Do immigrants take or create residents' jobs? Quasi-experimental evidence from Switzerland

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Abstract

We estimate the causal effect of immigration on unemployment, employment and wages of resident employees in Switzerland, whose foreign labor force has increased by 32.8% in the last ten years. To address endogeneity of immigration into different labor market cells, we develop new variants of the shift-share instrument that exploit only that part in the variation of immigration which can be explained by migration push-factors in the source countries. While OLS estimates suggest that immigrants have crowded out natives, our quasi-experimental results reveal that immigration has in fact reduced unemployment and increased employment of residents in the last decade.

JEL-Classification: F22, J21, J61; Keywords

Immigration, native employment, labor shortage, shift-share instrument

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1 Introduction

Do immigrants crowd out resident employees or do they plug gaps in the resident workforce, thus raising the productivity and job chances of the latter? Both scenarios are conceivable on a theoretical basis and so only the data can tell which one is more relevant for a given country and time period. The prominent approach to estimate labor market impacts of immigration on native workers is to partition the labor market into different labor market "cells" and to correlate differences in the extent of immigration with labor market outcomes of resident employees in those cells. Different studies have used different cell definitions, including education-experience [Borjas, 2003, 2006], region-occupation [Card, 2001, Orrenius and Zavodny, 2007, Glitz, 2012] and region-education cells [Altonji and Card, 1991].[1] We define cells by occupation and age group on the national level, rather than in terms of regions, so as to minimize the role of outflows of native employees out of the cell.

Regardless of the cell definition, however, two problems arise when such cross-cell comparisons are to be interpreted as the causal effect of immigration on the resident workforce: endogeneity of immigration, and spillovers of the effects of immigration across cells. We address the first problem with three new variants of the shift-share instrument, exploiting only *that* part of the variation in immigration that can be explained by push-factors in immigrants' countries

[1] For recent overviews of the literature of the impact of immigration on the labor market, see Blau and Kahn [2012] and Okkerse [2008]. An alternative to exploiting quasi-experimental variation in immigration is a more structural approach as pioneered by Borjas [2003] and refined by Ottaviano and Peri [2012] and Manacorda et al. [2012]. This approach imposes structural assumptions on the demand of labor using a production function, estimates the relevant elasticities of substitution between different types of labor, and subsequently simulates the wage effect of the increase in labor supply of foreigners. Gerfin and Kaiser [2010] have examined the Swiss case using such an approach. For a critical assessment of this literature see Card [2009].

of origin. We also investigate how results change when we explicitly account for cross-cell spillovers, exploiting how employees in each sector are distributed across the different occupation-age cells. We find that after accounting for endogeneity and cross-cell spillovers the effect of immigration on residents in Switzerland is on average one of complementarity, rather than of crowding out.

The first identification problem, endogeneity of immigration, arises for instance because immigrants might select labor market cells with good economic prospects and high labor demand, giving rise to a coincidence of high immigration and high resident employment growth, which one might mistake for evidence of complementarity between immigrants and residents. The methodologically ideal response to this problem would be to have border officials throw a dice to determine which labor market cells immigrants are allowed into, but of course such a research design is not feasible in practice. A possible alternative to such an experiment are quasi-experimental methods that exploit only that part of the variation in total immigration to a country which is due to migration push factors in the countries of origin, which are unrelated to labor market shocks in the labor market segment of the destination country. For instance, Friedberg [2001], and Cohen-Goldner and Paserman [2011] use the fall of the Iron Curtain, Hunt [1992] the repatriation of French-Algerians following the end of the colonial rule of France, and Card [1990] the immigration of Cubans after the Mariel boat lift to construct instrumental variables for immigration based on push factors of migration.

While these methods have allowed overcoming the endogeneity problem and have led to clean identification of the effect of immigration on the labor market, these methods are often enough only applicable to the very specific situation in question [Blau and Kahn, 2012]. Researchers that are interested

in the labor market effect of immigration for a specific country and time period might not have a natural experiment at hand that leads to exogenous variation in immigration. A possible solution in this case is the instrumental variable (IV) approach suggested by Altonji and Card [1991] and refined by Card [2001]. The idea is to build labor market cells in terms of regional labor markets (states or or metropolitan areas) and to exploit the finding of Bartel [1989] that immigrants tend to seek connection to earlier immigrants from the same country of origin, and therefore move to regions where many fellow compatriots already live. The problem of this approach are native outflows, i. e. the possibility that resident workers react to the immigrant inflows by leaving the preassigned labor market cell. If such outflows occur, a researcher that correlates immigration inflows into a cell with employment or wages of residents in the cell would underestimate the effects of immigration on natives, as the actual impact of immigration is spread across the predefined cells. While the possible importance of native outflows is subject to debate for countries as large as the US [Borjas, 2003, 2006, Card and DiNardo, 2000, Card, 2001], native outflows clearly are an important concern when the "spatial approach" is applied to small open economies.

This paper therefore develops a more broadly applicable IV strategy in the spirit of the shift-share instrument by Altonji and Card [1991] that is tailored to examine the labor market impact of immigration in small open economies, particularly because it is robust to native outflows. Focusing on a national labor market and on labor market cells defined in terms of occupation and experience, the concept of our instrument is to predict, for each year and cell, total immigration as the sum of predicted immigration into that cell from each country of origin. The country-cell element itself is given by the total

immigration into Switzerland from that country, multiplied by a time-invariant distribution of how immigrants from a given source country are distributed across occupation-experience cells.

We propose three methods to compute that time-invariant distribution, so that we end up with three related instruments. The first instrument follows previous work such as [Hunt and Gauthier-Loiselle, 2010, Card, 2001] in using a historical distribution from before our sample period, while the second instrument uses the average distribution across all sample years. The third instrument, by contrast, relies on the distribution of the labor force within each source country of immigration. Thus the source of the variation across years and cells in our instrumental variable originates in year-on-year changes in the numbers of immigrants hailing from the different source countries, while the three variants of the distribution translate those national into cell-specific shocks. Time invariance of that translation is important: in a year with high demand for engineers, the fraction of immigrants from each country who are engineers will typically be above the average, but our instrument will only pick up the fraction of immigrants from that country who would be coming in an average year, thus ignoring the component that is endogenous.

The second identification problem addressed in this paper that arises when comparing the labor market outcomes of natives across cells is that, depending on how cells are defined, immigration into one cell may affect outcomes also in another cell because of substitution effects or complementarity across cells, invalidating the latter as a suitable control group absent adequate corrections for such spillovers. In the terminology of the program evaluation literature, such spillovers constitute a violation of the "Stable Unit Treatment Value Assumption" (SUTVA).

A possible way to consider cross-cell interactions in a regression framework is to explicitly control for those immigrants into other labor market cells for which the existence of cross-cell interactions is likely. We argue in line with previous research that given our definition of cells in terms of age and broad occupational groups, there exist two possible cross-cell interactions to be considered: the elasticity of resident employment on immigration of foreign employees with similar occupation but different age, and the elasticity of resident employment on immigration of foreign employees with similar age but different occupation. To our knowledge, no study applying a regression approach to estimate the effects of immigration on the labor market has shown whether cross-cell effects influence the estimated elasticities.

Our empirical application is concerned with the case of Switzerland which has recently been subject to an influx of foreign workers of extraordinary magnitude. The case of Switzerland is interesting for at least two reasons. First, a substantial share of the immigrating employees have been highly skilled, which is in contrast to the situation analyzed in most previous studies of the labor market effects of immigration, mainly examining episodes of large-scale immigration of low-skilled workers. Switzerland's experience might thus exemplify the potential labor market effects of high-skilled immigration in an advanced knowledge economy. Second, the main driver of immigration to Switzerland is labor shortage. We are not aware of any study analyzing the labor market effects of immigration in a situation in which immigration is equally determined by the needs of firms to fill their vacancies.

Our results confirm that on average Switzerland's native workforce benefits from immigration. In particular, our quasi-experimental estimates suggest that a 10% increase in the share of newly hired foreign workers relative to the

resident workforce reduces resident unemployment by 1.5 to 2% and increases resident employment by a similar share. The study shows that these findings are neither influenced by native outflows, nor by cross-cell effects. Our results support the claims of many state officials and business representatives that immigration of mostly high-skilled employees to Switzerland does not harm (average) wages while improving job opportunities of the resident workforce by limiting job outsourcing in the face of skill shortages and by increasing the competitiveness of the economy.

2 Context

Between 2002 and 2011, Switzerland's foreign resident population grew on average by 2.4% percent *annually*. Relative to the resident population, no other OECD country had a larger immigrant inflow than Switzerland in 2010 (cf. Figure 1). As a large share of the foreign population immigrated due to work reasons[2], the foreign labor force in Switzerland's labor market grew by 351,737 persons (+32.8%) between January 2002 and December 2011, which is more than the increase in the total labor force of Swiss citizens (+322,971 persons, 71% attributable to naturalization), and which is a substantial influx in relation to the total of 4.27 million employees in January 2002.

The "new immigration wave" to Switzerland is linked to the enactment of a Free Movement of Persons Treaty (FMP) with the EU/EFTA states in June 2002 that gradually led to a full liberation of immigration from these countries. On the one hand, the FMP shifted the region of origin of immigration to

[2]From 2002 to 2011, 47.2% of all permanent immigrants held a job when immigrating to the country according to data from the Federal Office for Migration. In the case of the non-resident population, this fraction amounted to 87%.

