NBER WORKING PAPER SERIES

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Working Paper 19315
http://www.nber.org/papers/w19315

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 2013

We thank the Economic Policy Research Network, Denmark for funding this research project and Jakob Roland Munch for helpful suggestions and discussions. Søren Leth-Petersen, Cedric Jean-Laurent Elie Gorinas, Anna Piil Damm and Christian Dustmann provided useful comments and advice. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

At least one co-author has disclosed a financial relationship of potential relevance for this research. Further information is available online at http://www.nber.org/papers/w19315.ack

Immigrants and Native Workers: New Analysis Using Longitudinal Employer-Employee Data

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NBER Working Paper No. 19315
August 2013
JEL No. F22,J24,J61

ABSTRACT

Using a database that includes the universe of individuals and establishments in Denmark over the period 1991-2008 we analyze the effect of a large inflow of non-European (EU) immigrants on Danish workers. We first identify a sharp and sustained supply-driven increase in the inflow of non-EU immigrants in Denmark, beginning in 1995 and driven by a sequence of international events such as the Bosnian, Somalian and Iraqi crises. We then look at the response of occupational complexity, job upgrading and downgrading, wage and employment of natives in the short and long run. We find that the increased supply of non-EU low skilled immigrants pushed native workers to pursue more complex occupations. This reallocation happened mainly through movement across firms. Immigration increased mobility of natives across firms and across municipalities but it did not increase their probability of unemployment. We also observe a significant shift in the native labor force towards complex service industries in locations receiving more immigrants. Those mechanisms protected individual wages from immigrants competition and enhanced their wage outcomes. While the highly educated experienced wage gains already in the short-run, the gains of the less educated built up over time as they moved towards jobs that were complementary to those held by the non-EU immigrants.

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1 Introduction

In this paper we use individual data on the *universe* of Danish workers matched to data on the establishments where they worked during the years 1991-2008 to quantify the consequences of a large supply-driven inflow of less educated immigrants on the employment, wage, occupational choice and careers of natives. The richness, detail and scope of the data, the significant size and exogenous nature of the immigration shock allow us a much more detailed and informative analysis than done so far in this literature. Do immigrant displace similar native workers? Do they increase their job-separation rates? Or do they complement their productivity? Do they stimulate specialization of natives in complex tasks? Do these effects, combined, reduce or increase native wages? Does this happen within firms or in the transitions between firms and labor markets? And how do these mechanism unfold over time? These questions will find answers in the present paper.

The analysis of the labor market effects of immigration has a long history. Considered as a labor supply shock within the labor demand-labor supply canonical model, a long series of studies have estimated the impact of immigration on wages and employment of natives in local and national economies.[1] Those studies have generally found small effects of immigration on average wages and employment of competing natives.[2] This is at odds with the very simple canonical model that, other things equal, predicts a negative and significant impact of immigrants on wage and employment of similar native workers. Recently a new generation of studies has focussed on a series of departures from the canonical model. Those are very important to explain several aspects of the labor market, including the effect of immigration. They may account for the zero or even positive effects of immigration on native wages. The main departures from the canonical framework considered in recent studies are the following. Workers have multiple differentiated skills that differ systematically between immigrants and natives.[3] Immigrant labor generates the possibility of specialization and productivity effects within and across firms.[4] Investment and technology are adjusted to absorb immigrant labor in local markets.[5] These new lines of inquiry have produced new hypotheses about the possible impact of immigrants on the economy and on firms and economists have analyzed a richer set of outcomes to validate them.[6] Our paper follows this line of analysis and presents estimates of a set of native workers' outcomes in response to immigration.

In this paper we estimate the effects of a large and, arguably, exogenous inflow of less educated immigrants to Denmark. The considered immigration inflow is that of non-EU immigrants, initially refugees and later family reunifications, that increased substantially in 1995 because of the Bosnian crisis and continued until 2003 fed by waves of refugees and immigrants from Somalia, Afghanistan and Iraq, all countries plagued by wars and other developing countries. The flow of refugees was initially distributed following the Spatial Dispersal Policy across Danish municipalities. Later, when family reunification and working permits were the main causes of entry immigrants settled, at least initially, where their family sponsors were located.[7] An important goal of the Dispersal Policy was to provide a house to the refugees; hence, local house availability was a determinant of location. A second

[1] Examples are Altonji and Card (1991); Card (2001); Friedberg (2001); Borjas (2003); Ottaviano and Peri (2012).

[2] See for instance the meta-analysis in Longhi, Nijkamp, and Poot (2005), or the review article by Blau and Kahn (2012). Exceptions, finding significantly negative or significantly positive effects exist, but overall the estimates are centered around zero.

[3] This line of analysis is emphasized in Manacorda, Manning, and Wadsworth (2012); Ottaviano and Peri (2005, 2012); D'Amuri, Ottaviano, and Peri (2010)

[4] One paper analyzing this channel is Peri and Sparber (2009).

[5] Examples are Lewis (2011, 2013); Ottaviano, Peri, and Wright (forthcoming).

[6] See the recent analysis of immigration and productivity in Peri (2012), Immigration and firm creation in Olney (2013) and immigration and economic growth in Ortega and Peri (2013).

[7] By law the sponsor needed "adequately sized accommodation" for the re-unified family. In practice this meant that, at least initially, new family members lived at the same adress as their sponsor.

important goal was facilitating the refugee's reception by attaining ethnic clusters (see Damm (2009), page 285). Both conditions are exogenous to the economic trends of the municipality. Moreover, the fact that our data are available beginning with 1991 allows us to identify a "pre-immigration" period (1991-1994) and to test the exogeneity of the refugee distribution to pre-existing trends. Our instrumental variable approach (inspired by Dodson (2001) and Damm (2009)) is based on pre-1995 settlements of non-EU immigrants by nationality across Danish municipalities. It should produce a strong instrument and, for the reason described above, it should capture a genuinely exogenous supply-driven variation of immigrants. A second interesting feature of the immigration event considered is that non-EU immigrants were significantly less educated than natives and usually spoke the Danish language at a very low level of proficiency.[8] This made them potential competitors with the least skilled Danish workers, especially in manual intensive jobs. This feature is quite common of many non-EU immigrants across all countries of Europe. At the same time the Danish labor market, differently from those of many other EU countries, is extremely flexible. Especially for the private sector the hiring and layoffs were not costly, the transitions across jobs and occupations were frequent and wage bargaining was mainly (and increasingly over time) done at the decentralized firm-level (see Dahl, le Maire, and Munch (2013)). This flexibility enhanced the possibility for native workers and firms to make adjustments that responded optimally to immigration.

In this study we track native workers over the fourteen years following 1994. We focus on four main outcomes: the complexity of their occupation, their hourly wages, their yearly earnings and the length (as fraction of full-time) of their working year. We consider separately less educated and more educated natives and we analyze the effects in the short, medium and long run. First, we analyze what happened to native workers within establishments exposed to different local market inflows of non-EU immigrants. We use a panel regression that controls for establishment-worker fixed effects and a host of individual and firm characteristics. This provides estimates based on within-employment-spell variation of outcomes and immigrant shares. Then we analyze the impact of non-EU immigrants on inter-establishment and inter-municipality mobility of natives and on their probability of becoming non-employed. We estimate the cumulated effect over the long-run using long-differences in the data. Finally, we analyze the short- and long-run transition in wages, occupational complexity, career and labor supply following cohorts of native workers over their working careers. This part of the analysis, structured as an event study, exploits the differential exposure of natives to immigrants, depending on their municipality in 1994 (the year before the surge in non-EU immigrants). We follow individuals over 18 years and we also separate the effects on groups with different characteristics.

The combination of these three types of analysis (spell regressions, long differences, and cohort transitions) allows us to have a thorough and coherent picture of the response to immigration and of the adjustment mechanisms involved. The analysis provides new estimates of the effect of immigration following natives within and across establishments. In particular the only previous studies using comparable data are Hummels et al. (2011), who produce spell fixed-effects estimates of the impact of outsourcing on wages within manufacturing firms and Malchow-Møller, Munch, and Skaksen (2012) who employ establishment-worker fixed effects to analyze the impact of immigrants on wages of native coworkers.[9]

The analysis relative to the effects on workers within a municipality is more comparable to the

[8] Asylum seekers are not in our data and not allowed to work in Denmark. Once (if) their case has been approved they will move into an address in Denmark (assigned to them under the dispersion policy), be allowed to work and appear in the registers. Asylum seekers may attend language causes while their case is being processed.

[9] Using similar data Malchow-Møller et al. (forthcoming) analyze the impact of immigrant hirings on firm's job creation in the farm sector; Malchow-Møller, Munch, and Skaksen (2011) look at the Danish preferential tax scheme for foreign professionals and estimate the effect of hiring them on wages and productivity within the firm; and Parrotta, Pozzoli, and Pytlikova (2012) look at the effect of an ethnically diversified workforce on firm productivity. Contrary to these papers we consider the effect of changes in the immigrant share at the municipality - and not the firm - level, and we identify an abrupt change in the share of foreign born driven by refugee-sending countries.

canonical analysis of immigration in local labor markets (such as Card (2001); Glitz (2012); Peri and Sparber (2009)). Still, relative to those papers we are able to control for a much larger set of individual variables. New is also the analysis of the impact of immigration on inter-firm mobility and in inter-municipality mobility. Finally, the analysis of short- and long-run transitions, following a cohort of workers, is new in this literature. It follows the methodology of an event study. Walker (forthcoming) uses such method to analyze the effect of environmental regulation on jobs and wages. Von Wachter, Song, and Manchester (2007) use a similar approach to track the long-run effects of job separations in recession. The ability of the event-study method to analyze in the same framework the short- and long-run responses and to test how reasonable is the assumption of exogenous shocks makes it very appealing in this context. Very few studies analyze the dynamic effects of immigration. Cohen-Goldner and Paserman (2011) allow for labor market effects of immigration on natives to change over time but they assume that this is due to the dynamic adjustment of capital and of immigrants, not to a potentially dynamic response of natives. Notice also that our transition approach follows workers wherever they move. It is, therefore, immune from the criticism moved to area studies (e.g. Borjas (2003)) based on the idea that wage effects are not captured when limiting the analysis within a geographic area. By following individuals, our approach internalizes the effects that may "spill" to other regions through native mobility. Previous studies constructed pseudo-panel data, using aggregate local or national market outcomes linked over time. Hence, we knew little about wage, career and occupational effects on individuals within establishments, and how the effects could differ if we included those who move across establishments. Similarly, with few very recent exceptions (Cattaneo, Fiorio, and Peri, 2013) career and occupation effects of immigration have only been analyzed in the aggregate by previous studies (e.g. Peri and Sparber (2009) and D'Amuri and Peri (forthcoming)), while we will analyze them for individuals within and across firms in this paper. Finally, relative to the previous literature, the availability of the universe of individuals in the data minimizes measurement error and eliminates (or drastically reduces) the concern for attenuation bias expressed in studies such as Aydemir and Borjas (2011).

Our analysis has four main findings. First, considering native workers who stayed within the same establishment, larger flows of non-EU immigrants in the municipality increased wages and occupational mobility of natives, measured as the probability of changing occupation. This increased mobility was strongly associated to a move towards more complex jobs for workers who also changed establishment. This suggests that the specialization of natives in response to more manual skills in the local labor market materializes mainly across firms. Second, less educated natives experienced positive (not always significant) wage effects. The positive effects were particularly strong in the complex service sector. The only case in which some incumbent native workers had negative effects on their wages and careers was for the low skilled in the public sector. Third, the cumulated effect on weeks worked shows that immigration increased the mobility, particularly for highly skilled, both across establishments within municipality and towards other municipalities. However, non-EU immigrants did not reduce the cumulated weeks of employment of natives. Therefore immigration increased the cross-establishment and cross-municipality mobility of natives but did not affect the length of their working year. Fourth, following the transition in the short and long run, using an event-study-like method, we observe that less educated workers progressively increased their wage and the complexity of their occupations in response to non-EU immigration reaching the largest effect five to six years after the beginning of the event. This effect is similar for highly educated. Employment effects are not significant in the short or in the medium-long run on either group. Moreover, the upgrading effects on occupation and wages in response to immigrants appear to be stronger and more persistent for natives who were young and had low-tenure when the immigrant inflow started.

The rest of the paper is organized as follows. Section 2 describes the characteristics of the immigration inflow that we consider and the salient features of the Danish labor market. Section 3 presents the main data, their trends and summary statistics. Section 4 describes a simple framework to or-

ganize our empirical analysis and discusses the specification and the identification in our regressions. Section 5 details the empirical specifications and it shows and discusses the estimation results. Section 6 concludes the paper.

2 Immigration and Labor Markets in Denmark

Our analysis focuses on Denmark. Three reasons make this case highly suitable to learn new important lessons on an old question. First, the extraordinary coverage and richness of the longitudinal data available enables us to track several individual outcomes for native workers in greater detail and for a longer period than ever done before. Second, the immigration event that we consider represents an almost ideal episode to analyze the effect of less educated immigrants on labor market opportunities of natives. Third, the Danish labor markets, differently from those in many other European countries and similarly to the US and the UK (much more studied in terms of labor market effects of immigration), were quite flexible. They exhibited high turnover rates, low costs of hiring and layoffs and decentralization in wage setting (Dahl, le Maire, and Munch, 2013). This is the frame in which the response to a shock in terms of wage and employment should best reveal the effects on marginal productivity. Moreover, as occupational mobility is a potential mechanism of response to these shocks a flexible labor market allows this mechanism to operate most efficiently. The lessons that we learn on Denmark are likely, therefore, to apply to countries with similarly flexible markets such as the US and the UK.

In this section we describe the features of immigration to Denmark in the period 1991-2008. While immigrants of European and non-European origin were in the country before 1995, their presence as share of employment was rather small (one-two percent). A generous program for refugees and a policy to promote their dispersion across municipalities was in place since 1986 (see Damm (2009)). However, it only dealt with a limited number of refugees in the first years of its existence. This changed rater abruptly in year 1995, when a large wave of immigrants from the regions of Former Yugoslavia, and soon afterwards from Somalia, entered the country as refugees, because of ruinous wars in their countries of origin. Since then the share of immigrants, especially non-EU, has been growing significantly and continuously, until year 2007. This non-EU immigration boom was fueled during the 1995-2003 period by a sequence of refugees waves driven by international crisis, namely by Yugoslavians and Somalis in the period 1995-2000 and by Afghani and Iraqis in the period around 2000-2003. Later, family reunification immigrants from those and other countries and working-permit immigrants from those and few other countries continued to fuel the inflow of immigrants.[10] Figure 1 shows the growth of immigrant population, standardizing the 1994 value to 100, for the four refugee countries, for China, the only non-refugee country with comparable growth and, for comparison, from developed and from other non-EU countries. It is very clear that the population surge, in time order, of Yugoslavians, Somalis, Afghanis and Iraqis, in periods corresponding to their national crisis (wars) are remarkably different from the time behavior of immigrants from other non-EU countries. It is also clear that the increase in Chinese is much later in time (beginning in 2002). While we include all non-EU immigrants in our analysis, the surge of 1995-2001 was in large part fueled by the refugees-producing events.

Figure 2 shows EU and non-EU immigrants as percentage of employment. The figure confirms the two features described above. First, we observe the discontinuity in the trend-growth of foreign born (as percentage of the employment) beginning in 1995. Second, we notice the predominant role of non-EU immigrants in determining this trend. We also notice that the overall inflow was sizeable. From beginning to end (1994-2008) the cumulated increase of immigrants as percentage of employment

[10] Only Chinese immigrants experienced a similar increase, in terms of proportional growth, as the four "refugees" countries (Yugoslavia, Somalia, Iraq and Afghanistan) between 1995 and 2008. See Figure 1.

was equal to 3.1 percentage points (from 3.0% to 6.1%). This is a large value when compared to other OECD countries. During the same period the growth of foreign born in typically immigration receiveing countries such as Canada was +3.5%, in the US it was +3.8%, in the UK it was +3.9% (as percentage of the population in working age). All these economies have received much more attention as immigrant-receiving countries. In Germany, as percentage of population in working age, the inflow of immigrants implied only a growth by +1.4% and, similarly in France that share increased only by +1.1%. Figure 3 shows that non-EU immigrants were mainly from less developed countries outside of Eastern Europe. The inflow from Eastern European Enlargement countries and from developed non-EU economies in fact account for very little of the increased inflow.[11]

The unraveling over time of immigration of non-EU workers allows us to identify a period preceding the "event" during which the non-EU share of employment was constant (1991-1994). Then in 1995 the "event" itself began in the form of a change from zero to positive trend in the non-EU share. Such positive trend lasts for the period 1995-2007, that we consider post-event. With this time frame we analyze the consequences of non-EU immigrants on natives. Two other features make the 1995-2007 inflow interesting in terms of its potential labor market consequences on natives. First, those immigrants were generally less educated than natives. 52% of them did not have a post-secondary education versus only 36% without post-secondary among natives. They did not speak Danish, and as they were coming from non-European countries, they were often culturally and even ethnically different. Hence, they were likely to be employed in low-skilled manual occupations. Second, most of them were admitted in the country as political refugees or as family reunification immigrants. The first feature implies that those immigrants could be strong competition for less educated natives, especially those doing manual type of jobs. On the other hand, their skills might complement or not affect at all labor market outcomes for highly educated. The Spatial Dispersal Policy for refugees imply that many of the new immigrants settled, in the early years, near other people of the same nationality. Availability of housing and ethnic enclaves, rather than local labor conditions, were in practice a major determinant in location of refugees (see Damm (2009)). If anything, house availability might have been negatively correlated with previous economic performance or hardly correlated at all with it. Family reunifications, especially in the second part of the considered period (post 1998), implied that these new immigrants often chose an initial location close to the residence of existing relatives who sponsored their immigration Damm (2009). These two features imply that when we construct the imputed inflow of immigrants into Danish municipalities, based on the presence of the pre-existing communities by nationality, we are genuinely proxying for the dispersal policies and the resulting variation is likely to be supply-driven and exogenous to labor demand conditions. A final, but certainly also very relevant reason to focus on the impact of non-EU immigrants is that their entry is regulated, and hence affected by immigration policies of each individual EU country. While EU citizens can move freely across Europe, non-EU immigrant presence is strongly regulated and their presence is most controversial among citizens. If we are to learn the consequences of immigration to inform immigration policies this is the group we should consider.

3 Data

The data we use are extracted from the Integrated Database for Labor Market Research (IDA). IDA is a collection of registers that link data on individual characteristics of the workers to data on the characteristics of establishments using unique individual and establishment identifiers. The data are recorded annually and we can follow an individual and an establishment over time. We can observe in what year a match between a worker and an establishment is formed and when it is dissolved. We

[11] Eastern European laborers could come to Denmark for work and stay for up to 6 months without registering (like the EU-group) since 2004. These short durations will be under-represented in the annual records.

can also observe when workers change occupation and salary within an establishment.

We select individuals between 18 and 65 years old, not attending school (i.e. not eligible for student grants), and not permanently out of the labor force (i.e. not receiving disability pension). This implies that we consider the universe of individuals potentially available to work in the labor market and we refer to them simply as "labor force". We eliminate from the sample observations with a missing value in foreign born status or in the municipality of residence (a very small group).

The main outcome variables of interest in our dataset are the employment status, the occupation and the wage of Danish native individuals. Specifically, the database contains the annual earnings of an individual, the labor market status (categorized as self-employed, employed, unemployed, or out of the labor force), the hourly wage rate and the occupation code (according to the ISCO-88 classification).[12] We restrict the spell regression analysis in section 5.1 to individuals who were employed in order to analyze hourly wage changes and occupational upgrade. When turning to the long-difference analysis and the cohort based event-study of section 5.2 and 5.3 we consider a strongly balanced panel of individuals who were employed in 1994 and we analyze their employment and annual earnings without imposing further restrictions.

