms at which they can potentially work. Because labor markets of low-skill workers are more local, the market integration has a larger effect on the number of potential employers of low-skill workers than of high-skill workers. This implies that the labor supply of low-skill workers becomes more elastic as a result of the labor market integration. A flatter inverse supply curve – that is, an increase in ε_i – explains both why low-skill employment increases and why more productive and large firms raise wages more. Lastly, the market integration also made it more attractive to settle in the French border region because of an option value of getting a high-wage job in Switzerland (Harris and Todaro, 1970). While not captured in the simple equation above, it can be thought of as an amenity for working in a firm in the border region. Because high-skill workers are more mobile, they are the only ones that actually respond to the improved amenity: around 60% of the increase in high-skill employment in the border area can be explained by more in-migration from other parts of France. There is no internal migration response for other worker types. As a result, the supply curve of high-skill workers shifts out again, which overcompensates for the outflow to Switzerland and leaves high-skill wages unchanged.

In contrast, several other competing channels cannot explain all the findings. As more workers earn high wages in Switzerland, it is possible that the demand for local non-tradable services increased. This is not consistent with higher employment in the tradable sector and with wages gains in all sectors. The observed reduction in the skill premium could also come from the higher supply of high-skill workers which complement low-skill workers (Katz and Murphy, 1992). Yet, I find no evidence that the relative supply of high-skill workers increased. Another explanation for higher low-skill wages could be low-skill biased technology: as primarily high-skill workers leave to Switzerland, firms could start adopting technologies that raise the productivity of low-skill workers. Results from production functions suggest, however, that the marginal product of low-skill workers did not change. Finally, a bargaining model could also explain the wage effects (Beaudry et al., 2012). But in a bargaining model the policy only acts through an increase in the outside option because workers' bargainin power is an exogenous parameter. Moreover, employment would decrease in a bargaining omdel because firms create fewer jobs.

The present paper contributes to the literature on the effects of economic policy in imperfectly competitive markets. The leading example are studies on the minimum wage (Card and Krueger, 1995; Neumark and Wascher, 2010). In contrast I show that improving worker mobility can have distributional and pro-competitive effects on the labor market. Policy can enhance worker mobility both at the national and at the local level. On the one hand, labor market regulations may hinder worker mobility across firms (Gruber, 2000; Kleiner and Krueger, 2013; The Economist, 2019). Examples include employer-sponsered health insurance or the transferability of pension rights but also non-compete clauses. Recent evidence suggests that only a minority of workers covered by non-compete clauses possess trade secrets (U.S. Treasury, 2016; Starr et al., 2019). These restrictions make employers imperfect substitutes for workers and reduce incentives to change employers. On the other hand improving local access to good jobs – for instance through better commuting access – can raise wages because workers search very locally for jobs (Manning and Petrongolo, 2017). The existing literature on local economic policies focuses on the effects of local hiring subsidies and finds mixed evidence (Neumark, 2011; Kline and Moretti, 2014). The present paper suggests that both national and local policies that facilitate worker mobility across employers may be a cost-effective way to improve the labor market outcomes of workers that are particularl immobile, as low-skill workers often are. Naidu et al. (2016) find similar pro-competitive effect of facilitating employer transitions of immigrants. The present paper shows that even barriers to internal worker mobility can severely restrict employer competition and documents that low-skill labor markets are less competitive than high-skill labor markets.

The present paper also contributes to the empirical analysis of how outside options affect wage inequality. Jaeger et al. (2018) find no evidence that higher unemployment benefits increase wages, while Caldwell and Harmon (2018) and Caldwell and Danieli (2018) show that better outside options at other firms do. Beaudry et al. (2012, 2014) show that wage growth spills over across industries within locations. Green et al. (2019) show that long-distance commuting raoses wages of non-commuters in sending regions. In contrast to existing studies the present paper shows evidence more consistent with labor market monopsony than with bargaining models. The two models make differing predictions on the employment effect of the market integration and on heterogeneous wage effects across employers. Only a monopsony model can explain an increase in employment and faster wage and employment growth at larger and more productive firms.

The present paper also speaks to the theoretical sources of monopsony power in the labor market. The most common models can be grouped into two broad categories. On the one hand are models of job differentiation based on random utility as in Card et al. (2018) and Lamadon et al. (2019). In these models individual employers face upward-sloping supply curves because workers have heterogeneous preferences for different employers. This means that the supply curve to the firm is independent of the market structure: because of a random utility component there will always be some workers that strictly prefer working for one employer, even when adding more employers. Indeed, as Berry and Pakes (2007) discuss in the context of Industrial Organization, this might be a problematic assumption when studying the effects of introducing new products to the market. On the other hand are models where the supply curve is endogenous to the market structure. The evidence in the present paper are more consistent with these models. These can be search models with on-the-job search (Burdett and Mortensen, 1998; Bontemps et al., 2000) where the degree of competition in the market is measured by how easily workers locate better jobs. In these models the labor market integration increases the arrival rate of jobs to workers. This makes the labor market more competitive. Appendix D provides a formal model of this class with heterogeneous firms whose predictions broadly match the empirical findings. Models with job differentiation also feature endogenous supply elasticities when workers only care about a limited number of firm characteristics (Bhaskar et al., 2002; Boal et al., 1997). If for instance workers only care about the commuting distance, then the market integration increases the number of jobs close by. This provides workers with more close substitutes and their supply to existing firms becomes more elastic. Lastly, static models of oligopsony or dominant firms can also explain the tilt in the supply curve to individual employers (Berger et al., 2019)[1]. In these models, there is a large dominant firms that has wage-setting power. The market integration decreases the market share of large firms and therefore makes their labor supply more elastic.

2. Background and main data

2.1. 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[2]. In 1992 these agreements covered around 90% of workers. But for many workers these agreements are non-binding, and individual employers have considerable room to pay their employees more. As a result an important fraction of employees benefits from company-level bargaining (OECD, 2004, p. 151). For instance, in 1998 75% of large firms (above 50 employees) granted their workers individual pay rises (Barrat et al., 2007). Even though the French labor market is less decentralized than the American or British labor market, it is comparable to other European labor markets such as the German or Dutch market. This characterisation is consistent with the wage dispersion documented for instance by Abowd et al. (1999), and Cahuc et al. (2006) find that employer competition is important for French wages.

2.2. The integration of local labor markets

The labor market integration was a side effect of a larger set of agreements between Switzerland and the European Union (EU) which were implemented in 2002 after Switzerland had demanded closer economic integration with the EU in various sectors in the

[1] See Appendix E for an simple example

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

1990s. Switzerland intended to improve labor market access for both parties, standardize how products are approved to market and participate in European research programs. In contrast, the European Union put strong emphasis that all agreements became active simultaneously and were in line with the existing European norms ("acquis communitaire") (Bundesrat, 1999). In particular, access to the Swiss labor market had to be free for all EU citizens, which the European Commission repeated on several occasions (van den Broek, 1996; European Commission, 1995). The treaties were announced at the end of 1998. This will serve as the base year for the empirical analysis even though the reform was to be implemented only in 2002. Beerli et al. (2018) document anticipation effects as Swiss labor market authorities started approving more permits in 1999.

It was already possible to commute across the border but bureaucratic barriers remained. Residents from a set of "border municipalities" could work as commuters in the other country already before. This group of municipalities had been defined in a treaty between Switzerland and France in 1948 to facilitate residents' mobility in these border areas[3]. The general rules were symmetric fro 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 authorised. In contrast, countries specified individually how they issued work permits. Swiss firms could only hire a worker from across the border when they could not find a suitable worker in Switzerland before (Beerli et al., 2018). The subnational entity issued the permits and they were bound to the applying employer (Swiss Federation, 1986).

The integration removed all bureaucratic costs and firms could freely hire cross-border workers. A permit has since been valid for 5 years and holding one allows for job switches and weekly instead of daily commuting (Bundesrat, 1999). Until 2007 only residents from the border municipalities could commute across the border. I will use the border area to assign labor markets to treatment status.

2.3. Data sources

2.3.1. Full-count worker records

The empirical analysis uses a matched employer-employee dataset from France provided by the Statistical Office (INSEE). The data contain annual declarations for social security filed by employers excluding the self-employed. I use the vintage called *DADS postes* (DADS = "Déclarations annuelles des données sociales"). The data report employment spells which are employment relationships between individuals and establishments[4]. 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. If the worker was employed at the same firm in

[3]It consisted of all municipalities within 10km on both sides of the border, as well as municipalities in the French *Haute Savoie* department and in *Pays Gex*.

[4]Eg, if an individual is employed at two different establishments, there are two spells.

the previous year, information on wages and hours from that year are also available. If the workers was employed at another firm in the previous year, the information on the preceding spell is not available, however.

I focus on the main emplomyent spell[5] of each worker and keep those that are full-time employed as of June 30 in each year. 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.

Employees in any year are either firm stayers or new hires. Firm stayers are workers that work at the same employer in two consecutive years. The remaining workers are new hires. They can come from non-employment or from other firms. I focus on firm stayers because I can calculate changes in outcomes at the individual level. It controls for unobserved individual heterogeneity, but does not allow me to study in detail how the wages of newly hired workers respond. I build a dataset of wages and employment at the skill $\times$ year $\times$ labor market cell. I winsorise wages at the first and 99th percentile and residualise them with respect to gender and age[6]. I calculate wage growth as the change in the log hourly wage between two consecutive years[7]. I assign workers to skill groups with the skill group reported in the first of the two years. I use the INSEE's definition of local labor markets ("employment zones") of which there are 297 in France[8]. Workers are assigned to skill groups based on their two-digit occupational classification[9] similar to Combes et al. (2012) and Cahuc et al. (2006)[10]. High-skill 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).