Switzerland: while nearly total net migration to Switzerland in the 1990s could be attributed to non-EU European, especially ex Yugoslavian countries, 75% of the net increase in the foreign resident population between 2000 and 2010 is due to immigration from EU member countries. On the other hand, the FMP is also likely to have fostered the shift away from immigration of mostly low-skilled immigration in the 90s towards high-skilled immigration in the new decade [SECO et al., 2012]. Since 2002, the average formal qualifications of the immigrants exceed those of the resident workforce.[3]

Considering the magnitude of the inflow, it is not surprising that workers and unions are concerned about potential negative labor market effects. Yet, most state officials, business representatives and employer organizations deny that the immigration of foreign employees displaces native workers or reduces their wage. They argue that the inflow of highly skilled employees to Switzerland occurs because of a lack of qualified resident employees, and that the immigrants and the treaty hence do not only increase competitiveness and productivity in the country, but also prevent firms from outsourcing jobs, thus benefiting resident workers.

Several studies have examined the labor market effects of the new immigration wave to Switzerland in general and the effects of the introduction of the FMP in particular. Most of these studies do not find evidence that wages of low-skilled employees are affected by the inflow, while some papers find modest negative effects on wages of high-skilled employees [Gerfin and Kaiser,

[3]Only 20% of the permanent immigrants to Switzerland from 1986 to 1995 had a tertiary education. From 2002 to 2011, this share was 51% [SECO et al., 2012]. In 2010, 52% of all German citizens between 25 and 64 years living in Switzerland had a tertiary education compared to 29.6% within Switzerland's population of this age according to the Swiss Labor Force Survey.

2010, Favre, 2011, Cueni and Sheldon, 2011].[4]

However, the fact that most studies do not find significant effects of the immigration influx on wages of resident workers might be due to the fact that wages are fairly downward rigid in Switzerland [see Fehr and Goette, 2005, Puhani, 2003]. Thus, much of the labor market effects of the increase in labor supply may have occurred in employment and unemployment rather than wages.[5] This study therefore focuses on the impact of the immigration inflow on unemployment and employment of Swiss residents.

3 Methodology

3.1 Specification

We segment the labor market by occupational groups rather than geographical regions as this reduces the problem of native outflows, prevalent in a small open economy setup like Switzerland. This is because it is more difficult for employees to change their occupation than their regional labor market as a reaction to immigrant inflows [cf. Card, 2001, Favre, 2011, Orrenius and Zavodny, 2007]. We illustrate this fact in Section A.2 of the Online Appendix by showing that immigrant inflows are indeed unrelated to native outflows in our cells.

To account for the fact that workers with differences in work experience are imperfect substitutes, we segment each occupational group using the age

[4]This view has recently been questioned by Henneberger and Ziegler [2011] who examine wages of newly hired employees.

[5]In a similar vein, recent studies have highlighted that also other labor and product market institutions might play a crucial role in moderating wage and increasing employment effects of immigration [cf. Brücker et al., 2012, Prantl and Spitz-Oener, 2012].

of the labor force. Partitioning cells in terms of age approximates the fact that workers with different work experience are imperfect substitutes [Borjas, 2003]. We use 9 age groups, and occupations are grouped according to 9 major groups (i. e. the first digit) of the International Standard Classification of Occupations 1988 (ISCO-88), yielding a total of 81 "skill groups" in the Swiss labor market.[6]

Our empirical specification closely resembles the one of Orrenius and Zavodny [2007]:

$$\Delta log(O_{it}) = \alpha + \beta \Delta log(I_{it}/LF_{it}) + \gamma \Delta X_{it} + \tau T_t + \epsilon_{it} \quad (1)$$

In this equation, $\Delta log(O_{it})$ represents the growth in the economic outcome of interest (e.g., the growth of the absolute number of unemployed or employed native workers or the increase in their wage) in skill group i and year t. T_t are time fixed effects that capture all aggregate effects affecting the growth of the outcome of interest equally across cells. We run most of our estimations in first differences for reasons outlined below. In regressions in first differences, skill group specific effects are automatically accounted for. I_{it}/LF_{it} is the central independent variable in the regressions and indicates the number of newly hired foreign employees with a given skill group relative to the resident (native and foreign) labor force in that skill group. We consider the inflow of foreign employees taking permanent residence I_{it}^r (i. e. workers with a residency permit for more than one year), and the total influx of labor consisting of I_{it}^R, the inflow of foreign employees taking nonpermanent residence I_{it}^{NR}, and

[6]The nine age categories that we define are 15-24 years, 25-29 years, 30-34 years, 35-39 years, 40-44 years, 45-49 years, 50-54 years, 55-60 years and 60 and more years. A robustness test in the Online Appendix shows that our results are not driven by the relatively narrow grid for the age groups. We work with 9 instead of 10 broad occupational groups because ISCO major group 0 ("Armed Forces") is quantitatively irrelevant in our application.

the number of new cross-border permit holders I_{it}^{CB}. If a labor market cell experiences an influx of foreign employees within a given skill group, this fraction rises, reflecting the increase in the relative labor supply of immigrants. We log this fraction because the empirical analysis in logs proved to be more robust and because we can then interpret our estimates of β as elasticities, i. e. the coefficients indicate the average percent change in the outcome of interest for a 1 percent increase in the share of immigrating foreign employees to the total resident labor force in the cell.

Finally, X_{it} represents the vector of control variables. This vector comprises the one-year lagged first difference in the ratio of tertiary to primary educated resident employees in the cell (rescaled by $1/100$) and the first difference of the share of state workers in the occupational group in a given year. The motivation to include the latter regressor is that state workers are significantly less subject to unemployment [Rolf Schenker and Martin Straub, 2011] and, moreover, immigration of foreign employees in the cell is weakly positively related to the share of state workers in the cell.

An important concern with the above regressions is related to its specification. In particular, we regress a stock variable (e.g., the log of the number of unemployed persons) on a flow variable relative to a stock (immigrant inflows relative to the labor force).[7] This specification, however, might lead to an omitted variable bias. In particular, certain skill groups might be characterized by higher labor turnover than others, for example due to a larger importance of seasonality effects. Immigrant inflows relative to the labor force are positively correlated with higher labor turnover. Furthermore, because for

[7]Outflows of foreign employees and hence stocks of foreign employees in the cell are not observed in the data. Note, however, that changes in the stock of foreign (resident) workers living for at least 1.5 years in Switzerland are, up to certain problems of measurement due to small sample sizes in the SLFS, mirrored in changes in LF_{it} (see section 4).

instance seasonality effects are more likely for low-skilled occupations, and unemployment is higher for low-skilled workers, there possibly exists a positive cross-cell correlation between labor turnover and the number of unemployed. To examine the severity of this problem, we computed, on a yearly basis and using the SLFS, average job tenure in the cells, motivated by the presumption that job tenure proxies for the extent of worker flows in the cells. Including this variable and its square in the regressions does not change our results. Similar comments apply for the share of female employees in the cell and the cell size (controlled for by including the lagged labor force size). Both control variable are mostly insignificant in regressions in first differences, and we therefore omit them from regressions in which they do not impact the coefficient of interest.

3.2 Accounting for endogeneity

Endogeneity of immigration is a concern in the above regression. For example, if the labor market in certain cells is characterized by a shortage of skilled labor, then the coincidence of low hiring of resident workers together with a high influx of new foreign employees just mirrors the lack of qualified employees in the cell and not the negative or positive effects of immigrants. Note that part of this bias will already be controlled for by estimating the regression model in first differences because first differencing removes all time-invariant cell-specific factors affecting unemployment, among others constant differences in labor shortage across cells. A further step to remove the possible bias is to instrument (I_{it}/LF_{it}) by a variable that is, first, correlated with the change in the share of immigrating foreign employees relative to the total resident labor force and, second, uncorrelated with changes in the dependent variable (unemployment, employment or wages) other than through the immigration

channel, conditional on the covariates ΔX_{it} (i. e. the exclusion restriction must hold).

The main idea of our instrumental variable strategy is to exploit changes in the share of immigrants from specific countries of origin in the total number of immigrants to separate pull- from push-driven migration to Switzerland. Figure 2 illustrates this point. The figure plots the relative share of the number of immigrating foreign employees from six different source regions in the total number of immigrating foreign employees in Switzerland from 2002 to 2011. These six regions of origin are Southern Europe (Greece, Italy, Portugal, and Spain), Iraq, Haiti, the Horn of Africa (Somalia, Ethiopia and Kenya), eight European countries joining the EU in 2004 (EU-8: Poland, Hungary, Czech Republic, Slovenia, Slovakia, Estonia, Lithuania, Latvia) and the two newest EU countries (EU-2: Romania and Bulgaria). The first four of these regions were hit by negative shocks to different migration push factors throughout the last decade. For instance, Greece, Portugal, Spain, and Italy go through an economic crisis since 2008. The recessions in these countries led to a substantial increase in the number of immigrating foreign employees from these countries relative to the total number of immigrating foreign employees, after having decreased for several years. Also the Iraq War, the severe earthquake in Haiti in January 2010, or the devastating famines in the Horn of Africa in 2006 and 2008 are mirrored by (lagged) increases in the relative weight of work-related immigration from these regions in total work-related immigration. The relative increases of immigrating foreign employees from the last two source regions, the EU-8 and EU-2, in total immigration of foreign employees are attributable to changes in the strictness of the Swiss migration law for the population of these countries. In particular, mid-2006 (EU-8 countries) and mid-2009 (EU-

2) mark the beginning of the gradual introduction of free movement of persons between Switzerland and these countries. The institutional changes facilitate the influx of workers and are mirrored in substantial subsequent increases in the relative importance of immigration from these countries.[8]

The discussion illustrates that if one observes shifts in the composition of source countries of immigration of foreign employees to Switzerland, they can be attributed to changes in the economic, demographic, political or cost determinant that affect out-migration in the countries of origin—the compositional shifts provide a summary measure of changes in push factors affecting migration to Switzerland. This proposition holds because Switzerland as a small open economy exerts negligible influence on the economic situation in the countries of origin of its immigrants. Hence, changes in the cell-specific economic situation in Switzerland (i. e. shocks to ϵ_{it}) affect all countries homogeneously—they should not alter the country-composition of immigration of foreign employees observed in Switzerland, except for the two cases discussed below.