We correct hourly wage and the annual earnings to include mandatory payments to pension schemes. These pension contributions are administered by the employer and reported separately from the income. They are, however, part of the total labor payment and should be accounted for as part of the gross hourly wage and annual labor income. These mandatory pension contributions vary substantially across industries (between 0 and 17 percent of earnings). As data on the pension payments is available only from 1995 onwards, we only consider wage and income net of pension contributions when we include pre-1995 observations iin the event-like study. This might introduce some measurement error in the income variables. The spell analysis however, that can be implemented with net or gross earnings, proved to be robust to the choice of income measures.[13] All income variables have been deflated using the Danish consumer price index.

As a measure of the labor supply of an individual we use the fraction of the full-time year that he has been working. The variable takes a value of one if the worker has been full time employed throughout the year. If either the person is part-time employed and/or if the person is only employed in part of the year the employment variable takes a fractional value equal to a share of the regular working year. When we use this measure in evaluating the effects of an immigration inflow over a multi-year period for a native we cumulate the fraction of years worked. When we convert them in weeks, we consider 46 weeks as the typical full time working year.

As individual demographic controls we use age, labor market experience (the cumulated employment in years, since first joining the labor force), job tenure (calculated as the period elapsed between the hiring in the current establishment and the present), education and marital status. Using information on the country of origin and a variable that categorizes each individual into native and foreign born, we define as immigrants only those individuals who are born abroad and we use the country of origin to calculate immigrant populations by sending countries.

Immigrants are separated in two groups: One consisting of individuals from countries which have had free mobility of labor agreements with Denmark since 1995. These are the EU15 countries plus Norway, Iceland and Liechtenstein (as members of the European Economic Area) and Switzerland (through a bilateral agreement). The other group, consisting of immigrants from any other sending

[12] Labor market status, hourly wage, occupation as well as firm affiliation each year refer to last week of November.

[13] See Appendix Table A.4 and A.5 for comparisons of hourly wage results using the two measures, similar tables comparing annual earnings results are available upon request. The within worker-firm match estimates should be least sensitive to the two alternative measures, since they will only be affected if the mandatory payments to pension schemes change over time within the match with the employer. The within worker-municipality estimates should be more sensitive, because workers that change firm and industry are included. For both type of regressions, however, Table A.4 and A.5 prove that neither size nor significance of any of the estimates are notably affected by the choice of income measure.

country is defined as non-EU immigrants. Their immigration is regulated by laws. They are the source of the immigration "event" that we consider in this paper. The non-EU group is dominated by Turkey and Former Yugoslavia, but whereas Turks arrived mainly before our analysis window refugees from Former Yugoslavia and several other refugee sending countries such as Afghanistan, Iraq, Lebanon, Sri Lanka, Pakistan, Iran and Somalia fueled immigration through the period we consider. Eastern European Enlargement countries constituted a far smaller group as share of employment than the refugee-sending countries (see Figure 3), although beginning in 2005 (towards the end of the period considered) a large number of Eastern European citizens came to Denmark as temporary workers with no obligation to register if they stayed less than 6 months.

The geographic units that we consider as approximation of local labor markets are 98 municipalities that can be identified consistently in Denmark, over time, beginning in 1988. We merge Frederiksberg and Copenhagen since those two municipalities constitute one integrated labor market. This leaves us with 97 areas where Copenhagen, Aarhus and Odense are the biggest, most populous ones. Most municipalities are in the mainland part of Denmark. Some municipalities are islands. Bornholm, for instance, is separated by a 5.5 hours boat trip from the nearest municipality in Denmark and is thereby a rather isolated labor market. While municipalities are small geographical units, they correspond to labor markets in the case of metropolitan areas. Moreover as we can follow workers across municipalities, we observe that most of the mobility of workers takes place across firms within municipality. Only around 10% of the workers who move across establishments each year change municipality. In terms of schooling, we define individuals with tertiary education as high skilled, and other workers as low skilled.

Table 1 lists the 15 municipalities with the largest and the 15 municipalities with the smallest change in the non-EU foreign born share of employment together with the composition of low and high skilled natives in those municipalities. The table shows a very large difference in the growth of non-EU immigrants as share of employment across municipalities between 1994 and 2008. The top three municipalities experienced an increase of foreign-born larger than 10 percentage points of total employment while the bottom three experienced an increase of 1 percentage point or less. To provide stylized evidence that such remarkable gap between high and low non-EU immigration, opened rather abruptly across municipalities beginning in 1995, Figure A.1 in the Appendix shows the time series of non-EU immigrants as share of employment in Ishøj, Arbertslund and Brøndby (top receiving municipalities) and in Læsø, Assens and Lejre (bottom ones). One notices very clearly the break from a zero to a positive trend in 1995 for the top municipalities and essentially no change (flat line) for the share in the bottom three. Even more convincing in establishing the sudden change in immigration rate in 1995 in some municipalities relative to others, and directly related to the variation used in the event study of section 5.3, is Figure 4. It shows the difference in the non-EU share of employment between the treated group of municipalities (whose growth of predicted immigrant share is above the average) and the control group (whose growth of predicted immigrant share is below the average).[14] It is clear that there is no trend in the pre-1994 period as the share of non-EU immigrants was very small everywhere. It is also clear that starting in 1995 a steady and continued inflow of non-EU immigrants increased the share in the "treated" municipalities significantly more than the non-treated.

Among the areas with the largest immigrant inflows some are bigger cities in Denmark. The dispersion policy, however, spread the non-EU immigrants also to smaller towns. While differences in the initial characteristics of the municipalities will be controlled for, using fixed effects in the regressions, in order to check whether the pre-existing economic trend of a municipality affected the share of non-EU immigrants in 1988, we run several falsification tests for our instruments in section 4.3 below.

[14] The details of the first stage regression determining high and low immigration municipalities are explained in footnote 34.

The employment of each individual is associated to an occupation according to the internationally standardized ISCO-88 codes.[15] In order to measure the skill content of each occupation we merge the American O*NET database to the Danish registers using the four-digit ISCO classification of occupations. Thereby, we are able to link most workers to the task data. We follow Ottaviano, Peri, and Wright (forthcoming) and use measures of the communication, analytical and manual skill intensities to construct an occupational complexity index. The complexity of an occupation is defined as a composite index increasing in the intensity of communication and analytical skills and decreasing in the intensity of manual skills used.[16]

This method of calculating the skill content of an occupation assumes that such content for a given occupation is similar for Denmark and the US. We also observe directly occupational changes. Hence, we construct a variable that we call "occupational mobility" that equals one whenever an individual changes the (ISCO-88) occupation from period $t-1$ to t. To get a sense of the direction of the mobility, we also combine this variable with the hourly wage measure and define "career upgrade" that takes the value of one when a worker changes occupation and, at the same time, experiences a wage increase larger than the average wage growth for that year. A "career downgrade" is a change in occupation accompanied by a decrease in wage.

In our spell analysis we also distinguish between four broad sectors: manufacturing, complex services, non-complex services and public sector. While the first two sectors tend to produce tradable and differentiated goods and services and are subject to international competition and technological change, the other two tend to produce less differentiated goods, they are more protected from competition and may not be fully exposed to international market forces. The composition of each sub-sector and each occupation in terms of non-EU immigrants, native low skilled and native high skilled and the change over the period 1994-2008 is shown in Tables A.1 and A.2 of the Appendix.

Table A.1 shows also how sub-sectors are grouped into the manufacturing, complex service, non-complex service and public sector. By reporting non-EU immigrants as share of the employment they help identifying the industries and the occupations in which the potential competition by non-EU immigrants became stronger during the considered period. In terms of sectors the largest non-EU immigrant inflows have been into manufacturing. In terms of 2-digit ISCO occupations most of the increase in non-EU immigrant workers took place among elementary occupations and laborers. Those are occupations requiring little education and they are intensive in manual skills. This were also occupations employing relatively more low skilled natives as evident from the fraction of low skilled natives reported in the third and fourth column of Table A.2. Even more interesting to have an idea of the occupations that have been more exposed to non-EU immigrant competition is Table 2. In it we list the occupations that experienced the lowest and the highest inflow of non-EU workers, measured as the change in the share of non-EU immigrants employment between 1994 and 2008. For those occupations we also show the index of intensity of use of cognitive, communication and manual tasks and the derived complexity index that combines all of them. It emerges clearly that the occupations experiencing the largest inflow of non-EU immigrants are significantly more intensive in manual skills and less intensive in complex skills than those attracting few of them. Notice, interestingly that one exception is "armed forces". This occupation (within the public sector) is quite intensive in manual tasks but legal barriers prevent immigrants from entering it. This is a sign that the public sector does

[15] Occupations are reportet to Statistics Denmark by firms and there are no legal consequences of misrepporting as opposed to eg. the income of the worker that is reported for tax-purposes. We constructed an algorithm to handle missings and invalid values within job spells that replaces a missing or invalid ISCO-88 by the next within the match with the firm if the next is also the most frequent within the worker-firm match. We used next and not previous, since the occupation code is most often missing in the beginning of the worker-firm spell possibly due to lag in registering. This algorithm as well as lack of incentives for firms to change the occupation reported for an employee may lead to under-estimation of the true job mobility within firms.

[16] $\ln((\text{Communication}+\text{Analytical})/\text{Manual})$. The underlying skill intensities are between zero and one, and the constructed compleity index can therefore take values between $-\infty$ and $+\infty$.

not necessarily follow the productivity and specialization incentives driven by the market.

Finally, Table 3 shows the summary statistics for the controls and for the dependent variables used in the empirical analysis. The empirical analysis is based on a 20% random sample of natives.[17] The sample considered is the one used in the spell regression, in which some workers are added and some are lost every year (1995-2008). We divide the sample between low skilled and high skilled, based on their education when they enter the sample. The first group is younger, has less labor market experience and lower job tenure. As expected, it has also, on average, lower hourly wages and lower annual earnings.[18]

4 Framework, Empirical Strategy and Identification

Our empirical strategy uses post-1994 variation of non-EU immigrants over time and across Danish municipalities, as source of exogenous variation in the local supply of immigrants. We show below how this change in immigrant supply may affect the productivity of natives within firms as well as their distribution across firms. Previous studies using Danish data such as Malchow-Møller, Munch, and Skaksen (2012) and Parrotta, Pozzoli, and Pytlikova (2012) considered immigrant employment at the *firm level* as source of exogenous variation. Those studies analyze the correlation of foreign born with wages and with productivity across firms, and they mainly find negative effects. We believe that our strategy, focussing on variation of immigrants across local labor markets and analyzing the response of natives within and across firms constitutes a better approach from the theoretical and empirical point of view. First, the variation of immigrants across municipalities, especially of non-EU immigrants, captures better a supply shift. While we can argue that initial location of refugees and their families is the result of previous enclaves and house availability, the initial hiring of immigrants across firms is likely driven by firm-specific factors that may be correlated with its productivity and specialization. Moreover, the endogenous response of natives and their mobility across firms will worsen selection and endogeneity at the firm level. Second, the high mobility of workers within a municipality implies that, even when firms have some market power and ethnic networks make new immigrants more available to some firms than others, wages for a specific occupation are determined at the municipality level. Third, a firm level instrument based on the initial share of immigrants can only be constructed for a sample of long-lived firms, that would be very selected.[19] Hence, while firm-level data can improve our understanding of the consequences of immigration, when analyzing the impact of an exogenous change in immigrant supply, the units to measure such shocks are, more logically, local labor markets. Recently, Dustmann and Glitz (2011) also consider immigrants in local labor markets when analyzing the adjustment mechanisms of the local firms.

4.1 Framework

Consider a municipality[20] in which each native worker, that we denote with the index i, works in an establishment (firm) that we denote with the index j. Such initial match, for given initial conditions, maximizes her wage (utility). There is a set of M establishments in the municipality. Each has

[17] Immigrant shares (explanatory variable of interest and instrument) are calculated on the full sample to avoid measurement error.

[18] Table A.3 in the Appendix shows the statistics for the sample used in the cohort analysis. These are individuals who were working in 1994 and who are followed, as a group, over the period 1991-2008. Their characteristics in terms of age, labor market experience, education and wages are not very different from those of the unbalanced sample of employed reported in Table 3. We define low/high skilled in the cohort sample based on the education in 1994.

[19] As described in section 4.3 we use 1988-shares to impute our instrument.

[20] In this section we omit the municipality index, for brevity. The formulas should be considered as relative to the representative municipality.

a specific productivity when matched to worker i. I_{ij} is an indicator that equals 1, when worker i chooses to work in establishment j and it is defined as:

$$\begin{aligned} I_{ij} &= 1 \text{ if } w_{ij} = \max\{w_{i1,...}w_{iM}\} \\ I_{ij} &= 0 \text{ for all other values of } j \end{aligned} \tag{1}$$

where M is the number (and the set) of different establishments in the municipality. The wage that each worker gets paid depends on specific characteristics of the worker, of the firm and on the firm-worker match. The demographic characteristics of the worker X_i, the productivity of the firm A_j, as well as local labor market conditions in the municipality affect the wage that each worker receives from a firm. We focus, in particular, on the effect of the share of foreign born in the municipality, S, on the wages in each establishment. Hence, explicitly capturing this dependence, we can write $w_{ij}(S)$.

There are several channels through which the supply of foreign born can affect native wages in the municipality and in each establishment. First immigrants affect the supply of some skills making the value of complementary skills higher and of substitutable skill lower in the municipality (e.g. Ottaviano and Peri (2012); Peri and Sparber (2009)). This affects native individuals differentially. The competition effect is stronger for native workers whose skills are more similar to those of immigrants and the complementarity effects benefit natives with skills that are more differentiated from immigrants'. Second, immigrants may affect the productivity of the municipality by increasing variety of skills and intermediate goods produced and used there (Ottaviano and Peri, 2005; Ortega and Peri, 2013). They may also affect the productivity of the establishment by encouraging specialization within it (Ottaviano, Peri, and Wright, forthcoming). Such productivity effects may be stronger in establishments that employ a large share of foreigners. Hence, the share of immigrants affects the relative wages faced by individual i in different establishments and therefore also the optimal matching rule can be written as $I_{ij}(S)$.

We consider the aggregate of native workers initially in a municipality in year t and we denote it with N_t. We indicate the initial share of immigrants with S and we write the aggregate native wage in the municipality as:

$$W_t = \sum_{i=1...N_t} \sum_{j \in M} [I_{ij}(S) * w_{ij}(S)] \tag{2}$$

Consider now that between year t and year $t + \Delta t$ the share of immigrants in the municipality increases to $S + \Delta S$. This change has an impact on the wage that each establishment pays to native workers which would equal $w_{ij}(S + \Delta S)$ after the inflow. It will also affect the decision of a worker (to stay in an establishment or to move) through crowding-out, productivity or complementarity effects. The optimal decision would be $I_{ij}(S + \Delta S)$ after the inflow. Moreover, as the municipality is an open economy, native workers may also move out of it and find employment in an establishment outside of M after the immigrants inflow. Therefore, we can decompose the effect of an increase in the immigrant share by ΔS, on the average wage of workers who resided in the municipality at time t, into the following three terms:

$$\Delta W_t = \sum_{i=1...N_t} \sum_{j \in M} \underbrace{I_{ij}(S)[w_{ij}(S+\Delta S) - w_{ij}(S)]}_{\text{Wage Change Stayers}} + \tag{3}$$

$$+ \sum_{i=1...N_t} \sum_{j \in M} \underbrace{\left[I_{ij}(S+\Delta S) w'_{ij}(S+\Delta S) - I_{ij}(S) w_{ij}(S)\right]}_{\text{Wage Change for Workers changing Firm}} +$$

$$+ \sum_{i=1...N_t} \sum_{j \notin M} \underbrace{I_{ij}(S+\Delta S) w'_{ij}(S+\Delta S) - I_{ij}(S) w_{ij}(S)]}_{\text{Wage Change for Workers changing Municipality}}$$

The first term captures the wage change of people who remained in the same establishment.[21] As immigration affects the productivity of plants and municipalities this term captures simply the changes in the wages of natives who kept their job with the original employer. The second and third term, capture the change in wages of native workers who moved out of the original establishments. The important part of these terms is the fact that immigration affected both the distribution of natives across establishments and the wage of natives in the new establishments. The term $I_{ij}(S+\Delta S)$ captures the new allocation of native workers for those who changed establishment so that $I_{ij}(S+\Delta S) - I_{ij}(S)$ is a measure of the flows (transitions to new establishments). As it depends on S we can analyze how immigration has affected inter-firm movements. The second summation term in expression 3 includes changes in establishment within the municipality, $j \in M$ while the third term includes only moves to establishments outside of the municipality $j \notin M$. Finally the term $w'_{ij}(S+\Delta S)$captures the wage for native workers who moved establishment. The notation $w'_{ij}(S+\Delta S)$ implies that the wage for mover i in the new establishment j differ from the previous wage both because the new wages across establishment are affected by immigrants $w_{ij}(S+\Delta S)$ and because moving may have caused a loss of specific capital to the mover. Hence the notation $w'_{ij}(S+\Delta S)$ indicates the individual-specific wage for a mover and can be smaller or higher than $w_{ij}(S+\Delta S)$, the wage for an identical stayer in the same establishment.

Expression 3 allows us to organize the empirical results and what the theory and previous research predicts about each component. The first component that captures wage changes for individuals who stay within establishments will be the focus of the analysis of section 5.1 below. As we analyze the change in response to an increase of non-EU immigrants by one percentage point of the labor force we can measure if immigrants are complementary or substitutable for native workers within establishments. We can also analyze outcomes such as specialization in complex tasks and career advancements and other mechanisms through which the complementarity and productivity effects of immigrants are channelled. There is very limited literature analyzing the effect of immigration within a firm so these results will be relatively new.[22] In the second specification of section 5.1 we consider the first two terms of 3 together. Namely we focus on the wage (and specialization and career) effects on native workers who stay in the municipality (including those who change establishment). These effects, at least relative to wages, are more comparable with those found by the "area literature" (e.g.Card (2001); Glitz (2012); Peri and Sparber (2009)). In section 5.2 we analyze the long-run effects on the cohort of native workers initially in a municipality. Hence we combine the three terms in equation 3. We also analyze the effect that immigration has on the flows $I_{ij}(S+\Delta S) - I_{ij}(S)$ across establishments and out of the municipality and we are able to estimate whether the transition $I_{ij}(S+\Delta S) - I_{ij}(S)$ implies that some workers exit employment altogether or become self-employed (with non-employment

[21] The indicator $I_{ij}(S)$ denotes an allocation for these workers as it was before the change in S.

[22] Malchow-Møller, Munch, and Skaksen (2011, 2012); Malchow-Møller et al. (forthcoming); Parrotta, Pozzoli, and Pytlikova (2012) produce estimates of the effect of hiring immigrant workers on firm outcomes and worker outcomes within the firms. Kerr and Lincoln (2010) exploits the H-1B visa reform to estimate the effect of high skilled immigration on the patenting activity of 77 large firms.

as another choice to the set of establishments) as a consequence of immigration. In section 5.3 we vary Δt from 1 to 14 and we estimate the three terms in equation 3, as they accrue over time. In the remaining of this section we describe how we implement the estimation using different empirical specifications and how we identify the response to immigration.

4.2 Empirical Specifications

The richness of our dataset allows us to identify all the effects of immigration on native outcomes as described by the decomposition in expression 3. We will be able to consider native workers within and across establishments and municipalities as we can follow them in the short, medium and long run. In a frictionless, perfectly competitive economy, with identical firms and perfectly mobile identical workers, looking at the effect of immigration on aggregate wages and employment is all we need, in order to understand the labor market effects of immigration. However, in an economy in which workers and firms are heterogeneous, and in which mobility is imperfect and costly one needs to analyze the effects within firm, across firms and across municipalities, in the short and long run, to have a complete picture of the impact of immigration on natives and to know who gained and who lost from it. The richer set of outcomes that we analyze also helps to provide a more complete picture of the margins and of the mechanisms of adjustment.

