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ABSTRACT

How Middle-Skilled Workers Adjust to Immigration: The Role of Occupational Skill Specificity*

Our study explores the effects of immigration on the employment of native middle-skilled workers, focusing on how this effect varies with the specificity of their occupational skill bundles. Exploiting the 2002 opening of the Swiss labor market to EU workers and using register data on the location and occupation of these workers, our findings provide novel results on the labor market effects of immigration. We show that the inflow of EU workers led to an increase in the employment of native middle-skilled workers with highly specific occupational skills and to a reduction in their occupational mobility. These findings can be attributed to immigrant workers reducing existing skill gaps, enhancing the quality of job-workers matches, and alleviating firms' capacity restrictions. This allowed firms to create new jobs, thereby providing increased employment options for middle-skilled workers with highly specialized skills and reducing the need to change their occupations. This research provides novel insights on the impact of immigration on the labor market.

JEL Classification: J15, J24, J62

Keywords: migration, cross-border workers, occupational skill specificity

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1 Introduction

Despite widespread concern that opening borders to immigrant workers might deteriorate the labor market prospects of a country's native workforce (e.g., Borjas, 2003), empirical evidence supporting this concern remains inconclusive. Recent studies on the labor market effects of immigration even show that the opposite could be true. For example, Basten and Siegenthaler (2019); Beerli et al. (2021); Cattaneo et al. (2015); Foged and Peri (2015); Peri and Sparber (2009) show that workers adjust to immigration by moving to more complex, higher-skilled, managerial, and (ultimately) better-paid jobs . Other studies have argued that immigrants can generate new jobs for native workers by decreasing the wage costs of firms (Albert, 2021; Chassamboulli and Palivos, 2014).

However, little is known so far about the heterogeneity of these effects with respect to workers with different types of skill bundles. Specifically, most of the research has analyzed how the effects of immigration vary across workers with different *levels* of skills (i.e., levels of education) but not yet on how these effects vary across workers within the same level of skills but with different *combinations* or bundles of skills.

In this study, we close this gap by studying how workers with different degrees of occupational skill specificity are affected by an immigration shock. In theory, occupational skill specificity can affect how workers adjust to immigration in two opposing ways. On one hand, human capital theory (Becker, 1962; Lazear, 2009) predicts that workers with specific skills (i.e., skill bundles that are idiosyncratic to one or few firms or occupations) are less able to adjust to negative labor market shocks because their skill bundles are less transferable across occupations. Therefore, we would expect workers with specific occupational skills to be less able to adjust to an immigration-driven labor supply shock because, for example, they are less able to change their firm or occupation and to move towards better paid jobs Peri and Sparber (2009). A number of studies indeed seem to support the argument that workers with specific skills are more heavily affected by macroeconomic shocks (Lamo et al., 2011) and technological change (Hanushek et al., 2017).

On the other hand, specific skills could become relatively more valuable after a shock because they are scarce in the labor market. In a recent study using German data, Eggenberger et al. (2022) show that workers with specific occupational skills benefit more from a positive trade shock than workers with general occupational skills, an effect that they attribute to an increased demand for workers with specific occupational skills. Ultimately, which one of the two effects dominate is an empirical question. In our paper, we address this question by analyzing how immigration affects middle-skilled workers with different degrees of occupational skill specificity.

The focus of our study are middle-skilled workers because they constitute the largest part of the workforce in most developed economies. In Switzerland, these workers constitute roughly 60 percent of the total workforce and acquire well-defined bundles of skills through vocational education and training (VET) programs. Another reason for the focus on middle-skilled workers is that we can precisely measure their occupational skill specificity using training curricula of VET programs. We use Eggenberger et al.'s (2018) skill specificity measure, which has been shown to provide a meaningful categorization of occupational skill bundles according to their specificity (Eggenberger et al., 2022, 2018). To construct this measure, Eggenberger et al. (2018) analyze well-defined and nationally-binding VET curricula (based on Geel et al., 2011a; Lazear, 2009). While specific occupational skill bundles contain skills that are useful in only few other occupations, less specific skill bundles contain skills that are widely used across many occupations.

To identify the causal effect of immigration on workers with different degrees of occupational skill specificity, we exploit the 2002 introduction of the Agreement on the Free Movement of People (AFMP) between Switzerland and the European Union (EU). The AFMP opened the Swiss labor market to workers from the EU and led to an immediate sharp increase in the number of Cross-Border Workers (CBWs) in Switzerland, i.e., workers commuting to Switzerland for work but keeping their residency in their home country.

Between 2002 and 2009, the AFMP led to an increase in the fraction of CBWs in the total

Swiss workforce[1] by roughly 40 percent and therefore constitutes a substantial immigration-driven labor supply shock. As Beerli et al. (2021) point out, the increase was particularly strong among high-skilled (i.e., tertiary educated) CBWs. However, middle-skilled CBWs still constitute the largest fraction of CBWs, accounting for roughly 50 percent of the total CBWs. Therefore, middle-skilled CBWs also constituted a large fraction of the inflow of CBWs.

We use this sudden increase in the labor supply of CBWs and their distribution across narrowly-defined region-by-occupation cells in 1999—i.e., before the reform—to construct a shift-share instrument (Card, 2001) for identification. Using register data on the universe of CBWs in Switzerland between 1999 and 2009, we can precisely measure both the distribution of CBWs across these region-by-occupation cells before the AFMP and the increase in the number of CBWs after it.

To analyze how workers adjust to immigration, we use individual workers' panel data for the years 2000 through 2009 from the Swiss Labor Force Survey matched with register data. We focus on three outcomes for middle-skilled workers: employment probability, wages, and occupational mobility. Similar to Cattaneo et al. (2015) and Foged and Peri (2015), the panel structure of the data allows us to isolate the within-worker variation in exposure to immigration.

Our results show that the inflow of CBWs increased the employment probability of workers with specific occupational skills. Moreover, in contrast to the findings of previous studies (Basten and Siegenthaler, 2019; Cattaneo et al., 2015; Foged and Peri, 2015; Peri and Sparber, 2009), we observe that the inflow of CBWs reduced the occupational mobility of Swiss workers, particularly of those with specific occupational skills. This effect suggests that workers with specific occupational skills less often (need to) change to other occupations and, instead, are able to stay in their original occupation. Despite the reduced occupational mobility, however, we find that workers' wages were not affected by the inflow of CBWs.

[1] In this paper, "Swiss workforce" and "Swiss workers" include both Swiss nationals and permanent non–Swiss residents in Switzerland.

Overall, these results imply that CBWs did not substitute native middle-skilled workers with specific occupational skills but instead complemented them. Indeed, the inflow of CBWs increased the demand for Swiss workers in specific occupations, in turn increasing their employment probability. One possible explanation for these results is that the opening of the Swiss borders provided Swiss firms with EU skilled workers to fill vacancies in jobs and occupations that were previously experiencing skill shortages, thereby improving the job-worker match quality and generating opportunities for firms to create new jobs. In turn, the improved job-worker match quality and the creation of new jobs reduced the workers' need for occupational changes. Therefore, the opening of the Swiss labor market improved the allocation of workers to jobs, increasing the economic activity of firms and the total number of jobs, particularly for workers with specific occupational skills. In further analyses, we provide three pieces of additional empirical evidence that support this interpretation of our results.

Our paper builds on and crucially expands the insights of Beerli et al. (2021) and Basten and Siegenthaler (2019) in three ways. First, in our analysis we focus on middle-skilled workers. Despite middle-skilled workers being the largest group in the labor market in many countries—including Switzerland—the literature on the labor market effects of immigration has traditionally analyzed the labor market outcomes of high-skilled workers or low-skilled workers. Second, while for identification Beerli et al. (2021) use the distance from the border in a DiD framework and Basten and Siegenthaler (2019) use variation in the number of immigrants across occupation-age cells, our strategy exploits the variation in the number of immigrants across occupation-region cells (similar to Card, 2001). Therefore, we provide additional evidence on the effects of immigration in Switzerland using a different source of variation compared to these two previous studies. Third, while Basten and Siegenthaler (2019) show that immigration into Switzerland led to an increase in the probability of employment of native workers, we show that these effects varied substantially across workers with different degrees of occupational skill specificity.

Our study makes three additional contributions to the broader literature. First, we contribute to the empirical literature that uses individual-level data to analyze how workers adjust to an inflow of immigrant workers. This literature shows that occupational changes are one mechanism through which workers adjust to immigration (e.g., Basten and Siegenthaler, 2019; Cattaneo et al., 2015; Foged and Peri, 2015). We complement this important evidence by showing that the effect of immigration on occupational mobility depends on the specificity of workers' skills. Moreover, we show that, in our setting, workers in specific occupations experience an increase in the probability of being employed, although they do not necessarily change occupation more often when immigration is high.

Second, we add to the small but growing literature analyzing how skill specificity moderates the effect of globalization on workers. While Eggenberger et al. (2022) have already shown that import and export shocks on the product market have heterogeneous labor market effects on workers with different degrees of skill specificity, we complement this evidence by studying a different type of shock driven by globalization, that is, an immigration-driven labor supply shock. Moreover, similar to Eggenberger et al. (2022), our results also show that workers with specific occupational skills can benefit from positive demand shocks more than workers with less specific occupational skills.

Third, we contribute to the literature on the labor market effects of CBWs (Beerli et al., 2021; Dustmann et al., 2017). Economic studies on migration have traditionally focused on the effect of permanent migrants in the labor markets of the host economies. However, temporary migrants such as CBWs constitute an increasing fraction of the total number of migrants (OECD, 2019). Moreover, unlike permanent migrants, CBWs do not live in the country in which they work. Therefore, the inflow of CBWs affects only marginally the demand for non-tradable goods and services and constitutes a clean labor supply shock.