In the regression framework outlined above, it is straightforward to implement the idea of using shifts in the composition of immigrant's countries of origin to separate push- from pull-driven immigration. The most important step is to replace, for each country of origin, actual inflows into each cell by a prediction based on a *time-invariant* distribution of workers across the cells. This prediction will be used as instrument for actual immigration into each cell.

To understand this proposition, let us formalize our approach. Let π_{ij} be

[8]When immigration from the EU-8 is fully liberalized in June 2011, the importance of immigration of foreign employees from these countries again considerably increases.

a time-invariant share of workers from country j in skill group i derived from the time-invariant distribution of workers from country j across cells. These shares sum to one over all skill groups for each country ($\sum_i \pi_{ij} = 1$). Moreover let I_{ijt} be the actual number of immigrants in each skill group from country j in year t, and $\bar{I_{jt}}$ the total number of immigrants from that country in a given year across all skill groups, i. e. $\bar{I_{jt}} = \sum_i I_{ijt}$ Then our prediction PI_{ijt} of the number of immigrants from a certain country j in skill group i and year t is

$$PI_{ijt} = \sum_i \pi_{ij} \bar{I_{jt}} \tag{2}$$

The country-specific predictions are then aggregated over certain or all countries of origin of immigrants for each year, and we normalize the predictions with the resident labor force size in the cell, similarly as we do with the immigration variable. This yields our instrumental variable for $log(I_{it}/LF_{it})$:

$$log(\frac{\bar{PI}_{it}}{LF_{it}}) = log(\frac{\sum_j PI_{ijt}}{LF_{it}}) \tag{3}$$

As we only want to exploit *changes* in the composition of immigrants' countries of origin and not the composition itself, the regression of equation (1) using (3) as instrument has to be run in first differences such that constant differences in the predicted number of immigrants between any two pairs of skill cells do not affect the regression results. Additionally, we also need to control for year fixed effects because note from combining equations (2) and (3) that $\Delta\bar{PI}_{it}$ can vary over time because of two different reasons: first, due to changes in the composition of the number of employees that immigrate from different countries; and second, due to changes in the total number of immigrants from all countries. As we only want to exploit that variation in

our instrument which is due to compositional shifts, it is necessary to control for year fixed effects that absorb changes in the total number of immigrating foreign employees each year.

There are two cases where shifts in the country-composition of immigration of foreign employees in Switzerland might be related to cell-specific shocks. Firstly, as the discussion about the EU-8 and EU-2 countries in the context of Figure 2 has shown, changes in the law that facilitate labor mobility between Switzerland and certain countries of origin might increase the countries' relative share in total work-related immigration to Switzerland. However, such changes might also differentially affect the cell-specific economic situation in Switzerland. To circumvent this endogeneity problem, our instrument does not exploit variation arising from changes in the tightness of the immigration law. We achieve this by building separate predictions ($\bar{P}I_{it}$) for three groups of countries that have not been *differentially* affected by changes in the migration law in the period under examination.[9] By including the predictions as three separate instruments in the regressions below, we only exploit variation that arises due to shifts in the country-composition *within* the sets of countries. This approach has the additional advantage of enabling tests of overidentification.

The second potential endogeneity problem of our instrument is minimized by appropriately constructing the country-specific cell-shares π_{ij}. Specifically, compositional changes in the immigrants' countries of origin would be related to pull factors of migration if a (productivity) shock that *differentially*[10] affects

[9]These groups of countries are the EU-15 countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and United Kingdom), the EU-8 countries (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Slovakia, and Slovenia), and the non-EU27 countries (rest of the World).

[10]Shocks that affect all cells equally are captured by year fixed effects. In some regres-

the occupation-age cell leads to shortage of a specific type of labor that is supplied in a few specific countries of origin only. For example, a positive productivity shock in engineering might be followed by an increase in the relative share of immigrants from Germany, as Swiss firms preferably employ highly qualified engineers from Germany. This problem can to a large extent be dealt with by using cell shares π_{ij} that are plausibly unrelated to yearly variation in the cell-specific labor market situation in Switzerland. In this case, our prediction replaces any one-time increase in the relative importance of cell-specific immigration from a specific country that might be due to pull factors of migration (i. e. shocks to ϵ_{it}), and distributes such an effect across all cells where workers from the specific country "normally" immigrate.

3.3 Three related shift-share instruments

We propose three different methods to construct the constant country-specific cell-shares π_{ij}. The first approach is to derive the shares from a "historical" distribution of foreign workers across occupation-age groups in the Swiss labor market. To implement this strategy, we use data from the Swiss population census of 1990.[11] Replacing actual with predicted immigration across cells exploits the persistence of the correlation between the distribution of foreign employees from a specific country across occupation-age cells in 1990 and the distribution of immigrants from the same country across cells in the years from 2002 to 2011. Arguably, the distribution of foreign workers across occupation-age cells in 1990 is unrelated to cell-specific shocks that would lead to year-on-year shifts in the composition of countries of origin of immigrants 12 of more

sions, we also include occupation-year fixed effects. In these regressions, endogeneity can only arise if the shocks differentially affect age groups within occupational groups.

[11] We only consider countries that either belong to the current EU/EFTA states or to countries with at least 100 resident employees in Switzerland in 1990.

years later. In this specification, the instrument is computationally similar to the instrument employed by Hunt and Gauthier-Loiselle [2010] in their study on the effects of immigration on innovation. They and studies such as Altonji and Card [1991] and Card [2001, 2009] build labor market cells in terms of regional labor markets (states or or metropolitan areas) and exploit the finding of Bartel [1989] that immigrants tend to seek connection to earlier immigrants from the same country of origin, and therefore move to regions where many fellow compatriots already live. We argue that a related pattern can be exploited in an analysis based on occupation-age groups as it is likely that a historical distribution of foreign workers from a specific country across occupation-age groups is similar as the distribution of new immigrants from that country across the groups even many years later [cf. also Favre, 2011].[12]

A second strategy to derive the shares π_{ij} is to use the distribution of the labor force across occupation-age groups in immigrants' countries of origin in a certain base year. The motivation here is simple: if out-migration from a certain country occurs because of push-factors of migration, the distribution of migrants from this country across cells is likely to be related to the distribution of its labor force across cells. Moreover, using the shares will again distribute unobserved productivity shocks leading to changes in the country-composition of work-related immigration to Switzerland broadly across cells.[13]

[12]First, historical networks play an important role when firms recruit new employees. If, for example, firms have made positive experiences when recruiting German craftsman, it is likely that they continue hiring German craftsman also in the future. Second, the chances that a worker is looking for a job in a specific destination country and occupation increase because of informal networks [Favre, 2011]. Third, if we observed a specific distribution of immigrants from a certain country of origin across occupation-age groups in the past, it is likely that immigrants in later years will be similarly distributed across these cells simply due to the fact that the educational system and industrial structure of the country of origin of foreign workers—and hence the skill composition of workers from a country—do not change rapidly.

[13]This data-demanding approach is feasible for Switzerland because the Labor Force

Finally, the shares π_{ij} can also be computed from the sample distribution of the immigrants across occupation-age cells. In this case, we simply sum up, per country of origin, the number of immigrants per cell over the ten years in the sample, and relate these cell-specific sums to the overall number of immigrants from this country across all cells and years.

The advantage of using the first and the second approach is their arguably higher internal validity, i. e. these strategies remove the correlation between the relative extent of immigration from a specific country and unobservable cell-specific pull shocks that change the country-composition of immigration to Switzerland. The disadvantage is that the country-specific distribution of workers across cells observed in 1990 as well as the distribution of the labor force across cells in the countries of origin in 2000 might not be representative of the actual distribution of immigrants across cells observed during the sample period. This might be a concern, for example because the occupational mix of work-related immigration to Switzerland changed from predominantly low- to more and more high-skilled during the 1990s. As a consequence, high-skilled immigrant inflows are not mirrored in most country-specific predictions made with the historical distribution of 1990, and immigration of high-skilled workers caused by migration push factors are not adequately contained in the estimated local average treatment effect (LATE) of the instrument.

Therefore, an important advantage of simply employing the "in-sample" distribution over the two other approaches is that it might increase the external validity of the IV estimates, since the sample distribution of immigrant workers across cells mirrors the actual skill mix of immigration in the period

Survey (LFS) of Eurostat provides harmonized cell-specific employment and unemployment figures for most EU countries since the late 1990s, and the EU member countries are the major countries of origins of immigration of foreign employees to Switzerland. We use the year 2000 as our base year. The qualitative results, however, do not depend on this choice.

under examination. The possibly higher external validity of the IV estimate, however, comes at the cost of a smaller internal validity, since substantial and persistent cell-specific labor demand shocks may influence the country-specific distribution of immigrants across occupation-age cells, even if the distribution is an average across several consecutive years.

Generally, however, overidentification tests and the point estimates below suggest that it does not matter which strategy is employed to construct the instrument: the estimated elasticities are very similar in all three cases. This finding might not be very surprising. Firstly, within the same occupational group, the variation in our instrument essentially originates in cross-country differences in the age of the labor force of different countries of origin of immigrating employees. These differences are exogenous to the labor market situation in Switzerland. Secondly, substantial pull shocks that differentially affect *occupational groups* are rather unlikely because shocks to labor demand occur to firms or to industries. As our occupational groups are broadly distributed across different firms and industries, firm- and industry-specific productivity shocks are not likely to have a strong differential effect on our cells and are thus mainly controlled for by year fixed effects.