The strategy that we adopt implements three different empirical specifications to get to the different components of the effect of immigrants and to convey estimates of their evolution over time. The first specification focuses on the effect of immigration on wage, occupational complexity, career mobility of workers within an establishment (namely the component captured in the first term of 3) or within a municipality (the sum of the first two terms in 3). Looking at workers while they are within firms (or municipalities), we analyze the change in outcomes when the municipality (local labor market) receives a large number of non-EU immigrants. This approach described in section 5.1 is able to control for a very large set of fixed effects that capture heterogeneity of firm-worker matches. It does not consider, however, the potential effect of immigration on workers who move out of the sector-region or become non-employed or self-employed. Moreover, it is based on year-to-year differential changes and it misses the long-run cumulated effects of immigration.

To capture the effect of immigration on the probability of transition out of the establishment or out of the municipality (i.e. the specific impact on term $I_{ij}(S + \Delta S) - I_{ij}(S)$) we set up the second empirical specification described in section 5.2. In it we identify the cohorts of workers defined by their 1994 location in a municipality and exposed to different inflows of non-EU immigrant workers. Then we analyze the impact on subsequent outcomes following cohorts of native workers with different exposure to immigration between 1994 and 2008. We maintain the original cohorts as defined by their location in 1994 and treat subsequent mobility as endogenous (area, region and industry fixed effects are specific to the location the worker had in 1994). This specification evaluates the cumulative impact in the post-event period as a function of the exposure to non-EU immigrants in the original municipalities defined as the 1994-2008 difference in the non-EU share of employment (instrumented using the imputed share of labor force described in section 4.3). Its formulation is in expression 5 below.

Finally, to identify the short- and long-run effects on the outcomes of all native workers, including those who moved out of the firm or the municipality (i.e. including all the terms of expression 3) in the third specification we track the transition of native workers in terms of wages, employment and specialization in an analysis that resemble an event study. In this approach we distinguish between those municipalities with an inflow of immigrants above the average (treated), and those with an inflow below the average over the 1995-2008 period (control). We track the yearly response for workers who in the pre-1995 period where in the low-immigration and those who were in the high-immigration municipalities. This approach (described in section 5.3) allows us to analyze the transitions and to

validate the long-run effects of the long-difference approach. It also allows us to check for the existence of pre-event trends in the relevant dependent variables. Specifically, we can check whether the trend in the performance of workers in municipalities highly exposed and less exposed to immigrants from 1995 and onwards were similar or differed before 1995. Each of these approaches controls for a very large array of potential confounding factors with very demanding fixed effects. However as unobservable variables may still bias the estimates we will also use instrumental variables in all approaches. The next section describes the construction of instrument and shows some tests of its exogeneity.

4.3 Identification and Instrumental Variable

Our key explanatory variable measures non-EU individuals as share of employment in the municipality m at time t. We denote this as S_{mt}^{nonEU}. The inflow of non-EU immigrants may be correlated with unobserved demand shocks. We always control for the time invariant differences between municipalities, and for the industry level and regional level fluctuations in demand. Nevertheless, we may be left with some lingering local unobserved shock affecting both native and immigrant labor demand. Therefore we build an instrument based on the distribution of non-EU population by nationality across municipalities in Denmark as of year 1988, six years earlier than the acceleration in the non-EU immigration, driven by international events, and three years into the Spatial Dispersal Policy on refugees. Given the very small absolute size of these non-EU communities in 1988, small historical accidents together with the initial dispersal policy generated the variation. We then use the national inflow of non-EU immigrants by nationality, affected by international conditions and aggregate national policies, and independent of municipality-specific economic shocks, to impute the supply-driven increase in non-EU immigrants in each municipality. This method follows the literature since Altonji and Card (1991). In our case, however, as we chose non-EU immigrants and we consider a period of refugee dispersal policies and family reunifications, we can presume an even stronger exogeneity of the 1988-distribution and imputed flows with respect to the labor demand changes between 1995 and 2008.

Specifically, let us call F_{ct} the total population of immigrants from country c resident in Denmark in year t, and s_{cm1988} the share of that population resident in municipality m as of year 1988.[23] We then construct $\widehat{F}_{cmt}$ the imputed population from country c in municipality m in year t as follows: $\widehat{F}_{cmt} = s_{cm1988} \times F_{ct}$ and the imputed total share of immigrants with non-EU origin as: $\widehat{S}_{mt}^{nonEU} = (\sum_{c \in nonEU} \widehat{F}_{cmt})/P_{m1988}$, where P_{m1988} is the total population in municipality m in year 1988. The variation of $\widehat{S}_{mt}^{nonEU}$ is only driven by the changes in the imputed non-EU population (the denominator is held fixed at is 1988-value) and it is used as instrument for the actual share of non-EU immigrants in municipality m at time t (S_{mt}^{nonEU}).

The exclusion restriction requires that the imputed inflow of non-EU immigrants is orthogonal to the municipality-specific shocks to (and trends in) labor market conditions once we control for fixed effects and observed variables. While it is not possible to check that the instrument is independent of all the unobservable determinants of local labor market conditions we can do some important falsification tests. Table 4 tests whether the 1994-2008 change in the imputed non-EU share of labor force across municipalities (our instrument) is correlated to the growth of any of the outcome variables (occupational complexity, hourly wages, fraction of year worked and yearly earnings) in those municipalities between 1991 and 1994, the pre-event period. A significant correlation would cast doubts on the validity of the instrument, as it would reveal correlation with trends that pre-date the non-EU immigrants surge. In the analysis of the cohort-based transitions, in section 5.3, we can check whether there is a pre-event trend in the differences in outcomes between the high immigration municipalities

[23] In the construction of the instrument, as in the analysis of the labor market and as described in section 3, the population that we consider are individuals 16 to 65 years old, not in school and not permanently disabled.

and the low immigration municipalities.[24] This is a further check that it is reasonable to consider the post-event differences in outcomes as caused by the differences in immigration rates post 1994.[25]

Table 4 shows the explanatory power of the (1994-2008) change in our instrument on the pre-1995 change in average outcomes of natives across the 97 municipalities. The regression includes age, labor market experience, job tenure, (and each of them squared) and marital status averaged over the labor force in each municipality in 1994 and weights each municipality by its labor force in 1994. In the upper part of the table we include estimates using outcomes for low skilled natives and in the lower part of the table we consider outcomes for high skilled natives. The estimated coefficients are very small and never significant. Furthermore, we tested an instrument for EU-immigration. In this case the test for the exclusion restriction fails, as that instrument exhibits a significant positive relationship with wage growth in the municipalities controlling for age, labor market experience, job tenure, (each of those squared) and marital status. This suggests that while the pre-1988 location of non-EU immigrants was likely exogenous, the location of EU might have been correlated with persistent economic features of the regions. These tests are consistent with the assumption that our instrument only affects the outcomes of native workers in the municipality through its effect on the actual share of non-EU workers in the area.[26]

A tendency of immigrants to settle in prosperous areas would generally produce an upward bias in a coefficient based on OLS. However, as we consider non-EU immigrants and refugees, dispersed according to the availability of low cost housing, one may think that the correlation between the inflow of these groups and the economic conditions of a municipality can be negative, which would result in a downward bias of the OLS estimates. In the specific case considered here, the differences between our OLS estimates and 2SLS estimates suggest a negative correlation between the actual inflow and the contemporaneous labor market conditions (see for instance Table 5).

Let us also emphasize that Aydemir and Borjas (2011) point out that this instrumental variable approach may not solve attenuation bias due to measurement error in the immigrant share, if a correlated measurement error is also present in the instrument. Aydemir and Borjas (2011) show that when calculations are based on one percent samples of the American census the bias can be large. Furthermore, the presence of fixed effects in the regression may worsen such a bias by identifying the coefficient on time differences only. Our data, however, are not subject to measurement error arising from sampling. In fact our data, include the universe of individual and firms in Denmark. This allows us to use the full population registers to calculate the exact immigrant shares of each municipality.

We use the imputed non-EU share of the labor force as instrument in the spell regression (equation 4) and in the difference regression (equation 5). We also use it to classify municipalities into "high" and "low" immigration in the event study (equation 6).

5 Implementation and Results

5.1 Effects within establishment or municipality: The Spell Regression

Our first approach focusses on the impact of non-EU immigration on natives within establishments and within municipalities. We consider several outcomes relative to native (NAT) individual i in establishment j in municipality m at time t, that will be indicated as the variable y_{ijmt}^{NAT} in the regression

[24] High and low immigration municipalities are defined using the exogenous part of the actual inflows as explained in detail in footnote 34.

[25] This check uses individual level data, as opposed to the average trends in municipalities analysed in this section.

[26] Figure A.2 and A.3 in the Appendix shows the partial scatter plots of the 1991-1994 trend in outcomes on the 1994-2008 change in the instrument (thus plots corresponding the the relationships reported in Table 4). We also did the same exercise with the full set of controls listed in the first part of Table 3 and obtained similar non-significant relationships.

(4) below. The first outcome is occupational complexity. Then we present three outcomes relative to career mobility (career upgrade, career downgrade and occupational mobility), the logarithm of hourly wages, the logarithm of annual earnings and employment measured as a fractional value of a complete working year.[27] The main explanatory variable is the non-EU immigrant share of employment in municipality m and year t, S_{mt}^{nonEU}, calculated as F_{mt}^{NONEU}/P_{mt} where F_{mt}^{nonEU} is the stock of employed immigrants of non-EU origin and P_{mt} is the total employment in municipality m and year t. In the 2SLS specifications we instrument S_{mt}^{nonEU} with $\widehat{S}_{mt}^{nonEU}$ as described in section 4.3. The regression that we perform has the following structure:

$$y_{ijmt}^{NAT} = x_{it}'\alpha + \beta S_{mt}^{nonEU} + \phi_{t,IND} + \phi_{t,REG} + \gamma_{i,u} + \varepsilon_{ijmt} \tag{4}$$

The variable x_{it} is a vector of individual characteristics that are time-varying, at least for some individuals. It includes age, labor market experience, job tenure, education, and whether the person is married (plus age, experience and tenure squared). $\phi_{t,IND}$ and $\phi_{t,REG}$ are industry-by-time and region-by-time effects capturing regional and industry-specific time patterns. Regions are the five administrative regions in Denmark and industries are the eight industries of the 1-digit NACE industrial classification scheme.[28] A key set of controls in regression (4) is indicated with $\gamma_{i,u}$. This represents a set of fixed effects for each individual (i)-unit (u) pair. Depending on which unit we choose, the inclusion of these effects allow us to identify the impact of immigration on outcomes for different groups of native workers. One important thing is that the fixed effects $\gamma_{i,u}$ are always nested within municipality. This implies that any time-invariant municipality-specific factor in equation 4, that is possibly correlated with the share of non-EU immigrants in the population, is controlled for by the inclusion of those effects.

In the first set of regressions we choose the unit u to be an establishment, j. In this case the set of fixed effects $\gamma_{i,j}$ will vary for each different employee-establishment pairing.[29] We will call this pairing a "spell" because it usually represents a spell of employment for a worker, between changes of establishment, or between moves in and out of employment. This is a very demanding specification and it implies that our regression controls for any unobserved productivity component that is specific to the worker-establishment match. The regression identifies the impact of an increased supply of non-EU immigrants in the municipal labor market on the outcome of native workers only using within spell variation.[30] The results of these regressions are very interesting. They shed light on the effects for workers within firms when an inflow of immigrants increases the availability of non-EU workers in their municipality. Identifying whether the productivity and the specialization/career of native workers, within the firm, is affected by this exogenous event is important and, as of now, we do not know much about it. Moreover the effect is identified on the "within" firm-worker match variation and hence after controlling for individual-firm heterogeneity (fixed effects). The estimates cannot be affected by composition effects such as the changing type of firms or of workers over time.

In the second set of regressions the unit u is the municipality. Hence, we include a set of individual-municipality fixed effects $\gamma_{i,m}$. These specifications controls for individual-municipality specific productivity, and they estimate the impact of immigrants on the wage, occupation and career of native workers who may change establishment, but remain within the same municipality. Comparing the

[27] All the variables have been defined in section 3.

[28] The regions and industries are listed in Table 3.

[29] This type of fixed effect is similar to the one used in Hummels et al. (2011) and Malchow-Møller, Munch, and Skaksen (2011).

[30] 10.7 percent of the observations (individuals × year) are in job spells where the worker changes municipality of residence at some point during the match with the employer. This includes small moves across municipality borders and moves that are due to imperfect timing of job change and change of residence. We exclude these job spells from the within worker-firm match regressions, but results are not sensitive to whether they are excluded or included as two different job spells (Table A.6 and A.7 in Appendix).

estimated effects using these two different types of individual time variation allow us to understand much better how the local labor market respond to an inflow of immigrants. Are workers more exposed to the wage/specialization effects of an inflow of immigrants while they stay within the firm or do the largest effects materialize when we follow them across different firms within the municipality? Do negative wage and career effects due to loss of specific human capital or positive wage effects due to specialization, upgrading and comparative advantages arise for natives when we consider their mobility within a municipality in response to immigrants? Or does immigration increase productivity of natives within an establishment while hurting workers who are displaced to other establishments? The two sets of regressions that we estimate allows us to shed light on these questions.

Notice, finally, that our key explanatory variable, the share of non-EU immigrants, varies at the municipality-year level. This implies that we cannot control for a municipality-year effect, as it would absorb all the identifying variation. To minimize omitted variable bias we use the instruments and to account for error correlation within the level of variation of the explanatory variable we cluster standard errors at the municipality level.

5.1.1 Estimation and Results

Tables 5 and 6 report the basic estimated effects of immigrants on natives within establishments (column 1 and 2) and within municipalities (column 3 and 4). The tables report estimates of the coefficient β from specifications (4) using different outcomes.[31] Hence, the first two columns identify the effects only on changes in outcome for workers who stay in the same establishment, and the third and fourth identify the effects on those workers who remain in the same municipality (including movers between establishments). Table 5 considers the outcomes for natives without post-secondary education only, that we call "low skilled". Table 6 shows the estimated effects for native workers with tertiary education ("high skilled"). We separate the analysis between the two skill groups because, as described in section 2, immigrants from non-EU countries, as a group, were more likely to compete with low-skilled Danish workers.

The structure of Tables 5 and 6 is the same. The first row shows the effects of an increase in non-EU immigrants by one percentage point of the labor force on the occupational complexity of native workers. The second, third and fourth rows report the estimated effects on the probability of a career upgrade, a career downgrade and a change in occupation. The fifth row reports the effects on the (logarithm of) hourly wages. The sixth row shows the effect on the (logarithm of) annual earning. The seventh row shows the effect on the fraction of the full-time working year that the individual worked. For each specification we report the OLS (columns 1 and 3) and the 2SLS (columns 2 and 4) estimates. The last three lines of each table show, respectively, the number of observations and, for the 2SLS regressions, the F-statistics and the coefficient for the first stage. The instrument used is the imputed non-EU immigrant share of the population described in section 4.3. In parenthesis under the estimates we report the heteroskedasticity robust standard errors clustered at the municipality level.

First, let us notice that the instrument is reasonably strong with a F-statistics of the first stage always above 10 (the value under which weak instrument concerns may arise (Stock and Yogo, 2005)). We consider the 2SLS estimates as the preferred specification, given our concern for potential omitted labor demand shocks at the municipality level. Notice, that in most cases the OLS have a downward bias implying a negative correlation between economic shocks and inflow of non-EU immigrants which is consistent with the idea that refugees were dispersed in areas with available (or less expensive) buildings. Looking at the 2SLS estimates, several interesting findings emerge.

The first interesting result is that on average hourly wages, annual earnings and labor supply

[31] The extremely high dimensionality of the fixed effects $\gamma_{i,u}$ implies that the fixed effects estimator has to be implemented by performing a within-transformation. This is inconsequential since we are not interested in the fixed effects per se and hence we do not miss any relevant estimate.

increase (or stay unaffected) in response to immigration for all native workers. For low skilled there is a positive significant effect on hourly wages within establishment. For highly skilled the largest effect is on hourly wages of workers within municipality (including those who change establishment). The estimates for the within establishment and within municipality are not statistically distinguishable though. Considering less skilled it appears that the inflow of non-EU immigrants (likely employed in manual type of tasks) encourage career upgrade and occupational mobility, leading to higher labor supply and higher hourly wages within establishments. This is a sign that less educated natives benefited from complementarity of immigrants in the same establishment. Less educated natives who moved across establishments within municipalities are also significantly more likely to change occupation and some do this with a significant wage loss (career downgrade), while others climb towards more complex occupations and experiences wage progress such that the average effect on wages is neutral. If those who change occupation and experience wage loss due to specific capital loss at first, move simultaneously towards more complex occupations (whose wage grows faster) they may catch up or increase their wage in the medium or long run. If those who change occupation and experience wages losses are different individuals from those moving to more complex jobs, then wage dispersion within the group is likely to increase. While, among less skilled workers, those remaining within establishments seem to achieve the larger wage gains, on average all less skilled in a municipality have non-negative wage and employment effect. Similar patterns, with larger wage gains (and insignificant changes in labor supply) are found for high skilled. Immigrants (likely their complements) afford them higher wages and earnings, even without triggering the degree of career upgrade and change in occupational complexity experienced by the low skilled. This is reasonable as they already perform production tasks quite different from immigrants. An interesting implication of our results is that, in general, immigration spurs occupational mobility of natives, including more career upgrade as well as more downgrade. While on average the mobility rewards natives with higher wages and employment (though not always significant), it is also likely to increase the variance in performance of natives. Immigrants generate an opportunity for natives: those who take advantage of it by upgrading skills gain, while those who do not may lose. On average the gains are larger than the losses among the more and the less educated. However there may be individual winners and losers.

Quantitatively the effects are non trivial, but not unreasonably large. Municipalities with above-average immigration experienced a growth of the non-EU percentage of employment larger by 2 percentage points than the municipalities below-average, for the 1994-2008 period. This translates in wages larger by 0.9% and 1.7% for native low skilled and high skilled workers within an establishment, respectively. If we consider the effect on all native workers in the municipality, including those who changed establishment, the average gain for less skilled is an insignificant 0.3% while high skilled gained 2.1% of their hourly wages (for an increase in the immigrant share by 2 percentage point of the labor force). These are non-trivial gains. For comparison, the overall increase in average real wages in Denmark during the 1994-2008 period was 18 percentage points for less skilled workers and 19 percentage points for high skilled. One tenth of the wage gain of more educated can be attributed to immigration.

Taken together these results suggest that non-EU immigrants performed different production tasks than natives and were complementary to their productivity. Probably because of their manually-intensive and low skilled occupations, their presence encouraged natives to take more complex (complementary) occupations, and it also increased their upward mobility within the firm. Firms in labor markets with larger availability of non-EU workers ended up with increased native mobility, increased complexity of their occupations and higher wages and employment, on average.

Pushing the analysis a step further, it is reasonable to think that the degree of complementarity and task specialization/upgrade available to natives in response to immigrants may depends on their industry of employment. In industries producing differentiated goods or services and using a larger range of manual and complex abilities, the need for differentiated skills, and the complementarity across

workers may be larger. In industries producing more homogenous goods and services, with limited varieties of skills, the opportunities for these gains from complementarity/diversity may be smaller. A second feature that could make workers and firms more responsive to immigration is their exposure to market pressures. The private sector workers should be able to move across occupations more easily and firms would have stronger incentives to encourage efficient worker allocation and specialization, with stronger potential for the observed specialization/complemetarity effects, especially in sectors were wages are bargained at the industry level. This happened in large part of the private sector, in Denmark. In the public sector, instead, workers and firms may not respond so actively to the complementarity and specialization opportunities, especially if they arise at the municipal level. If individuals are tied to their occupation and pay is centrally determined, immigrants may not induce complementarity but only have a competition effects.

In order to examine these differences we divide the economy in four broad sectors. The first is manufacturing, the sector producing goods, several of which can be highly differentiated and exposed to international competition; the second is non-complex services (utility, construction, wholesale, retail and hospitality services) producing non-tradable, local and sometimes manual intensive services; the third is complex services (transport, telecommunication, finance, business and real estate) producing differentiated and more sophisticated, skill-intensive services. The last is the public sector (including mainly administration, health care, education and armed forces) whose wages and employment level may be much less responsive to the market and to productivity. Table 7 and 8 show the effects of non-EU immigrants on native workers divided into each of the four sectors defined above. Table 7 shows estimates of the effects on occupational complexity, hourly wages and annual earnings for less educated Danish workers. Table 8 does the same for tertiary educated.