2.3.2. Balance sheets from tax records

I combine these 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[11] as well as finance and insurance companies. Because the data are only available at the level of the legal entity, I focus on single-establishment firms for the analysis of variables derived from this dataset. I follow Gopinath et al. (2017) to prepare

[5]This definition is provided by INSEE and is based the spell's duration and total compensation.
[6]I estimate the regressions separately for each year and include a gender dummy and a quartic in age.
[7]Because individual growth rates exhibit large tails I winsorise them at the first and 99th percentile.
[8]Their size and commuting patterns are comparable to counties in the United States.
[9]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.
[10]I pool skill groups 2 and 3 from Cahuc et al. (2006).
[11]This threshold is from 2010, but only changes marginally over time (Di Giovanni et al., 2014).

and clean the data. I source employment by firm, year and skill type from DADS and join them to the firm-level data.

I use the data in two ways. In aggregate form I use them as separate outcomes similar to the wage outcomes at the labor market × year level. In individual form I use them to estimate production functions.

3. Descriptive analysis

I now describe the labor markets along the border in 1998 and show how French workers reacted to the new employment opportunities. I do this for three education groups separately: compulsory education or less, secondary education, and tertiary education. In the main analysis I group workers by skill based on occupation. I use education here because I can better compare wages across the border. Since the occupation is not defined for non-employed workers, it also enables me to assess transitions between labor market statuses.

In the first part I use data from the Swiss Employment Structure Survey (Bundesamt für Statistik, 2017) and from the 4% worker panel in France which both report the education of the workers[12]. In the second part I use the French Labor Force Survey from 1993 to 2002, a rotating panel survey of the French 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 identify cross-border commuters by their country of work.

3.1. All French workers could gain from commuting to Switzerland

Figure 1 shows that there were large wage differences between France and Switzerland in 1998. The Figure plots the average wages in Euros for three education groups. French wages are in red and Swiss wages are in green. Wages for highly educated workers were more than twice as high in Switzerland than they were in France: a French worker could increase her salary from 10 Euros per hour to more than 25 Euros per hour when switching to work in Switzerland. Workers of other education groups could also gain, but less so. Workers with mandatory education could increase their wage from around 7 Euros per hour to 13 Euros per hour.

Appendix A.1 graphically documents other dimensions of the labor markets along the border. French labor markets are less dense than their Swiss neighbors. Wages do change discontinuously at the border for all education groups, supporting the conclusion drawn from comparing average wages in the two countries. French labor markets are between 13 and 96 minutes away from the next border crossing to Switzerland[13].

[12] I harmonize education groups according to the ISCED-1997 classification.

[13] Data on the location of border crossings have been thankfully provided by Henneberger and Ziegler (2011).

3.2. Employees in high-skill professions reacted most strongly

How did French workers adapt to the new employment opportunities? For treated and control areas, Figure 2a 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[14] and in 2002 almost 6% of the labor force commutes to Switzerland[15].

Figure 2b plots the same number for the three education groups in 1998 and 2002. The red bars refer to 1999, the green bars to 2002. All education groups commute more, but there is a strong education gradient: It is strongest for highly educated workers whose share increases from below five percent to more than eight percent in 2002. Workers with mandatory education react the least.

Figure 3 shows that the new commuters[16] were primarily workers that lived and worked in the border area in the previous year. Figures 3a and 3b consider education groups (columns) and years (rows) separately. Figure 3a shows that on average roughly 75% of new border commuters did not migrate before they accepted a job in Switzerland. An exception is 1999 when almost 50% of new commuters with tertiary education did not live in the border area in the previous year. Figure 3b shows that among the non-migrating new border commuters, the vast majority worked in France in the previous year. It presents transition rates of workers by labor market status: employed[17], unemployed, inactive. In each year between four and eight percent of highly educated employees accepted a new job in Switzerland. The number decreases by education: around 2.5% 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.

To bridge the current section to the main empirical part, I present some more evidence by occupation. Figure 4a shows that high-skill occupations were most affected by the outflow of workers. It plots the average transition rate for employed workers by their previous occupation from 1999 to 2002. On average, almost seven percent of managers and engineers left their jobs to work in Switzerland every year. The number drops steadily for less skill-intensive professions. Four percent of office employees and a bit more than two percent of manufacturing employees transitioned to Switzerland. Figure 4b shows how stayers (workers that remain employed in France) and new commuters distribute across the occupations. Most importantly, 60% of new commuters with tertiary education worked in managerial or engineering professions before they accepted a job from Switzerland compared to less than 40% of workers with the same education that did not

[14] It is plausible that the trend only reverses after 1999 because the survey is collected in March 1999 and the market integration was only announced in December 1998.

[15] Swiss commuters in France are less well documented. In 2000 0.03% of the Swiss labor force in the border region worked in France (Bundesamt für Statistik, 2000).

[16] A new border commuter is a worker that works in Switzerland in the current, but did not work there in the previous year.

[17] This only includes workers that did not have any intermittend unemployment spell in the last 12 months

start commuting. For workers with secondary education the distribution is similar for stayers and leavers.

In sum, the evidence shows that while all workers could earn higher wages from accpeting a job in Switzerland, the new commuters were highly educated. Most of them had been living and working in the border area before accepting a job in Switzerland. The largest outflow was from managerial and engineering professions.

4. Empirical design

4.1. Estimating the effect of the labor market integration

To estimate the effects of local shocks and policies one has to solve a trade-off between power and bias (Manning and Petrongolo, 2017): local labor markets are overlapping because workers search for jobs close to where they live[18]. A shock in one area can thus have ripple effects to neighboring areas that are not directly hit by the shock. While the effective treatment area increases, the size of the shock relative to the affected area shrinks and it becomes statistically harder to estimate the effect of the shock. In their model, Manning and Petrongolo (2017) find that ripple effects can reach up to ten times as far as the median commute.

I accomodate such concerns and define the effective treatment area as follows. There are 12 labor markets that are directly affected because they have at least one municipality in the eligible area as defined by the agreement. I calculate $\bar{d} = 84$ kilometers as the maximum distance between the Swiss border and any point in the directly treated labor markets. Any labor market that is not directly treated, but is at most $\bar{d}$ away from the Swiss border, is then assigned to be possibly affected by spillovers. The resulting are 22 treatment labor markets[19] are represented in Figure 6a. The eligible municipalities are in navy blue, the directly treated labor markets are in red, and the labor markets affected by spillovers are in green.

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

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

with

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

First differences absorb time-constant heterogeneity at the level of the labor market × skill group level. α^{θ}_{τ} accounts for a skill-specific time trend that is constant across all labor markets. The coefficients of interest are β^{θ}_{τ} which estimate the effect of the labor market

[18]Monte et al. (2018) also study commuting linkages.

[19]The maximum commuting time to Switzerland in these labor markets is 96 minutes, and the median commute in France in 2004 was 12 minutes. The treated area thus includes the plausible reach of ripple effects (Manning and Petrongolo, 2017).

integration on workers with skill θ for different years. v_{it}^{θ} is an error term orthogonal to the treatment assignment and possibly correlated across space. The hypothesis that $\beta_{\tau}^{\theta} = 0$ 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.

To account for spatial correlation of the error term, I cluster the standard errors at the state level[20] (*département*) following Imbens and Kolesar (2016). Their procedure approximates the t-statistic by a t-distribution (instead of a normal) with a degrees of fredom correction that depends on the matrix of regressors. The procedure has, when there are not many clusters, lower rejection rates than all other conventionally used methods, including the wild-cluster bootstrap with the null hypothesis imposed (Cameron et al., 2008) (see Table 4 in Imbens and Kolesar (2016) and also Cameron and Miller (2015, p. 348))[21].

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: 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.

It is therefore important to find control areas that are as similar as possible to the treated areas. 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 I use Mahalanobis matching, which minimizes the normalized Euclidean distance between variables across the treated and control groups. It is relatively robust in different settings, in particular in small samples, but the set of included variable should not be too large (Stuart, 2010; Zhao, 2004). I therefore include a limited set of variables that I believe are related to the outcome[22]. I match on the cumulative growth rates of residual wages of firm stayers for the three skill groups between 1995 and 1998 to account for different trends in the outcome 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

[20] When a labor market lies in more than one state, I assign it the state where it has the largest employment share.

[21] In the present case standard errors are similar when using the wild-cluster bootstrap.

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

(tradable, non-tradable, construction, other), and employment shares of three skill groups. I also match on the share of residents that live and work in the same labor market to account for heterogeneous labor supply elasticities 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 refer to the full set of variables as covariates even though some of them are pre-existing trends in outcomes.

I assess balance in the covariates following Imbens and Rubin (2015, Ch. 14). I measure how well their distributions in the treatment group overlap with the one in the control group. I consider three measures[23]. Normalized differences between treatment and control measure the position of the distributions. Log ratios of standard deviations between treatment and control measure the dispersion of the distributions. 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. To be specific, it shows the probability mass of the distribution for the treated units that is outside the 0.025 and 0.975 quantiles of the distribution for the control units, and vice versa. Intuitively it is more difficult to impute the counterfactual 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 (see Imbens and Rubin (2015) for more details).

Figure 7 presents normalized differences and log ratios of standard deviations for the variables used for matching. The x-axis denotes the value of the measure and the y-axis denotes the variables. I compare the treated units to the set of controls before and after matching: the red dots use all potential controls, and the green diamonds use only the matched controls. The left panel shows the normalized differences and the right panel the log ratio of standard deviations. 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. Especially wage growth, share high-skill employment and the own-ommuting share are less dispersed in the treatment group than in the potential controls. The green dots indicate that the matching strategy improves balance for most covariates. Normalized differences shrink in all cases except for the share of high-skill workers. The covariates also have more similar variability after matching even though some imbalances remain.