2 Institutional framework and the access of cross-border workers to the Swiss labor market

Despite its geographical location in the middle of Europe and its strong economic ties to European countries, Switzerland is not a member of the EU. Instead, since the early seventies, the Swiss government has negotiated a series of agreements regulating bilateral relations with the EU—including the movement of persons between Switzerland and the EU. These agreements resulted in Swiss migration policies that have undergone substantial changes over the past three decades, changes that considerably improved the ability of Swiss firms to recruit foreign workers and expanded the locally available supply of labor.

Before 2002, Swiss firms faced two major constraints in the recruitment of CBWs. First, firms had to provide evidence that no Swiss worker was available for the particular job under consideration—a constraint known as the "priority requirement for Swiss workers." Under this requirement, before firms were allowed to hire foreign workers, they had to prove that they had engaged in an unsuccessful search for a local worker and that they had registered their open position at the local unemployment office.[2] Second, the cantonal authority[3] would only issue a work permit for a foreign worker if the job either met or was above the minimum salary and working conditions for the industry (SECO, 2014). Although these restrictions were aimed at protecting Swiss workers from competition, they also generated substantial administrative costs for hiring firms, along with legal barriers to the recruitment of foreign workers (Abberger et al., 2015).

In addition to these requirements, the pre-2002 Swiss immigration law restricted both the geographical mobility and the length of stay of CBWs in Switzerland. CBWs were not allowed to stay in Switzerland for more than one day, so they had to commute daily between their country of residence and their Swiss workplace.

Moreover, the CBWs' mobility was regionally restricted to areas along the borders be-

[2]Art. 7, *Verordnung über die Begrenzung der Zahl der Ausländer* (1986) AS 1986 1791 (CH)

[3]In Switzerland, cantons are administrative subdivisions similar to states in the U.S.

tween Switzerland and its neighboring countries (Austria, France, Germany, and Italy). CBWs had legal permission to work only in a predefined set of Swiss municipalities within a specific distance from the border, known as the "border region." This set of municipalities in the border region was defined by a finite list that unambiguously distinguished the "border region," where CBWs were allowed to work, from the "non-border region," where CBWs were not allowed to work. The precise definitions of the border and non-border regions were based on the bilateral agreements regulating transportation between Switzerland and its neighboring countries.[4] For example, the border region between Switzerland and France extended for roughly 10 km(6.2 miles) on each side of the border.

In addition to regulating the set of Swiss municipalities to which CBWs were allowed to commute for work, Swiss law also clearly defined the set of foreign municipalities where CBWs had to have resided for at least the preceding six months. These municipalities were also within roughly 10 km (6.2 miles) (depending on the region) from the Swiss border. Workers living farther from the Swiss border in their home country (e.g., French workers living in Paris or Italian workers living in Rome) were thus not eligible for CBW work permits.

However, this situation changed substantially when Switzerland and the EU signed the Agreement on the Free Movement of Persons (AFMP) in 1999. After long and complex negotiations, the new regulations became effective in 2002. The AFMP marked a substantial shift in Swiss migration policy: It aimed at gradually lifting restrictions against EU citizens working and living in Switzerland, thereby gradually opening the Swiss labor market and guaranteeing a completely free movement of labor in and out of Switzerland with the EU. Because a substantial part of the Swiss population was concerned about the consequences of

[4] *Accord entre la Suisse et la France relatif aux travailleurs frontaliers* (1958) RO 1986 446 (CH); *Abkommen zwischen dem Schweizerischen Bundesrat und der Regierung der Bundesrepublik Deutschland über den Grenzübertritt von Personen im kleinen Grenzverkehr* (1970) AS 1970 1020 (CH); *Abkommen zwischen der Schweizerischen Eidgenossenschaft und der Republik Österreich über den Grenzübertritt von Personen im Kleinen Grenzverkehr* (1973) AS 1974 693 (CH); *Convenzione tra la Svizzera e l'Italia per il traffico di frontiera ed il pascolo* (1953) RU 1956 581 (CH)

the AFMP for the wages and employment of Swiss workers,[5] federal authorities in agreement with the EU implemented the reform in three phases between 2002 and 2014, making the liberalization of the Swiss labor market more gradual.

The first phase of the reform, 2002–2004, extended the CBWs' mandatory daily commute to a weekly one. This extension allowed CBWs to stay in Switzerland during the week and return to their home country on weekends, thereby increasing their possibilities for working in municipalities farther from the border but still within the predefined set of municipalities in the border region.

The second phase of the reform, 2004–2007, eliminated both the priority requirement granted to Swiss workers and the cantonal authorities' inspection of salary and working conditions, thereby significantly reducing firms' costs for recruiting CBWs. However, both reform steps affected only firms in the border region, because firms in the non-border region still had no unrestricted permission to hire CBWs.

The third phase of the reform, 2007–2014, completely eliminated all restrictions in all regions, extinguishing the distinction between border and non-border regions. Therefore, starting from 2007, firms in the former non-border region were also free to hire CBWs.

In our study, we exploit the sharp increase of roughly 40 percent in the supply of CBWs generated by the introduction of the free movement of persons throughout its three phases, together with the distribution of CBWs across both regions and occupations before the reform. Figure 1 shows the increase of the fraction of CBWs over time in total employment in the Swiss labor market (all regions), a fraction that was roughly four percent until 2000. Because the 2002 reform removed several restrictions on the employment of CBWs in the Swiss border region, the number of CBWs sharply increased. The fraction of CBWs kept increasing throughout the three phases of the reform, reaching six percent in 2009. This increase was even more pronounced in the border region, going from roughly 5,5 percent in

[5] According to a 1999 survey, "Measurement and Observation of Social Attitudes in Switzer land," roughly 70 percent of Swiss respondents were expecting negative wage effects from the free movement of persons in Switzerland.

1996 to more than 8 percent in 2009.

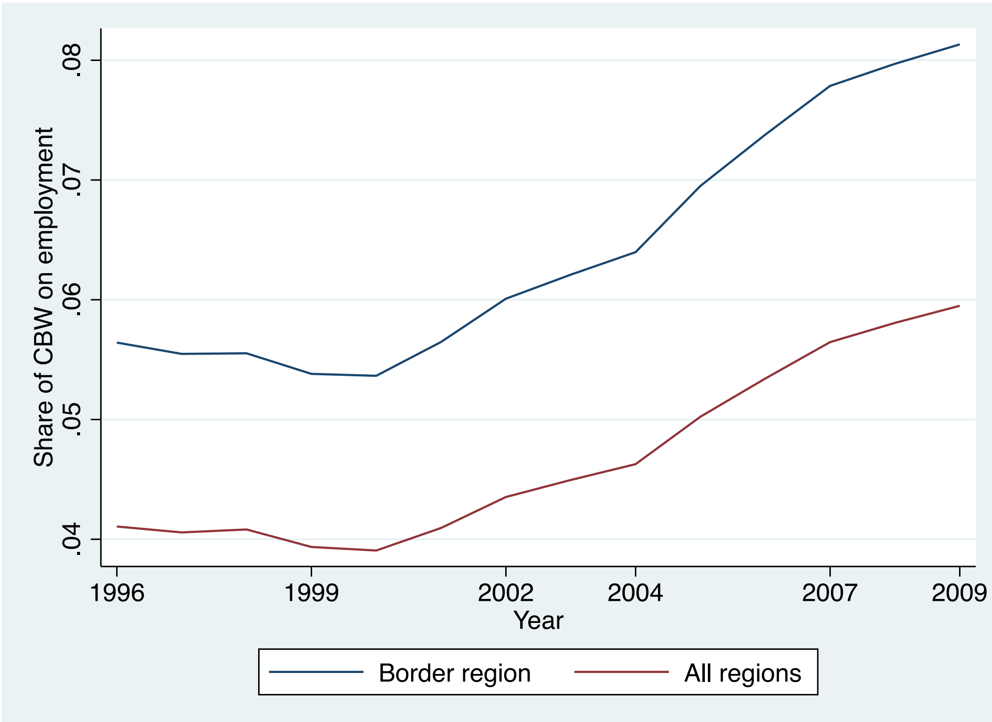

Figure 1: Percentage of CBWs on total employment in the border region and in all regions. Authors' calculations based on data from the Cross-Border Commuters Statistics (FSO).

As Beerli et al. (2021) point out, the fraction of tertiary-educated CBWs has steadily increased after the introduction of the AFMP, mainly at the expenses of low-educated CBWs (i.e., CBWs with compulsory education). However, the largest fraction of CBWs were secondary educated (i.e., middle-skilled), accounting for more than 50 percent of the total number of CBWs in 2010.[6] Therefore, the three phases of the reform lead to a substantial increase also in the number of secondary-educated CBWs.

3 Data sets, sample selection, and descriptive statistics

For our empirical analysis, we combine three different datasets. First, to study the labor market outcomes of Swiss workers after the inflow of CBWs, we use the Social Protection

[6]Source: Swiss Earnings Structure Survey. In 2010 the proportion of tertiary educated CBWs was roughly 25 percent. The remaining 25 percent were CBWs with compulsory education.

and Labour Market data (SESAM). Second, to measure the occupational skill specificity of workers in the SESAM data, we use the measure of occupational skill specificity developed by Eggenberger et al. (2018). Third, for our identification, we measure the exposure of Swiss workers to CBWs at both regional and occupational levels by using register data on the universe of CBWs in Switzerland (Cross-Border Commuters Statistics).

3.1 The SESAM data

The SESAM project links data from the Swiss Labor Force Survey (SLFS) with information from different social insurance registers (i.e., old age, survivors' and disability insurance, disability pensions, complementary benefits, and unemployment insurance). This linkage augments the SLFS with accurate register data on each individual's employment status and wages. We use the SLFS data for 2000 through 2009.

The SLFS is conducted yearly by the Federal Statistical Office through computer-assisted telephone interviews on a representative and randomly selected sample of the adult population permanently living in Switzerland. Depending on the year, the annual samples include between 18,000 and 55,000 individuals older than 15, who are either Swiss citizens resident in Switzerland or non-Swiss residents who have been residing in Switzerland for at least one year.