Considering the effects on low skilled workers, the results in Table 7 confirm our hypothesis. The largest positive and usually significant effects on occupational complexity, hourly wages and annual earnings are experienced by native workers in the complex service sector. The magnitude of the effect is quite large: a one point increase in the non-EU immigrant percentage of the labor force produces (using the 2SLS estimates) an increase of native hourly wages between 1.6 and 2.4 percentage points depending on the sample. Low-skilled natives in the non-complex service sector and manufacturing sector are much less affected; experiencing a significant effect only on annual earnings only within non-complex service firms and a significant effect on hourly wages only for workers in manufacturing when mobility across firms is considered. Finally, those in the public sector did not experience any change in occupational complexity and occasionally suffered negative effects on their hourly wages and annual income.

For high skilled natives most of the wage and earnings effects are positive, and the estimates are particularly large and significant in the complex service sector. Native high skilled in manufacturing and non-complex services seem to climb more towards complex jobs, still their wage effects are less than half the magnitude of those in complex services and not always significant (annual earnings effects are never statistically significant). In the public sector immigration had a negative effect on complexity of tasks performed by skilled natives, the effects on hourly wages were small, and earnings effects were non-significant.

These results confirm the idea, that the gains from complementarity and specialization are larger in more complex, diversified sectors responding to private incentives. In those industries, less educated natives who would be in closer competition with immigrants specialize in response to immigration and the high skilled seem to gain directly from immigration without further specialization since they already perform tasks complementary to those supply by immigrants. Hence, both low and high skilled natives in complex industries are able to increase their marginal productivity in response to immigration. In sectors with less scope for differentiation and with no private incentives to do that (the public sector) natives do not move towards complex jobs and high skilled even decrease their progression towards more complex jobs. High skilled in the public sector still increase their marginal

productivity due to their complementarity with the immigrants, but wages and earnings of low skilled in the public sector decrease due to a crowding (competition) effect from immigrants and loss of specific capital for those who change employer.

The results of this section add several new findings to this literature. While it was known from Peri and Sparber (2009) that immigration can cause specialization and positive productivity effects for natives, we learn using these individual data that occupational mobility towards more complex jobs in response to immigrants takes place mainly across firms. It also increases wage dispersion such that some workers may experience significant downgrade while other experience upgrade with resulting zero or positive effects on the wage of an average unskilled worker. Gains from complementarity and specialization are the strongest when movers across firms are considered. Those gains offset the loss of some firm-specific human capital. We also learn that the positive effects are stronger in sectors producing complex differentiated goods and services and follow market incentives. As in D'Amuri and Peri (forthcoming) this seems to support the idea that mobility and flexibility are important characteristics for the firms and workers to earn productivity dividends from immigration.

5.2 Cumulated employment effects: long differences

The analysis of section 5.1 above identifies the effects of immigration on workers within an employment spell in an establishment or within an employment period in the municipality. It misses, however, two important potential consequences of immigration. First, native workers who change jobs may become more likely to spend periods as non-employed. Second, they can become more likely to move to other municipalities. If separation rates increase and workers experience costly transitions through unemployment, the above analysis will miss important displacement effects of immigration that can penalize native workers. Furthermore, this effect - like the competition from immigrants - may build up over time. To capture this one needs to follow individuals over a long time horizon.

The strategies that we adopt in this and in the next section address these shortcomings and look at the impact of non-EU immigrants on cohorts of native individuals experiencing different immigration rates in the municipality where they worked. We define a cohort as natives (divided in high or low skilled) working in a municipality m as of 1994, and we follow the entire cohort over time by using a strongly balanced panel of individuals from 1991-2008. Individuals are traced irrespective of their labor market status from 1991 to 2008 across establishments, municipalities and in and out of employment. To attain a strongly balanced panel of individuals potentially available for work throughout the period, the sample criterion is tightened to those fulfilling our labor force definition in all years. Natives aged 21-51 in 1994 satisfy the age criterion (18-65) throughout the panel and will be included in the panel unless they go back to study, become disabled, leave Denmark or die within the sample.

We use the variation in the change in non-EU immigration share between 1994 and 2008 in the municipality, denoted as $\Delta S^{NONEU}_{m,1994-2008}$, to capture immigration exposure. In this section we analyze the correlation of these changes with the changes in cumulative labor market outcomes for native people between 1995 and 2008. We denote those cumulated changes in individual outcomes as $\Delta y^{NAT}_{i,m,1995-2008}$. The outcomes that we consider in this section are several. We analyze the cumulated employment, measured as share of full-time year worked; the employment in the same or new establishment; the employment in the same or new sector; and employment in the same or new municipality. Moreover, we analyze the cumulated effect on the probability of being self-employed and unemployed. These long differences reveal if native workers in municipalities with high non-EU immigration rates had higher probability to work less, change establishment, change sector or change municipality relative to identical native workers in municipalities with low immigration rates. In order to avoid correlation between the changes in non-EU immigrants and unobserved municipality-specific shocks we instrument the change with the imputed supply-push variable described in section 4.3. The estimated specification, a cross section in changes, is as follows:

$$\Delta y^{NAT}_{i,m,1995-2008} = \alpha \tilde{x}'_{i,1994} + \beta \Delta S^{NONEU}_{m,1994-1998} + \tilde{\phi}_{IND} + \tilde{\phi}_{REG} + \varepsilon_{it} \quad (5)$$

In regression (5) a tilde indicates variables that are measured in year 1994; hence, they capture individual characteristics before the non-EU immigration boom. The controls $\tilde{x}_i$ are as those defined as in equation 4, but here they are relative to the worker as of 1994 and includes additional information on the initial occupation of the worker.[32] Region and industry effects $\tilde{\phi}_{REG}$ and $\tilde{\phi}_{IND}$ are also assigned to individual workers according to their 1994 industry and municipality affiliation. The standard errors are clustered by the 1994- municipality. The strongly balanced nature of the panel avoids compositional changes in the cohorts due to individuals entering or exiting the labor market that could otherwise have confounded the estimated effect of immigration.

5.2.1 Estimation and Results

Table 9 (low skilled) and Table 10 (high skilled) report the estimated effects of an increase in non-EU immigrants by one percentage point of the labor force on the cumulated employment (over the 14 years). The first line reports the impact on employment including all sectors (column 1), and then in turn considering natives initially in manufacturing, non-complex services, complex services and the public sector (column 2-5). The following rows produce estimates of the increased (decreased) length of employment in the same (and new) establishment, sector and municipality in response to immigration increases by one percentage point of the labor force. Then we show the effects on the length of cumulated unemployment and self-employment.

The estimated coefficient in the first column and row of Table 9 implies that less educated native workers in municipalities receiving an increase in non-EU immigrants equal to one percentage point of the labor force experienced a non-significant decline in cumulated employment (over fourteen years) by five percent of one work-year, namely two working weeks. A high skilled native also experienced an insignificant change to their cumulative employment over the fourteen year period (Table 10).[33] Hence, non-EU immigration did not have any significant effect overall on cumulated employment of native individuals. Similarly, immigration did not affect the cumulated time spent as unemployed neither for low nor for high skilled natives. In Table 10 we see that immigration actually decreased the probability of high skilled to become self-employed, while it did not have any significant effect on probability of self-employment of less skilled.

Even more interesting is to consider the effect of immigration on the cumulated employment in the same establishment, in the same sector and in the same municipality. For highly educated natives immigration increased the time spent in a new establishment and municipality and decreased the time spent in the original one. For low skilled this effect is significant only for the municipality. On average highly educated natives spent six weeks less in the same establishment over the following 14 years, in a municipality experiencing an increase of non-EU immigrants by one percent point of the workforce. Similarly, they spent 15 working weeks less in the original municipality and 15 weeks more in a new one during the 14 years, if the original municipality experienced an increase of non-EU immigrants by one percentage point of the labor force. The effects were smaller, but very significant in terms of municipality switching, also for less educated natives. Cross-sector mobility does not seem to be much affected by immigration, except for workers in the manufacturing sector who in municipalities with high immigration stayed shorter, while workers in the complex service sector remained longer in their original sector when experiencing higher immigration rates. Immigration, therefore, was associated

[32] Initial occupation in the firm would not be a wise control variable in the spell regressions of section 5.1 because it is potentially endogenous to immigration, but in the cohort analyses of this section and section 5.3 the occupation in 1994 can be used to remove differences in pre-immigration career paths. These occupations are listed in Table A.3 in Appendix together with the remaining controls and the outcome variables in the cohort sample.

[33] We are using 46 weeks as the usual full-time work-year for a Danish worker.

with a movement of the native labor force away from manufacturing and into complex services. This is consistent with the findings of section 5.1 that natives move towards more complex tasks in response to immigration. These moves are likely to be associated with wages and earning gains that may offset and reverse the cost of moving across establishments and sectors due to loss of specific human capital.

Overall immigration seems to increase the churning of jobs and generate a tendency of moving towards more complex jobs, a higher tendency to moving out of the establishment and out of the municipality and out of the manufacturing sector into more complex and differentiated industries. Most of these changes are associated to upgrades and better opportunity, rather than to displacement and loss of skills, as they may generate increases in wages and yearly income. The probability of being employed or unemployed was not affected. The analysis of the next section will track more carefully the transitions of native workers in terms of wages, occupation and employment, and like this section follow individuals over time even if they leave their initial municipality.

5.3 The Effects on a Cohort: Transitions

Section 3 showed that the immigrant share accelerated in 1995 in some municipalities, while leaving other municipalities virtually unaffected. We now exploit this to define as "exposed" to immigration (or "treated") those individuals who in year 1994 were living in areas that experienced a subsequent non-EU immigration inflow above the median. "Non-exposed" or "control" individuals as those who lived in areas with less than median inflow.[34] Instead of the median, we also replicated the analysis comparing the upper and lower quartile of immigration exposure. This analysis gave larger but less precise estimates; hence, the preferred specification showed here uses the median value as separator. We interact indicators for exposure M_i, corresponding to one if individual i was in a treated municipality m in 1994, with a set of year dummies, $D(year = t)$, that are one in the relevant year and zero otherwise. The coefficients γ_t below then capture the differential in outcomes between 1991 (year -3) and 2008 (year 14) for treated and non-treated individuals. Year 1994 is year 0 and the coefficient for that year is standardized to 0.[35]

$$\begin{aligned} y_{imt}^{NAT} &= \tilde{x}_i'\alpha + \sum_{t=-3}^{-1} \gamma_t M_{im} D(year = t) + \sum_{t=1}^{14} \gamma_t M_{im} D(year = t) + \\ &\quad + \tilde{\phi}_{t,IND} + \tilde{\phi}_{t,REG} + \tilde{\phi}_{t,EDUC} + \tilde{\phi}_{t,OCC} + \tilde{\phi}_m + \varepsilon_{it} \end{aligned} \tag{6}$$

As in equation 5 municipality (m), region (REG), industry (IND) and individual characteristics ($\tilde{x}_i$, $EDUC$ and OCC) are specific to 1994, and equation 6 is estimated using a strongly balanced panel to be able to identify the effect on individual workers (unaffected by compositional changes and non-random sorting across industries and areas). We include fixed effects for the 1994-municipality of the worker, and several different year effects to account for different evolution in outcomes across workers that could potentially be confounded with immigration. These are region-by-year effects, industry-by-year, education-by-year and initial occupation-by-year effects.[36]

[34] Specifically, high and low immigration municipalities are defined using the population weighted distribution of the 1994-2008 difference in the predicted non-EU immigrant share. The predicted shares are obtained from a first stage regression of the actual immigrant shares on imputed immigrant shares as well as year and municipality fixed effects.

[35] In another specification not shown here, we defined 1995 as the year prior to the event and used the 1995-2008 difference in predicted non-EU share to define esposed and non-exposed. We tried that because the discontinuity in the labor force seem to occur one year later than the discontinuity in employment. Results for high skilled were very robust to this change, whereas results for low skilled became a smaller and less significant.

[36] As we include municipality and year effects in the model we omit year 1994 in the interactions with the "treatment" effects. Hence, 1994 is the reference year, namely year 0 in the event. We let NACE 1 in 1991 be reference for the industry-by-year effects, and leave all year effects for one region, education and position out (again 1991 can be thought of as the reference and 1992-2008 because the overall year effects already are captured by including all industry-year effects

Consistently with the analysis of the previous sections, we consider as outcome variables, y_{imt}^{NAT} which captures, alternatively, occupational complexity, hourly wages, annual earnings and employment as fraction worked of the full-time year. This approach allows us to identify the long-run effect on the whole cohort of native workers from an exposed municipality, including those that, endogenously, decided to leave the area or to leave employment. This method allows us to examine the pre-event behavior of the outcome variables in exposed and non-exposed municipalities, once we control for individual characteristics and fixed effects, and detect whether there were trends. This is a check that unobserved differences in the two type of municipalities are not systematically associated with immigration. Finally, we split the sample between different types of workers (young and old, high and low tenure, male and female) to see if the response to the immigration event was systematically different for these groups.[37]

5.3.1 Estimation and Results

The main results of the event-like estimation specified in equation 6 are reported in Table 11 and 12 for selected years before and after the event. Figures 5 and 6 show the whole trajectory of the difference in outcomes between three year before and fourteen years after the event-year (1994). As usual we separate the effects on more and less educated Danish citizens. The two tables show three important results, that are confirmed by the figures. First, except for hourly wage of highly educated, which show an upward trend, there is no sign of a pre-event trend in any of the differences in outcomes between treated and control municipalities. This is reassuring and it confirms that after controlling for individual characteristics, constant and time-varying fixed effects there was no systematic difference in the trend of wage, employment and occupational complexity of natives before 1994 between high- and low-immigration municipalities. Second, confirming the within-spell regressions (and the shifting across sectors in the cumulative regressions) we find that there is clear evidence that both more and less educated native workers moved, slowly but steadily, towards more complex occupations in response to high immigration. Fourteen years after the beginning of the event natives in high immigration municipalities had moved to more complex jobs resulting in a significant effect equal to 3 points of the complexity index. This corresponds to a small but significant change of the complexity of an occupation, equal to 4 percent of a standard deviation in the complexity index in the Danish population. Third, in part as a consequence of this occupational move there is also evidence of a positive effect on hourly wages of more and less educated in the medium run (3 to 9 years after the beginning of the event), while in the long run the effect is less clear. No significant effect on employment, measured as fraction of year worked, of either group is found in the short and medium run. Towards the end of the response period (after 10 years) a small significant effect on labor supply (positive for high skilled and negative for low skilled) appear to arise. However, as we will see below, these effects are mainly due to older workers who eleven to fourteen years after the event might go on early retirement.[38]

These results confirm several findings of the spell regression and at the same time are the first results in this literature, to the best of our knowledge, obtained by following over time (and across municipalities) a cohort of individuals working in municipalities with high or low exposure to non-EU immigrants. Hence, this is the first time that we can track the actual workers exposed to an exogenous change in competition from immigrants and measure the impact on their wages, specialization and employment over time. These estimates cannot be driven by changes in composition or selection out

for 1992-2008). Lastly, since the municipality fixed effects are collinear with region-year fixed effects, one municipality per region is left out.

[37] For each group we also calcalulate the present discounted value of the 1995-2008 stream of earnings effects reported in table A.8 in the Appendix.

[38] Effect of immigrants on early retirement can be an additional outcome to analyze. We leave it for future research.

of the municipality as the composition of the group is kept constant. They also confirm a clear result revealed in the spell regression that showed how natives moved to complex occupations in response to immigrants, that they were not displaced out of employment and that their wages increased or remained unchanged. The magnitudes of the positive effects estimated for the medium to long run in Table 11 (5 to 9 years) is larger than those estimated in the spell regression. After nine years from 1994 the difference in share of non-EU immigrants between treated and non-treated municipalities was about 1.25% of the labor force. The effect on the wage of less skilled was a positive 1.1 percentage points and for the high skilled was a (non-significant) 0.7 percentage points. This implies and elasticity of 0.9 and 0.6 (respectively for low and high skilled), while the within establishment estimates of those elasticities in Table 5 and 6 were 0.3 and 2.1. This suggests that those who changed municipality were differently selected among the low and high skilled, and that the contemporaneous effects estimated in the spell regressions do not persist: The wage effects for high skilled are far more modest in the long run, when considering also those workers who changed municipality. For the low skilled their hourly wages slowly increased in response to immigration revealing positive medium and long run effects.

Analyzing the full transition for less educated workers (in Figure 5) we see how the long-run effects accrue over time. In particular we can observe a progressive increase in the occupational complexity, faster in the first five years after the shock for this group. Hourly wage also climb in the first five years and then stabilizes to a permanently higher level. At the same time, we do not observe any significant change in labor supply in the first 9 years after the event. Only towards the very end a slight decline (barely significant) may be due to early retirement behavior (as we will discuss below the effect is driven by older people). Patterns are similar for highly educated, with positive and occasionally significant effects on hourly wages and employment and a progressive and significant increase in the occupational complexity. Towards the end of the period there is an increase in labor supply for highly skilled in treated municipalities, and again it may have to do with their retirement behavior. Overall, there is no evidence of negative effects from displacement, wage competition and loss of specific capital, when we consider all workers exposed to immigrant competition. When comparing to the spell regressions, we observe that some of the immediate gain high-skilled experience from their complementarity with the non-EU immigrants are attenuate in the long run and when we consider all workers, including those leaving the municipality. Low skilled to the contrary slowly move towards more complex tasks thereby raising their productivity and wage, even in the long run and when considering all workers. The present discounted value of the effects on annual earnings between 1995 and 2008 show zero effect for low skilled and an insignificant positive effect for high skilled.[39]

5.3.2 Transitions for different Groups

To complete the picture of the native labor market transitions following the non-EU immigration event we consider two further partitions of the native labor force (besides the usual split into more and less educated). First, we consider young and old workers, namely those who were 21 to 36 years old in 1994 and those 37 to 51. All those workers were still below the statutory retirement age (65) as of 2008. The older workers (aged 46-51 in 1994) turn 60 within the last years of the transitions and thereby become eligible for early retirement pension ("efterløn"). The second dimension we consider is the tenure of workers in the establishment as of 1994. We call "low tenure" those workers with less than average tenure (4.35 years) and "high tenure" those with more than 4.35 years of tenure at the establishment, at the time of the beginning of the immigration boom. In both cases we can expect the group of young, low-tenure workers to have lower costs and more opportunities to upgrade and change their occupation. If the opportunity of wage gains from immigration is in part linked to the ability of upgrading and increasing one's occupational complexity, then low tenure, young workers should be better positioned to take advantage of it. Similarly, if the cost of changing occupation, because of loss

[39] See Table A.8 in Appendix.

of specific capital, is larger, the longer is tenure and the older is the worker then older workers should be less inclined to pursue it.