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 the same information as Figure 7, and columns (7) and (8) show the overlap measures in the tail of the distributions.

[23] Imbens and Rubin (2015) use them instead of t-statistics because they are invariant to scale and sample size.

The second-last row in each panel measures the overall 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. I am not aware of benchmarks for these measures, so I refer to those reported in Imbens and Rubin (2015). They refer to substantial imbalance for a sample with overall distance of 1.78, and to excellent balance for a sample with overall distance of 0.44. These numbers suggest that my matching strategy, at least on average, reaches a good balance between the treated and the control units. 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)).

As an alternative matching strategy I also use Entropy Balancing (Hainmueller, 2012)[24]. It finds weights for all potential control units such that the weighted covariate means of the control coincides with the equi-weighted covariate means of the treated units. I then estimate equation (4.1) on all labor markets and weight observations by the entropy weights.

4.3. Identifying assumptions

Input or output markets could transmit the local shock to the rest of the French economy. By comparing labor markets close to the Swiss border with units located elsewhere in France, I assume that the matched control areas are not affected by the labor market integration.

The market reforms which accompanied the labor market integration could affect the French border regions in other ways than through the labor market if their effects were more or less concentrated at the border than in other parts of France[25]. Table B.1 shows the content of the agreements and associated changes in column (2). I give here a short overview of these agreements[26]. An agreement on product certifications reduced the fixed cost of trade in some manufacturing sectors. Evidence from Switzerland shows that the agreement had the strongest effects on imports (Hälg, 2015), suggesting that French firms in the border region could have benefitted from more sales opportunities. An agreement on transport reduced the cost of freight crossing Switzerland by motortrucks by 8.3%. This could have increased profit margins of transportation firms. An agreement on air transport possibly made it cheaper to fly. An agreement on public procurement made it easier for French firms to sell to Swiss municipalities[27]. I argue that it is unlikely that the agreements other than the labor market integration had any differential effect on French

[24] I do not use Synthetic Controls because the three pre-treatment period are insufficient to find appropriate weights

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

[26] I drop the agreements on agriculture because this sector is dropped from the analysis. I also drop the agreement on research cooperation for which it seems unlikely to have had a direct effect on the economy.

[27] French municipalities and Swiss districts and cantons had already been bound to do so by a WTO agreement since 1996.

border region: Transporting people is much more costly than transporting goods (Monte et al., 2018) suggesting that the effect of the labor market integration decays much more quickly across space than the (possible) effects of the other agreements.

The identifying assumption is also violated when labor markets were differentially exposed nation-wide policies around 1998 because they can affect labor market outcomes. One possibility is that the French government substantially increases the legal minimum wage. This could violate the identifying assumption when 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 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 try to control for these changes and the results remain unaffected.

5. Results

5.1. Effect on wage growth of firm stayers

Figure 8 presents the main effect of the labor market integration on wage growth of firm stayers. For instance, the effect in 2000 is the sum of wage growth from 1998 to 1999 and from 1999 to 2000. Panel A in Table 2 contains detailed results for selected years.

Panel 8a shows the average effect across all skill groups. The regressions from 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 1.8% more in the treatment region. The effect remains on the level until 2003 and is statistically significant.

Panels 8b to 8d show the estimated treatment effects by skill group. All cases suggest that treatment and control groups are on parallel trends before 1998. Wages of mid-skill workers grow more in the treatment than in the control area from 1995 to 1996 but not significantly so. 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 1.8% for low-skill workers and 2% for mid-skill workers, but they are statistically indistinguishable from each other.

Panel B in Table 2 shows that the estimated effects are robust to the workweek reduction and to minimum wage hikes at the national level. It presents estimates from a regression where I additionally control for exposure to these policies. I measure exposure to changes in the minimum wage by the share of workers with wages around the minimum wage. I measure exposure to the workweek reduction as the share of employees that work in firms with at least 20 employees. The point estimates become marginally smaller but remain significant.

Panel C in Table 2 and Figure A2 show that results also hold when using Entropy Balancing. In the Figure the estimated coefficients follow closely the ones from the baseline sample, except for the high-skill workers where it remains close to zero. The standard errors are slightly larger than in the baseline sample but in most cases the results remain statistically significant at the 5% confidence level.

5.2. Effect on total employment and hours worked

I now assess how the labor market integration affected employment of the different skill groups. I estimate the effect on employment because in models of monopsony – including, but not limited to the one described above – firms face an upward-sloping labor supply curve: A higher wage attracts more workers and firms expand. I estimate the effect on hours worked because the increase in hourly wages may arise when workers work fewer hours but their earnings are downardly rigid.

Figure 9 shows the main results for total employment. In the Figure, Panel 9a shows that overall employment increases in the short-run after 1998 by 2.8%. 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. Detailed results are are in Panel A of Table 3.

Panel B of Table 3 and Figure 10 shows the effect on hours worked per day of firm stayers. I calculate this in the same way as wage growth. Hours worked by all workers do not change throughout the sample period, suggesting that hourly wages do not grow because of downwardly rigid earnings and a reduction in hours worked. For high-skill workers Panel 8b shows that hours worked seem to increase after 1999 even thoug the confidence intervals quickly become large. A possible explanation for this pattern is that remaining high-skill workers partly substituted the high-skill workers that left to Switzerland with more hours. For mid-skill workers hours worked per day do not change (Panel 8c). For low-skill workers hours worked per day show a negative trend after the year 1999 (Panel 8d). The point estimate is, however, only significant in 2003. Comparing the timing of the effect on low-skill wages and low-skill hours suggests that the hours response is a consequence of the higher wages rather than a cause. For instance, in the year 2000 there is already a significant positive effect (estimate 0.009, se 0.003) but no effect on hours worked (estimate -0.001, se 0.005). This interpretation is also consistent with Audenaert et al. (2014) who find little evidence of downward nominal wage rigidity in France.

5.3. Effect on firm-level rents and 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[28]. A firm j in sector s and located in labor market i at time t

[28] An obvious concern is the endogeneneity of inputs (Olley and Pakes, 1996). As far as I am aware existing methods that account for this (Olley and Pakes, 1996; Levinsohn and Petrin, 2003; Ackerberg et al.,

produces value added y with capital and three labor inputs:

$$y_{jits} = \alpha + x'_{jit}\delta \tag{5.1}$$

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:

$$\begin{aligned} y_{jits} =& x'_{jit}\delta_0 + post_t \times treat_i \times x'_{jit}\beta_1 + post_t \times x'_{jit}\delta_1 + \\ & treat_t \times x'_{jit}\delta_2 + post_t \times treat_i + \alpha_i + \alpha_t + \alpha_s + u_{jits} \end{aligned} \tag{5.2}$$

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 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 state level.

Table 5 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 (-0.005, se 0.003), and positive and larger for mid-skill workers (estimate 0.013, 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.

The discussion so far suggests that the effects of the labor market integration are hard to explain with competitive model of the labor market commonly used. If, in contrast the labor market is not perfectly competitive, then there is rent-sharing between firms and workers, and higher rents at the firms could explain the wage gains.

If the labor market integration increased quasi-rents at the firm, then wages could increase because of rent-sharing. This could happen if the labor market integration makes firms more productive and workers earn some rents. If the labor market integration increased the marginal product of low- and high-skill workers, then their wages should increase even if the labor market is perfectly competitive. For instance, firms could invest in technologies to make low-skill workers more productive if they expect low-skill workers to become more abundant after the labor market were integrated (Acemoglu, 2002).

To explore whether the labor market integration increased quasi-rents, I estimate the

2015) are not well suited for more than one or two proxy variables. The specification below has four state variables and thus requires four proxy variables.

effect on quasi-rents per worker as measured by the change in log value added per worker (see the review in Card et al. (2018)). Table 4 presents the estimated effects on firm-level rents. The point estimate is never statistically distinguishable from zero and sometimes even negative.

6. Discussion and Conclusion

Does labor market competition raise wages? Restrictions to worker mobility have become to be seen as possibly lowering labor market dynamism (Council of Economic Adivsors, 2016). The claim has been founded on models of oligopsonistic labor markets where workers cannot freely move across employers. Yet to date a causal assessment of how mobility restrictions affect labor market equilibrium has been missing.

I study the effects of improving workers' access to high-wage jobs and exploit the opening of the Swiss labor market to French border commuters as a natural experiment to the contact rate. I document that even though more skilled workers take up the new opportunities in Switzerland, their wages in Fracne do not change. Yet, the less skilled workers stay behind and higher wages. I also find that the policy slightly increases employment of low-skill workers. I argue that a model of competitive labor markets cannot explain these patterns, but a model of frictional labor markets can: as low-skill labor markets are less competitive their wages can adjust more strongly to the labor market integration. High-skill wages cannot sufficiently adjust and these workers accept the new jobs more often. A number of additional exercises support this interpration: I do not find any evidence that workers become more productive nor that there are more rents available that firms share with their employees.

The results in the present paper support the view that labor market frictions lead to some market power for firms over their workers. It suggests that removing barriers to worker mobility can have two distinct effects: it not only helps workers move to better jobs but also increases wages of those that stay behind because labor market competition raises workers' bargaining power. While I exploit spatial variation in access to jobs, it is conceivable that policies that increase occupational mobility can have similar effects. It is important to assess such policies in future work.