The panel structure of the data allows us to follow these individuals for a maximum of five years and therefore observe their employment histories during these five years. The average number of observations per individual is 3.6. Although attrition is not a major concern (only about 13 percent of the individuals leave the panel after the first interview, and about 48 percent remain in the panel for five years), the Federal Statistical Office provides weights that account for attrition, post-stratification adjustment, and the probability of being included in the sample. We use these weights in our analysis. In addition, we test whether our instrument affects the probability of leaving the panel. For every individual in the panel, we create an indicator that takes values 1 when an individual leaves the panel. We then regress this indicator on our instrument. The results in Table A.2 shows that our instrument does not affect the probability of leaving the panel and we therefore conclude that attrition is unlikely to drive our results.

Three characteristics make the SESAM data well-suited for our analysis. First, the rich set of individual-level information provided by the survey, together with the panel structure of the data, allows us to analyze the effect of the inflow of CBWs not only on wages but also on occupational mobility and employment status. Second, as the data provides detailed information on the training occupation, we can identify workers who received formal training and education in a VET occupation and have therefore acquired a well-defined bundle of occupational skills. We use this information to link the training occupation in the SESAM data to Eggenberger et al's (2018) measure of skill specificity. Third, in addition to the training occupation, we also observe the municipality of residence of each individual in the sample. Those two variables—the training occupation and the municipality of residence—allow us to measure the exposure of each individual to the inflow of CBWs at both regional and occupational levels (see Section 3.3).

For the analysis of worker occupational mobility and wages, we restrict the initial sample to employees and the self-employed between the ages of 18 and 65 (for men) and 18 and 64 (for women), to exclude upper-secondary school[7] students and retirees. Moreover, to ensure that our results are not driven by outliers, we exclude individuals working less than 10 percent (fewer than 4.25 working hours per week) or with an annual wage below the 1st percentile or above the 99th percentile.

Finally, we restrict the sample to middle-skilled workers with a VET diploma, thereby excluding those who—after receiving that diploma—acquired further formal education. We need this restriction to ensure that the specificity measure we derive from the VET occupation correctly matches the workers' occupational skills and is not contaminated by the later

[7] In Switzerland, upper-secondary education includes baccalaureate schools/*Gymnasium* (college-preparatory high schools) and VET, which combines curriculum-based on-the-job training in a firm with classroom education in vocational schools. These programs are also known as "apprenticeship programs."

acquisition of a tertiary degree.[8] The final sample for the analysis of occupational mobility and wages (mobility and wage sample) consists of 21,549 individuals and 66,947 observations.

Using the annual wage reported in the SESAM data from the social benefit register and the information on hours worked per week at the time of the interview, we calculate wages in full-time equivalents.[9] To control for inflation, we deflate the wages by 2000 prices. The average annual wage in the mobility and wage sample was roughly 68,000 Swiss Francs (80,000 USD in 2020 prices).

The longitudinal structure of the data allows us to observe workers over time and measure their occupational mobility. Our occupational change variable for worker i takes value 0 if at time t the worker works in the occupation specified at the time of the first interview (measured at the 5-digit level of the Swiss Standard Classification of Occupations 2000), and 1 otherwise.[10]

Similar to Cattaneo et al. (2015), our occupational mobility variable measures occupational mobility relative to the occupation at the time of the first interview. However, in contrast to Cattaneo et al. (2015), we base our definition of occupational changes on narrower occupational categories. Specifically, while Cattaneo et al. (2015) define occupational changes according to four large categories (resulting from an aggregation of the 1-digit ISCO codes), we define occupational changes according to roughly 380 narrowly defined categories (i.e., the 5-digit codes of the Swiss Standard Classification of Occupations 2000). Unlike the ISCO classification, the Swiss Standard Classification of Occupations 2000 classifies occu-

[8] Workers who continue their education after the VET training can acquire tertiary degrees—e.g., a university of applied sciences degree or a professional education degree—and thus could have developed skills that are more or less specific than those acquired during the VET training.

[9] Given that part-time jobs with small percentage reductions (e.g., 80 or 90 percent of a full-time position) are common in Switzerland, we include part-time workers in our sample and compute full-time equivalents (similar to Eggenberger et al. (2018)). Specifically, we take the total yearly income reported in the SESAM data and divide it by the hours worked in the month of the interview (as a percentage of a full-time job) reported in the SAKE data.

[10] To define occupational changes, we use the current occupation, which might differ from the training occupation (the one in which a worker has been trained and the one we use to measure the worker's occupational skill specificity) (see Section 3.2). If an individual is unemployed at time t, the variable occupational mobility is missing at time t. If an individual is unemployed at the time of the first interview (and the occupation is therefore missing), we consider the occupation in the next available non-missing year.

pations according to the sector of economic activity, and not according to their skill level. Consequently, changes across these narrow categories might not necessarily reflect a change in the skill level of the occupation (as in Cattaneo et al., 2015) but can also indicate a worker's change to an occupation with the same skill level. In total, 20.4 percent of the workers in the mobility and wage sample changed occupations at least once during the observational period.

For the analysis of employment, we again exclude from the initial sample those workers who acquired further formal training after the VET diploma, but we include individuals with no employment. After accounting for missing values and singleton observations, the employment sample includes 28,450 individuals and 91,663 observations. We define employment as a binary variable taking value 1 if an individual is officially employed in the month of the interview, and 0 otherwise. Table A.1 in the Appendix reports descriptive statistics for the mobility and wage sample and for the employment sample.

3.2 Data on occupational skill specificity

To measure the occupational skill specificity of each worker in the SESAM data, we use the measure developed by Eggenberger et al. (2018), who define skill specificity at the occupational level in a two-step approach. In the first step, they select the 111 most common Swiss VET occupations.[11] In Switzerland, each training occupation has a nationally binding training curriculum defining the set of skills to be taught. Upon successful completion of the training—typically lasting three to four years—graduates receive a federal diploma certifying their proficiency in the skills of their chosen occupation. Eggenberger et al. (2018) use the information in the training curricula to define the bundle of skills taught in each occupation and the relative importance of each skill (i.e., the weight of the skill) in the bundle.[12]

In the second step, drawing on Lazear's (2009) skill-weights approach, Eggenberger et al.

[11] In total, there are roughly 220 VET occupations in Switzerland. Eggenberger et al. (2018) consider the 111 most common occupations, covering roughly 91 percent of all active Swiss VET-educated workers.

[12] The weight of each skill is determined by the proportion of the curriculum that is dedicated to that skill. For more detail, see Eggenberger et al. (2018)

(2018) measure the specificity of a given occupation by comparing it to the overall labor market. Specifically, they define specificity as the degree of overlap of the occupation's skill bundle and weights with the average skill bundle and weights in the overall labor market.[13] To account for differences in the potential demand for different occupations, they weigh the specificity of each occupation for the size of the occupation. In this approach, workers trained in a specific occupation have a bundle of skills that are required in few other jobs in the labor market, whereas workers trained in a general occupation have a bundle of skills that can be used in many other jobs.

This measure of occupational skill specificity provides two main advantages for our analysis. First, the occupational skills contained in the training curricula and used for building the specificity measure are standardized and tested nationally, ensuring that graduates in the same occupation have indeed acquired the same skill bundle (and thus the same occupational skill specificity), irrespective of where in Switzerland they received their training. Second, the approach provides a measure of specificity at the occupational level. This approach is consistent with findings that human capital is occupation-specific (e.g., Kambourov and Manovskii, 2009; Mueller and Schweri, 2015).

We match Eggenberger et al.'s (2018) measure of occupational specificity to the training occupation of each worker in the SESAM data. To identify occupations in both the skill specificity and SESAM data, we use the 5-digit Swiss Standard Classification of Occupations 2000. This approach allows us to assign a degree of specificity to the training occupation of each worker who received formal VET training in one of the 111 occupations contained in the skill specificity data.

Following Eggenberger et al. (2018), we match the skill specificity measure to the training

[13] Formally, (Eggenberger et al., 2018) define the overlap between the skill bundles of two occupations, say O and P, as angular distance between the two skill weights vectors of these occupations (Eggenberger et al., 2018, p.100). Specifically, this distance is given by:

$AngularDist_{OP} = \frac{\sum_{i=1}^{n} x_{Oi} * x_{Pi}}{\sqrt{\sum_{i=1}^{n} x_{Oi}^2 * x_{Pi}^2}}$, where x_{Oi} and x_{Pi} are the weights attached to skill i in the skill bundles of occupation O and P respectively. The average angular distance of an occupation to all other occupations measures the specificity of that occupation.

occupation (i.e., the one in which a worker has been trained), rather than to the current occupation (i.e., the one in which a worker is employed), for two reasons. First, because the worker has received formal training in this occupation, the specificity of the training occupation closely reflects the specificity of a worker's skill bundle. Second, matching the specificity measure to the training occupation reduces the concern of reverse causality. Indeed, for most workers in our sample, the training occupation is predetermined relative to the 2002 reform and is therefore not affected by the inflow of CBWs after the reform.

Before matching Eggenberger's (2018) occupational skill specificity measure to the SESAM data, we standardize it to have zero mean and unit variance. In Table A.3 in the appendix we provide the complete list of occupations sorted according to their specificity and divided into the four quartiles of the specificity distribution in the wage and mobility sample.

3.3 Cross-Border Commuters Statistics

To model the inflow of CBWs across Swiss regions and occupations, we draw on data from the Cross-Border Commuter Statistics (CBCS). This data includes annual individual-level information on the full population of CBWs in Switzerland. Starting from 1999, we observe both the municipality of the workplace and the occupation of each CBW at first entry into Switzerland.