Figures 7 and 8 show the transitions of the usual four outcomes (occupational complexity, hourly wage, annual earnings and fraction of year worked) separately for old and young workers (still separating high and low skilled). Figures 9 and 10 show the split between outcomes of high and low tenure native workers. The results are, reassuringly, as expected. For less skilled natives (7 and 9), the low-tenure workers are those who have a stronger move towards higher occupational complexity in treated municipalities, and this implies larger hourly wage gains for them. Young low skilled workers have also larger hourly wage gains, relative to old low skilled in treated municipalities. Labor supply of young low skilled workers does not respond significantly in treated municipalities, and also labor supply of old low skilled workers, except in the last 3-4 years when a decline in the treated municipalities may be due to early retirement behavior. The reallocation towards more complex jobs is even clearer for high skilled workers (shown in Figures 8 and 10). Young and low-tenure high skilled workers experience larger and more significant progress in occupational complexity in treated regions compared to similar low skilled. Whether it translates into higher wages as for the low skilled is harder to establish though, since wages for young and low-tenure high skilled workers exhibit a bit of a pre-trend. Older and high-tenure ones, have a smaller increase in occupational complexity and no significant effect on hourly wages and earnings.[40]

Overall, separating between groups shows that the decline observed in labor supply after 9 years from the event for less educated natives in treated municipalities is mainly due to older worker and hence possibly driven by early retirement behavior. It is possible that the only long-run displacement effect of immigrants on less educated natives is to push early retirement on some of them. Overall, the largest benefit from immigration accrue to young, less experienced workers who can direct their careers towards more complex occupations, which are complementary of immigrant jobs. Their upgrade may imply some further training but it does not need to come at the expenses of labor supply. In a further analysis (shown in Figure A.6 of the Appendix) we find that the probability of low skilled obtaining a higher degree increases by 2 percentage points if the non-EU immigration share in the municipality increased by one percentage point and that the effect accrued mainly in the early year of the immigration boom. The effect was driven by vocational education which is often organized as training programmes that allow workers to obtain formal competencies on the job. No significant effects on educational upgrading are found for high skilled or older workers.

6 Discussion and Conclusions

In this paper we have used a unique source of individual and firm data during a period that contains a sustained and supply-driven non-EU immigration boom to Denmark to estimate the short- and long-run effects on native occupation, wage and employment. The fact that our data allows us to follow every single worker in Denmark and the high quality of the register information imply high reliability. It also implies that we can analyze immigration effects for workers who remained within the establishment as well as for those who left establishment and municipality. We can also estimate the effects of immigration on mobility of workers across establishments, municipalities and in and out of employment. The fact that we can observe a pre-event period of essentially no change in the non-EU immigrant share followed by a sharp and protracted increase in the share of non-EU migrants, and the fact that their motivations to immigrate where not labor-related and their distribution across municipalities was orthogonal to the economic conditions in the municipalities provides us with an ideal exogenous supply-driven inflow of immigrants. We find robust evidence that native workers, within and

[40] In the Figure A.4 and A.5 in Appendix we show the split in transition between men and women. The strongest positive effects on complexity and wages are for men.

across firms responded to immigration increasing significantly their mobility towards more complex occupations. Immigration also increased mobility of natives across firms and out of the municipality. We do not observe an increased probability of unemployment, nor a decrease in employment. Hourly wages of less educated natives were on average positively affected by immigration, the effect increases as the low skilled gradually move towards more complex occupations and a fraction receive formal training to increase their complementarity with the manual jobs performed by non-EU immigrants. Highly educated natives experienced higher wages within and across establishments in the short run, but their gains attenuate over time, possibly as the initial gains are traded away by mobility across local labor markets.

We think that this analysis is much richer and detailed than ever done before in that it analyzes individual responses of natives to immigrants within and across firm and local labor markets. It produces a much more detailed picture by tracking occupations, careers, wages and employment of natives in response to immigrants. It also shows the importance of looking at the dynamic adjustment mechanisms for native workers and looking at individuals in a municipality as well as to include those who (endogenously) may leave over time. Finally our paper uses a highly credible exogenous increase in non-EU immigrants. We find a negative impact of immigrants on native wages - as a naive labor demand-labor supply model would imply - only for low skilled in the public sector. We hope that the future analysis of the impact of immigration in several other countries may follow the detail and the approach adopted in this paper.

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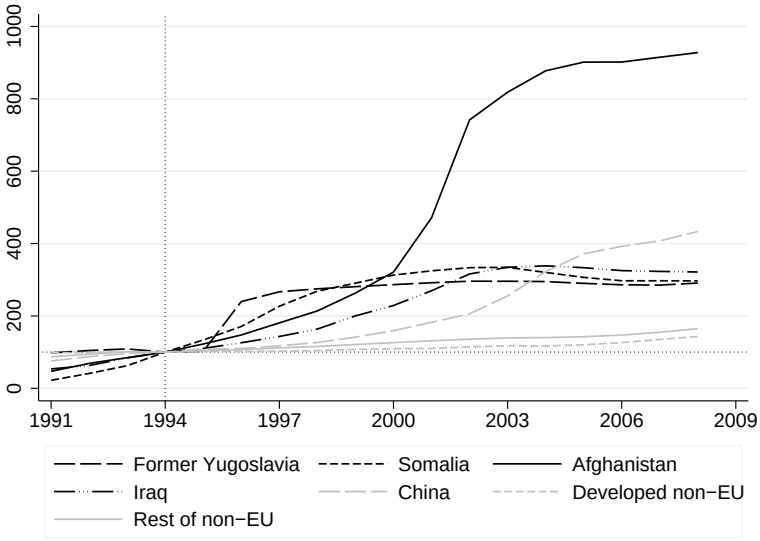
Figure 1: Growth in non-EU foreign born populations



Notes: Population between 18 and 65 years old, not attending school (i.e. not eligible for student grants), and not permanently out of the labor force (i.e. not receiving disability pension) indexed to 100 in 1994.

Figure 2: Foreign born share of employment in Denmark, 1991-2008

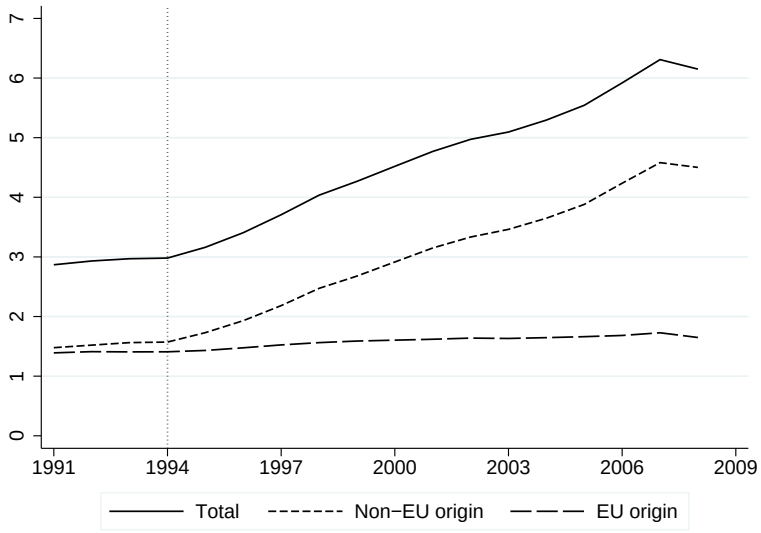


Figure 3: Non-EU share of employment in Denmark, 1991-2008

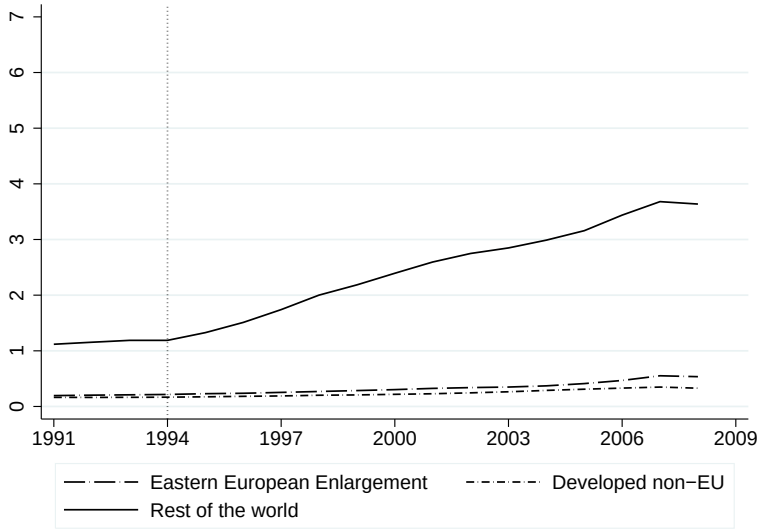
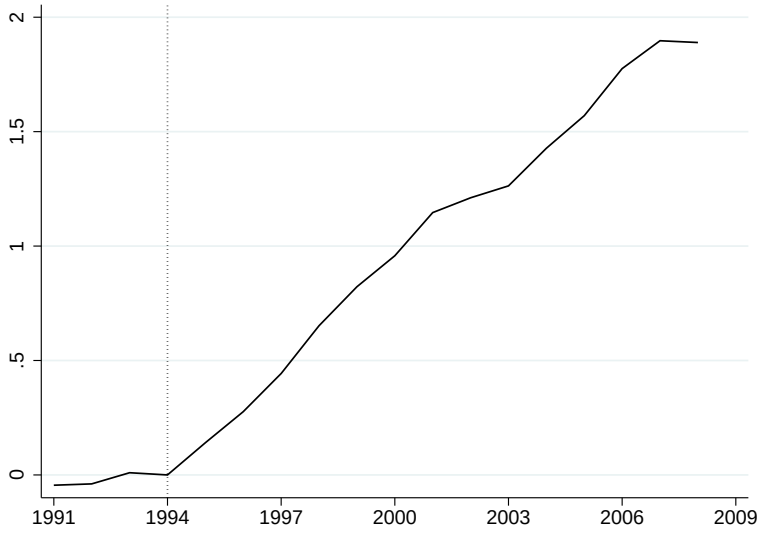


Table 1: Employment shares in local labor markets

	Non-EU origin			Low skilled natives			High skilled natives		
	1994	2008	Dif.	1994	2008	Dif.	1994	2008	Dif.
Highest inflows:									
Ishøj	6.5	20.1	13.5	37.1	26.9	-10.3	54.8	51.5	-3.3
Albertslund	4.9	15.7	10.9	31.8	21.2	-10.5	61.8	61.6	-0.2
Brøndby	4.9	15.1	10.2	35.6	27.9	-7.6	58.2	55.6	-2.6
Høje-Tåstrup	3.1	11.1	8.0	35.0	25.9	-9.1	60.7	61.9	1.1
Vallensbæk	2.5	8.8	6.3	29.9	20.1	-9.8	66.1	69.7	3.6
Rødovre	2.4	8.6	6.2	33.7	25.6	-8.1	62.5	64.5	1.9
Herlev	3.0	8.7	5.7	30.9	23.1	-7.8	64.4	66.6	2.1
Glostrup	2.1	7.3	5.2	34.3	25.8	-8.5	62.3	65.7	3.5
Hvidovre	3.0	8.1	5.0	34.2	25.9	-8.2	61.3	64.4	3.2
Gladsaxe	2.5	7.4	4.8	29.4	20.5	-8.9	66.3	70.1	3.8
Copenhagen	4.3	9.0	4.7	34.0	22.4	-11.6	59.0	65.0	6.1
Fredensborg	2.2	6.7	4.5	28.7	20.2	-8.6	66.9	70.7	3.8
Ballerup	2.3	6.4	4.1	32.1	22.9	-9.2	64.1	69.2	5.1
Odense	1.7	5.7	4.0	32.0	21.9	-10.1	65.0	70.9	5.9
Århus	2.1	5.9	3.8	30.3	19.5	-10.7	66.1	72.7	6.6
Lowest inflows:									
Læsø	0.0	0.7	0.7	49.9	33.1	-16.9	49.1	64.5	15.3
Assens	0.4	1.4	1.0	38.6	25.6	-13.0	60.1	72.0	11.9
Lejre	0.6	1.6	1.0	31.1	20.0	-11.1	67.0	76.9	10.0
Brønderslev	0.4	1.5	1.1	38.6	24.3	-14.4	60.3	73.6	13.3
Stevns	0.6	1.8	1.1	39.6	28.8	-10.7	58.5	68.2	9.7
Rebild	0.4	1.5	1.1	39.7	25.5	-14.2	59.3	72.1	12.8
Nordfyns	0.3	1.5	1.2	39.4	26.7	-12.7	59.6	71.0	11.5
Frederiksværk-Hundested	3.3	4.4	1.2	36.7	27.3	-9.4	58.9	66.9	8.0
Fåborg-Midtfyn	0.4	1.6	1.2	36.9	24.4	-12.5	61.8	72.8	11.0
Bornholm	0.4	1.6	1.2	38.8	27.5	-11.3	59.7	69.5	9.8
Dragør	1.2	2.4	1.2	28.4	22.7	-5.7	67.4	72.3	5.0
Faxe	0.6	1.9	1.3	38.9	27.5	-11.4	59.5	69.5	10.0
Jammerbugt	0.3	1.5	1.3	41.0	29.2	-11.9	58.1	68.4	10.3
Odder	1.2	2.5	1.3	33.2	19.1	-14.1	64.6	76.9	12.3
Gribskov	1.0	2.3	1.3	34.1	24.2	-9.9	63.6	71.7	8.1
Total:									
Share of total employment	1.6	4.5	2.9	35.2	24.0	-11.2	61.8	69.8	8.0
Share of total labor force	2.9	5.1	2.3	37.8	25.8	-12.1	57.8	67.4	9.6

Notes: Each row shows foreign born with non-EU origin, low skilled and high skilled natives as share of employment in 1994 and 2008 and the change. We use as local areas 97 municipalities; Fredriksberg has been included in Copenhagen.

Figure 4: Non-EU share of employment, difference between most and least exposed



Notes: Difference in actual non-EU share of employment for employed natives above versus below the median of the 1994-2008 difference in predicted non-EU share, normalized to zero in 1994.

Table 2: Skill content of occupations and their non-EU inflow between 1994-2008

	Non-EU share	Skill content of occupation			
	1994-2008 dif.	Cognitive	Communication	Manual	Complexity
Lowest inflow					
Managers of small enterprises	-0.018	0.666	0.677	0.432	1.136
Legislators and senior officials	0.002	0.897	0.989	0.303	1.828
Corporate managers	0.003	0.796	0.796	0.367	1.488
Armed forces	0.003	0.441	0.390	0.633	0.225
Skilled agricultural and fishery workers	0.007	0.362	0.248	0.736	-0.328
Highest inflow					
Drivers and mobile plant operators	0.039	0.352	0.265	0.810	-0.322
Laborers in mining, construction, mfr. and transport	0.045	0.215	0.156	0.769	-0.783
Machine operators and assemblers	0.057	0.276	0.146	0.790	-0.655
Other elementary occupations	0.087	0.260	0.205	0.742	-0.633
Sales and services elementary occupations	0.148	0.126	0.103	0.695	-1.234

Notes: The skill content of each occupational grouping (2-digit ISCO) is the population weighted average of the underlying occupations (4-digit ISCO).

Table 3: Summary statistics for spell-sample

	Low skilled				High skilled			
	Mean	S.d.	Min	Max	Mean	S.d.	Min	Max
Age	37.77	12.26	18.00	65.00	43.32	9.93	18.00	65.00
Labor market experience	14.68	10.13	0.00	45.00	19.42	9.31	0.00	45.00
Job tenure	4.16	5.45	0.00	28.00	5.62	6.23	0.00	28.00
Married	0.48	0.50	0.00	1.00	0.63	0.48	0.00	1.00
Education, primary	0.63	0.48	0.00	1.00	0.00	0.00	0.00	1.00
secondary	0.15	0.36	0.00	1.00	0.00	0.01	0.00	1.00
vocational	0.16	0.37	0.00	1.00	0.57	0.50	0.00	1.00
higher	0.05	0.22	0.00	1.00	0.43	0.50	0.00	1.00
Region, Northern Jytland	0.11	0.31	0.00	1.00	0.10	0.30	0.00	1.00
Central Jytland	0.23	0.42	0.00	1.00	0.23	0.42	0.00	1.00
Southern Denmark	0.23	0.42	0.00	1.00	0.21	0.41	0.00	1.00
Greater Copenhagen Area	0.28	0.45	0.00	1.00	0.31	0.46	0.00	1.00
Zealand	0.15	0.36	0.00	1.00	0.15	0.36	0.00	1.00
Agriculture, fishing and quarrying	0.03	0.16	0.00	1.00	0.01	0.10	0.00	1.00
Manufacturing	0.23	0.42	0.00	1.00	0.17	0.38	0.00	1.00
Electricity, gas and water supply	0.00	0.07	0.00	1.00	0.01	0.09	0.00	1.00
Construction	0.08	0.28	0.00	1.00	0.06	0.24	0.00	1.00
Wholesale and retail sale, hotels and rest.	0.18	0.38	0.00	1.00	0.14	0.34	0.00	1.00
Transport, post and telecommunications	0.10	0.30	0.00	1.00	0.05	0.23	0.00	1.00
Finance and business activities	0.10	0.29	0.00	1.00	0.14	0.34	0.00	1.00
Public and personal services	0.28	0.45	0.00	1.00	0.42	0.49	0.00	1.00
Occupational complexity	0.14	0.90	-2.69	2.11	0.66	0.81	-2.69	2.11
ln(Hourly wagerate)	5.02	0.39	0.13	9.17	5.24	0.35	-0.17	10.01
ln(Annual earnings)	12.32	0.50	7.05	16.97	12.60	0.45	4.20	17.96
Fraction of year worked	0.92	0.17	0.00	1.00	0.95	0.13	0.00	1.00
Observations	1,864,027				3,160,760			

Notes: Employed natives 1995-2008. High/low skilled is defined as the individual enters the panel. Some low skilled upgrade their education level while at the labor market (16% that start out with no post-secondary education obtain a vocational education and 5% obtain a higher education). Native-municipality combinations that are singletons are dropped, since they would not contribute to any of the spell-regressions because all spells are nested within municipalities.

Table 4: Pre-trend in native outcomes and in-sample trend in instrument

	1991-1994 difference in average			
	Occupational complexity	Hourly wage	Annual earnings	Fraction of year worked
Low skilled				
1994-2008 dif. in instrument	0.424	0.146	-0.059	-0.103
	(0.225)	(0.142)	(0.331)	(0.127)
Averaged controls	Yes	Yes	Yes	Yes
Observations	97	97	97	97
R-squared	0.08	0.37	0.21	0.62
High skilled				
1994-2008 dif. in instrument	0.165	0.111	-0.067	-0.095
	(0.097)	(0.073)	(0.144)	(0.072)
Averaged controls	Yes	Yes	Yes	Yes
Observations	97	97	97	97
R-squared	0.63	0.52	0.30	0.71

Notes: Regressions are based on labor force averages for each municipality, and weighted by the size of the labor force in the municipality in 1994. Averaged controls are age, experience, temure, (each of those squared) and marital status averaged for each municipality in 1994.

Table 5: Spell regressions for the *low* skilled natives

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
Occupational complexity	0.122	0.464	0.632*	2.563**
	(0.139)	(0.289)	(0.284)	(0.867)
Career upgrade	0.003	0.392**	0.079	0.324*
	(0.090)	(0.147)	(0.077)	(0.128)
Career downgrade	0.046	0.136	0.176*	0.552***
	(0.057)	(0.100)	(0.085)	(0.131)
Occupational mobility	0.097	0.695**	0.359*	1.102***
	(0.163)	(0.242)	(0.162)	(0.285)
Hourly wage	0.236*	0.460*	0.072	0.136
	(0.114)	(0.234)	(0.111)	(0.298)
Annual earnings	0.092	0.527	0.168	0.553*
	(0.127)	(0.297)	(0.122)	(0.276)
Fraction of year worked	0.014	0.323***	0.115*	0.465***
	(0.052)	(0.093)	(0.055)	(0.109)
Observations	1,396,517	1,396,517	1,816,727	1,816,727
First stage F-statistic		27.83		24.34
First stage coefficient		0.401***		0.414***
		(0.076)		(0.084)

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation 4 using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. The dependent variables have the same first stage except for occupational complexity that has fewer observations (some missings).