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7. Figures

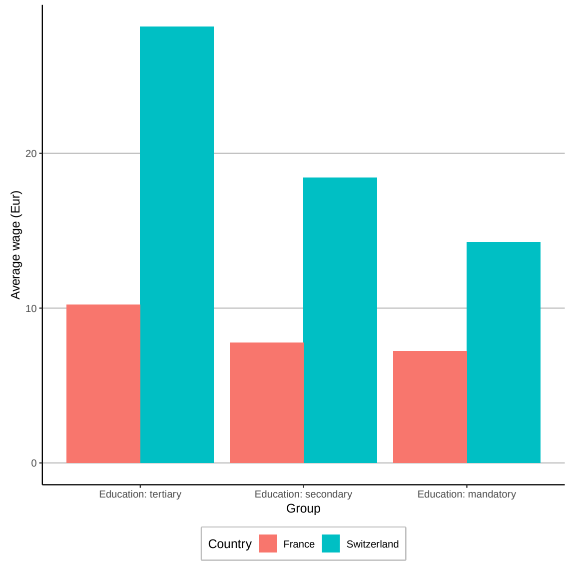
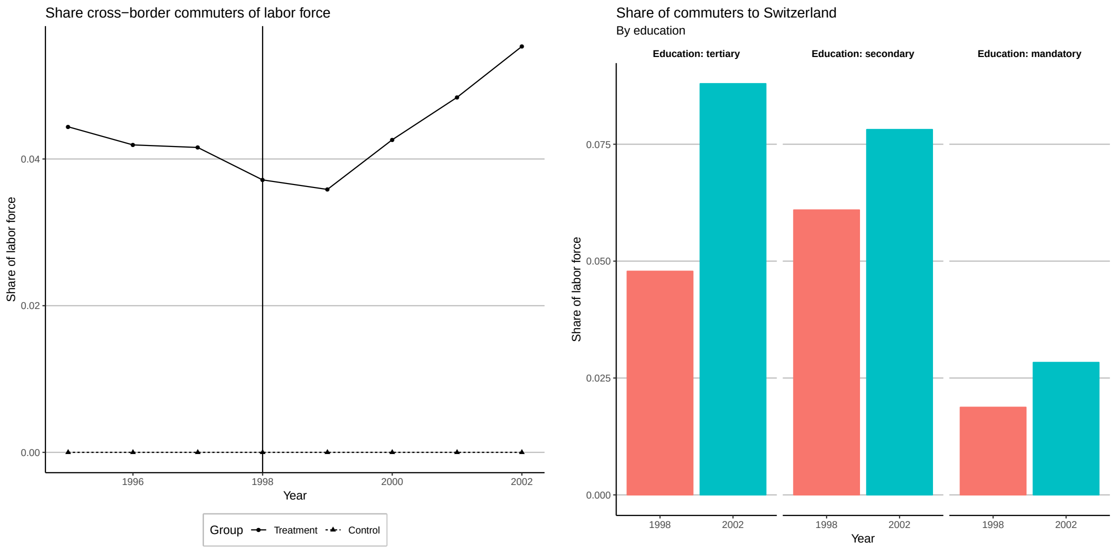


Figure 1: Average wages in the French-Swiss border area in 1998

The figure shows average wages by education group in the labor markets along the border. *Data: DADS Panel, Bundesamt für Statistik (2017).*

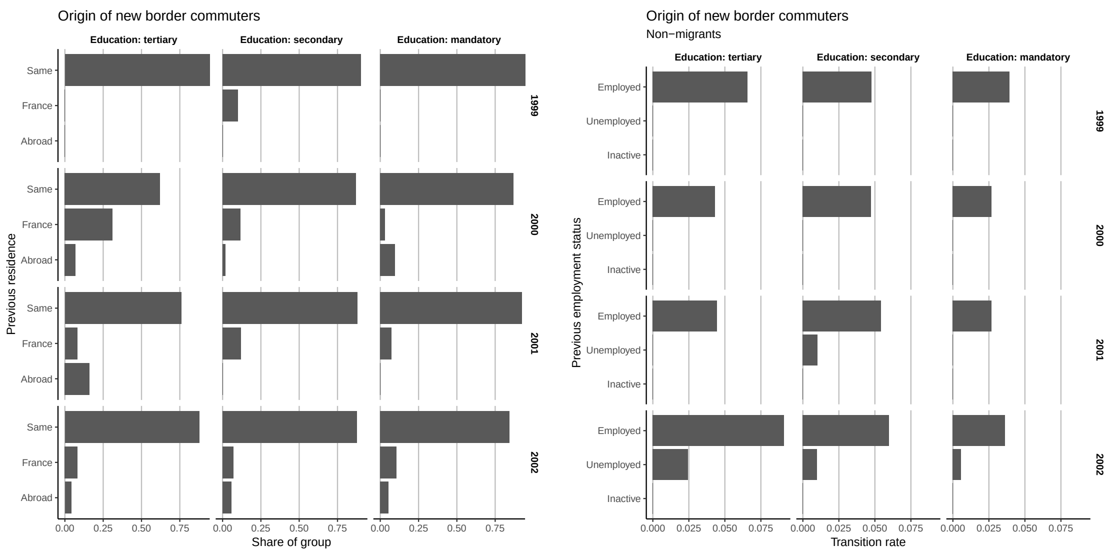


(a) All

(b) By education

Figure 2: Commuters as share of labor force

The Figures show the number of residents that work in Switzerland as share of the total labor force. The solid line in Panel 2a refers to the treated region, the dashed line to the matched control areas. Panel 2b shows the share for three education groups in 1998 and 2002 in the treatment region. *Data: French Labor Force Survey.*

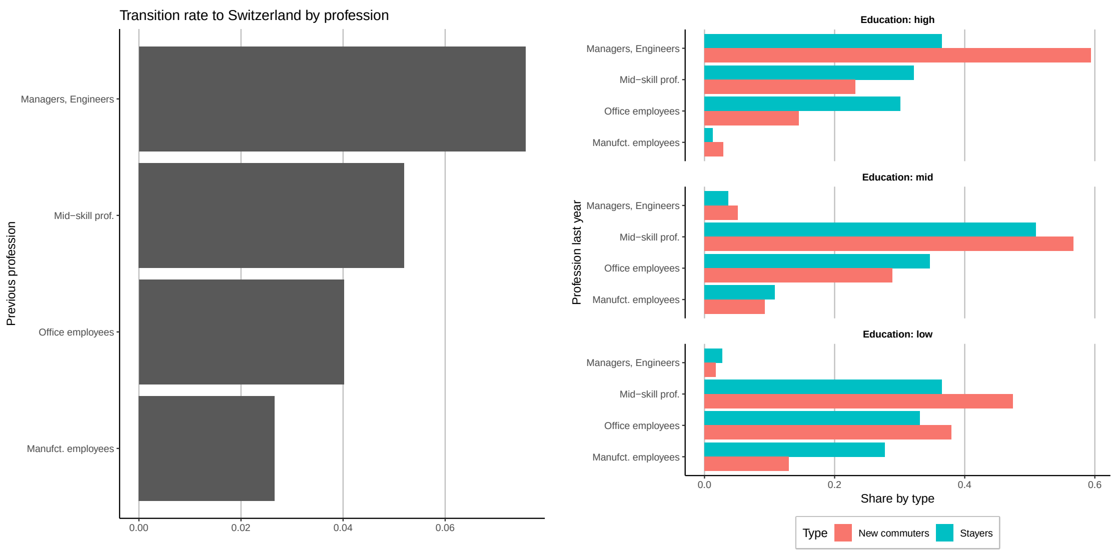


(a) Residential origin

(b) Transition rates by labor market status

Figure 3: Previous place of residence and labor market status of new border commuters

The data refer to the treatment region. In both panels rows refer to years and columns refer to education groups. Panel 3a 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 3b shows transition rates for people that previously lived in the area by labor force status: Employed, Unemployed, Inactive. *Data: French Labor Force Survey.*



(a) Transition rate by profession

(b) Stayers and new commuters by occupation

Figure 4: New commuters and their previous profession

The data refer to the treatment region. In both panels "Mid-skill prof." are middle-skill occupatoins such as X and Y 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 4a plots the average transition rates 1999 to 2002 by occupation. Panel 4b 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: French Labor Force Survey.*

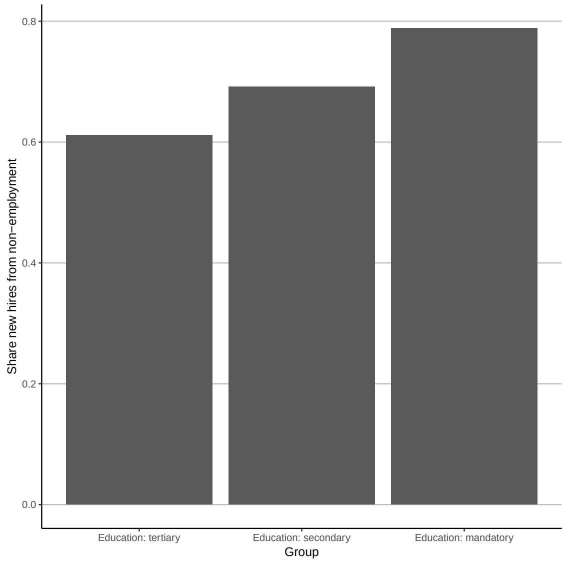
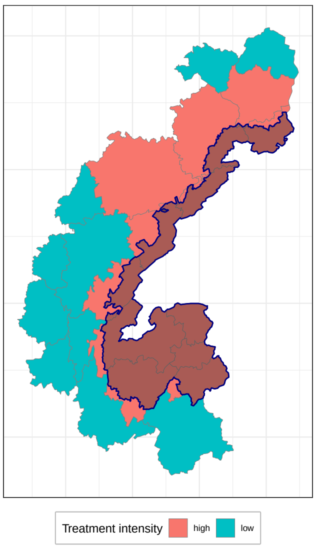
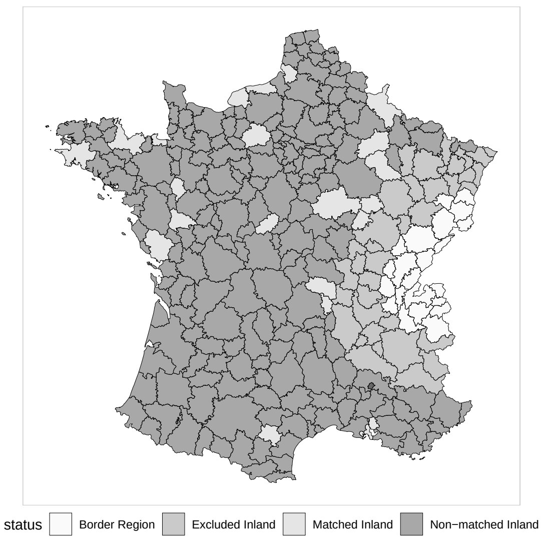