4 Data

Table 1 provides summary statistics of the most important variables used in this study. It also indicates the different data sources used to construct cell-specific averages.

Figures on immigration into Switzerland are from the central migration information system (*Zentrales Migrationsinformationssystem*, ZEMIS). The

ZEMIS is in fact a continuous census of the foreign resident and nonresident population in Switzerland. In particular, the ZEMIS provides a complete count of the number of *immigrating foreign employees* into our skill groups for any given year since 2002, i. e. it indicates personal characteristics of immigrating employees such as their country of origin, sex, age, residency permit, and their occupation.[14] In the regressions below, we will separately analyze the effects of three different kinds of inflows of foreigners to the Swiss labor market: the inflow of immigrating employees taking permanent and nonpermanent residence, respectively, and the inflow of new cross-border workers.[15]

Since the ZEMIS is a complete count of immigrants to Switzerland, the cell-specific numbers of immigrating foreign employees are not subject to measurement error as is a major concern for many other studies that use data from households surveys to compute the average number of foreign workers in the labor market cells.[16]Another advantage of our data is that we can correctly

[14]Two comments on the ZEMIS data are in order. Firstly, the ZEMIS does not provide the net increase in the number of foreign employees within our cells. The problem is that foreigners that leave the workforce or that leave the country are not obligated to report the change in their employment status. Our variable thus measures inflows into the skill groups in relation to the total labor force (where outflows of foreign workers are contained). Secondly, the ZEMIS employs the Swiss Standard Classification of Occupations 1990. We therefore have to recode the 5-digit occupation codes of the Swiss classification into the 4-digit ISCO-88 classification using a key that translates the two classifications into each other. The key is, however, not one to one, which introduces certain imprecision. This is not a great concern for two reason. First, we just use the first digit of the ISCO-88 classification, and the imprecision in the reclassification is small on this level. Second, most of our regressions are run in first differences. Constant errors in the assignment of occupations to the ISCO groups are hence not relevant for the analysis.

[15]The latter phenomenon is quantitatively important in Switzerland. In 2011, cross-border workers made up 5.2% of the total labor force, increasing from 3.8% in 2002.

[16]A recent paper by Aydemir and Borjas [2011] has demonstrated that even if the researcher has more than 100 observations per cell to estimate average immigrant inflows into cells, the regressions of interest can have a severe attenuation bias. Note, however, that cell-specific immigration I_{it} is normalized by the cell-specific labor force size (LF_{it}), which is mainly driven by cell-specific employment computed from the Swiss Labor Force Survey (see below). To reduce possible problems of measurement error in the denominator of the variable of interest arising because of small cell sizes in the SLFS, we use a two-year moving

assign immigrants to labor market cells upon arrival because the assignment is determined by the actual job they found in Switzerland. Thus, our estimates do not suffer from the problem that immigrants may change the labor market cell and compete with natives in another labor market than to which they had been assigned based on observed qualifications [cf. Dustmann et al., 2012].

Skill group specific employment of native workers as well as their earnings[17] are constructed using the Swiss Labor Force Survey (SLFS). The SLFS is a representative household survey conducted by the Federal Statistical Office (FSO) of Switzerland since 1991, covering, depending on the year, between 0.5 and 1.2% of Switzerland's labor force. It is a rotating panel in which households are surveyed for 5 consecutive years. The sample size of the SLFS has substantially increased over time. After elimination of the non-employed, of retirees and of persons belonging to the nonresident population, we are left with between 18,900 and 35,600 employees per year that we use to compute total cell-specific employment, mean log earnings, and all control variables mentioned above, applying the sampling weights from the SLFS when building the cell averages and counts. Foreign employees that belong to the resident population are included in these figures if they declare to live in Switzerland for at least 1.5 years. Hence, immigrant inflows occurring in year t neither affect the cell-specific labor force size (LF_{it}), nor any of the control variables in the vector X_{it} in the same year.

Our main outcome of interest, cell-specific unemployment of resident employees, was compiled by the State Secretariat for Economic Affairs (SECO)

average of the labor force size instead of just the contemporaneous labor force.

[17]Since the SLFS does not contain monthly or hourly wages, our wage measure is the full-time equivalent mean log yearly net nominal wage of employees. Similar as Ottaviano and Peri [2012], we exclude earnings of self-employed persons since self-employed earnings are subject to substantial reporting errors.

from its electronic database on unemployed persons in Switzerland (*Arbeitsmarktstatistik* AMSTAT). The database is a complete count of all unemployed persons registered at regional unemployment agencies in Switzerland in any month since 2004. The number of individual episodes of unemployment in our data varies between 101,000 in 2008 to 153,000 in 2004. The superior quality, sample size and reliability of this data compared to the data on (self-declared) wages from the household survey is also an important reason why the main focus of our study lies on the effects of immigration on unemployment rather than wages.

The data for our instruments are derived from two other sources. Firstly, country-specific historical distributions of foreign resident employees across skill groups are derived from data of the population census in 1990. Secondly, age- and occupation-specific unemployment and employment in the countries of origin of the immigrants—needed to construct the cell-specific labor force size in 2000—are from Eurostat's Labor Force Survey (LFS).[18]

5 Results

Table 2 provides WLS and OLS estimates of the level version of equation (1). The dependent variable is the log of the average number of unemployed persons in Switzerland over the whole year—an average from monthly counts for the years 2004–2011. All estimations include a set of year dummy variables that control for effects affecting all cells equally, such as for example GDP or

[18]In the case of employment, Eurostat allows partitioning ISCO-specific employment into certain age groups. These age categories are 15–24 years, 25–39 years, 40–49 years, 50–59 years and more than 60 years. However, our grid for the age groups is finer than the one of the LFS. We build cell-specific employment in the remaining categories by multiplying the number of persons in employment in an occupational group with the share of employees in the respective age group across all occupational groups.

the population size. Moreover, the regressions in Columns 2–4 also include 9 occupation and 9 age dummies. All estimations except the one in Column 3 weight observations according to their cell size[19], and standard errors are robust to clustering on the level of the labor market cell. All control variables included are significant and have the expected signs. The estimates of interest (i. e. the estimates of β presented in the first row) suggest that unemployment of resident workers increases ceteris paribus due to immigration of foreign workers. The point estimates of the elasticity in the third column implies that a 10 percent increase in the share of new foreign employees relative to the labor force size increases the number of unemployed natives by about 1.9%. The elasticity is smaller if the control variables are included (Column 1 vs. 2) or if observations are weighted (Column 2 vs. 3).

The last column in Table 2 shows the elasticity of native unemployment to the total inflow of foreign labor to Switzerland ($I_{it}^R + I_{it}^{NR} + I_{it}^{CB}/LF_{it}$). This elasticity is of slightly lower magnitude as the elasticities in the first three columns, indicating that the effect of all three forms of work-related immigration on native unemployment is slightly less negative than the effect of immigrating foreign employees joining the resident population only.

Thus, the WLS estimates displayed in the table suggest significant displacement effects of immigration in Switzerland. Note, however, that the estimations do not control for skill group fixed effects. This is problematic, since there are likely to exist time-invariant factors affecting cell-specific unemployment and the extent of immigration inflows simultaneously.[20] Such influences

[19]We use the average labor force size from 2002 to 2011 as weight of the respective cell. All estimations are qualitatively similar if one only uses the number of unemployed in the cell or would not weight observations at all. Generally, however, the weighted regressions are more robust.

[20]Most importantly, immigrant inflows to Switzerland as well as unemployment clearly

can be controlled for when the estimations are run in first differences. The results if this is done are shown in Table 3. Clearly, controlling for cell fixed effects has a substantial impact on the coefficient of interest: the elasticities in the differenced regressions have a negative sign. In other words, the regressions in first differences indicate that unemployment of native workers was actually slightly reduced by the inflow of foreign workers to Switzerland.

However, Column 3 shows that this result is not robust to the inclusion of occupation-year fixed effects. Such a regression controls for differential year-specific shocks to the growth of unemployment across our 9 occupations. In these regressions, the coefficient of interest is identified solely from changes over time in the effect of immigrant inflows across age groups within an occupational group. Given the endogeneity problem discussed above, it would be reassuring if the results withstood the introduction of occupation-year fixed effects.

Table 4 shows the impact of instrumenting the immigration variable using the proposed shift-share instruments. The F-statistic of tests of joint significance of all instruments indicate that the first stages are sufficiently strong in all specifications such that weak instruments are not a concern. The p-values of the Hansen J statistic suggest that the overidentifying restrictions are valid.[21]

follow an age-occupation pattern: for instance, immigrants to low-skilled occupations are substantially younger than immigrants to high-skilled occupations. But young and unskilled workers also have structurally higher unemployment than older and more skilled workers. This is potentially important in our case because immigrating employees to Switzerland are young—64% of all foreign employees immigrating to Switzerland are less than 34 years old—and either highly skilled or very unskilled.

[21] Table 9 in the Online Appendix provides the corresponding first stage regressions. The values of the partial R-squared in this table imply that our instruments exploit between 8 and 13 percent of the variance in the instrumented variable, which is the change in new foreign employees relative to the resident workforce. The relatively low partial R-squareds are sensible as push-driven migration of employees to Switzerland is more the exception than the rule.