To provide an accurate measure of the exposure of each Swiss worker in our sample to the immigration-driven labor supply shock, we measure the inflow of CBWs at both regional and occupational levels. To do so, we first divide Switzerland into its official 106 commuting zones, which the Federal Statistical Office defines according to the commuting behavior of the resident population (BFS, 2019). We further divide each commuting zone into the 111 occupations that we observe in the specificity data, thereby obtaining 11766 commuting zone-by-occupation cells. We opt for such a narrow definition of cells for two reasons. First, immigration in narrowly-defined occupational groups is relevant for immigration policies because competition for jobs mainly occurs at the occupational level.[14] Second, given that we observe the universe of CBWs in Switzerland, we are able to precisely measure the number of CBWs in narrowly-defined cells. We fully exploit this valuable information in our analysis.

We assign each worker in the SESAM data to a commuting zone-by-occupation cell according to the worker's training occupation and the commuting zone of residence. Because the commute statistics contain data on the entire population of CBWs in Switzerland, the representativity of the data in narrowly-defined cells is not a concern. About 45 percent of the workers in the mobility and wage sample are in cells with no CBWs, because their training occupation experienced no inflow of CBWs in the commuting zone where they live. For workers in commuting zone-by-occupation cells with a strictly positive number of CBWs, the average number of CBWs is 252 (mobility and wage sample). However, the distribution of the number of CBWs is highly skewed, with 50 percent of the workers in commuting zone-by-occupation cells with fewer than 19 CBWs. This low number is not surprising, given the narrow definition of the commuting zone-by- occupation cells. Moreover, substantial variation exists in the number of CBWs (sd: 550 CBWs).[15]

4 Empirical model

To analyze how Swiss workers with different degrees of occupational skill specificity are affected by an immigration-driven labor supply shock, we exploit the 2002 opening of the Swiss labor market to workers from the EU. As described in Section 2, the 2002 reform led to a sharp increase in the number of CBWs commuting to Switzerland for work. Our

[14] One example that strongly supports the assumption of competition at the occupational level is provided by a recent legal regulation to prevent excessive competition from job seekers from abroad. In 2018, the Swiss government introduced a job registration requirement for certain occupations. Since 2020, this new law requires firms with jobs in occupations with an unemployment rate above 5 percent to register their vacancies with the regional employment center five days before they make it public. This law aims at providing an informational advantage to job seekers that are registered with the regional employment center compared to job seekers from abroad.

[15] Among the commuting zone-by-occupation cells with the highest number of CBWs, we find "Commercial Employees" ("Kaufmännische Angestellte") in Geneva (2009: 4.428 CBWs), Basel (2008: 2.040 CBWs), and Lugano (2009:1.719 CBWs), and "Nurses and Nursing Assistants" ("Krankenschwestern/-pfleger") in Geneva (2009: 3.439).

empirical strategy exploits the variation in the exposure to CBWs across commuting zones and occupations. Specifically, we estimate the following model:

$$y_{irot} = \beta_0 + \beta_1 M_{rot} \times S_{ot} + \lambda_i + \phi_r + \sigma_o + \delta_t + \rho_s + \epsilon_{irot} \quad (1)$$

Where y_{irot} is one of three outcomes (occupational mobility, log wages, and employment)[16] of individual i, living in commuting zone r, trained in occupation o, and in year t. M_{rot} is the number of CBWs (in hundreds) in commuting zone r, occupation o , and at time t.

In so doing, we divide training occupations into quartiles according to the occupational skill specificity measure. For example, commercial employees and metal workers are in the first quartile (least specific); kitchen staff and laboratory assistants in the second quartile; electricians and hairdressers in the third quartile; and health care assistants and tailors in the fourth quartile (most specific). Workers in the lower quartiles of the occupational skill specificity distribution like, for example, commercial employees, acquired skills during their training that can be easily employed in other occupations, while workers in the higher quartiles like, for example, electricians or tailors, acquired skills that are idiosyncratic to their own and few other occupations and, therefore, less transferable. In Table A.3 in the appendix, we provide examples of occupations in the wage and mobility sample and show how they are ranked according to their occupational specificity. Moreover, TableA.4 in the appendix shows descriptive statistics of workers in the different quartiles of the occupational skills specificity distribution.[17]

To control for time-invariant observed and unobserved differences across individuals, we also include individual fixed effects λ_i, allowing us to identify the impact of the inflow of

[16] We use a linear probability model for the binary outcomes: occupational mobility and employment.

[17] Consistent with the literature on skill specificity (e.g., Eggenberger et al., 2018; Geel et al., 2011b; Lazear, 2009), Table A.4 in the appendix shows that workers with higher degrees of occupational skill specificity are less likely to experience occupational changes. To further validate our skill specificity measure, we tested how the occupational specificity of the training occupation affects the probability that workers, at the time of the interview, work in an occupation that is different from their training occupation. Consistent with the theory on skill specificity, we find that a higher degree of occupational skills specificity of the training occupation negatively correlates with the probability of changing to another occupation after the training.

CBWs within individuals. To account for systematic differences in different years, regions, occupations, and industries, we include year fixed effects δ_t, commuting zone fixed effects ϕ_r, two-digit training occupation fixed effects σ_o, and one-digit industry fixed effects ρ_s. Finally, we cluster the standard errors at the commuting zone level.[18]

In all regressions, we standardize M_{rot} to mean zero and unit variance.[19] We are interested in the parameter β_1 representing the change in the outcome of interest for a one-unit change in M_{rot} (i.e., a one-standard deviation increase in the occupation- and region-specific number of CBWs, corresponding to roughly 550 CBWs).

4.1 Instrumental variable estimation

When we estimate Equation 1, we are concerned that β_1 might capture the non-random sorting of CBWs across commuting zone-by-occupation cells, generating a spurious correlation between M_{rot} and the outcome variable y_{irot}. For example, commuting zone- and occupation-specific labor demand shocks are likely to positively affect the outcomes of Swiss workers and simultaneously attract more CBWs. As a result of these demand shocks, one would observe a positive relationship—that would not necessarily be causal—between the outcomes and the inflow of CBWs.

To deal with the potential endogeneity of the CBWs' choice of location, Card (2001) proposes a shift-share instrument that builds on the insight that newly arriving immigrants tend to settle in regions with a larger number of co-nationals—what he calls the "nationality-pull factor." Combining the distribution of earlier immigrants across U.S. metropolitan areas and the later inflow of newly arriving immigrants, he builds the shift-share instrument by assuming that these newly arriving immigrants mirror the distribution of the earlier immigrants.[20]

[18]Similar to Foged and Peri (2015), we cluster the standard errors at the level of the initial commuting zone, i.e., the commuting zone of residence at the time of the first interview. The reason is that roughly 6.5 percent of the individuals changed their commuting zone during the observation period.

[19]We do so by subtracting the mean of the overall sample and dividing by the standard deviation of the overall sample.

[20]For example, assume that in year $t-1$ out of the total population of immigrants from country g living in the U.S., the fraction x_{t-1} lives in the metropolitan area r. Moreover, assume that in year t the U.S.

In our setting, the shift-share instrument exploits the greater likelihood that CBWs coming to Switzerland after the 2002 reform will work in commuting zones that already had a large number of CBWs before the reform. In our case, the linguistic differences across commuting zones largely drive the nationality-pull factor: Most CBWs from Austria and Germany work in the German-speaking commuting zones; most CBWs from France work in the French-speaking commuting zones; and most CBWs from Italy work in the Italian-speaking commuting zones.[21]

To build our shift-share instrument, we exploit the distribution of nationalities across not only commuting zones but also pre-reform occupations. This approach builds on the insights of the labor and personnel literature that many workers find their jobs through social contacts and employee referrals (Burks et al., 2015; Calvó-Armengol and Zenou, 2005; Corcoran et al., 1980; Granovetter, 1983; Montgomery, 1981). In our setting, CBWs who entered Switzerland after the 2002 reform likely found work through other CBWs who had been working in Switzerland in the same occupation before the reform. In other words, occupations that already had a large number of CBWs before the 2002 reform were more likely to experience a large inflow of CBWs after it.

To construct the distribution of earlier CBWs across commuting zones and occupations, we use the CBCS data from 1999, the first year in the data in which we observe both the commuting zone of the workplace and the occupation. We construct two variables: λ_{gr}^{1999} is the proportion of CBWs with nationality g working in commuting zones r in 1999, and τ_{go}^{1999} 1999 is the proportion of CBWs with nationality g working in occupation o in 1999. These two fractions constitute the "share" part of the instrument. We then predict the number of

experiences a total inflow M_g of individuals from country g, M_{rg} of which settle (potentially endogenously) in metropolitan area g. The shift-share instrument uses the product of the fraction x_{t-1} (share) and the total inflow from country g, M_g (shift), to predict the inflow from country g into metropolitan area r in year t, M_{rg}.

[21] In 1999, only about three percent of the CBWs working in Switzerland and living in one of Switzerland's neighboring countries were not nationals of that country.

CBWs in commuting zone r and occupation o for 2000–2009, using the following formula:

$$\widehat{M}_{rot} = \sum_{g} \lambda_{gr}^{1999} * \tau_{go}^{1999} * M_{gt} \qquad (2)$$

Where M_{gt} is the total inflow of CBWs with nationality g in year t. The instrument in formula 2 is similar to Card's (2001) shift-share instrument. However, while he uses the contemporaneous distribution of immigrants across occupations, we use the distribution prior to the reform.

To illustrate the 1999 geographical distribution of CBWs in Switzerland, Figure 2 shows the distribution of CBWs across commuting zones in 1999 in percentage of the total working population.

4.2 Validity of the identification strategy

To solve the endogeneity of M_{rot}, $\widehat{M}_{rot}$ has to fulfill two conditions. First, the predicted number of CBWs in a given year and commuting zone-by-occupation cell must be correlated with the actual number of CBWs (first stage). Figure 3 plots the predicted number of CBWs, $\widehat{M}_{rot}$, versus the actual number of CBWs, M_{rot}. The plot shows that the two measures are highly correlated (i.e., the dots are close to the 45-degree line), thus suggesting a strong first stage.