Figure 5: Labor market competition in France

The figure shows the share of workers that are hired from non-employment as opposed to employment in 1998 by education group. Transitions between employment are recorded when the worker worked at two different firms in March of two consecutive years, and did not have any intervening spell of non-employment in between. Remaining transitions are recorded as from non-employment. *Data: French Labor Force Survey.*



(a) Eligible areas and treatment group



(b) All labor markets and their matching status

Figure 6: Commuting zones in France

Panel 6a shows the treated labor markets. The navy blue area are the municipalities eligible to send commuters. Labor markets are colored by whether they are highly exposed to the market integration (red) by lying directly at the border to Switzerland or less exposed (green). Panel 6b 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.

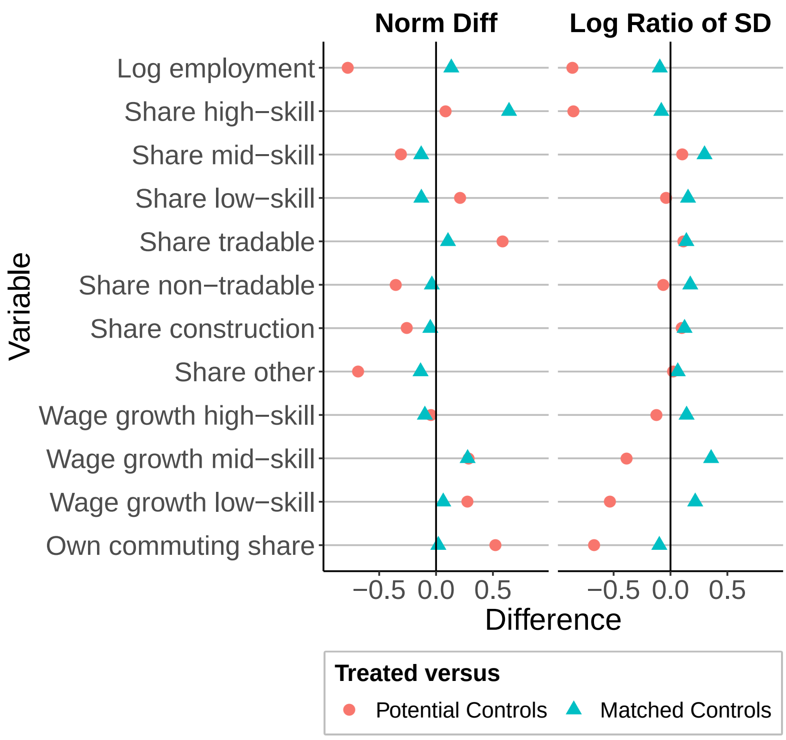
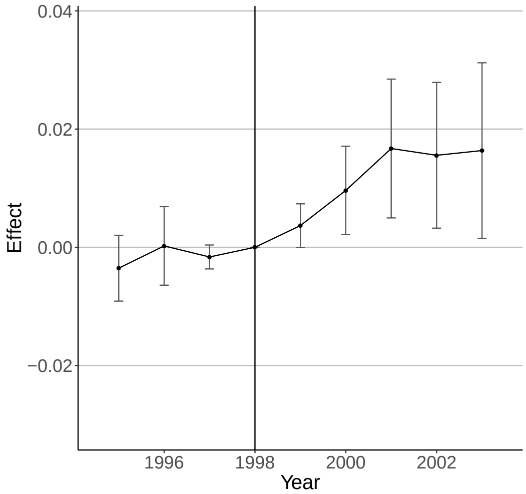
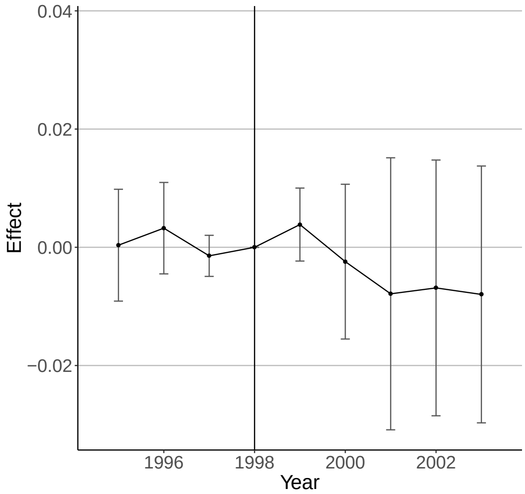


Figure 7: Balance before and after matching

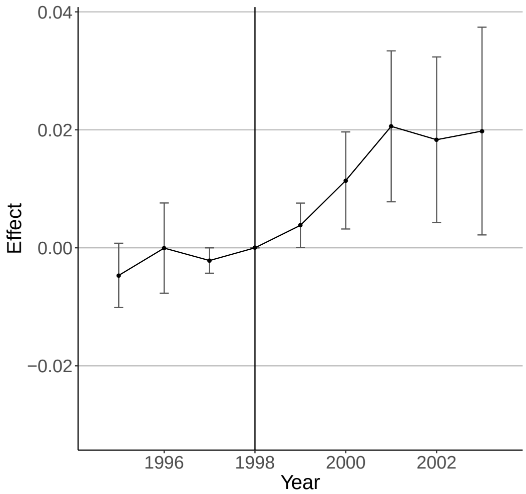
The Figure shows the normalized differences and log ratio of standard deviations between the treatment group and the control group for each variable as indicated on the y-axis. Controls are all potential controls for the red dots and the matched controls for the green diamonds. The variables refer to: 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 text for details.



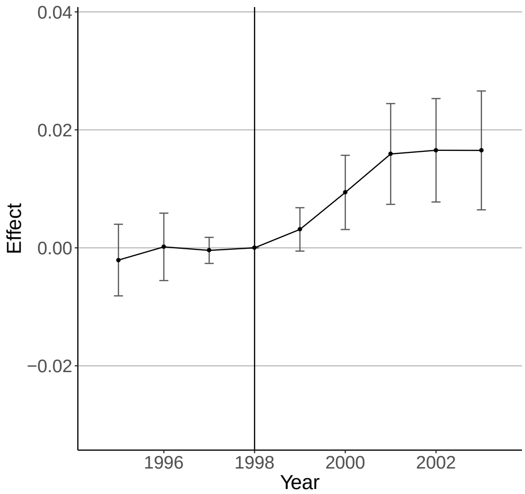
(a) All workers



(b) High-skill occupations



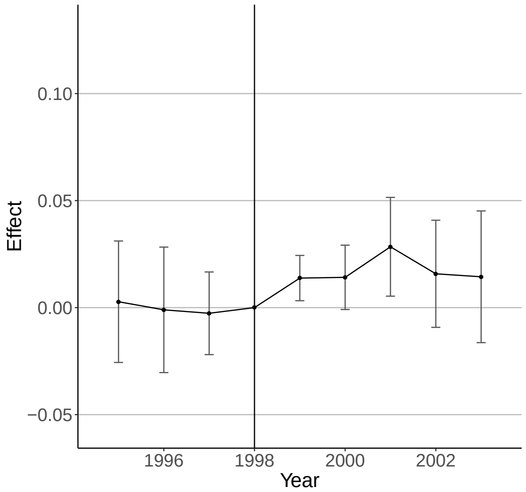
(c) Mid-skill occupations



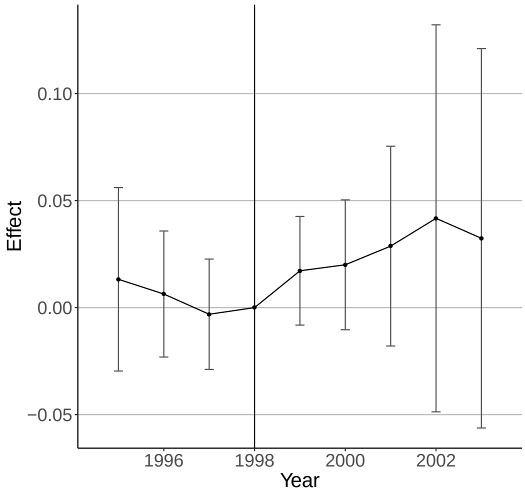
(d) Low-skill occupations

Figure 8: Main effects on wage growth of firm stayers

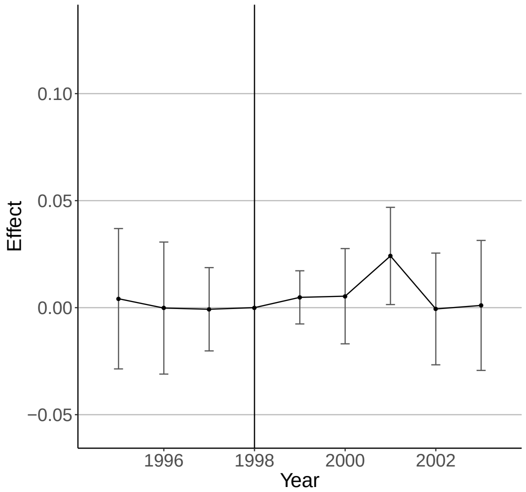
The figure shows annual estimates of the treatment effect in equation (4.1) on cumulative growth in hourly wages of firm stayers relative to 1998. Units are weighted by their skill-specific employment in 1998. Hourly wages are residualized for gender and age. The error bars show the 95% intervals around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