The 2SLS estimates in the table suggest that immigration of foreign employees has reduced unemployment of resident employees in Switzerland. The point estimates in the first three columns imply that a 10 percent increase in the fraction of new foreign employees relative to the labor force decreases the number of unemployed natives by approximately 2%. The estimations in these columns only differ in the way the constant shares π_{ij} are computed used to predict country-specific immigration into each skill group. The first column uses data from the population census 1990, the second column employs in-sample averages for each country of origin over the ten years for which country-cell-specific immigration data is available, and the third column applies shares computed from the distribution of the labor force across the cells in immigrants' countries of origin. Column 5 shows that the effect of the total inflow of foreign labor on unemployment of residents are similarly positive and of similar magnitude.[22]

Two comments on these results are in order. First, it is not surprising that all three variants of the instruments yield similar results concerning the instrumented variable: as long as the time-invariant distribution is not affected by cell-specific labor demand shocks that alter the country-composition of migration to Switzerland, the variation of the instruments is from the same source—it stems from changes in the relative weight of countries of origin in immigration to Switzerland. Thus, the results also substantiate our claim that year-specific labor demand shocks that differentially affect occupational groups are a second-order concern.

Second, all estimated elasticities are robust to the inclusion of a set of

[22]In this case, we build separate predictions for the inflow of cross-border workers and immigration of foreign employees taking nonpermanent residence in the same way as we do for the inflow of permanent foreign employees.

occupation-year dummies that control for occupation-specific trends in the growth of unemployment and year-specific shocks to the growth in the number of unemployed within the 9 occupational groups. As discussed above, the coefficient in Column 4 is effectively identified on variation in the growth of unemployment across age groups within an occupational group. This naturally carries over to the first stage: in this regression, we only exploit variation in predicted immigration that arises because changes in the country-composition of immigration to Switzerland lead to shifts in the way we predict immigration to vary across the 9 age groups. Thus, the instrument basically exploits demographic differences in immigrants' countries of origin.

Tables 6 and 7 contain the results for the two other outcomes of interest considered in this paper: the log of the number of employees and mean log yearly net nominal earnings in the cell, respectively. Both, the cell-specific average wage and the number of employees are constructed from the SLFS. In contrast to the unemployment data which is a complete count from administrative registers, the cell-specific number of employees and their wage are hence just a sample estimate calculated from a household survey. Moreover, since the SLFS is conducted in the second quarter of the year, we regress the two outcomes on the total inflow of foreign employees in the year before. Both facts introduce imprecision to the estimation of the elasticities. The sample covers, on the other hand, now also the years 2002 and 2003.

In the case of employment, the first difference estimates suggest that inflows of foreign employees in the last year do not significantly affect employment of natives in the second quarter. Instrumenting lagged growth in the number of new foreign employees relative to the labor force shows that immigration of foreign employees has indeed increased employment of natives in Switzerland.

The elasticities suggest that a 10 percent increase in the share of new foreign employees in the labor force increases the number of resident employees by 1.2 to 2.8%. Since the number of unemployed is about 1/20 of the number of employed workers, the estimated elasticities of unemployment and employment with respect to immigration of foreign employees imply that the major impact of the immigrant influx on the labor market was to increase the resident labor force, i. e. to increase labor market participation of resident workers.

By contrast, we do not find any significant effects of the immigrant influx on wages, although all point estimates are positive. This result might partly emerge because nominal wages in Switzerland are rigid, and adjustments to the increase in labor supply occur along employment. However, it might also be due to the relatively poor quality of the wage data of the SLFS [cf. the discussion about reporting error in the SLFS in Fehr and Goette, 2005].

An important particularity of our case study is that instrumenting migration inflows *increases* the *positive* effects of immigration on unemployment and employment of resident workers. Most previous studies on the effects of immigration on the labor market found that conventional (OLS) estimates *understate* the *negative* effects. This finding need not imply that labor demand is upward sloping in Switzerland. It can be explained by the fact that immigration to Switzerland mainly takes place in occupations where there is shortage of resident workers. In a wage survey by *UBS [2010]*, 72% of the sampled Swiss firms reported that the reason for recruiting foreign personnel is shortage of resident employees. Clearly, if the main driver of work-related immigration to Switzerland is labor shortage, OLS estimates might overestimate the negative effects of immigration because cells experiencing substantial inflows of foreigners in a specific year are likely to display low hiring of resident work-

ers, ceteris paribus. Using push-driven migration overcomes this endogeneity problem arising from labor demand. Moreover, reduced labor shortages also provide an explanation for the beneficial effects of immigration in Switzerland: if immigration is due to labor shortages, we would not only expect that immigrating foreign workers are largely complementary to the resident workforce, but might also expect that firms face reduced unit labor costs ceteris paribus (e.g., through decreased recruitment costs), causing an upward shift of their labor demand curve.

In Table 5, we analyze the question whether there are heterogeneous effects of the inflow of permanent foreign employees on unemployment and employment, respectively, for certain subgroups of the resident population. All coefficients are derived from separate 2SLS estimations for each of the subpopulations.[23]

The tables demonstrate that not all resident employees have equally gained from the immigrant inflow—although there were no losers. Similar to other studies that analyze recent immigration to Switzerland (Henneberger and Ziegler [2011], SECO et al. [2012]), we find evidence that the labor market situation of foreign resident employees in Switzerland is less positively affected by the influx of foreigners, suggesting that foreign workers are closer substitutes to immigrating employees than Swiss citizens. Pertaining to skill groups, high-skilled workers clearly profit more in terms of employment than low-skilled workers, but the picture is reserve pertaining to unemployment. Similarly, while young workers benefit more in terms of increased employment than old workers, old workers gain relatively more in terms of reduced unemployment than young workers.

[23]The elasticities are estimated using the same specification and instrument set as in Columns 3 of Table 4 and Table 6, respectively.

Finally, we analyze the question whether the effect of immigration has been stable over time. In particular, the free movement regime with the EU-15 countries became only fully effective in mid-2007. Prior to this date, filling a vacancy with an employee from an EU-15 country was still partially restricted, particularly because employers had to provide evidence not to find a resident employee for the job (until 2004) and because of binding quotas on the total number of immigrants. These regulations expired after June 2007. Since then, EU-15 and Swiss workers are on equal legal footing on the labor market. Particularly in the case of unemployment, the change in the migration law is indeed mirrored in the estimated elasticities: the beneficial impact of inflows of employees from EU-15 countries on native unemployment is clearly smaller after compared to before 2007. This result suggests that studies that examine the effects of the introduction of the FMP on Switzerland's labor market should separately evaluate the immigration impact on the resident labor force before and after 2007. Most existing studies on the effects of the FMP on the labor market only consider June 2002 as the important threshold date.

6 Cross-cell effects

In two influential contributions, Ottaviano and Peri [2012] criticize previous empirical work on the effects of immigration on labor market outcomes of natives because it does not account for cross-skill group effects. Their critique is based on general equilibrium considerations: if different types of labor are imperfectly substitutable and the relative supply of a specific type of worker changes due to immigration, the demand for other types of labor will shift as well, leading to cross-cell effects of immigration on the outcome of interest. Another possible scenario for cross-cell effects in our empirical application is

that immigration of high-skilled workers to Switzerland increases job opportunities of low-skilled workers because firms are prevented from outsourcing jobs or relocate to Switzerland because of the availability of qualified personnel.

The problem of such interactions between cells is that immigration into cell A may influence employment and wages in cell B. In this case, the use of cell B as a counterfactual for cell A without accounting for spillovers means that we might under- or overestimate the counterfactual employment or wage change.[24] The "partial" elasticities estimated above (i. e., the effect of immigration on the outcome in the own cell) might be misleading.[25] In the jargon of the treatment effects literature, the bias occurs because cross-cell effects constitute a violation of the Stable Unit Value Treatment Assumption (SUTVA): the control group is treated as well, invalidating it as a proper control group absent any controls for the cross-cell effects in the regression.

Accounting for cross-cell effects, however, poses the problem that there are 81 times 80 possible spillover effects per year in our case with 81 skill groups. Given the available data, it is hence impossible to estimate the cross-cell effects without imposing *a priori* (homogeneity and exclusion) restrictions on the elasticities. Ottaviano and Peri [2012] and Manacorda et al. [2012] impose this structure by assuming a nested constant elasticity of substitution (CES) production function for which they estimate different elasticities of substitution. By contrast, in the standard regression framework outlined above,

[24]Suppose, for instance, that the employment prospects of construction workers are increased by the inflow of foreign engineers. As a result, both, the number of resident and immigrant construction workers increases. Then our estimated elasticity of employment to immigration in the own cell would be biased upwards, as it is not the inflow of foreign construction workers that leads to increased employment of resident construction workers, but the inflow of engineers.

[25]Ottaviano and Peri [2012] distinguish the partial from the "total effect" of immigration, which takes into account all possible cross-cell interactions occurring after an inflow of foreign labor.

controlling for cross-cell effects can be achieved by including weighted averages of the inflow of immigrants into other cells as additional regressors, similar to what is commonly done in spatial econometrics. Intuitively, we estimate a reduced form regression that examines whether the labor market outcome of residents in cell i correlates with the weighted number of immigrants in other cells $j \neq i$.