Table 6: Spell regressions for the *high* skilled natives

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
Occupational complexity	0.144	0.068	0.354***	0.441***
	(0.104)	(0.164)	(0.099)	(0.132)
Career upgrade	0.041	0.216	-0.004	0.120
	(0.042)	(0.113)	(0.040)	(0.072)
Career downgrade	0.103*	0.135	0.173**	0.452***
	(0.048)	(0.072)	(0.063)	(0.115)
Occupational mobility	0.177	0.603**	0.273*	0.923***
	(0.095)	(0.221)	(0.107)	(0.257)
Hourly wage	0.254*	0.864**	0.229	1.055**
	(0.121)	(0.271)	(0.144)	(0.376)
Annual earnings	0.071	0.840**	0.105	0.971*
	(0.130)	(0.281)	(0.144)	(0.385)
Fraction of year worked	-0.062	0.089	-0.009	0.086
	(0.032)	(0.077)	(0.033)	(0.085)
Observations	2,571,043	2,571,043	3,125,934	3,125,934
First stage F-statistic		32.56		28.66
First stage coefficient		0.418***		0.430***
		(0.073)		(0.080)

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation 4 using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. The dependent variables have the same first stage except for occupational complexity that has fewer observations (some missings).

Table 7: Spell regressions for the *low* skilled natives, by sector

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
Manufacturing				
Occupational complexity	0.243	0.586	0.588	1.205
	(0.338)	(0.482)	(0.425)	(0.747)
Hourly wage	0.074	0.733	0.333	1.357*
	(0.287)	(0.571)	(0.304)	(0.603)
Annual earnings	-0.308	1.049	0.313	1.044
	(0.341)	(0.844)	(0.300)	(0.572)
Observations	370,574	370,574	446,667	446,667
First stage F-statistic		38.56		42.11
Non-complex				
Occupational complexity	0.287	0.641	0.088	2.135
	(0.348)	(0.543)	(0.495)	(1.118)
Hourly wage	0.689**	0.506	0.080	-0.532
	(0.245)	(0.444)	(0.191)	(0.555)
Annual earnings	0.889**	1.270**	0.414	0.482
	(0.300)	(0.405)	(0.233)	(0.516)
Observations	356,677	356,677	466,721	466,721
First stage F-statistic		22.37		20.64
Complex				
Occupational complexity	1.118***	2.469***	1.254**	4.361***
	(0.324)	(0.718)	(0.460)	(1.117)
Hourly wage	0.467*	1.641***	0.517	2.318***
	(0.189)	(0.393)	(0.267)	(0.519)
Annual earnings	0.534*	1.780***	0.736**	2.731***
	(0.221)	(0.380)	(0.250)	(0.552)
Observations	263,719	263,719	338,155	338,155
First stage F-statistic		22.51		18.46
Public				
Occupational complexity	-0.584*	-0.676	-0.152	0.563
	(0.284)	(0.539)	(0.278)	(0.626)
Hourly wage	0.038	-0.416	-0.145	-0.695*
	(0.110)	(0.263)	(0.156)	(0.351)
Annual earnings	-0.289*	-0.889*	-0.296	-1.179*
	(0.137)	(0.382)	(0.214)	(0.489)
Observations	400,249	400,249	498,244	498,244
First stage F-statistic		25.21		24.52

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation 4 using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. The dependent variables have the same first stage except for occupational complexity that has fewer observations (some missings).

Table 8: Spell regressions for the *high* skilled natives, by sector

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
Manufacturing				
Occupational complexity	0.524	1.227*	0.519	1.530**
	(0.388)	(0.565)	(0.376)	(0.582)
Hourly wage	0.193	0.732*	0.044	0.512
	(0.207)	(0.358)	(0.189)	(0.354)
Annual earnings	-0.025	0.944	0.020	0.617
	(0.263)	(0.501)	(0.243)	(0.360)
Observations	480,547	480,547	565,152	565,152
First stage F-statistic		38.83		40.40
Non-complex				
Occupational complexity	0.486*	1.021	0.754**	1.538***
	(0.240)	(0.620)	(0.267)	(0.429)
Hourly wage	0.333	0.891*	0.182	0.834*
	(0.196)	(0.423)	(0.138)	(0.361)
Annual earnings	0.036	0.792	0.042	0.766
	(0.212)	(0.453)	(0.173)	(0.518)
Observations	521,673	521,673	630,500	630,500
First stage F-statistic		28.24		23.65
Complex				
Occupational complexity	0.185	-0.161	0.570**	0.124
	(0.219)	(0.357)	(0.198)	(0.332)
Hourly wage	0.418	1.824***	0.482	2.403**
	(0.241)	(0.508)	(0.288)	(0.779)
Annual earnings	0.414	2.281***	0.429	2.711**
	(0.318)	(0.663)	(0.349)	(0.847)
Observations	464,989	464,989	572,636	572,636
First stage F-statistic		30.96		25.57
Public				
Occupational complexity	-0.148	-0.678**	-0.091	-0.457*
	(0.138)	(0.228)	(0.124)	(0.215)
Hourly wage	0.143*	0.492**	0.162*	0.502***
	(0.073)	(0.155)	(0.069)	(0.130)
Annual earnings	-0.047	0.258	-0.021	0.254
	(0.079)	(0.148)	(0.097)	(0.139)
Observations	1,094,197	1,094,197	1,297,569	1,297,569
First stage F-statistic		32.39		29.85

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation 4 using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. The dependent variables have the same first stage except for occupational complexity that has fewer observations (some missings).

Table 9: The cumulative effect on employment and mobility of *low* skilled, 1995-2008

Dependent variable	(1) All	(2) Mfr.	(3) Non-Complex	(4) Complex	(5) Public
Cumulative employment	-4.731	-2.839	-8.303	5.022	-10.263
	(4.868)	(5.697)	(6.023)	(4.562)	(5.410)
- same establishment	-6.137	-8.052	-13.947	2.031	-6.309
	(3.183)	(7.631)	(8.596)	(3.423)	(4.096)
- new establishment	1.406	5.213	5.644	2.991	-3.954
	(3.715)	(8.989)	(5.474)	(5.485)	(3.876)
- same sector	-2.396	-33.182**	-4.605	23.632***	-2.100
	(3.940)	(10.824)	(6.155)	(6.934)	(3.830)
- new sector	-2.335	30.344***	-3.698	-18.610**	-8.163*
	(1.868)	(6.909)	(3.545)	(5.805)	(4.104)
- same municipality	-23.049***	-35.128**	-34.148***	-13.696*	-14.673**
	(6.666)	(12.704)	(9.412)	(5.702)	(5.410)
- new municipality	18.318***	32.289**	25.845***	18.718***	4.410
	(5.210)	(11.634)	(6.441)	(5.111)	(5.574)
Cumulative unemployment	2.211	0.302	3.515	-0.109	3.618*
	(2.397)	(3.697)	(2.469)	(2.440)	(1.790)
Cumulative self-employment	-0.053	0.612	-1.120	-0.368	-0.029
	(1.167)	(1.414)	(1.302)	(2.301)	(1.135)
Observations	71,028	22,274	14,534	14,572	19,648
First stage F-statistic	15.07	21.49	11.47	12.70	16.70

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigration exposure) in equation 5 using a *strongly balanced* panel of natives employed in 1994. Additional controls not shown in the table are the list of 1994-characteristics in table A.3. Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered at the 1994-municipality. The final row is the discounted sum of the 1995-2008 earnings stream using a four percent annual discount rate.

Table 10: The cumulative effect on employment and mobility of *high* skilled, 1995-2008

Dependent variable	(1) All	(2) Mfr.	(3) Non-Complex	(4) Complex	(5) Public
Cumulative employment	-0.114	-2.630	-1.226	-0.748	1.987
	(2.597)	(3.355)	(4.052)	(3.388)	(1.891)
- same establishment	-12.433**	-13.914**	-13.672**	-15.608**	-8.258*
	(3.912)	(5.293)	(5.037)	(5.459)	(4.189)
- new establishment	12.319***	11.285*	12.446**	14.860*	10.245**
	(3.628)	(5.683)	(4.080)	(6.962)	(3.671)
- same sector	-1.055	-26.343***	-2.113	7.247**	4.963**
	(1.767)	(7.139)	(4.111)	(2.266)	(1.665)
- new sector	0.941	23.713***	0.887	-7.995*	-2.976
	(1.631)	(5.055)	(2.717)	(3.260)	(1.752)
- same municipality	-32.268**	-48.351***	-44.684**	-38.251**	-16.312*
	(11.195)	(14.572)	(16.363)	(14.387)	(6.572)
- new municipality	32.154***	45.721***	43.458**	37.502**	18.300**
	(9.486)	(12.583)	(13.221)	(11.727)	(6.164)
Cumulative unemployment	2.198	3.980*	2.649	1.055	1.696*
	(1.168)	(1.643)	(1.899)	(0.978)	(0.822)
Cumulative self-employment	-3.211***	-3.938**	-4.558***	-2.661*	-2.894***
	(0.693)	(1.225)	(1.268)	(1.313)	(0.654)
Observations	164,025	33,833	37,908	29,229	63,055
First stage F-statistic	18.16	21.48	14.67	17.31	19.64

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigration exposure) in equation 5 using a *strongly balanced* panel of natives employed in 1994. Additional controls not shown in the table are the list of 1994-characteristics in table A.3. Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered at the 1994-municipality. The final row is the discounted sum of the 1995-2008 earnings stream using a four percent annual discount rate.

Table 11: The long-run effect on *low* skilled (event-like study)

	(1) Occupational complexity	(2) Hourly wage	(3) Annual earnings	(4) Fraction of year worked
t = -3	0.005	0.002	0.003	-0.002
	(0.006)	(0.003)	(0.008)	(0.004)
t = 0	.	.	.	.
t = 1	0.009*	0.006**	-0.003	-0.001
	(0.004)	(0.002)	(0.006)	(0.003)
t = 5	0.017*	0.017***	0.005	-0.006
	(0.008)	(0.004)	(0.010)	(0.006)
t = 9	0.021*	0.011**	0.005	-0.004
	(0.009)	(0.004)	(0.009)	(0.005)
t = 14	0.034***	0.006	-0.012	-0.013*
	(0.009)	(0.005)	(0.010)	(0.006)
Observations	1,072,035	1,071,244	1,206,145	1,280,376
R-squared	0.44	0.22	0.16	0.13

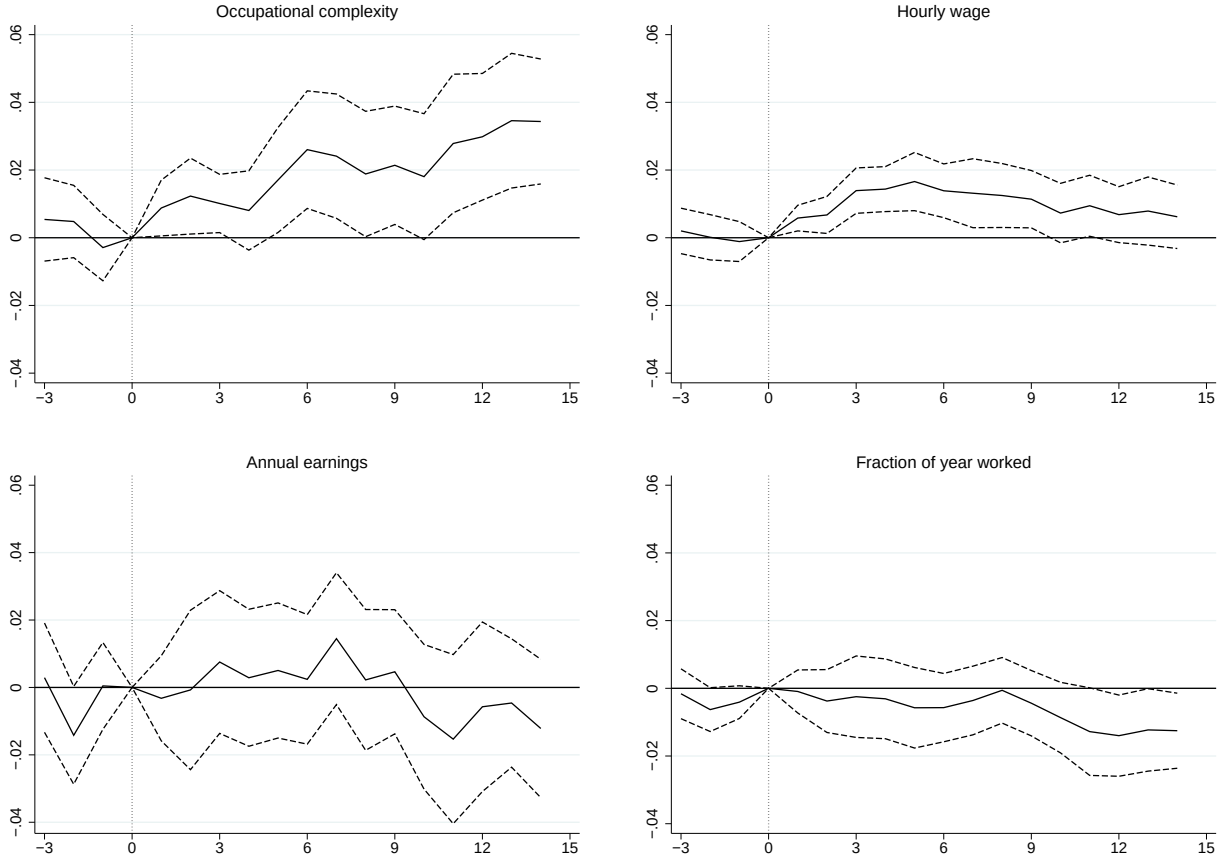
Notes: *** p< 0.01, ** p< 0.05, * p< 0.10. This table reports selected regression coefficients on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors in parentheses are clustered at the 1994-municipality.

Table 12: The long-run effect on *high* skilled (event-like study)

	(1) Occupational complexity	(2) Hourly wage	(3) Annual earnings	(4) Fraction of year worked
t = -3	-0.001	-0.008*	-0.001	0.004
	(0.004)	(0.003)	(0.005)	(0.003)
t = 0	.	.	.	.
t = 1	0.005	0.001	0.003	0.001
	(0.003)	(0.001)	(0.003)	(0.002)
t = 5	0.017***	0.007**	0.010*	0.004
	(0.004)	(0.003)	(0.005)	(0.002)
t = 9	0.025***	0.007	0.007	0.003
	(0.006)	(0.004)	(0.005)	(0.003)
t = 14	0.030***	0.003	0.019***	0.009*
	(0.005)	(0.003)	(0.005)	(0.004)
Observations	2,699,752	2,617,994	2,838,069	2,955,330
R-squared	0.47	0.31	0.17	0.08

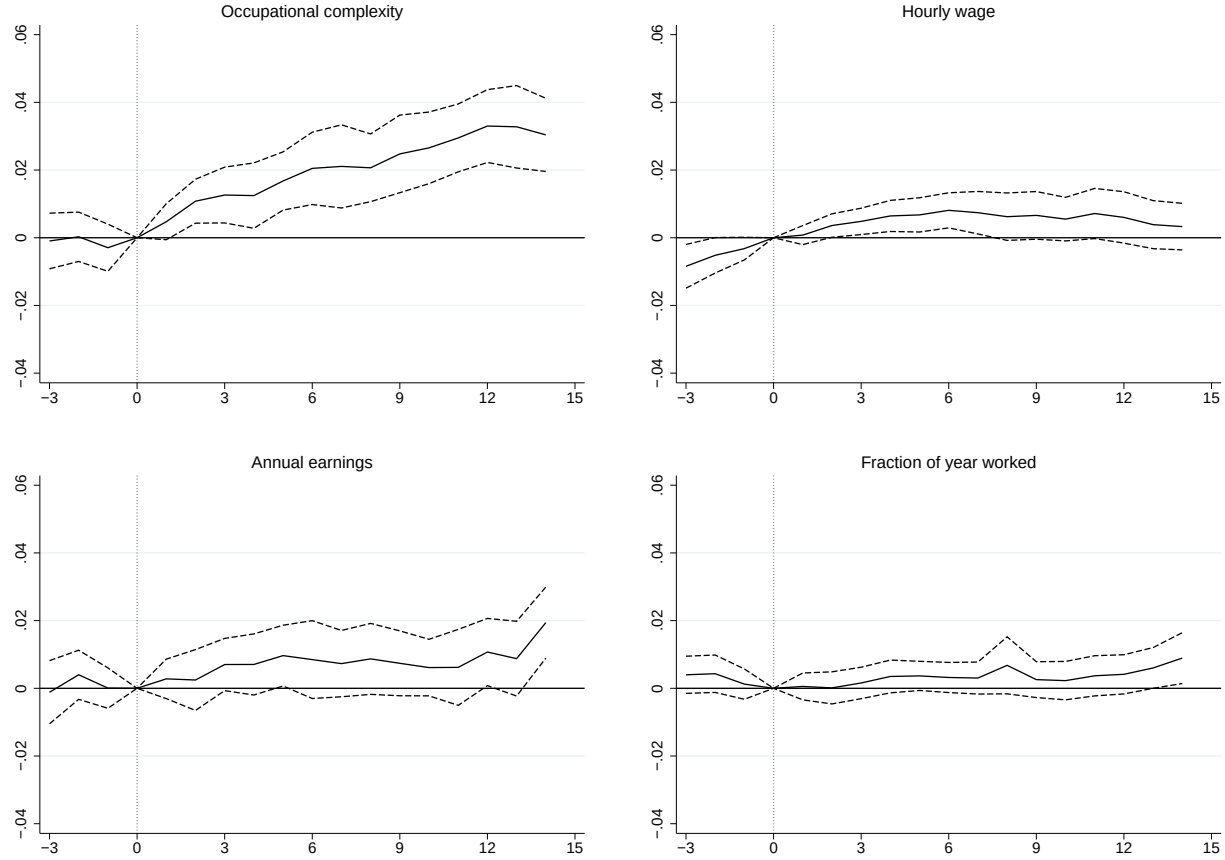
Notes: *** p< 0.01, ** p< 0.05, * p< 0.10. This table reports selected regression coefficients on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors in parentheses are clustered at the 1994-municipality.

Figure 5: The long-run effect on *low* skilled (event-like study)



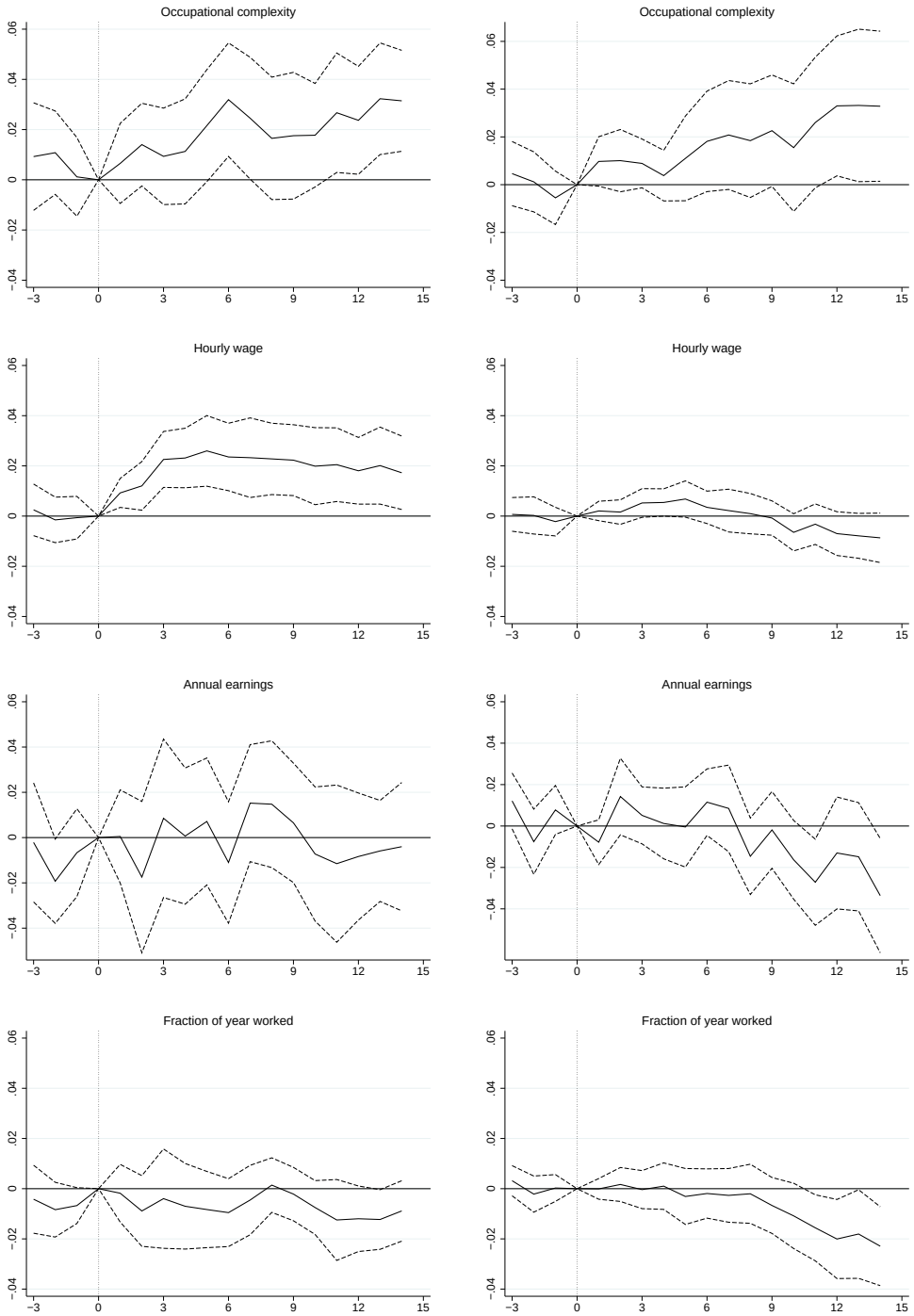
Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality.