Second, $\hat{M}_{rot}$ has to be exogenous. In other words, the shift-share instrument in formula (2) must be uncorrelated with the error term ϵ_{irot} in Equation (1). Because the term M_{gt} in formula (2) represents the *total* inflow of CBWs with nationality g in Switzerland in a given year t, it is unlikely to be correlated with commuting zone- or occupation- specific shocks. As long as commuting zone- and occupation-specific demand shocks are not persistent, the fractions λ_{gr}^{1999} and τ_{go}^{1999} in formula (2) are uncorrelated with ϵ_{irot}. This condition requires that the demand shocks that determined the 1999 distribution of CBWs across commuting zones and occupations be uncorrelated with the inflow of CBWs into commuting zones and

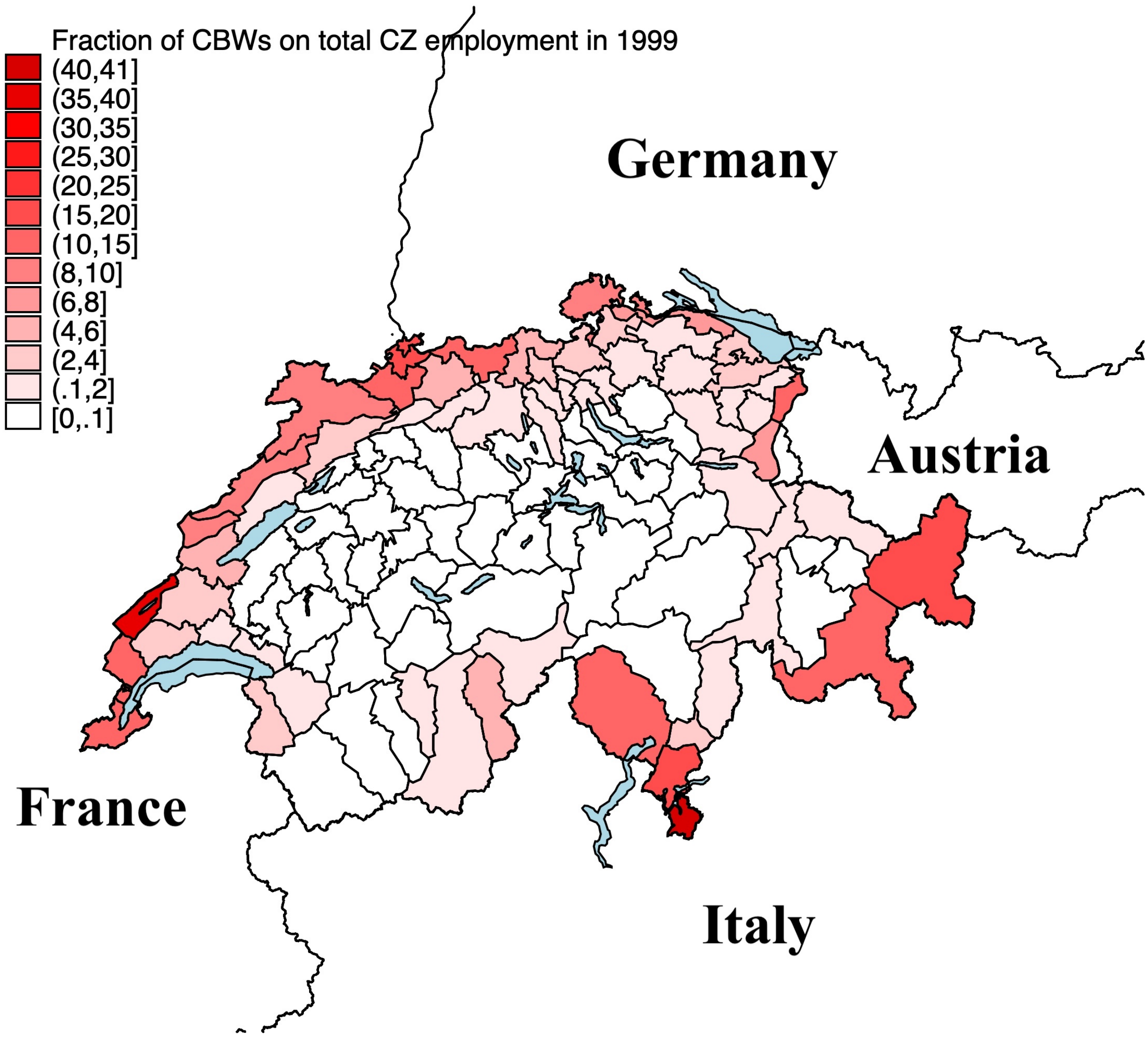

Figure 2: Percentage of CBWs on local employment in 1999. Source: Authors' calculations based on data from the Cross-Border Commuters Statistics (FSO)

occupations in subsequent years.

Although some recent work has challenged this assumption (e.g., Jaeger et al., 2018), in our setting the sharp increase in CBWs generated by the 2002 reform is likely to make any demand shock less persistent. In the spirit of Borusyak et al. (2019), we run two tests to assess the credibility of this assumption.

In the first test, we analyze the distribution of our instrument. Table 1 reports descriptive statistics of the instrument after the residualization of different fixed effects. The raw index

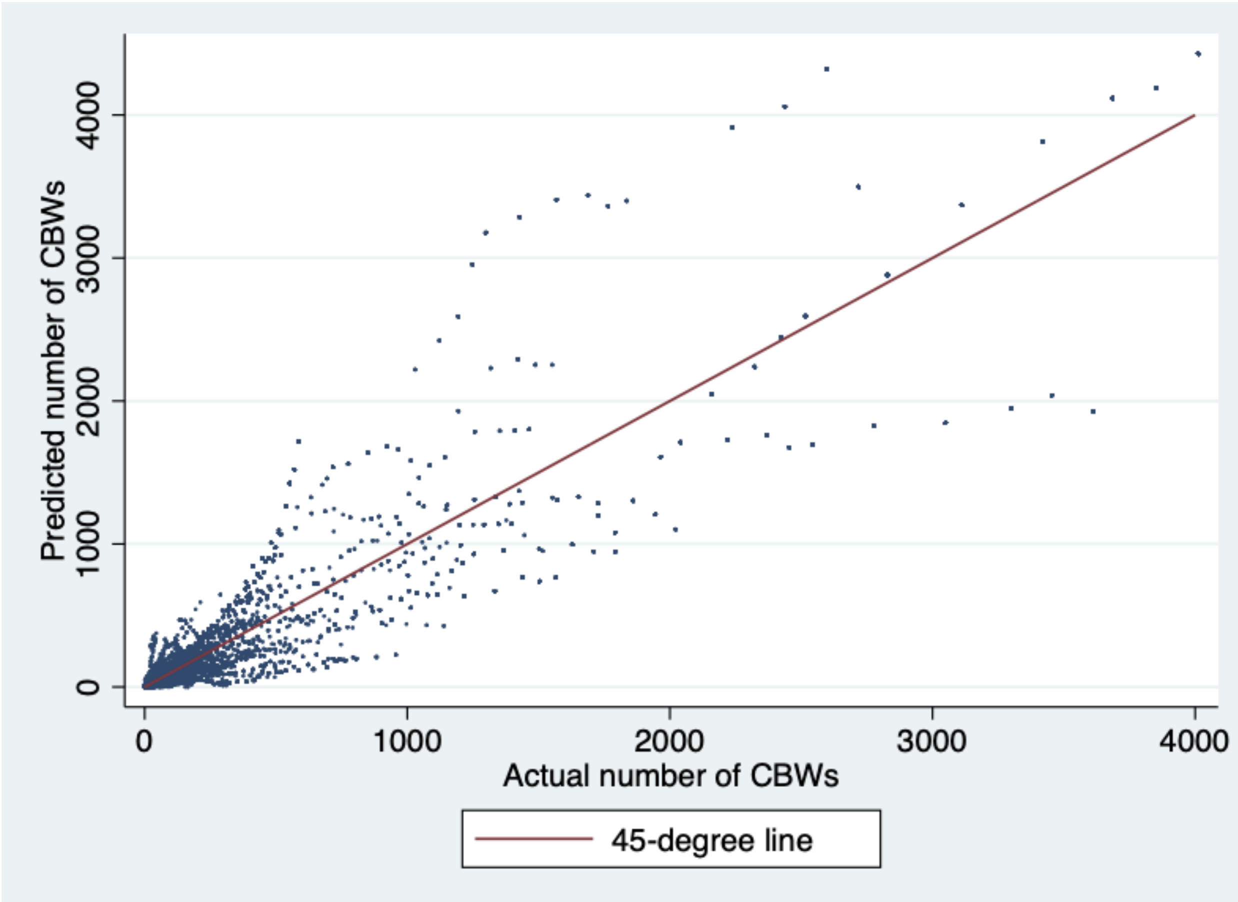

Figure 3: Predicted vs. actual number of CBWs. Source: Authors' calculations based on data from the Cross-Border Commuters Statistics (FSO)

varies between 0 and roughly 4000 with a standard deviation of 500. The mean implies that, on average across all occupations and region, the instrument predicts 136 CBWs. Residualizing the instrument on commuting zone and occupation fixed effects (row 2), year fixed effects (row 3), industry fixed effects (row 4), re-center the instrument around 0 and reduces its variation by roughly 30 percent. In row 5, we residualize the instrument on individual fixed effect, thereby substantially reducing the instrument's variation. Our main model with individual fixed effects uses this variation for estimation.