The expected source of spillover effects determines the way how the immigrant shocks in other cells are weighted. One possible cause leading to spillover effects are native outflows.[26] As we show in the Online Appendix, native outflows are not a major concern in our application. More likely are cross-cell effects arising from imperfect substitution or from complementarity between different types of workers [cf. Ottaviano and Peri, 2012]. Therefore, we restrict ourselves to the estimation of two additional elasticities between natives and immigrants of differing cells, closely following the convention in the recent literature [cf. Card, 2009, Ottaviano and Peri, 2012, Manacorda et al., 2012]: an elasticity of the outcome to immigrants with different age in the same occupation (ϕ_{age}), and an elasticity of the outcome to immigrants of the same age but different occupational group (ϕ_{occ}). Formally, we estimate the following augmented model:

$$\begin{aligned}\Delta log(O_{it}) =& \alpha + \beta \Delta log(I_{it}/LF_{it}) + \phi_{age} \Delta log(\mathbf{AI_t}) + \phi_{occ} \mathbf{\Delta} log(\mathbf{OI_t}) \\ &+ \gamma \Delta X_{it} + \tau T_t + \epsilon_{it}\end{aligned} \tag{4}$$

[26] If, for example, immigrant inflows into cell A cause natives to move from cell A to cell B, where they may then crowd out other natives or reduce their wages, the spillovers would be negative (outcome-deteriorating).

The new terms in equation (4) compared to equation (1) are $\phi_{age}\Delta log(\mathbf{AI_t})$ and $\phi_{occ} log(\Delta \mathbf{OI_t})$, where $\mathbf{I_t}$ is a 81×1 column vector in which the number of immigrants into cells $i = 1, ..., 81$ (I_{it}) are stacked up for any year t, and $\mathbf{A}$ and $\mathbf{O}$ are time-invariant weighting matrices of dimension 81×81 used to weight the number of immigrants in other cells with zero elements on the diagonal. The weighting matrices mirror the expected *probability of workplace interaction* between different cells.

The coefficient ϕ_{age} captures wage and employment spillovers between immigrants and natives across age groups within an occupational group. Its corresponding weighting matrix, $\mathbf{A}$, represents the average relative size of the resident labor force of a specific cell compared to the total labor force within the same occupation across the sample period. The weights mirror the probability that an employee in cell i works together with an employee belonging to the same occupational but to age group $j \neq i$.[27]

The second type of cross-cell effects that we account for are spillovers across occupational groups (ϕ_{occ}). These might arise, on the one hand, because of labor shortage in specific occupations: since Switzerland is characterized by shortages of doctors and engineers, the increased availability of doctors and engineers might increase the number of jobs for nurses and construction workers, respectively. On the other hand, firms may substitute between different types of occupations as a reaction to changes in labor supply. In both cases, interactions between occupations are more likely if employees from different occupational groups are work colleagues. It is, conversely, very unlikely that for instance the employment prospects of construction workers are influenced

[27]The cell i for which the spillover is calculated is excluded from both, the nominator and the denominator of the weight. Therefore, the number of immigrants are weighted with $LF^{o\bar{c}c}_{age=j\neq i} / \sum_j LF^{o\bar{c}c}_{age=j\neq i}$.

by increased immigration of doctors. Following this line of reasoning, we can gauge the relative importance of spillovers between any pair of occupations by analyzing the relative frequencies with which members of the different occupational groups are workmates in different industries. This is the main idea underlying the construction of the weighting matrix **O**. A detailed description of how we constructed this matrix is deferred to the Online Appendix.

Table 8 contains estimation results for the augmented regression model according to equation (4) for the three outcome variables analyzed above (i. e. unemployment, employment and wages). The essential message from the table is that all partial elasticities of unemployment, employment and wages to immigration of foreign employees established above are robust to the inclusion of cross-cell effects. None of the point estimates changes significantly once spillover effects across cells are controlled for, suggesting that potential biases because the SUTVA assumption might not hold are small in our application.

Furthermore, the insignificance of the spillover coefficients suggests that cross-cell effect do on average not play an important role for resident employees. There only is weak evidence of a significant and negative age spillover effect on employment of residents, providing evidence for partial substitutability between age groups within occupational groups.[28] The average effects shown in the table, however, mask quite substantial heterogeneity in the spillover effects within certain subgroups of the population. Particularly, high-skilled and old workers face larger outcome-deteriorating cross-cell effects than low-

[28]Note that we expect *lower* spillover coefficients if the elasticity substitution along the age or occupation dimension is close to infinity, as in this case the effect of immigrant inflows is fully captured by the effect in the own cell—any additional foreign worker in the own cell also substitutes any other foreign worker in other cells. If, conversely, there is imperfect substitution between skill groups, the inflow of foreigners in another cell may be beneficial to the own cell. In this case, controlling for cross-cell effects might also affect the estimate of β.

skilled and young workers, respectively, especially in terms of employment and along the age dimension within occupation. The findings suggest that highly skilled and older workers are partially substituted by younger workers, and these substitution effects partially offset the positive within-cell effects.

7 Conclusions

We have examined the effects of the recent large-scale inflow of foreign workers on the labor market situation of resident workers in Switzerland. While simple cross-sectional regressions of unemployment and employment among Switzerland's resident workforce on the extent of immigration of foreign workers into the different labor market cells suggest significant displacement effects on the labor market, findings are reversed when we account for endogeneity of work-related immigration. It then turns out that in fact in the average labor market cell unemployment of residents has been reduced as a result of immigration of foreign employees, and employment has been increased. We show that these findings are robust to the inclusion of cross-cell effects.

The methodology which we have developed in this paper does not only allow identifying the causal effects of immigration on the labor market outcomes of residents in a small open economy, but it is also broadly applicable beyond specific political events in the country of origin or policy changes in the destination country. Moreover, the paper has shown the importance of properly accounting for the endogeneity of immigration in an analysis based on occupation-age cells in a small open economy. Many previous studies using cells based on skill groups have not considered this endogeneity problem and only report OLS coefficients [cf. Favre, 2011]. Yet, our results indicate that

when immigration is characterized by labor shortages, regressions of residents' labor market outcomes on immigration that do not account for endogeneity of immigration *underestimate* the *positive* effects of immigration. This finding stands in contrast to most previous studies on the effects of immigration on native labor market outcomes that have generally highlighted that conventional (OLS) estimates *underestimate* the *negative* effects of immigrant inflows.

It is important to note that our analysis ignores two channels through which immigrant inflows might have influenced the labor market situation of resident employees. First, immigration increases demand which in turn fuels growth in GDP. Several authors have argued that demand-induced growth has stabilized the Swiss economy in recent years, for example, in the construction and retail sales sectors [e.g., Siegenthaler and Sturm, 2012]. Through this channel, immigration limited the extent of job losses in Switzerland in the course of the financial crisis of 2008/2009 and was thus beneficial for the resident labor force on an aggregate level that is precluded from the above analysis by the inclusion of year fixed effects.

Second, immigration of workers with average skills exceeding those of the native workforce might have increased labor productivity in the economy, for example by increasing innovation activities within firms or by strengthening their competitiveness [Kerr et al., 2012, Peri, 2012]. The positive externalities on native employment arising from such productivity effects of high-skilled immigration are only considered in this study to the extent to which they lead to positive cross-cell effects within a year. However, productivity effects may not only take longer to become manifest, but are also likely to be widely spread across occupational groups since they arise within firms and not within occupational groups. Therefore, possible productivity effects of immigration

in Switzerland remain largely disregarded by our regression framework even when we consider cross-cell effects.

If it is not enhanced productivity, what explains the beneficial impact of immigration on the resident workforce? As we have argued, the most important of explanation is the reduction of skill shortages to which immigration led: only with the inflow of qualified immigrants that are largely complementary to the resident labor force have firms in Switzerland been able to keep and increase their global market share, thus securing the jobs of residents by, for instance, preventing firms from outsourcing jobs. While skill shortages are not equally drastic in all OECD economies, most economies are likely to suffer from skill shortages in some sectors and for those our findings underline the potentially beneficial effects of immigration.

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8 Appendix

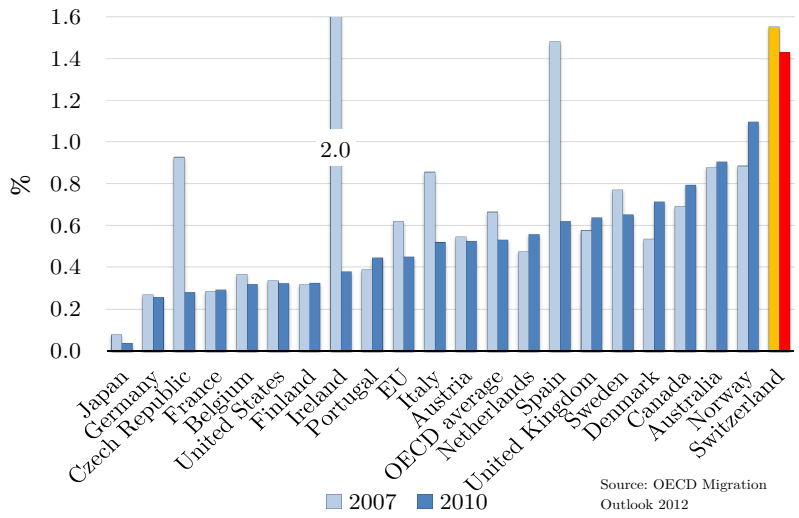

Figure 1: Permanent inflows into selected OECD and non-OECD countries 2007 and 2010 (as percentage of total resident population)