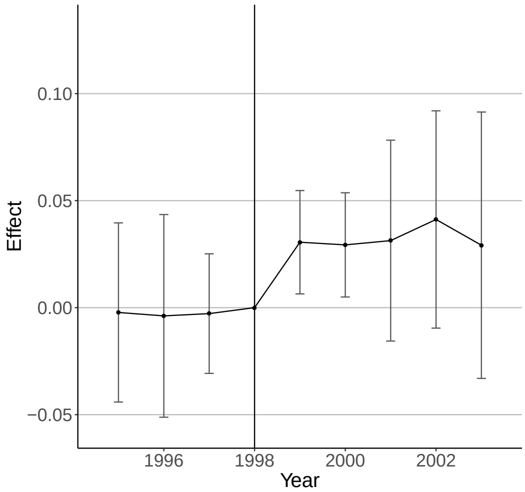
(a) All workers



(b) High-skill occupations



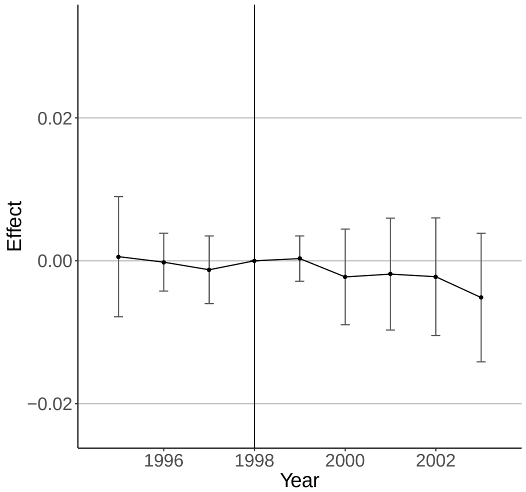
(c) Mid-skill occupations



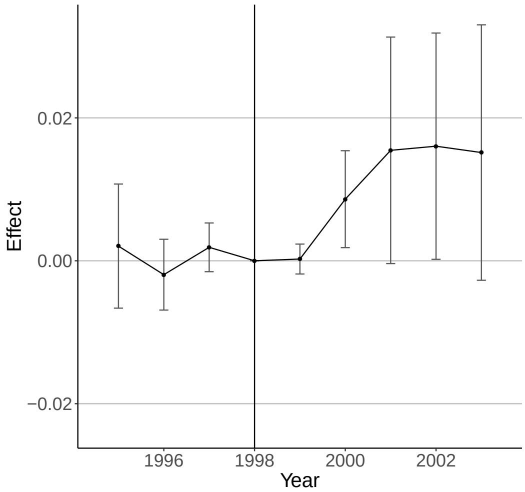
(d) Low-skill occupations

Figure 9: Main effects on total employment

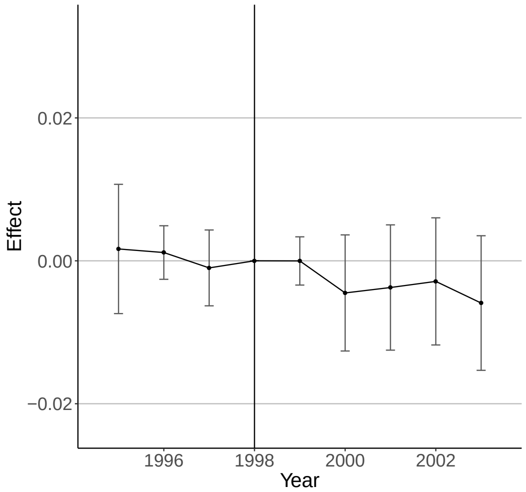
The figure shows annual estimates of the treatment effect in equation (4.1) total employment. The error bars show the 95% intervals around the point estimate using standard errors clustered at the state level. See text for details. *Data: DADS.*



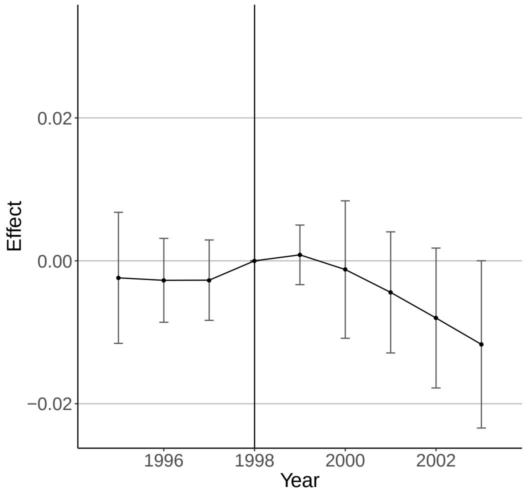
(a) All workers



(b) High-skill occupations



(c) Mid-skill occupations



(d) Low-skill occupations

Figure 10: Main effects on hours worked per day

The figure shows annual estimates of the treatment effect in equation (4.1) total employment. The error bars show the 95% intervals around the point estimate using standard errors clustered at the state level. See text for details. *Data: DADS.*

8. Tables

	Controls		Treated		Overlap measures			
	Mean	(S.D.)	Mean	(S.D.)	Nor Dif	Log ratio SD	pi c	pi t
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Controls: All								
Log employment	12.30	(1.68)	11.30	(0.71)	−0.78	−0.86	0.13	0.00
Share high-skill	0.09	(0.03)	0.09	(0.01)	0.08	−0.85	0.30	0.00
Share mid-skill	0.62	(0.04)	0.61	(0.04)	−0.31	0.10	0.07	0.00
Share low-skill	0.29	(0.05)	0.30	(0.04)	0.21	−0.04	0.12	0.00
Share tradable	0.42	(0.12)	0.49	(0.13)	0.59	0.11	0.05	0.18
Share non-tradable	0.13	(0.04)	0.12	(0.03)	−0.35	−0.06	0.10	0.14
Share construction	0.12	(0.03)	0.11	(0.03)	−0.26	0.10	0.06	0.14
Share other	0.33	(0.08)	0.28	(0.08)	−0.68	0.02	0.08	0.14
Wage growth high-skill	0.06	(0.02)	0.06	(0.02)	−0.04	−0.12	0.12	0.00
Wage growth mid-skill	0.06	(0.02)	0.06	(0.01)	0.29	−0.39	0.17	0.00
Wage growth low-skill	0.05	(0.02)	0.06	(0.01)	0.28	−0.53	0.23	0.00
Own commuting share	0.78	(0.12)	0.83	(0.06)	0.52	−0.67	0.15	0.05
Overall distance					1.19			
N	238.00		22.00					
Panel B. Controls: Matched								
Log employment	11.20	(0.78)	11.30	(0.71)	0.13	−0.09	0.05	0.05
Share high-skill	0.08	(0.02)	0.09	(0.01)	0.64	−0.08	0.18	0.09
Share mid-skill	0.62	(0.03)	0.61	(0.04)	−0.13	0.30	0.00	0.14
Share low-skill	0.30	(0.04)	0.30	(0.04)	−0.13	0.15	0.00	0.14
Share tradable	0.48	(0.11)	0.49	(0.13)	0.11	0.14	0.00	0.14
Share non-tradable	0.12	(0.03)	0.12	(0.03)	−0.04	0.17	0.05	0.14
Share construction	0.11	(0.03)	0.11	(0.03)	−0.05	0.12	0.09	0.00
Share other	0.29	(0.07)	0.28	(0.08)	−0.14	0.06	0.05	0.09
Wage growth high-skill	0.06	(0.02)	0.06	(0.02)	−0.10	0.14	0.05	0.05
Wage growth mid-skill	0.06	(0.01)	0.06	(0.01)	0.28	0.36	0.00	0.18
Wage growth low-skill	0.06	(0.01)	0.06	(0.01)	0.06	0.22	0.00	0.18
Own commuting share	0.83	(0.07)	0.83	(0.06)	0.02	−0.10	0.09	0.00
Overall distance					0.22			
N	22.00		22.00					

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. 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 overall 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 1: Balance before and after matching

	Skill: all		**Skill: high**		**Skill: mid**		**Skill: low**	
	2000	2001	2000	2001	2000	2001	2000	2001
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Baseline								
beta	0.01	0.017	-0.002	-0.008	0.011	0.021	0.009	0.016
	(0.004)	(0.006)	(0.007)	(0.012)	(0.004)	(0.007)	(0.003)	(0.004)
N	44	44	44	44	44	44	44	44
R2	0.195	0.267	-0.018	0	0.223	0.313	0.164	0.242
B: Controls								
beta	0.009	0.016	-0.004	-0.01	0.011	0.02	0.009	0.016
	(0.004)	(0.006)	(0.007)	(0.012)	(0.004)	(0.007)	(0.003)	(0.004)
N	44	44	44	44	44	44	44	44
R2	0.191	0.261	-0.042	-0.015	0.188	0.294	0.316	0.329
C: EntBal								
beta	0.009	0.016	0.001	0.002	0.01	0.019	0.007	0.014
	(0.005)	(0.005)	(0.004)	(0.007)	(0.005)	(0.006)	(0.005)	(0.005)
N	260	260	260	260	260	260	260	260
R2	0.059	0.12	-0.003	-0.002	0.073	0.151	0.038	0.102