Table 1 shows that even after including individual fixed effects, the instrument still has enough variation to precisely estimate the effect of an increase in the number of CBWs. Second, after residualizing the instrument on different sets of fixed effects and, most importantly, on individual fixed effects, the distribution of the instrument appears normally

Table 1: Distribution of the instrument

Variable	Obs	Mean	Std. Dev.	Min	Max
Raw instrument	66,947	138.35	502.12	0	4011.52
Residuals after region and occupation FE	66,947	0.00	335.52	-1490.55	2366.98
Residuals after region, occupation, and year FE	66,947	0.00	334.66	-1527.97	2322.66
Residuals after region, occupation, year, and industry FE	66,947	0.00	334.50	-1538.24	2348.96
Residual after region, occupation, year, industry, and individual FE	66,947	0.00	52.73	-1516.17	1606.47

Note: Distribution of the instrument after inclusion of different sets of fixed effects. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)

distributed around zero. This pattern is empirically consistent with what we would expect from a randomly assigned instrument, thereby supporting the exogeneity assumption needed for the IV estimation.

In the second test, we analyze whether pre-trends in our outcome variables in the years before the reform (i.e., 1991-1999) predict changes in the instrument after the reform (2002-2009). The results are reported in Table A.5 and show no systematic correlation between pre-trends and change in the instrument. We interpret this evidence as supportive of the instrument exogeneity assumption.

5 Results

5.1 Main results

Table 2 reports the OLS and 2SLS estimates of the coefficients of M_{rot} on wages and employment in different quartiles of the occupational skill specificity distribution. In the OLS estimation, we use the actual number of CBWs in a given commuting zone-by-occupation cell and year, M_{rot}, and we interact this variable with S_{ot} containing the quartiles of the occupational skill specificity distribution. In the 2SLS estimation, we instrument each interaction term $M_{rot} \times S_{ot}$ by the respective interaction with the predicted number of CBWs in a specific commuting zone-by-occupation, that is $\widehat{M_{rot}} \times S_{ot}$. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs (i.e., roughly 550 CBWs)[22] on the respective outcome.

For employment, the 2SLS estimate of the effect of the inflow of CBWs on employment probabilities is positive for workers with the highest degree of occupational skill specificity (4th quartile). In contrast, the estimates do not show any effect for workers in the other quartiles of the occupational skill specificity distribution. These effects imply that the inflow of CBWs increased the employment probability of workers with the most specific occupational skills by 7.5 percentage points, while it did not significantly affect the employment probability of workers with less specific occupational skills.[23]

These results suggest that, first, the inflow of CBWs generated new employment opportunities for workers with very specific occupational skills and, second, the inflow of CBWs had different effects on workers with different degrees of occupational skill specificity. While the positive estimates in the 4th quartile are consistent with the results in Basten and Siegenthaler (2019), who also find positive average employment effects, our results in addition show that these positive effects were not homogeneously distributed across workers with different types of skill bundles.[24]

For wages, the estimates are not significant. This result is in line with Beerli et al. (2021), who also find, on average, no effect on wages after the liberalization of the Swiss labor market, and with Basten and Siegenthaler (2019), who also find a reduction in unemployment but

[22] The average increase in the number of CBWs for Swiss workers in the mobility and wage sample experiencing a strictly positive increase was 70 (SD = 230). Some Swiss workers experienced an increase as high as 1057 CBWs (99th percentile), whereas others experienced an increase as low as 1 CBW (1st percentile).

[23] This effect appears to be even stronger for older workers. The heterogeneity along the age dimension could be further investigated in future research.

[24] Given that our data contain a large number of commuting zone-by-occupation cells with no CBW, we test the robustness of our results to the exclusion of these cells. In other words, we exploit the within-individual variation in the inflow of CBWs only for those individuals in cells with a strictly positive number of CBWs. The results are reported in Table A.8 and are largely consistent with out main results.

only little effect on wages in Switzerland after the liberalization.[25]

Table 2: OLS and 2SLS estimates on employment and wages

	Employment		Wages	
	OLS	2SLS	OLS	2SLS
1st quartile	0.003	-0.001	0.011**	0.009
	(0.003)	(0.015)	(0.005)	(0.009)
2nd quartile	0.007**	0.004	0.009*	0.005
	(0.003)	(0.014)	(0.005)	(0.008)
3rd quartile	-0.055*	-0.045	-0.057*	-0.090
	(0.030)	(0.047)	(0.034)	(0.054)
4th quartile	0.017	0.075*	-0.043	-0.049
	(0.031)	(0.043)	(0.027)	(0.061)
Year FE	yes	yes	yes	yes
Commuting zone FE	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes
F-stat 1st quartile		454.69		411.18
F-stat 2nd quartile		67.17		82.73
F-stat 3rd quartile		125.92		171.82
F-stat 4th quartile		110.65		66.22
Obs.	91663	91663	66947	66947
Ind.	28450	28450	21549	21549

Note: The dependent variables are an indicator of employment and the natural logarithm of annual wages in full-time equivalents. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs. The estimated effects are obtained by interacting the treatment variable M_{rot} with the variable S_{ot} containing the different quartiles of the occupational skill specificity distribution. In the 2SLS estimations, the interaction terms $M_{rot} \times S_{ot}$ are instrumented by $\widehat{M_{rot}} \times S_{ot}$. Industry FE are at the one-digit industry level. Occupation FE are at the two-digit occupational level. Standard errors in parentheses clustered at the levels of the initial commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)

To explain the positive employment effect for workers with specific occupational skills, we draw on recent work analyzing the effects of immigration in a search model (e.g., Albert, 2021; Battisti et al., 2018; Chassamboulli and Palivos, 2014). In these models, immigration

[25] For reference, we present in Table A.7 in the Appendix the estimates obtained from a simple model with no interactions. The OLS estimates for the effects of the inflow of CBWs on employment and wages are both positive and significant, although the effects are relatively small. When we employ our shift-share strategy, the coefficients turn insignificant, but the point estimates remain positive.

has two opposing effects. On one hand, immigration can lead to the substitution of native with immigrant workers, decreasing the employment probabilities of native workers. On the other hand, immigration can lead to job creation through different channels. For example, Albert (2021) argues that immigrant workers typically accept lower wages than incumbent workers. By hiring immigrant workers at a lower wage, firms can reduce their production costs, increase their profits, and create new jobs, in turn increasing the employment probabilities of native workers. In line with the latter mechanism, Orefice and Peri (2020) show that immigration increases the quality of firm-worker matches and leads to higher productivity. The increased productivity also increases firm profits, allowing firms to create new jobs. As a result of this job creation effect, the employment probability of native workers increases.

This framework appears particularly well-suited to our setting for two reasons. First, given that living costs are, on average, higher in Switzerland than in its neighboring countries, the reservation wage of CBWs is lower than for workers living in Switzerland. In turn, the lower reservation wage of CBWs leaves more scope for wage costs reduction when firms employ CBWs. Second, substitution effects are likely to be strongest when considering the immigration of workers with similar skills, as is the case in our empirical analysis, in which we measure inflows of CBWs at the occupational and regional levels.

Our empirical model captures the substitution effect directly because CBWs and Swiss workers in the same occupations and regions are likely to be a substitute. In contrast, the model captures the job creation effect indirectly because this effect plays out at the firm (and not the occupational) level. Indeed, firms employ a mix of workers in different occupations, and it is a priori unclear in which occupation firms create new jobs.

In our setting, it appears that for workers with specific occupational skill bundles, the job creation effect clearly dominates the substitution effect. That is, the new availability of CBWs from the EU after the introduction of the AFMP provided firms with cheaper skilled workers to fill previously existing skill gaps, thus alleviating capacity restrictions, providing better options for growth, and creating new jobs also for native workers. Swiss workers with specific occupational skills bundles appear to have benefitted particularly from the new jobs created. These results are in line with Eggenberger et al. (2022), who also find that workers with specific occupational skills benefit from positive labor market shocks resulting from international trade. This effect is consistent with classical human capital theory (Becker, 1964; Lazear, 2009), which posits that workers with specific skills cannot be easily substituted. Therefore, a positive labor demand shock results in improved outside options for workers with specific skills and improve their bargaining position. Eggenberger et al. (2022) use a similar argument to explain why workers with specific skills benefit from positive trade shocks (i.e., increased exports) more than workers with general skills.

5.2 Further analyses

We provide three additional pieces of evidence that support our interpretation of the main results. First, to investigate more in depth the mechanisms behind the positive employment effect on native workers with specific occupational skills, we differentiate between movements into and from employment. Indeed, the positive employment effect could result from an increase in the probability of becoming employed or a reduction in the probability of exiting employment. The panel structure of our data allows us to differentiate between these two probabilities. We define movements into employment when a worker was not employed in period $t-1$ and becomes employed in period t. Analogously, we define movements out of employment when a worker was employed in period $t-1$ and is no longer employed in period t. Table 3 shows that the positive effect on employment for workers with the most specific occupational skills comes mainly from an increase in the probability of entering employment rather than a reduction in the probability of exiting employed. This result supports our interpretation that the inflow of CBWs created new jobs for Swiss workers and that Swiss workers with specific occupational skills disproportionately benefited from this job creation.