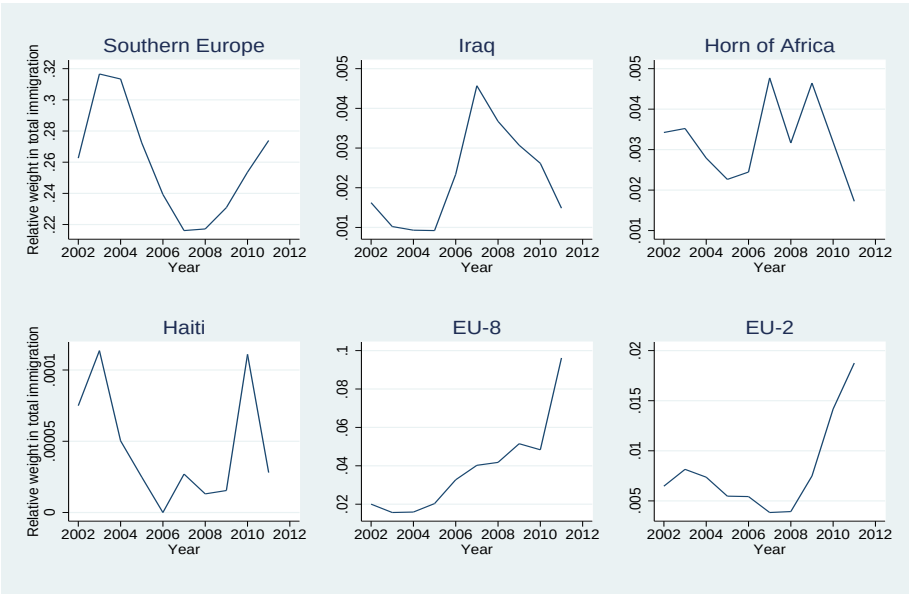

Figure 2: Share of immigrating foreign employees from certain regions of origin in total immigration of foreign employees to Switzerland

Table 1: Summary statistics

Variable	Mean	Std. Dev.	Min.	Max.	N	Source
No. of unemployed	1,636	1,215	48	7,809	648	AMSTAT
No. of employed	49,069	30,476	2,970	139,878	972	SLFS
Annual earnings (wage, CHF)	69,403	23,972	22,676	235,993	972	SLFS
Immigrating employees*	0.017	0.03	0	0.256	810	ZEMIS
Immigrating employees (NRP)*	0.033	0.065	0	0.528	810	ZEMIS
New cross-border workers*	0.014	0.023	0	0.187	810	ZEMIS
Fraction of state employees	0.198	0.137	0.027	0.428	972	SLFS
Fraction of female employees	0.43	0.213	0.078	0.834	972	SLFS
Education	7.99	16.67	0	115.61	891	SLFS

* Relative to resident labor force. NRP = Nonresident population

Table 2: Unemployment: Weighted least squares (WLS) estimations

VARIABLES	(1)	(2)	(3)	(4)
Immigrating employees	0.273***	0.184***	0.330***	
	(0.056)	(0.058)	(0.073)	
Inflow of foreign labor				0.098*
				(0.053)
Fraction of state employees		-3.860***	-2.556**	-2.779***
		(0.908)	(1.247)	(0.730)
Fraction of female employees		-1.226***	-1.474***	-1.259***
		(0.423)	(0.349)	(0.425)
Education $(t-1)$		0.484*	0.584**	0.542*
		(0.260)	(0.255)	(0.293)
Labor force size $(t-1)$	0.782***	0.579***	0.683***	0.534***
	(0.087)	(0.126)	(0.127)	(0.147)
Constant	0.446	4.436**	1.635	3.919**
	(0.937)	(1.697)	(1.247)	(1.819)
Observations	648	648	648	648
R^2	0.636	0.948	0.953	0.944
Year fixed effects	Yes	Yes	Yes	Yes
Age fixed effects	No	No	No	No
Occupation fixed effects	No	Yes	Yes	Yes
Weights	Yes	Yes	No	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Education: Ratio of tertiary to primary educated employees times 1/100

Table 3: Unemployment: Differenced regressions

VARIABLES	(1)	(2)	(3)	(4)
Δ Immigrating employees	-0.078***	-0.051**	-0.016	
	(0.020)	(0.023)	(0.019)	
Δ Inflow of foreign labor				-0.123***
				(0.026)
Δ Fraction of state workers	-1.638***	-0.401		-1.637***
	(0.493)	(0.498)		(0.494)
Δ Education $(t-1)$	-0.142**	-0.164**	-0.099**	-0.134**
	(0.059)	(0.064)	(0.046)	(0.056)
Constant	-0.210***	0.667***	0.753***	-0.209***
	(0.014)	(0.009)	(0.039)	(0.014)
Observations	567	567	567	567
R^2	0.934	0.923	0.964	0.935
Year fixed effects	Yes	Yes	Yes	Yes
Occupation-year effects	No	No	Yes	No
Weights	Yes	No	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Education: Ratio of tertiary to primary educated employees times 1/100

Table 4: Unemployment: Two-stage least squares (2SLS) regressions

VARIABLES	(1)	(2)	(3)	(4)	(5)
Δ Immigrating employees	-0.212***	-0.201***	-0.197***	-0.160***	
	(0.065)	(0.052)	(0.056)	(0.057)	
Δ Inflow of foreign labor					-0.167***
					(0.064)
Δ Fraction of state workers	-1.187**	-1.225**	-1.237**		-1.542***
	(0.597)	(0.594)	(0.597)		(0.550)
Δ Education $(t-1)$	-0.149**	-0.148**	-0.148**	-0.105**	-0.132**
	(0.069)	(0.069)	(0.068)	(0.048)	(0.057)
Constant	-0.189***	-0.191***	-0.191***	-0.159***	-0.205***
	(0.018)	(0.018)	(0.018)	(0.015)	(0.017)
Observations	567	567	567	567	567
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Occupation-year effects	No	No	No	Yes	No
Weights	Yes	Yes	Yes	Yes	Yes
RMSE	0.0830	0.0824	0.0822	0.0623	0.0791
F statistic first stage	20.13	39.05	34.72	31.09	30.62
p-value of Hansen J statistic	0.345	0.129	0.188	0.442	0.979

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments: Change in predicted share of immigrating foreign employees

Columns 1+5: Census 1990

Column 2: Average of immigration data 2002-2011

Columns 3+4: Occupation-age distribution of labor force in country of origin

Education: Ratio of tertiary to primary educated employees times 1/100

Table 5: Estimated elasticities of unemployment and employment on immigration of permanent foreign employees ($\hat{\beta}$) for different subgroups of the population (instrument set used: average of immigration data 2002–2011)

	$\hat{\beta}$	S.E		$\hat{\beta}$	S.E
Unemployment					
Swiss citizens	-0.264^{***}	(0.086)	Foreign population	-0.144^{**}	(0.071)
High-skilled workers (ISCO 1–3)	-0.198^{*}	(0.104)	Low-skilled workers (ISCO 4–9)	-0.233^{***}	(0.055)
Young workers (age 15–40)	-0.061	(0.068)	Old workers (age 40–65)	-0.24^{***}	(0.063)
Immigration from EU-15 (2004–2006)	-0.468^{**}	(0.204)	Immigration from EU-15 (2008–2011)	-0.078	(0.091)
Employment					
Swiss citizens	0.129	(0.103)	Foreign population	0.13	(0.103)
High-skilled workers (ISCO 1–3)	0.56^{**}	(0.267)	Low-skilled workers (ISCO 4–9)	-0.014	(0.064)
Young workers (age 15–40)	0.238^{**}	(0.118)	Old workers (age 40–65)	0.051	(0.065)
Immigration from EU-15 (2002–2006)	0.069	(0.088)	Immigration from EU-15 (2008–2011)	0.007	(0.112)

Table 6: Employment

VARIABLES	(1) FD	(2) 2SLS	(3) 2SLS	(4) 2SLS	(5) 2SLS
Δ Immigrating employees $(t-1)$	0.028	0.187**	0.123*	0.278***	
	(0.017)	(0.083)	(0.071)	(0.095)	
Δ Inflow of foreign labor $(t-1)$					0.169*
					(0.090)
Δ Fraction of state workers	-0.735	-0.842	-0.799	1.593	-0.934
	(0.607)	(0.623)	(0.609)	(4.754)	(0.611)
Δ Fraction of female employees	0.188	0.130	0.153	-0.021	0.152
	(0.163)	(0.181)	(0.171)	(0.191)	(0.166)
Δ Education $(t-1)$	-0.100**	-0.079*	-0.088*	-0.091**	-0.103**
	(0.049)	(0.048)	(0.048)	(0.044)	(0.048)
Constant	-0.010	0.025**	0.024**	0.038	0.008
	(0.012)	(0.012)	(0.012)	(0.118)	(0.013)
Observations	648	648	648	648	648
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes	Yes
Occupation-year effects	No	No	No	Yes	No
RMSE	0.0790	0.0843	0.0805	0.0810	0.0805
F statistic first stage	.	18.86	30.59	20.28	29.21
p-value of Hansen J statistic	.	0.930	0.204	0.575	0.623

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments: Predicted share of immigrating foreign employees

Column 2: Census 1990

Column 3: Average of immigration data 2002-2011

Columns 4+5: Occupation-age distribution of labor force in country of origin

Education: Ratio of tertiary to primary educated employees times 1/100

Table 7: Wages

VARIABLES	(1) FD Total	(2) 2SLS Total	(3) 2SLS Total	(4) 2SLS Total
Δ Immigrating employees $(t-1)$	0.041	0.052	0.009	
	(0.026)	(0.045)	(0.047)	
Δ Inflow of foreign labor $(t-1)$				0.047
				(0.039)
Δ Fraction of state workers	-0.455	-0.463	-0.522	-0.489
	(0.337)	(0.337)	(2.446)	(0.336)
Δ Education $(t-1)$	0.039***	0.040***	0.036**	0.034***
	(0.014)	(0.015)	(0.018)	(0.013)
Δ Fraction of female employees	-0.298**	-0.302**	-0.368***	-0.296**
	(0.119)	(0.120)	(0.117)	(0.123)
Constant	0.014**	0.010	-0.019	0.006
	(0.007)	(0.007)	(0.055)	(0.008)
Observations	648	648	648	648
Year fixed effects	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes
Occupation-year effects	No	No	Yes	No
RMSE	0.0613	0.0608	0.0559	0.0619
F statistic first stage	.	18.86	15.32	36.34
p-value of Hansen J statistic	.	0.153	0.967	0.521