Figure 6: The long-run effect on *high* skilled (event-like study)



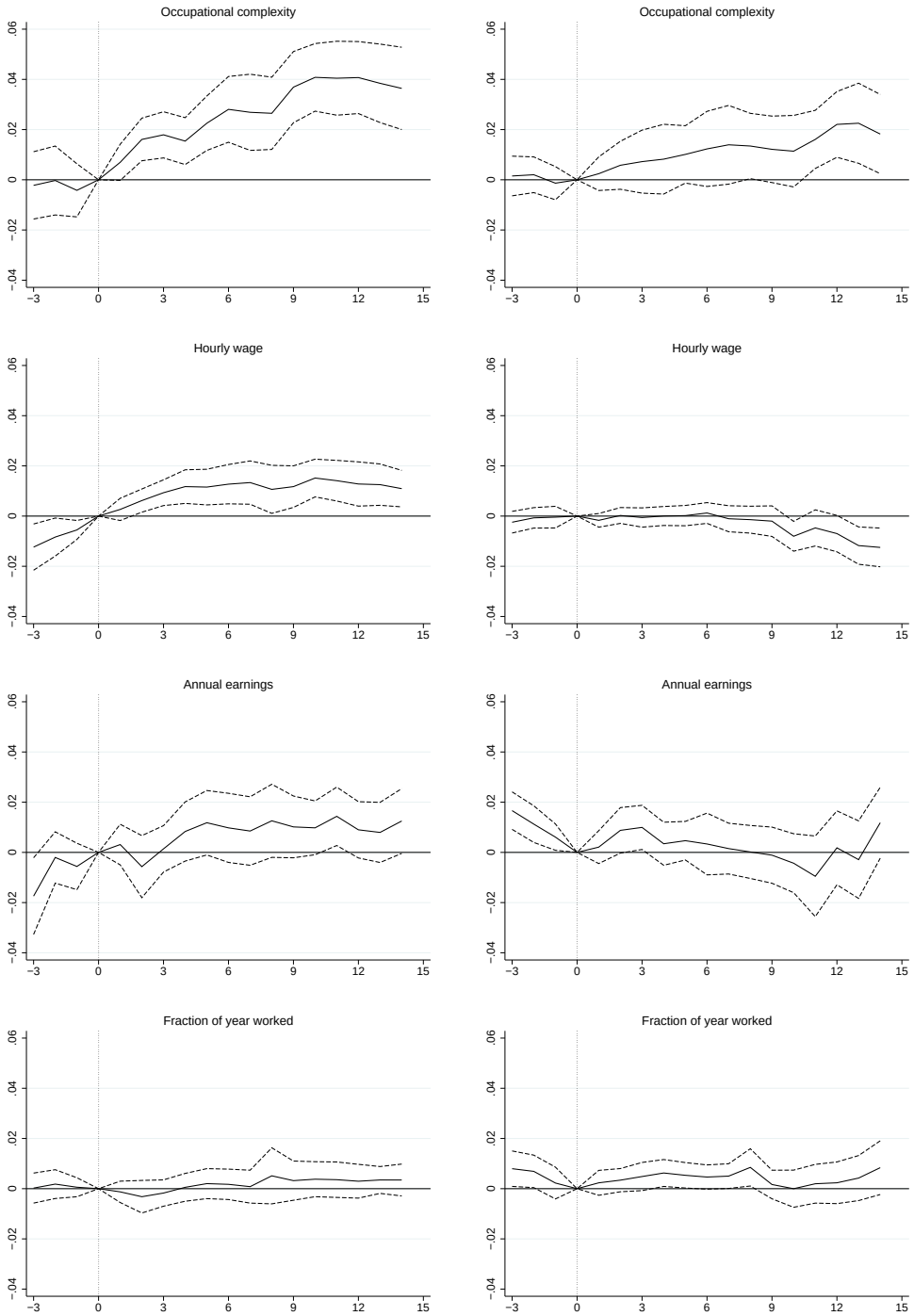
Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality.

Figure 7: The long-run effect on *low* skilled (event-like study), by age in 1994



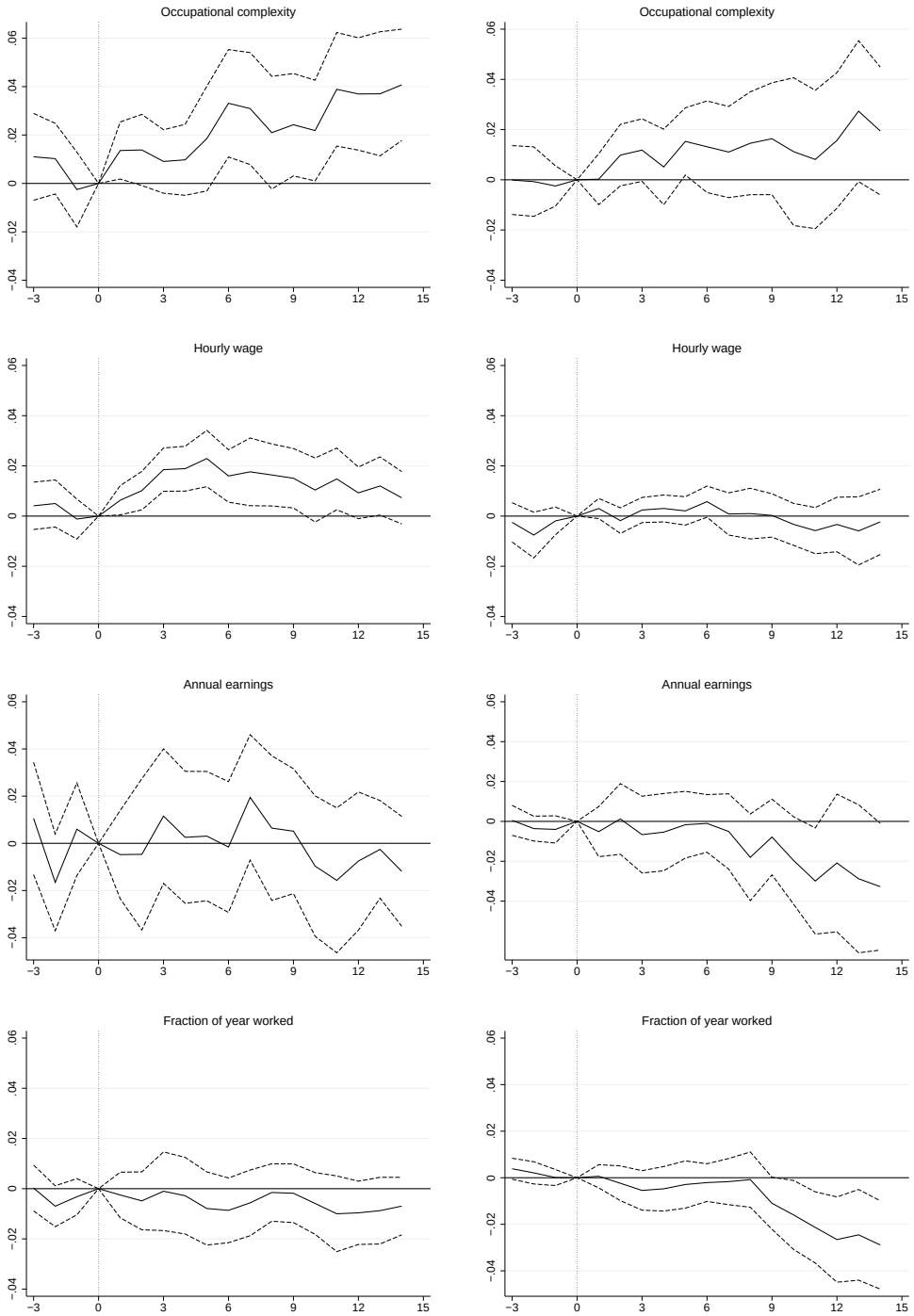
Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality. Young (old) are those aged 21-36 (37-51) in 1994.

Figure 8: The long-run effect on *high* skilled (event-like study), by age in 1994



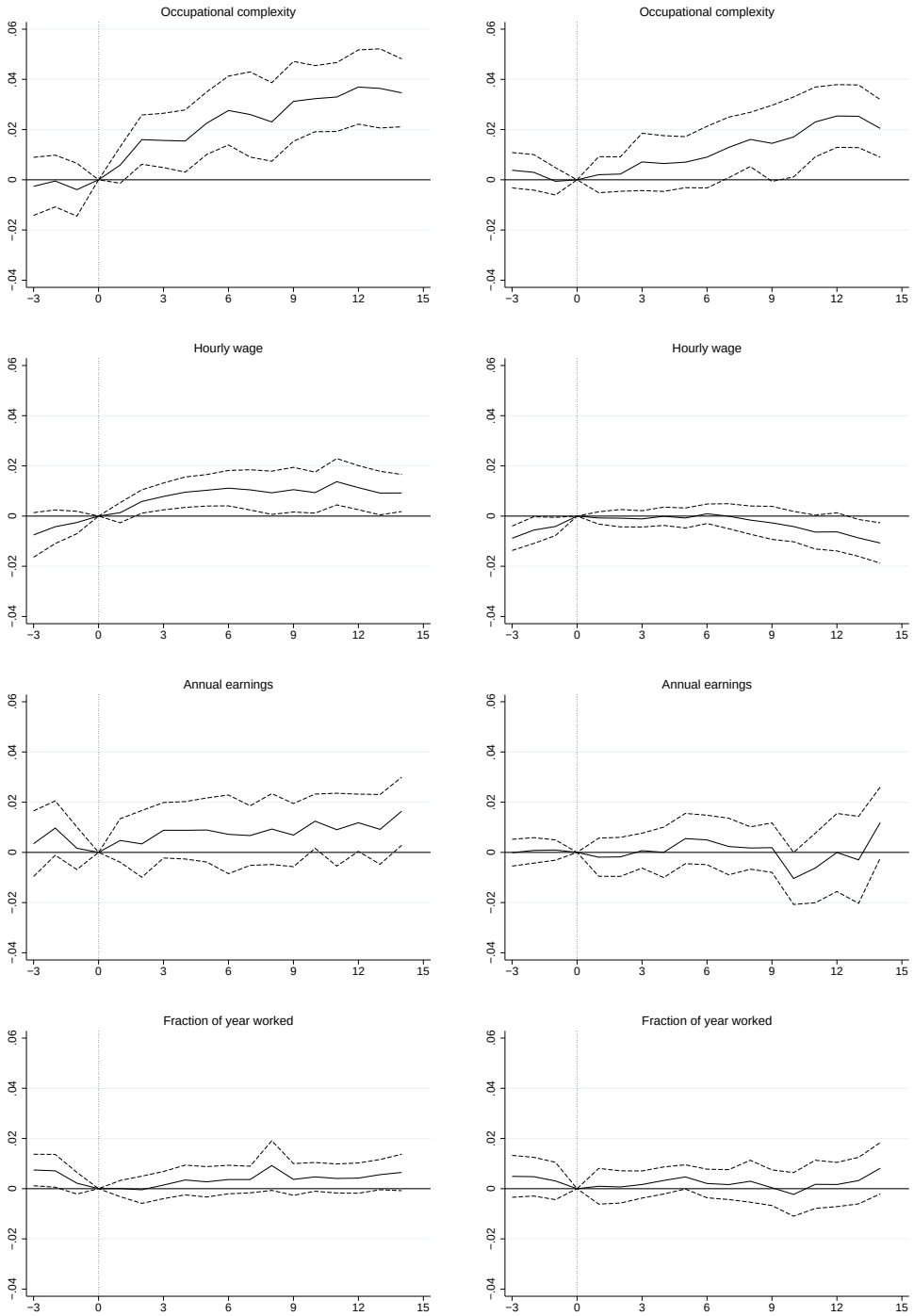
Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality. Young (old) are those aged 21-36 (37-51) in 1994.

Figure 9: The long-run effect on *low* skilled (event-like study), by tenure in 1994



Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality. Low (high) tenure are those with less than (at least) 4.35 years in the firm in 1994.

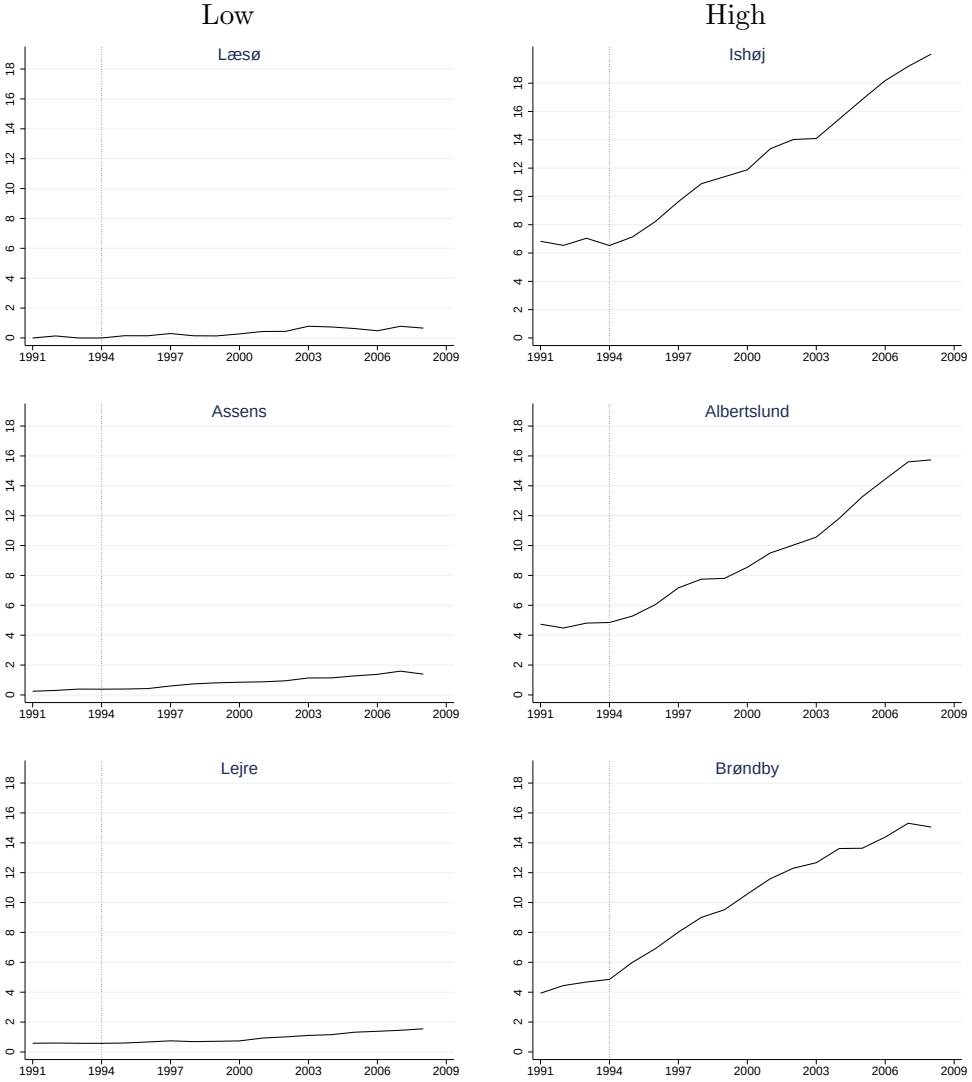
Figure 10: The long-run effect on *high* skilled (event-like study), by tenure in 1994



Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality. Low (high) tenure are those with less than (at least) 4.35 years in the firm in 1994.

Appendix

Figure A.1: Non-EU share of employment across municipalities



Notes: Low (high) refers to the three municipalities with the lowest (highest) change in the non-EU share of employment. Subsequent graphs (available upon request) show similar pattern; flat (kink) for low (high) immigration municipalities.

Table A.1: Employment shares in industries *(NACE 27-grouping)*

	Non-EU origin			Low skilled natives			High skilled natives		
	1994	2008	Dif.	1994	2008	Dif.	1994	2008	Dif.
Manufacturing									
Agriculture, horticulture and forestry	1.0	7.6	6.6	58.2	36.9	-21.3	39.9	53.9	14.1
Fishing	0.2	0.9	0.7	67.4	54.0	-13.4	30.6	42.6	12.0
Mining and quarrying	0.7	1.9	1.1	43.0	26.5	-16.5	54.3	69.1	14.8
Mfr. of food, beverages and tobacco	2.0	8.0	6.0	49.5	36.4	-13.0	47.5	54.3	6.8
Mfr. of textiles and leather	3.2	6.1	2.8	58.2	37.4	-20.8	37.2	54.8	17.6
Mfr. of wood products, printing and publ.	1.1	3.5	2.4	39.2	32.6	-6.5	58.7	62.8	4.1
Mfr. of chemicals and plastic products	2.7	4.8	2.1	37.9	22.0	-15.9	57.9	71.1	13.1
Mfr. of other non-metallic mineral products	1.4	3.7	2.3	51.6	40.9	-10.7	46.0	54.3	8.3
Mfr. of basic metals and fabr. metal prod.	2.4	5.2	2.8	36.1	27.2	-8.8	60.2	66.0	5.8
Mfr. of furniture; manufacturing n.e.c.	1.9	6.1	4.2	48.8	31.9	-16.9	48.2	60.4	12.2
Non-complex services									
Electricity, gas and water supply	0.8	1.5	0.7	27.1	15.3	-11.8	71.2	82.1	11.0
Construction	0.5	1.6	1.1	33.3	28.3	-5.0	65.4	69.2	3.8
Sale and rep. of motor vehicles, sale of auto. fuel	0.6	2.5	1.8	33.5	26.4	-7.1	65.2	70.5	5.2
Wholesale except of motor vehicles	1.2	3.2	2.1	32.6	24.8	-7.8	64.7	70.3	5.6
Re. trade and repair work except of motor vehicles	0.9	4.4	3.5	38.7	31.8	-7.0	59.5	62.6	3.1
Hotels and restaurants	5.9	16.3	10.4	55.2	36.8	-18.4	35.8	43.0	7.2
Complex services									
Transport	1.9	6.8	4.9	48.7	40.1	-8.6	47.7	51.5	3.8
Post and telecommunications	0.7	4.8	4.1	52.6	40.2	-12.5	46.1	53.8	7.7
Finance and insurance	0.5	1.8	1.4	19.6	15.7	-3.9	79.1	81.3	2.2
Letting and sale of real estate	1.0	2.9	1.9	41.5	29.0	-12.5	56.1	66.5	10.4
Business activities	1.8	5.4	3.7	26.3	19.1	-7.2	70.2	73.3	3.1
Public									
Public administration	0.9	2.0	1.2	27.8	18.6	-9.2	70.5	78.6	8.1
Education	1.7	3.4	1.7	18.5	12.1	-6.4	77.6	82.4	4.8
Human health activities	1.3	4.2	2.9	22.4	12.0	-10.4	74.7	81.9	7.2
Social institutions etc.	1.6	4.9	3.3	34.4	18.4	-16.0	62.3	75.1	12.8
Associations, culture and refuse disposal	1.5	3.6	2.1	40.7	30.1	-10.6	56.1	64.0	7.9

Notes: Each row shows foreign born with non-EU origin, low skilled and high skilled natives as share of employment in 1994 and 2008 and the change.