Second, we analyze workers' occupational mobility. Given that immigration can improve the quality of job-worker matches (as suggested by Orefice and Peri, 2020), and given that

Table 3: To employment, from employment, and occupational changes

	To employment		From employment		Occupational change	
	OLS	2SLS	OLS	2SLS	OLS	2SLS
1st quartile	0.003	0.005	0.007***	0.016***	-0.019***	-0.034
	(0.004)	(0.006)	(0.002)	(0.005)	(0.007)	(0.023)
2nd quartile	0.004	0.005	0.003	0.011**	-0.023***	-0.036*
	(0.004)	(0.005)	(0.002)	(0.005)	(0.006)	(0.020)
3rd quartile	-0.014	0.034	0.030	0.025	-0.045	-0.016
	(0.034)	(0.024)	(0.034)	(0.044)	(0.047)	(0.052)
4th quartile	0.068**	0.118***	-0.016	-0.071*	-0.133***	-0.166***
	(0.030)	(0.036)	(0.033)	(0.041)	(0.025)	(0.022)
Year FE	yes	yes	yes	yes	yes	yes
Commuting zone FE	yes	yes	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
F-stat 1st quartile		454.69		454.69		411.18
F-stat 2nd quartile		67.17		67.17		82.73
F-stat 3rd quartile		125.92		125.92		171.82
F-stat 4th quartile		110.65		110.65		66.22
Obs.	91663	91663	91663	91663	66947	66947
Ind.	28450	28450	28450	28450	21549	21549

Note: The dependent variables are an indicator for movements to employment, an indicator for movements from employment, and an indicator for occupational changes. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs. The estimated effects are obtained by interacting the treatment variable M_{rot} with the variable S_{ot} containing the different quartiles of the occupational skill specificity distribution. In the 2SLS estimations, the interaction terms $M_{rot} \times S_{ot}$ are instrumented by $\widehat{M_{rot}} \times S_{ot}$. Industry FE are at the one-digit industry level. Occupation FE are at the two-digit occupational level. Standard errors in parentheses clustered at the levels of the initial commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO) workers are less likely to leave their jobs when the quality of these matches increases (Gielen and van Ours, 2010), we expect immigration to reduce the probability of occupational changes. Table 3 explores this hypothesis. Indeed, both the OLS and the 2SLS coefficients are negative across all specificity quartiles. For workers in the 4th quartile, the estimated effect is stronger and significant even when using the IV strategy. Therefore, the inflow of CBWs reduces the occupational mobility of workers with very specific occupational skills. We interpret this result as suggestive evidence that the increased availability of CBWs in the Swiss labor market alleviated previously existing skill shortages for some firms and increased the quality of job-worker matches, particularly for workers in occupations requiring specific skills, thereby reducing the workers' need and willingness to change their occupation.

These results are somewhat in contrast with the previous findings that workers respond to immigration by changing occupations (and skill level of the occupation) more often (Basten and Siegenthaler, 2019; Cattaneo et al., 2015; Foged and Peri, 2015). However, differences in the measurement of occupational changes can explain these differing results because our measure does not capture upward mobility. While our indicator of occupational mobility measures changes to a different occupation with the same skill level, Cattaneo et al.'s (2015) measure of occupational mobility captures changes to an occupation with a different skill level (i.e., occupational upgrading).[26] Moreover, our measure of occupational mobility captures changes across narrowly-defined occupational groups. These changes are potentially more sensitive to changes in the job-worker match quality compared to changes across broader occupational groups. Therefore, we interpret the result of a reduction in the occupational mobility of workers with specific occupational skills as an indication that the inflow of CBWs led to better job-worker matches in these specific occupations.

Third, we analyze how the effects of the inflow of CBWs vary across different Swiss language regions.[27]. In each Swiss language region, CBWs mainly come from the neighboring

[26]Basten and Siegenthaler (2019), when defining occupational changes according to narrow occupational categories, also report negative effects of the inflow of migrant workers on occupational mobility. However, their estimates become positive when they use broader occupational categories.

[27]Switzerland has four language regions. 71 percent of the population lives in the German-speaking region;

country speaking the same language. For example, most CBWs in the German-speaking region come from Germany, and virtually every CBW working in the Italian-speaking region comes from Italy. Because the degree of similarity between the Swiss educational system and the educational systems in these neighboring countries varies, we expect CBWs in different language regions to have skills that are more or less comparable to those of Swiss workers.

Specifically, similar to Switzerland, the German educational system strongly emphasizes VET (Backes-Gellner and Lehnert, 2021). Therefore, German CBWs have skills comparable to those of Swiss VET workers, making it easier for Swiss firms to integrate German CBWs into existing production and business processes. In contrast, French and Italy have educational systems emphasizing general education. Therefore, the skills of CBWs from Italy and France are potentially less comparable to those of Swiss VET workers, making the integration of CBWs from these countries into the existing production processes more difficult. Therefore, we expect the inflow of CBWs into the German-speaking region to have a more positive impact on the quality of job-worker matches compared to the inflow of CBWs into the French- and Italian-speaking regions.

Table 4 reports the estimates (for simplicity, we report only the 2SLS estimates) of the effect of the inflow of CBWs in different language regions. In line with our main results, we observe positive employment effects for workers with the most specific occupational skills in the German-speaking region. In contrast, In the French- and Italian-speaking regions, the estimated effects on employment and wages tend to be more negative and, in some cases, statistically significant, particularly for workers in the 3rd quartile of the specificity distribution.

When we analyze occupational changes, we observe the same patterns as in the entire sample: the inflow of CBWs reduced the occupational mobility of workers with the most specific occupational skills. However, this pattern is much stronger in the German-speaking region. Taken together, these results show that the positive employment effects were mainly

24 percent in the French-speaking region; 4 percent in the Italian-speaking region; and less than 1 percent in the Roman-speaking region.

concentrated in the German-speaking region, possibly because CBWs from Germany had skills comparable to those of Swiss VET workers, making it easier for Swiss firms to integrate these workers into existing production and business processes, and leading to better job-worker matches. In contrast, CBWs from France and Italy have skills that are less comparable to those of Swiss VET workers and, therefore, did not have the same positive effect on the quality of job-worker matches.

Table 4: 2SLS estimates in different language regions

	German-speaking region			French- and Italian-speaking regions		
	employment	wages	Occupational change	employment	wages	Occupational change
1st quartile	0.033	0.020	-0.009	-0.020**	0.003	-0.030*
	(0.025)	(0.032)	(0.030)	(0.009)	(0.009)	(0.016)
2nd quartile	0.042**	0.013	-0.015	-0.014*	0.001	-0.029*
	(0.018)	(0.035)	(0.020)	(0.008)	(0.007)	(0.015)
3rd quartile	0.061	-0.067	-0.083*	-0.111***	-0.091***	0.126*
	(0.069)	(0.103)	(0.042)	(0.025)	(0.026)	(0.065)
4th quartile	0.157***	-0.069	-0.165***	0.046	-0.017	-0.107***
	(0.048)	(0.103)	(0.043)	(0.052)	(0.020)	(0.018)
Year FE	yes	yes	yes	yes	yes	yes
Commuting zone FE	yes	yes	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
F-stat 1st quartile	2092.52	7326.12	2092.52	7326.12	768.36	8557.89
F-stat 2nd quartile	3791.80	3964.38	3791.80	3964.38	708.47	4397.94
F-stat 3nd quartile	53.55	315.95	53.55	315.95	281.88	477.69
F-stat 4nd quartile	1341.66	3897.30	1341.66	3897.30	1865.10	2042.81
Obs.	65593	48420	48420	25947	18443	18443
Ind.	20428	15617	15617	8012	5919	5919

Note: The dependent variables are an indicator of employment, the natural logarithm of annual wages, and an indicator for occupational changes. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs. The estimated effects are obtained by 2SLS. The interaction terms $M_{rot} \times S_{ot}$ are instrumented by $\widehat{M_{rot}} \times S_{ot}$. Industry FE are at the one-digit industry level. Occupation FE are at the two-digit occupational level. Standard errors in parentheses clustered at the levels of the initial commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)

6 Conclusion

In this study, we explore how middle-skilled workers with different degrees of occupational skill specificity are affected by an immigration-driven labor supply shock. To identify the effect of this labor supply shock, we use the 2002 Agreement on the Free Movement of Persons between Switzerland and the EU, leading to a sudden and substantial increase in the number of CBWs in Switzerland.

Our results suggest that opening the Swiss labor market to workers from the EU did not have an adverse effect on the employment of middle-skilled workers, as initially feared in policy discussions. To the contrary, the free movement of persons increased the employment probability of middle-skilled workers in specific occupations and reduced the need for occupational changes.

We interpret these results as evidence that the opening of the Swiss labor market led to better conditions for firms and, consequently, to a better allocation of native workers to jobs (i.e., better job-worker matches), thereby allowing firms to expand and create new jobs for the incumbent Swiss workforce. The creation of new jobs and the resulting increase in labor demand had a positive effect on the employment probability of workers with specific occupational skills, as these workers have skills that are relatively scarce on the labor market.

Overall, our results show that not only the level of skills (as shown by previous studies) but also the type of skills (i.e., the specificity of occupational skill bundles) matters when investigating the effects of immigration. Therefore, analyses of the effects of immigration and, more generally, labor market shocks on individual labor market outcomes should factor in occupational skill specificity, particularly when analyzing the heterogeneity of these effects across different workers.

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Appendix

Table A.1: Descriptive statistics

	Obs.	Mean	SD	Min	Max
Annual wage	66947	68339.65	27309.55	1519	524355
Occupational change	66947	0.12	0.32	0	1
Male	66947	0.52	0.50	0	1
Swiss national	66947	0.74	0.44	0	1
Industry					
Agriculture, forestry and fishing	66947	0.02	0.13	0	1
Mining and quarrying	66947	0.00	0.03	0	1
Manufacturing	66947	0.18	0.39	0	1
Electricity, gas, steam and air-conditioning supply	66947	0.01	0.09	0	1
Water supply; sewerage, waste management and remediation activities	66947	0.00	0.06	0	1
Construction	66947	0.08	0.27	0	1
Wholesale and retail trade, repair of motor vehicles	66947	0.19	0.39	0	1
Transportation and storage	66947	0.06	0.23	0	1
Accomod. and food serv. act.	66947	0.04	0.19	0	1
Information and communication	66947	0.03	0.16	0	1
Financial and insurance activities	66947	0.07	0.25	0	1
Real estate activities	66947	0.01	0.08	0	1
Prof., scientific and tech. act.	66947	0.05	0.23	0	1
Admin. and support serv. act.	66947	0.03	0.16	0	1
Public administration and defence	66947	0.06	0.23	0	1
Education	66947	0.02	0.14	0	1
Human health and social work act.	66947	0.12	0.32	0	1
Arts, entertainment and recreation	66947	0.01	0.11	0	1
Other service activities	66947	0.03	0.16	0	1
Act. of households as employers	66947	0.00	0.07	0	1
Act. of extraterritorial org. and bodies	66947	0.00	0.02	0	1
Year	66947	2005	2.46	2000	2009
Employed	91663	0.86	0.35	0	1