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Education: Ratio of tertiary to primary educated employees times 1/100

Instruments: Predicted share of immigrating foreign employees using census 1990 distribution

Table 8: Spillover effects

VARIABLES	(1) 2SLS Δ U	(2) 2SLS Δ U	(3) 2SLS Δ E	(4) 2SLS Δ E	(5) 2SLS Δ w	(6) 2SLS Δ w
Δ Immigrating employees	-0.217***					
	(0.072)					
$\hat{\phi}_{age}$	-0.033					
	(0.113)					
$\hat{\phi}_{occ}$	0.059					
	(0.092)					
Δ Inflow of foreign labor		-0.177**				
		(0.072)				
$\hat{\phi}_{age}$ total inflow		-0.059				
		(0.100)				
$\hat{\phi}_{occ}$ total inflow		-0.099				
		(0.089)				
Δ Immigrating employees $(t-1)$			0.223***		0.050	
			(0.083)		(0.056)	
$\hat{\phi}_{age}$ $(t-1)$			-0.216**		0.006	
			(0.086)		(0.052)	
$\hat{\phi}_{occ}$ $(t-1)$			0.051		0.076*	
			(0.067)		(0.040)	
Δ Inflow of foreign labor $(t-1)$				0.154*		0.075
				(0.093)		(0.048)
$\hat{\phi}_{age}$ total inflow $(t-1)$				-0.116		-0.067
				(0.107)		(0.064)
$\hat{\phi}_{occ}$ total inflow $(t-1)$				-0.021		-0.016
				(0.079)		(0.038)
Observations	567	567	648	648	648	648
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes	Yes	Yes
RMSE	0.0831	0.0789	0.0846	0.0794	0.0606	0.0623
F statistic first stage	21.31	61.67	21.33	117.7	21.33	70.66
p-value of Hansen J statistic	0.319	0.991	0.615	0.135	0.193	0.881

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Instruments: Change in predicted share of immigrating foreign employees
Columns 1-5: Census 1990
Controls: Δ Fraction of state workers, Δ Education $(t-1)$, Δ Fraction of female employees.
Constant not shown

A Online Appendix

A.1 First stage estimations

Table 9: First stage estimations of unemployment

VARIABLES	(1)	(2)	(3)	(4)	(5)
Δ Pred. immigrants EU-15 (*Census 1990*)	0.524***				
	(0.144)				
Δ Pred. immigrants EU-8 (*Census 1990*)	0.312***				
	(0.095)				
Δ Pred. immigrants non-EU (*Census 1990*)	0.134				
	(0.150)				
Δ Pred. immigrants EU-15 (*in-sample*)		0.978***			
		(0.200)			
Δ Pred. immigrants EU-8 (*in-sample*)		0.287			
		(0.206)			
Δ Pred. immigrants non-EU (*in-sample*)		-0.034			
		(0.101)			
Δ Pred. immigrants EU-15 (*Labor force*)			1.138***	0.382	
			(0.280)	(0.508)	
Δ Pred. immigrants EU-8 (*Labor force*)			-0.077	0.499	
			(0.259)	(0.489)	
Δ Pred. immigrants (*Census 1990*)					0.027
					(0.189)
Δ Pred. immigrants NRP (*Census 1990*)					0.303
					(0.230)
Δ Pred. cross-border workers (*Census 1990*)					0.646**
					(0.259)
Δ Fraction of state workers	1.599	1.701*	2.294**		1.292*
	(1.104)	(0.991)	(1.062)		(0.729)
Δ Education $(t-1)$	-0.064	-0.064	-0.064	-0.067	0.026
	(0.091)	(0.094)	(0.095)	(0.075)	(0.046)
Constant	-0.130*	-0.178	0.116	-0.312	0.029
	(0.076)	(0.158)	(0.191)	(0.344)	(0.029)
Observations	567	567	567	567	567
R^2	0.561	0.585	0.569	0.737	0.383
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Occupation-year effects	No	No	No	Yes	No
Weights	Yes	Yes	Yes	Yes	Yes
F statistic	20.13	39.05	34.72	31.09	30.62
Partial R^2	0.0830	0.131	0.0990	0.0796	0.128

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
In italics: method to distribute country-specific number of immigrants across cells
NRP = Nonresident population

A.2 Native outflows

An important concern in all studies that correlate labor market outcomes of residents with immigration within predefined labor market cells are native outflows, i. e. the possibility that resident workers might respond to immigrant inflows by changing their job and thus leave their preassigned labor market cell. If employee movements across cells occur, the impact of immigration on employment into a cell would spread to other cells and thus influence the outcome in the control group. Thus, one possible way to account for native outflows is controlling for appropriately constructed cross-cell effects.

We also take a more direct way of testing the importance of native outflows and exploit the fact that we observe if individual employees move across cells in the SLFS. In particular, we count the number of employees that change their occupation cell from the second quarter of a year to the next year. Using the observation weights from the SLFS we can then approximate the number of native outflows from cell i occurring between two consecutive second quarters in years t and $t+1$ ($Outflows_{it}$). However, since on average only about 5% of all employees change to another ISCO major group from one year to another, measurement error in the count of outflows is an important problem. We therefore reduce the number of age categories by pooling age groups 1 to 4 (15-39 years) and 5 to 9 (40 and more). Furthermore, the analysis is restricted to the years 2002 to 2009 due to changes in the SLFS in 2010.

We then regress the log of outflows relative to the labor force on the log of the number of immigrating workers relative to labor force entering the cell in year t ($log(I_{it}/LF_{it})$). The results of these regressions are shown in Table 10. The first column illustrates that the relative importance of outflows correlates positively with the inflow of new foreign employees within and across

cells. However, this regression only controls for year fixed effects, and removing all time-invariant factors affecting immigration inflows and native outflows by first differencing the regression renders the coefficient insignificant and its point estimate close to zero.[29] Moreover, if we only use variation from push-driven migration by instrumenting actual cell-specific immigration with the shift-share instruments, the estimated coefficient remains close to zero and statistically insignificant. Similar comments apply pertaining to the total inflow of foreign workers.

Finally, the last column of the table illustrates that the elasticity of unemployment on immigration of foreign employees is still in the same range as those established in the paper even though we pooled most age groups and only use a reduced sample period.

[29]The regression also includes the same controls as in the employment and wage regressions of the paper. However, the results do not depend on the inclusion of control variables.

Table 10: Native outflows

VARIABLES	(1) WLS Outflows	(2) FD Outflows	(3) FD 2SLS Outflows	(4) FD 2SLS Outflows	(5) FD 2SLS Δ U
Immigrating employees	0.213***				
	(0.049)				
Δ Immigrating employees		-0.034	0.021		-0.243**
		(0.141)	(0.394)		(0.102)
Δ Inflow of foreign labor				0.117	
				(0.610)	
Observations	108	108	108	108	90
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	Yes	Yes	Yes
Weights	Yes	Yes	Yes	Yes	Yes
RMSE	0.245	0.196	0.187	0.187	0.0644
F statistic first stage	.	.	13.51	5.866	12.33

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Instruments: Change in predicted share of immigrating foreign employees

Columns 3-5: Occupation-age distribution of labor force in country of origin

Controls: Δ Fraction of state workers, Δ Education $(t-1)$, Δ Fraction of female employees.

Constant not shown

A.3 Weighting matrix O

This section documents the construction of the weighting matrix **O** used to weight cross-occupational effects of immigration. As mentioned in the main text, we argue that the extent to which immigration into one occupational group may affect outcomes in another occupational group is related to the extent to which employees from the two cells are colleagues in the same industry. We estimate these relationships from the data. In particular, for any industry on the 2-digit level (NACE reform 1.1), we count the number of employees

with occupational group i working together with employees of occupational group $j \neq i$ in the same industry. The relevant data for this exercise comes from the waves 2002 through 2011 of the Swiss Labor Force Survey. By aggregating over all industries, we then compute the economy-wide frequencies $f_{occ=i,occ=j}$, indicating, for any occupational group i, the relative importance of workplace ties with occupation j. The resulting weighting matrix applied to each of the age groups is shown in Table 11. As can be seen in the table, the probability that a manager works together with a professional worker is 17%. The reverse probability is only 9%. The asymmetry arises because the size of the own group matters: the probability that a professional worker works with a manager is smaller than the reverse because managers are a smaller group.

Table 11: Importance of workplace ties across occupational groups

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Managers (ISCO 1)	0.00	0.17	0.20	0.14	0.16	0.01	0.15	0.06	0.06
Professionals (2)	0.09	0.00	0.35	0.15	0.12	0.01	0.10	0.04	0.09
Technicians (3)	0.08	0.29	0.00	0.16	0.19	0.01	0.10	0.04	0.07
Clerks (4)	0.09	0.19	0.24	0.00	0.14	0.02	0.14	0.07	0.07
Service workers (5)	0.11	0.15	0.25	0.14	0.00	0.02	0.12	0.04	0.09
Skilled agricultural workers (6)	0.06	0.11	0.15	0.11	0.12	0.00	0.11	0.05	0.23
Craft workers (7)	0.10	0.14	0.19	0.16	0.11	0.02	0.00	0.13	0.09
Plant operators (8)	0.08	0.13	0.15	0.16	0.09	0.01	0.25	0.00	0.07
Elementary occupations (9)	0.07	0.18	0.19	0.12	0.17	0.04	0.13	0.05	0.00