The columns present estimates from equation (4.1) different specifications for years as indicated in the second row. *Baseline* is the baseline specification, *Controls* controls for exposure to the reduction in the workweek and to minimum wage hikes, *EntBal* uses Entropy Balancing for matching. Regressions are weighted by skill-specific employment in 1998 except for Entropy Balancing which uses the entropy weights. Standard errors robust to clustering at the state level are in parentheses. Details: see text. *Data: DADS.*

Table 2: Effect on wage growth of firm stayers

	Skill: all		Skill: high		Skill: mid		Skill: low	
	2000	2001	2000	2001	2000	2001	2000	2001
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A: Employment								
beta	0.014	0.028	0.02	0.029	0.005	0.024	0.029	0.031
	(0.008)	(0.012)	(0.015)	(0.024)	(0.011)	(0.012)	(0.012)	(0.024)
N	44	44	44	44	44	44	44	44
R2	0.042	0.155	0.037	0.053	-0.02	0.058	0.08	0.035
B: Daily hours								
beta	-0.002	-0.002	0.009	0.015	-0.004	-0.004	-0.001	-0.004
	(0.003)	(0.004)	(0.003)	(0.008)	(0.004)	(0.004)	(0.005)	(0.004)
N	44	44	44	44	44	44	44	44
R2	-0.01	-0.016	0.143	0.168	0.012	-0.001	-0.021	0.001

The columns present results from estimating equation (4.1) for different years. *Employment* measures the aggregate change in local employment, *Hours* measures the cumulative change in hours worked per day for firm stayers. Regressions are weighted by skill-specific employment in 1998. Standard errors robust to clustering at the state level are in parentheses. Details: see text. *Data: DADS.*

Table 3: Effect on employment and hours

	Value added per worker	
	2000	2001
	(1)	(2)
beta	0.007	-0.007
	(0.006)	(0.01)
N	44	44
R2	0.004	-0.014

The columns present results from estimating equation (4.1) for different years as reported in the second row. The outcomes the change in log value added per worker since 1998. Regressions are weighted by total employment in 1998. Standard errors clustered at the state level are in parentheses. *Data: DADS, Ficus.* See text for details.

Table 4: Effect on quasi-rents per worker

	All	Tradable	Non-tradable	Construction	Other
	(1)	(2)	(3)	(4)	(5)
Intercept	1.706	1.666	2.205	2.228	2.35
	(0.088)	(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
	(0.007)	(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	0.013	0.005	0	0.001	0.027
	(0.008)	(0.015)	(0.012)	(0.014)	(0.013)
l x post x treat	-0.005	-0.007	0.004	-0.012	-0.013
	(0.003)	(0.006)	(0.009)	(0.007)	(0.011)
N (firm x year)	181454	67224	41911	31632	40520
R2	0.852	0.881	0.758	0.873	0.812

Results from estimating equation (5.2). Standard errors clustered at the state 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 time 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.*

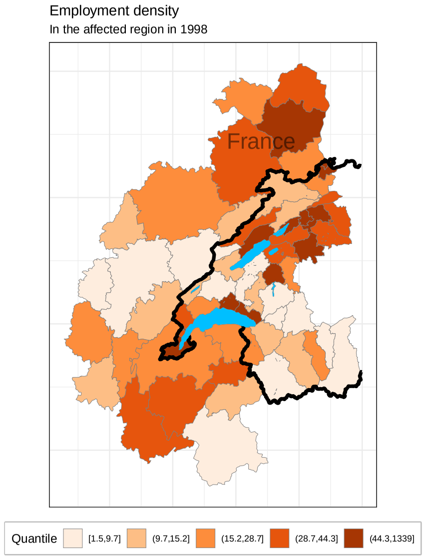
Table 5: Results from production functions

A. Additional figures

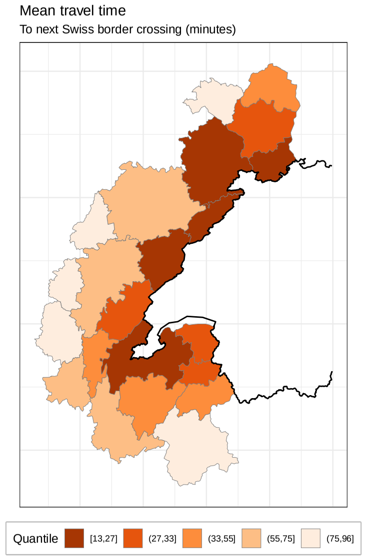
A.1. Descriptive analysis

Figure A1 illustrates the situation in labor markets along the French-Swiss border in 1998. The units are local labor markets as defined by the statistical offices of the two countries. The colors refer to quantiles of the distribution of the variable depicted[29]. Panel A1a shows the employment density per square kilometer. French labor markets along the border are less dense than their Swiss neighbors. There are two Swiss cities in the west (Geneva) and in the north (Basel). Panel A1b shows the travel time by car from French labor markets to Switzerland. The time is the population-weighted average time between all municipalities in the labor market and their closest border crossing to Switzerland. Travel times are sourced from Project OSRM (2018), refer to 2018 and are net of congestion time. Labor markets immediately at the border are between 13 and 33 minutes away from the next border crossing to Switzerland. The maximum time to the next border crossing is 96 minutes. Panel A1c plots mean log wages in the labor markets. Wages change discontinuously at the border: average wages in France are lower than in Switzerland. Panels A1d to A1f show the wages by education level and labor market. The numbers in the panels by labor market and education should be interpreted with caution because some of them rely on a small number of observations.

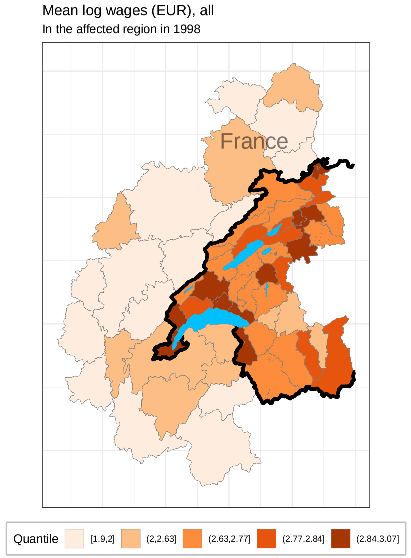
[29] The light blue areas are lakes.



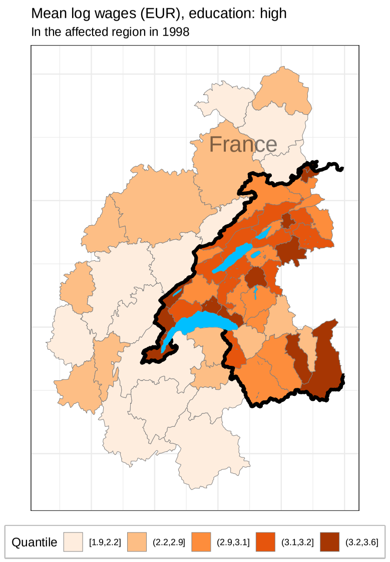
(a) Employment density



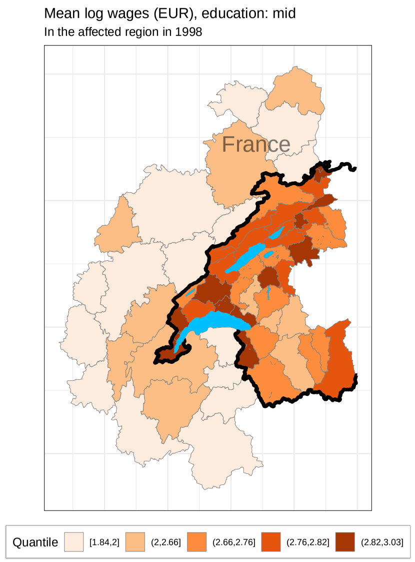
(b) Travel time (car) to the next border crossing



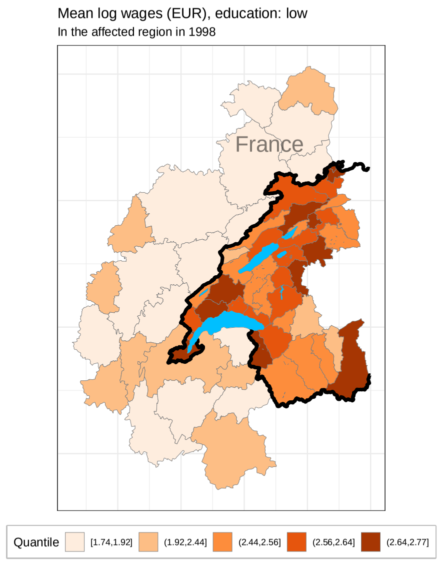
(c) Average wages



(d) Tertiary education



(e) Secondary education



(f) Compulsory or less

Figure A1: Labor markets at the border in 1998

The black solid line in all panels is the border between Switzerland and France. Colors refer to quantiles. Panel A1a shows employment per square kilometer in 1998. Panel A1b plots the mean travel time (minutes) to the next border crossing. The mean is calculated as the population-weighted average time between a municipality's centroid and the next border crossing to Switzerland. Travel times are for car and net of congestion. Panel A1c shows mean log wages by labor market, Panels A1d to A1f show mean log wages by eduation and labor market. *Data: DADS Panel, DADS Postes, Bundesamt für Statistik (2017), Project OSRM (2018).*