Source: Authors' calculations based on the SESAM/SLFS data

Table A.2: Test for attrition

	(1) OLS	(2) OLS	(3) OLS
$\widehat{M}_{rot}$	0.003**	0.001	0.003
	(0.001)	(0.002)	(0.003)
Year FE	no	yes	yes
Commuting zone FE	no	yes	yes
Occupation FE	no	yes	yes
Weights	no	no	yes
Obs.	89867	89867	89867
Adj. R2	0.000	0.074	0.038

Note: The dependent variable is an indicator that takes value 0 as long as an individual stays in the panel and 1 when an individual leaves the panel (mobility and wage sample). Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)

Table A.3: Examples of occupations in different quartiles of the specificity distribution

1st quartile (least specific)	2nd quartile	3rd quartile	4th quartile (most specific)
Commercial employees (Kaufmännische Angestellte, sowie Büroberufe)	Kitchen staff (Küchenpersonal)	Mechanical engineers (Mechaniker:innen)	Healthcare assistants (Krankenschwestern:pfleger)
Retail clerks (Verkäufer:innen, Detailhandelsangestellte)	Cabinetmakers (Möbelschreiner:innen)	Electricians (Elektromonteure:monteurinnen)	Automotive technicians (Automechaniker:innen)
Janitors (Servicepersonal)	Laboratory assistants (Laboranten:innen)	Hairdressers (Coiffeure, Coiffeusen)	Architectural and civil drafters (Hoch- und Tiefbauzeichner:innen)
Metal workers (Metallbauer:innen, Metallbauschlosser*innen)	Printing technicians (Drucker:innen)	Farmers (Landwirte, Landwirtinnen)	Tailors (Schneider:innen)

Note: The table reports the four most common occupations in each quartile of the specificity distribution according to the mobility and wage sample. Original German in parentheses. In the 1st quartile are the least specific occupations; in the 4th quartile the most specific ones. We assigned each occupation to one of the four quartiles according to the average specificity over the whole observation period. Source: Eggenberger et al.'s (2018) occupational skill specificity data.

6.1 Descriptives of workers in different quartiles of M_{rot}

Table A.4: Descriptive statistics of workers in different quartiles of the occupational skill specificity distribution

	Obs.	Mean	SD
1st Quartilee			
Yearly wage in FTE	19853	65906.79	27495.38
Age	19853	41.18	11.05
Male	19853	0.34	0.47
Occupational change	19853	0.12	0.33
Employment	27850	0.84	0.36
2nd Quartile			
Yearly wage in FTE	15738	72198.14	28363.92
Age	15738	41.70	11.14
Male	15738	0.44	0.50
Occupational change	15738	0.11	0.31
Employment	21629	0.85	0.35
3rd Quartile			
Yearly wage in FTE	17190	67435.06	25635.09
Age	17190	42.04	11.13
Male	17190	0.78	0.42
Occupational change	17190	0.12	0.33
Employment	23037	0.87	0.33
4th Quartile			
Yearly wage in FTE	14166	68560.21	27352.94
Age	14166	41.78	10.75
Male	14166	0.56	0.50
Occupational change	14166	0.10	0.31
Employment	19147	0.86	0.35

Source: Authors' calculations based on the SESAM/SLFS data

Pre-trends

To test whether pre-trends in the three outcome variables (wages, employment, and occupational mobility) predict changes in the instrument, we proceed as follows. First, we compute pre-trends in the three outcome variables before the reform using data from SESAM/SLFS. To increase the number of observations in each commuting zones-by-occupation cell, we pool observations in two periods t_1 (1991-1995) and t_2 (1996-1999). We exclude cells with less than 5 observations as this would lead to an imprecise estimate of the average outcome in the cell[28]. We then compute changes in wages, employment, and occupational mobility between t_1 and t_2 within commuting zone-by-occupation cells as $\Delta y_{ro} = y_{ro,t=t2} - y_{ro,t=t1}$, where y is one of three outcomes, r is an index for the commuting zone, and o an index for the occupation.

Second, we compute changes in the instrument between 2000 and 2009, that is during our period of analysis as $\Delta\widehat{M_{ro}} = \widehat{M_{ro,t=2009}} - \widehat{M_{ro,t=2002}}$, where $\widehat{M}$ is the instrument, r is an index for the commuting zone, and o an index for the occupation. We then regress $\Delta\widehat{M_{ro}}$ on Δy_{ro}.

The results are reported in Table A.5 and show no evidence of a significant correlation between pre-trends and our instrument. We, therefore, conclude that pre-trends in our outcome variables are unlikely to drive the distribution of the instrument across commuting zones and occupations in our period of analysis.

[28]excluding cells with less than 10 observations reduces the number of cells by roughly 30 percent and does not significantly change the results

Table A.5: Do changes in pre-trends predict changes in the instrument?

	(1) $\Delta\widehat{M_{ro}}$	(2) $\Delta\widehat{M_{ro}}$	(3) $\Delta\widehat{M_{ro}}$
Δ wage	0.35		
	(2.21)		
Δ employment		-19.54	
		(15.13)	
Δ occupational mobility			1.748
			(24.58)
N	1421	1440	1439

The dependent variable is the change in our instrument between 2000 and 2009. Δwage represents the change in average annual wage (in thousands) in a given commuting zone-by-occupation cell in the pre-treatment period; Δemployment represents the change in the proportion of employed; and Δoccupational mobility is the change in the proportion of occupational changes. Standard errors in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)

Middle- and high-skilled CBWs

An alternative explanation for our main results in Table 2 is that the positive employment effects for workers with specific occupational skills are driven by complementarities with high-skilled workers. Indeed, (Beerli et al., 2021) show that a large fraction of the total increase in immigration (including CBWs) after the AFMP is high-skilled. We investigate whether these complementarities can drive our results by testing whether our instrument $\widehat{M_{rot}}$ correlates with the immigration of high-skilled CBWs into the same region. We define as high-skilled CBWs those CBWs in a given commuting zone that are in the ISCO-08 categories 1 (Managers) and 2 (Professionals). The coefficients in Table A.6 show a negative and significant correlation between our instrument and the number of high-skilled CBWs in a given commuting zone. However, the correlation becomes smaller and no longer significant as we include year FE and commuting zone FE. We include both sets of FE in our main regression model. We, therefore, conclude that the immigration of high-skilled CBWs is unlikely to explain our results.

Table A.6: Middle- and high-skilled CBWs

	$\widehat{M_{rot}}$	$\widehat{M_{rot}}$	$\widehat{M_{rot}}$
High-skilled CBWs	-9.140***	1.692	1.273
	(0.563)	(1.166)	(1.169)
Year FE	no	no	yes
Commuting zone FE	no	yes	yes
Obs.	313677	313677	313677

The dependent variable is the instrument. Each observation is a commuting zone-by-occupation-by-year cell. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on data from the Cross-Border Commuters Statistics (FSO)

6.2 Main model without interactions

Table A.7: OLS and 2SLS estimate without interactions

	Employment		Wages	
	(1) OLS	(2) 2SLS	(3) OLS	(4) SSLS
M_{rot}	0.007***	0.008	0.008*	0.005
	(0.003)	(0.012)	(0.005)	(0.008)
Year FE	yes	yes	yes	yes
Commuting zone FE	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes
Obs.	91663	91663	66947	66947
Ind.	28450	28450	21549	21549
F-stat		78.17		89.03

Note: The dependent variables are an indicator for employment and the natural logarithm of annual wages in full-time equivalents. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs M_{rot}. In the 2SLS estimations, M_{rot} is instrumented by $\widehat{M_{rot}}$. Industry FE are at the one-digit industry level. Occupation FE are at the two-digit occupational level. Standard errors in parentheses clustered at the levels of the initial commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO).

6.3 Exclusion of commuting zone-by-occupation cells with zero CBWs

Table A.8: OLS and 2SLS estimate without zeros

	Employment		Wages		Occupational change	
	OLS	IV	OLS	IV	OLS	IV
1st quartile	0.005	-0.003	0.018**	0.032*	-0.029***	-0.050
	(0.005)	(0.022)	(0.007)	(0.017)	(0.008)	(0.033)
2nd quartile	0.010**	0.004	0.017**	0.029*	-0.034***	-0.052*
	(0.004)	(0.020)	(0.008)	(0.016)	(0.008)	(0.030)
3rd quartile	-0.068*	-0.049	-0.051	-0.030	-0.052	-0.018
	(0.041)	(0.064)	(0.054)	(0.069)	(0.080)	(0.085)
4th quartile	0.018	0.092**	-0.026	0.028	-0.158***	-0.208***
	(0.038)	(0.043)	(0.031)	(0.055)	(0.026)	(0.027)
Year FE	yes	yes	yes	yes	yes	yes
Commuting zone FE	yes	yes	yes	yes	yes	yes
Occupation FE	yes	yes	yes	yes	yes	yes
Industry FE	yes	yes	yes	yes	yes	yes
Individual FE	yes	yes	yes	yes	yes	yes
Obs.	49957	49957	36397	36397	36397	36397
Ind.	15598	15598	11781	11781	11781	11781

Note: The dependent variables are an indicator for employment, the natural logarithm of annual wages in full-time equivalents, and an indicator for occupational changes. The coefficients represent the estimates of the effect of a one-standard-deviation increase in the commuting zone- and occupation-specific number of CBWs. The estimated effects are obtained by interacting the treatment variable M_{rot} with the variable S_{ot} containing the different quartiles of the occupational skill specificity distribution. In the 2SLS estimations, the interaction terms $M_{rot} \times S_{ot}$ are instrumented by $\widehat{M_{rot}} \times S_{ot}$. Industry FE are at the one-digit industry level. Occupation FE are at the two-digit occupational level. Standard errors in parentheses clustered at the levels of the initial commuting zone. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source: Authors' calculations based on the SESAM/SLFS data and data from the Cross-Border Commuters Statistics (FSO)