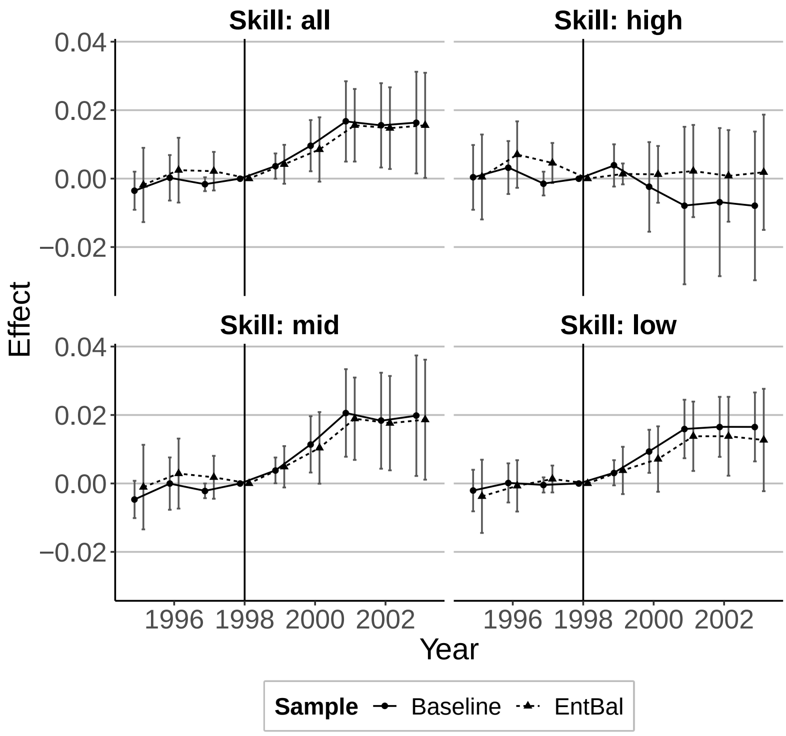


Figure A2: Main wage effects with different matching strategy

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. 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 units by the entropy weights. 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 state level. See Section 5.1 for details. *Data: DADS.*

B. Additional tables

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)

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

Table B.1: The content of the bilateral treaties between Switzerland and the EU.

C. Data appendix

C.1. Treatment group and matching

Defining the treated labor markets Labor markets consist of municipalities. Denote the municipalities of labor market i as $j_i,\ j \in \{1, ...J_i\}$. Define the set of eligible municipialities E. This is the navy blue area in Figure 6a. A labor market i is eligible if $\{j_i\}_{j=1}^{J_i} \cap E \neq \emptyset$, eg, if at least one municipality is in the eligible area. 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 $\bar{d} = 84km$.

D. 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.

D.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_θ^u. When employed they receive wage flow w and receive offers for new jobs at rate λ_θ^e. 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}[30].

The value function for an unemployed worker is

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

and the value function for an employed worker is

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

Unemployed workers follow a reservation wage strategy and accept any job that offers

[30] 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 2.1

at least ϕ_θ:

$$\phi_\theta = b_\theta + (\kappa_\theta^u - \kappa_\theta^e) \int_{\phi_\theta}^{\overline{w}_\theta} \frac{\overline{F}_\theta(x)}{\beta + 1 + \kappa_\theta^e \overline{F}_\theta(x)} \tag{D.1}$$

where $\kappa_\theta^j = \lambda_\theta^j / \delta_\theta$ 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 $u_\theta = \frac{1}{1+\kappa_\theta^u}$. 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 durations (Eckstein and Wolpin, 1990; Bontemps et al., 1999; Eckstein and Van den Berg, 2007) 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. I will compare theoretical predictions of the two models below and discuss the empirical evidence in light of the two models.

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

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

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.

For simplicity 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 fim 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:

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

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[31]. 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 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 wage sharing between firms and workers, it is limited at high-productivity firms because they face less competition from other firms.

D.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^e_θ), but not unemployed workers (κ^u_θ). 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 below 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.

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

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^e_θ

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 D.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[32].

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

[32]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.

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. I will implicitly make the same assumption when studying the effect of the labor market integration on wage growth.

D.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).

D.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

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

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 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.

D.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

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

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:

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

The number of active firms is therefore $N_\theta = N_0\overline{\Gamma_0}(\underline{p}_\theta)$, eg 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:

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

where

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

follows from equations (D.5) and (D.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 (D.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 $F_\theta(.) = \int F_\theta(.;p)d\Gamma_\theta(p)$

D.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 (D.6).
3. ϕ_θ satisfies (D.1).
4. $F_\theta(., p)$ is a distribution over all strategies that satisfy (D.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

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

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, $\frac{\partial \pi_\theta[K_\theta(p)]}{\partial p}$:

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

which simplifies to

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

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

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

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

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

Using $\pi_\theta(p) = [p-K_\theta(p)]l_\theta[K_\theta(p)]$, rearrange for $K_\theta(p)$, substitute (D.13) for profits and (D.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:

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

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 $\underline{p}_\theta$ make the model non-recursive.

D.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

$$K_\theta(p) = p - \frac{(\overline{p}-\underline{p})(p-\underline{p}) + \kappa_\theta^e(\overline{p}-p)(p-\underline{p})}{(1+\kappa_\theta^e)(\overline{p}-\underline{p})} \tag{D.15}$$

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.

$$\frac{\partial K(p)}{\partial \kappa_\theta^e} = -\frac{(\overline{p}-p)(p-\underline{p})(1+\kappa_\theta^e)(\overline{p}-\underline{p}) - \left[(\overline{p}-\underline{p})(p-\underline{p}) + \kappa_\theta^e(\overline{p}-p)(p-\underline{p})\right](\overline{p}-\underline{p})}{(1+\kappa_\theta^e)^2(\overline{p}-\underline{p})^2} \tag{D.16}$$

Simplifying and collecting terms yields

$$\frac{\partial K(p)}{\partial \kappa_\theta^e} = \frac{(p-\underline{p})^2}{(1+\kappa_\theta^e)^2(\overline{p}-\underline{p})} \geq 0 \tag{D.17}$$

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

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

$$\frac{\partial l_\theta[K_\theta(p)]}{\partial \kappa_\theta^e} = \frac{M_\theta - U_\theta}{N} \frac{[1+\kappa_\theta^e\overline{\Gamma}(p)]^2 - 2(1+\kappa_\theta^e)[1+\kappa_\theta^e\overline{\Gamma}(p)]\overline{\Gamma}(p)}{[1+\kappa_\theta^e\overline{\Gamma}(p)]^4} \tag{D.18}$$

Simplifying yields

$$\frac{\partial l_\theta[K_\theta(p)]}{\partial \kappa_\theta^e} = \frac{M_\theta - U_\theta}{N} \frac{1-\overline{\Gamma}(p)(2+\kappa_\theta)}{[1+\kappa_\theta^e\overline{\Gamma}(p)]^3} \tag{D.19}$$

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 $\underline{\tau}_\theta^l$ above which the term is positive:

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

The threshold $\underline{\tau}_\theta^l$ is increasing κ_θ^e. ■

E. Alternative model where the supply elasticity to individual firms is endogenous

This exposition follows Kaplow and Shapiro (2007) and contemporaneous work by Arnold (2019). Denote the local market by j. Assume there is a single dominant firm that employs $L(w_j)$ workers where w_j is the wage set by the firm. There is a fringe of small firms that are price-takers and they employ $R(w_j)$ workers. Total employment in the local market is $M(w_j)$ with $\frac{\partial M(w_j)}{\partial w_j} > 0$. Employment of the dominant firm is then $L(w_j) = M(w_j) - R(w_j)$. Taking derivatives with respect to w_j gives

$$\frac{\partial L(w_j)}{\partial w_j} = \frac{\partial M(w_j)}{\partial w_j} - \frac{\partial R(w_j)}{\partial w_j} \tag{E.1}$$

Multiply by $\frac{w_j}{L}$ and expand the right-hand side as follows

$$\frac{\partial L(w_j)}{\partial w_j}\frac{w_j}{L} = \frac{\partial M(w_j)}{\partial w_j}\frac{w_j}{L}\frac{M(w_j)}{M(w_j)} - \frac{\partial R(w_j)}{\partial w_j}\frac{w_j}{L}\frac{R(w_j)}{R(w_j)} \tag{E.2}$$

Denote the market share of the large firm by $s_j \equiv \frac{L(w_j)}{M(w_j)}$ and the residual share by $1 - s_j \equiv \frac{R(w_j)}{M(w_j)}$. Denote further $\varepsilon_{market} = \frac{\partial M(w_j)}{\partial w_j}\frac{w_j}{M(w_j)}$ the local labor supply elasticity and $\eta_R = \frac{\partial R(w_j)}{\partial w_j}\frac{w_j}{R(w_j)}$ the labor demand elasticity of the fringe firms. The elasticity to the large firm is then

$$\frac{\partial L(w_j)}{\partial w_j}\frac{w_j}{L} = \varepsilon_j = \frac{\varepsilon_{market} - \eta_R(1 - s_j)}{s_j} \tag{E.3}$$

In the limiting cases where the firm is a monopsonist ($s_j = 1$), the elasticity of labor supply to the firm equals the elasticity to the market. In a perfectly competitive market the market share of each firm is infinitesimally small and it faces an infinitely elastic labor supply. Assuming that the labor demand elasticity of the fringe firms is negative, a smaller market share of the large firms makes supply to that firm more elastic:

$$\frac{\partial \varepsilon_j}{\partial s_j} = \frac{\eta_R - [\varepsilon_{market} - \eta_R(1 - s_j)]}{(s_j)^2} < 0 \tag{E.4}$$

The labor market integration can be thought of as reducing the market share of the largest firm in the market as it now faces more competitors from across the border. Moreover as low-skill workers are less mobile, their relevant market is smaller which implies a larger share for the large firm, rendering the supply curve to that firm less elastic. This is one reason for higher monopsony power in the low-skill labor market.