Table A.2: Employment shares in occupations *(2-digit ISCO)*

	Non-EU origin			Low skilled natives			High skilled natives		
	1994	2008	Dif.	1994	2008	Dif.	1994	2008	Dif.
Armed forces	0.2	0.5	0.3	49.9	43.4	-6.5	49.5	55.7	6.2
Legislators and senior officials	0.4	0.6	0.2	19.3	18.0	-1.3	79.4	80.4	1.0
Corporate managers	0.5	0.8	0.3	18.2	13.9	-4.2	79.7	83.9	4.2
Managers of small enterprises	3.0	1.2	-1.8	33.0	18.5	-14.5	61.7	78.7	17.1
Physical, mathematical and engineering science professionals	1.6	3.6	2.0	6.2	7.5	1.3	90.1	86.2	-3.9
Life science and health professionals	1.8	5.6	3.9	0.8	0.8	-0.0	95.2	90.4	-4.7
Teaching professionals	1.2	2.0	0.8	7.7	6.2	-1.5	88.9	89.5	0.6
Other professionals	1.4	2.2	0.8	15.8	8.2	-7.7	80.7	87.5	6.7
Physical and engineering science associate professionals	1.2	2.8	1.5	17.7	16.4	-1.3	79.5	79.3	-0.2
Life science and health associate professionals	0.9	2.6	1.7	7.2	5.3	-1.9	90.3	90.4	0.1
Teaching associate professionals	1.2	2.4	1.2	10.9	5.6	-5.3	85.9	90.5	4.6
Other associate professionals	0.5	1.6	1.1	22.7	17.4	-5.3	75.3	79.7	4.4
Office clerks	0.6	3.0	2.4	36.5	28.4	-8.1	62.0	67.4	5.4
Customer service clerks	0.8	2.3	1.5	30.8	25.5	-5.3	67.3	70.9	3.6
Personal and protective services workers	1.8	5.6	3.8	43.8	26.6	-17.2	52.8	66.3	13.5
Models, salespersons and demonstrators	0.6	4.4	3.8	33.9	34.1	0.2	64.9	60.4	-4.4
Skilled agricultural and fishery workers	0.3	1.0	0.7	46.8	24.5	-22.3	52.0	73.3	21.3
Extraction and building trades workers	0.5	1.8	1.3	21.4	22.0	0.7	77.4	75.2	-2.1
Metal, machinery and related trades workers	1.0	2.8	1.8	22.2	19.5	-2.7	76.0	76.8	0.8
Precision, handicraft, craft printing and related trades workers	1.2	3.7	2.5	24.9	21.0	-3.9	72.6	73.6	1.0
Other craft and related trades workers	1.3	3.4	2.1	40.2	24.2	-16.0	57.1	71.3	14.2
Stationary plant and related operators	2.8	6.2	3.5	53.8	39.9	-13.9	41.9	52.5	10.6
Machine operators and assemblers	3.5	9.2	5.7	60.5	46.3	-14.2	34.8	43.2	8.4
Drivers and mobile plant operators	2.4	6.3	3.9	67.3	49.5	-17.8	29.5	43.2	13.7
Other elementary occupations	4.4	13.1	8.7	69.0	53.7	-15.3	25.3	31.7	6.4
Sales and services elementary occupations	4.1	18.9	14.8	66.0	43.2	-22.8	28.4	36.1	7.7
Agricultural, fishery and related laborers	2.0	4.1	2.1	66.5	62.2	-4.4	30.3	32.1	1.8
Laborers in mining, construction, manufacturing and transport	1.8	6.3	4.5	64.5	51.5	-13.0	32.6	40.7	8.2

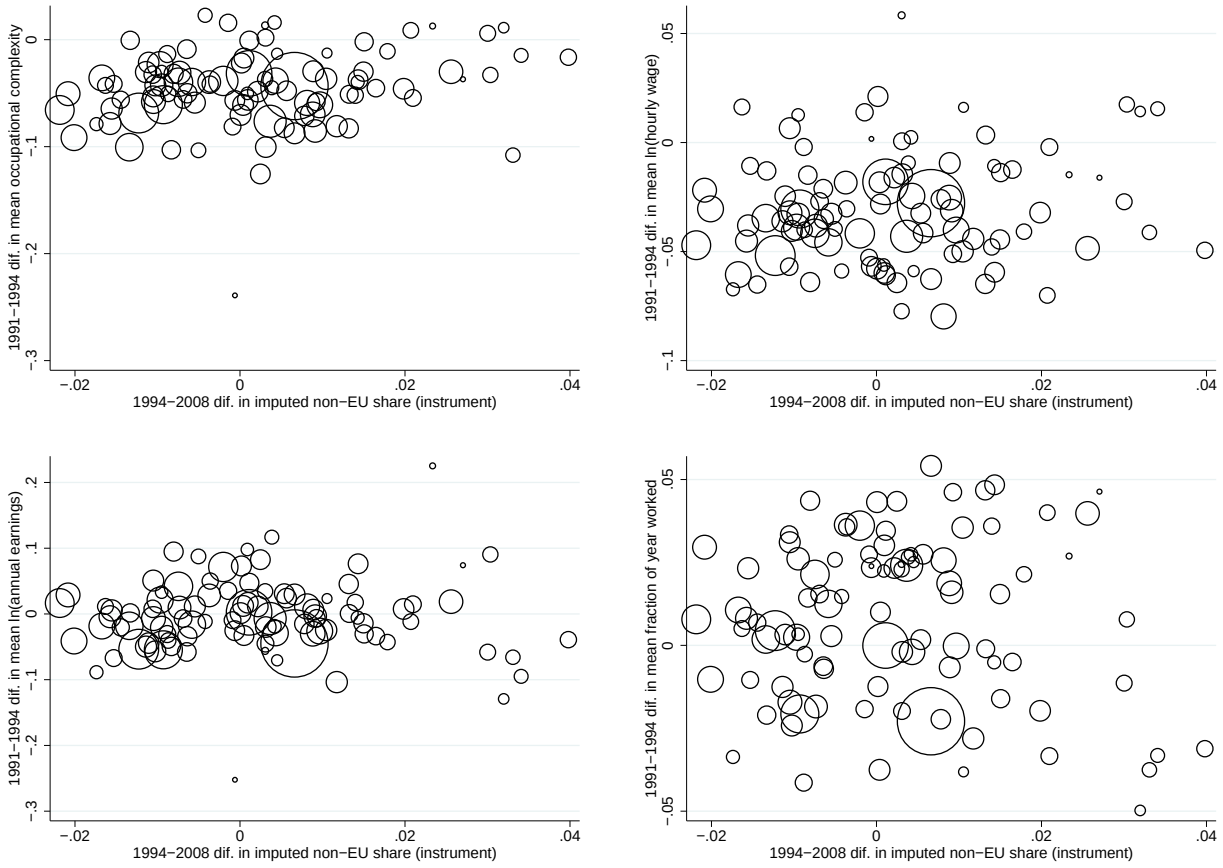
Notes: Each row shows foreign born with non-EU origin, low skilled and high skilled natives as share of employment in 1994 and 2008 and the change.

Table A.3: Summary statistics for cohort-sample

	Low skilled				High skilled			
	Mean	S.d.	Min	Max	Mean	S.d.	Min	Max
1994-characteristics								
Age	36.40	8.32	21.00	51.00	37.22	7.98	21.00	51.00
Labor market experience	13.86	7.29	0.00	31.00	15.01	6.76	0.00	31.00
Job tenure	4.10	4.47	0.00	14.00	4.46	4.56	0.00	14.00
Married	0.52	0.50	0.00	1.00	0.59	0.49	0.00	1.00
Education, primary	0.85	0.36	0.00	1.00	0.00	0.00	0.00	0.00
secondary	0.15	0.36	0.00	1.00	0.00	0.00	0.00	0.00
vocational	0.00	0.00	0.00	0.00	0.65	0.48	0.00	1.00
higher	0.00	0.00	0.00	0.00	0.35	0.48	0.00	1.00
Position, unskilled worker	0.53	0.50	0.00	1.00	0.13	0.33	0.00	1.00
skilled worker	0.08	0.27	0.00	1.00	0.19	0.39	0.00	1.00
intermediate professionals	0.35	0.48	0.00	1.00	0.54	0.50	0.00	1.00
higher grade professionals	0.04	0.18	0.00	1.00	0.14	0.34	0.00	1.00
executive	0.01	0.08	0.00	1.00	0.00	0.07	0.00	1.00
Region, Northern Jytland	0.11	0.32	0.00	1.00	0.10	0.30	0.00	1.00
Central Jytland	0.23	0.42	0.00	1.00	0.23	0.42	0.00	1.00
Southern Denmark	0.23	0.42	0.00	1.00	0.22	0.41	0.00	1.00
Greater Copenhagen Area	0.27	0.44	0.00	1.00	0.30	0.46	0.00	1.00
Zealand	0.16	0.36	0.00	1.00	0.15	0.36	0.00	1.00
Agriculture, fishing and quarrying	0.03	0.17	0.00	1.00	0.01	0.11	0.00	1.00
Manufacturing	0.28	0.45	0.00	1.00	0.19	0.39	0.00	1.00
Electricity, gas and water supply	0.01	0.08	0.00	1.00	0.01	0.10	0.00	1.00
Construction	0.06	0.23	0.00	1.00	0.07	0.25	0.00	1.00
Wholesale and retail sale, hotels and rest.	0.14	0.35	0.00	1.00	0.15	0.36	0.00	1.00
Transport, post and telecommunications	0.12	0.33	0.00	1.00	0.06	0.23	0.00	1.00
Finance and business activities	0.08	0.28	0.00	1.00	0.12	0.33	0.00	1.00
Public and personal services	0.28	0.45	0.00	1.00	0.38	0.49	0.00	1.00
Time-varying variables								
Occupational complexity	0.09	0.95	-2.69	2.11	0.59	0.82	-2.69	2.11
ln(Hourly wagerate)	5.13	0.32	0.07	9.17	5.26	0.35	-0.07	10.01
ln(Annual earnings)	12.34	0.70	-0.17	16.61	12.54	0.64	-0.17	17.96
Fraction of year worked	0.82	0.32	0.00	1.00	0.88	0.28	0.00	1.00
Fraction of year unemployed	0.06	0.16	0.00	1.00	0.03	0.12	0.00	1.00
Self-employed	0.02	0.15	0.00	1.00	0.02	0.16	0.00	1.00
Observations	1,280,376				2,955,330			

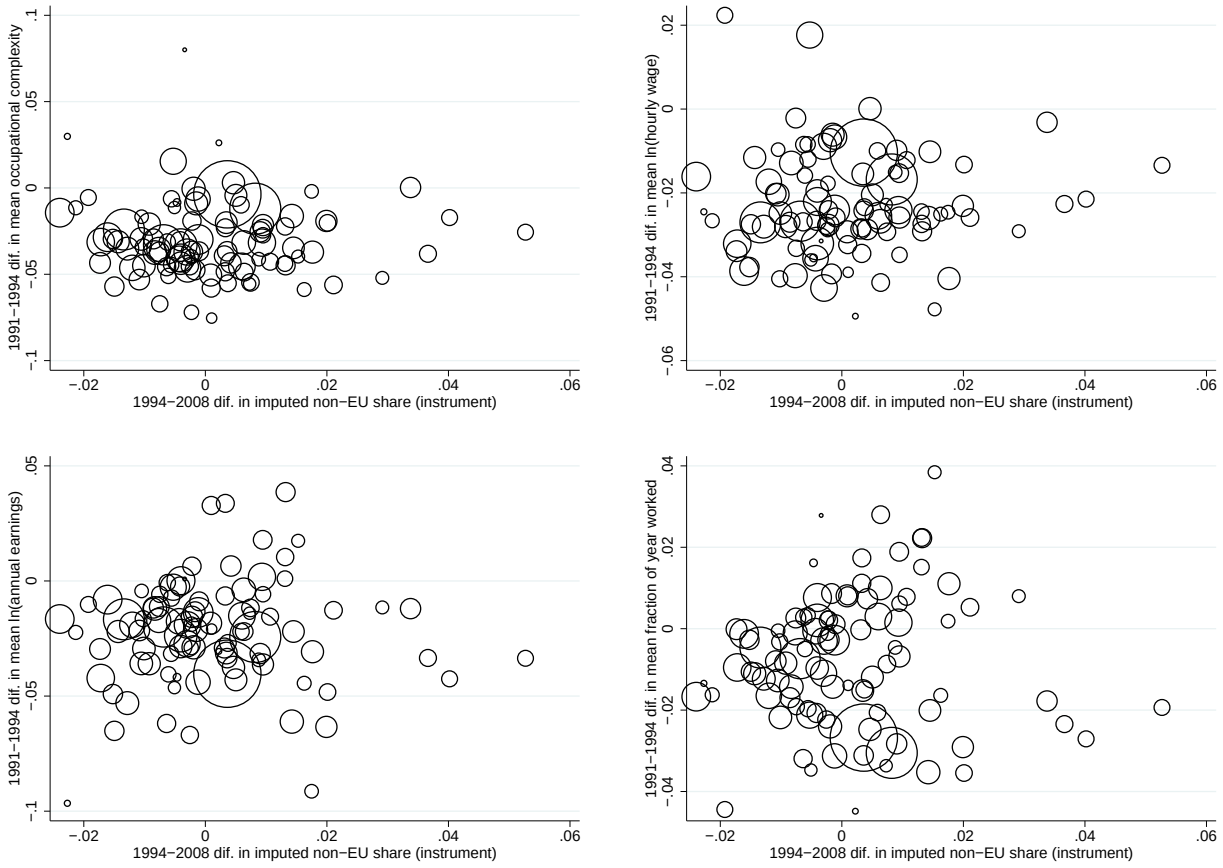
Notes: Strongly balanced panel (1991-2008) of natives employed in 1994. High/low skilled is defined by education in 1994.

Figure A.2: Partial plots of pre-trend in native outcomes and in-sample trend in instrument, *low* skilled



Notes: Each circle represents a municipality, and it's size reflects the average size of the *low* skilled native labor force in the municipality in 1994. The vertical axis shows the pre-event trend in outcome variables averaged for the *low* skilled native labor force in the municipality, and the horizontal axis shows the post-event difference in the instrument (controling for age, experience, temure, (each of those squared) and marital status averaged for each municipality in 1994).

Figure A.3: Partial plots of pre-trend in native outcomes and in-sample trend in instrument, *high* skilled



Notes: Each circle represents a municipality, and it's size reflects the average size of the *high* skilled native labor force in the municipality in 1994. The vertical axis shows the pre-event trend in outcome variables averaged for the *high* skilled native labor force in the municipality, and the horizontal axis shows the post-event difference in the instrument (controling for age, experience, temure, (each of those squared) and marital status averaged for each municipality in 1994).

Table A.4: Compare wage measures, *low* skilled

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
All				
Hourly wage (raw)	0.233*	0.514*	0.078	0.190
	(0.116)	(0.243)	(0.113)	(0.306)
Hourly wage (preferred)	0.236*	0.460*	0.072	0.136
	(0.114)	(0.234)	(0.111)	(0.298)
Manufacturing				
Hourly wage (raw)	0.068	0.683	0.282	1.241*
	(0.277)	(0.564)	(0.291)	(0.605)
Hourly wage (preferred)	0.074	0.733	0.333	1.357*
	(0.287)	(0.571)	(0.304)	(0.603)
Non-complex				
Hourly wage (raw)	0.612*	0.523	0.025	-0.458
	(0.239)	(0.419)	(0.185)	(0.504)
Hourly wage (preferred)	0.689**	0.506	0.080	-0.532
	(0.245)	(0.444)	(0.191)	(0.555)
Complex				
Hourly wage (raw)	0.494**	1.750***	0.571*	2.414***
	(0.188)	(0.401)	(0.277)	(0.518)
Hourly wage (preferred)	0.467*	1.641***	0.517	2.318***
	(0.189)	(0.393)	(0.267)	(0.519)
Public				
Hourly wage (raw)	0.090	-0.239	-0.093	-0.503
	(0.100)	(0.228)	(0.142)	(0.313)
Hourly wage (preferred)	0.038	-0.416	-0.145	-0.695*
	(0.110)	(0.263)	(0.156)	(0.351)

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation (4) using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in Table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. First stage as well as the preferred estimates are identical to Table 5 and 7 in the main text.

Table A.5: Compare wage measures, *high* skilled

	(1)	(2)	(3)	(4)
	Within worker-firm match		Within worker-municipality	
Dependent variable	OLS	2SLS	OLS	2SLS
All				
Hourly wage (raw)	0.206	0.726**	0.200	0.941**
	(0.113)	(0.267)	(0.131)	(0.358)
Hourly wage (preferred)	0.254*	0.864**	0.229	1.055**
	(0.121)	(0.271)	(0.144)	(0.376)
Manufacturing				
Hourly wage (raw)	0.124	0.534	-0.032	0.344
	(0.198)	(0.389)	(0.178)	(0.359)
Hourly wage (preferred)	0.193	0.732*	0.044	0.512
	(0.207)	(0.358)	(0.189)	(0.354)
Non-complex				
Hourly wage (raw)	0.239	0.799	0.121	0.749
	(0.214)	(0.500)	(0.139)	(0.387)
Hourly wage (preferred)	0.333	0.891*	0.182	0.834*
	(0.196)	(0.423)	(0.138)	(0.361)
Complex				
Hourly wage (raw)	0.390	1.627***	0.447	2.126**
	(0.217)	(0.492)	(0.259)	(0.710)
Hourly wage (preferred)	0.418	1.824***	0.482	2.403**
	(0.241)	(0.508)	(0.288)	(0.779)
Public				
Hourly wage (raw)	0.118	0.396**	0.153*	0.437***
	(0.064)	(0.137)	(0.061)	(0.114)
Hourly wage (preferred)	0.143*	0.492**	0.162*	0.502***
	(0.073)	(0.155)	(0.069)	(0.130)

Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation (4) using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in Table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. First stage as well as the preferred estimates are identical to Table 6 and 8 in the main text.

Table A.6: Sensitivity of within-worker firm match estimates to movers, *low* skilled

	(1)	(2)	(3)	(4)
	Include movers		Exclude movers	
Dependent variable	OLS	2SLS	OLS	2SLS
Occupational complexity	0.202	0.535	0.122	0.464
	(0.136)	(0.299)	(0.139)	(0.289)
Career upgrade	0.002	0.344*	0.003	0.392**
	(0.085)	(0.140)	(0.090)	(0.147)
Career downgrade	0.026	0.100	0.046	0.136
	(0.051)	(0.093)	(0.057)	(0.100)
Occupational mobility	0.066	0.598**	0.097	0.695**
	(0.143)	(0.225)	(0.163)	(0.242)
Hourly wage	0.236*	0.552*	0.236*	0.460*
	(0.112)	(0.222)	(0.114)	(0.234)
Annual earnings	0.154	0.634*	0.092	0.527
	(0.124)	(0.275)	(0.127)	(0.297)
Fraction of year worked	0.038	0.295**	0.014	0.323***
	(0.052)	(0.092)	(0.052)	(0.093)
Observations	1,564,737	1,564,737	1,396,517	1,396,517
First stage F-statistic		26.13		27.83
First stage coefficient		0.400***		0.401***
		(0.078)		(0.076)

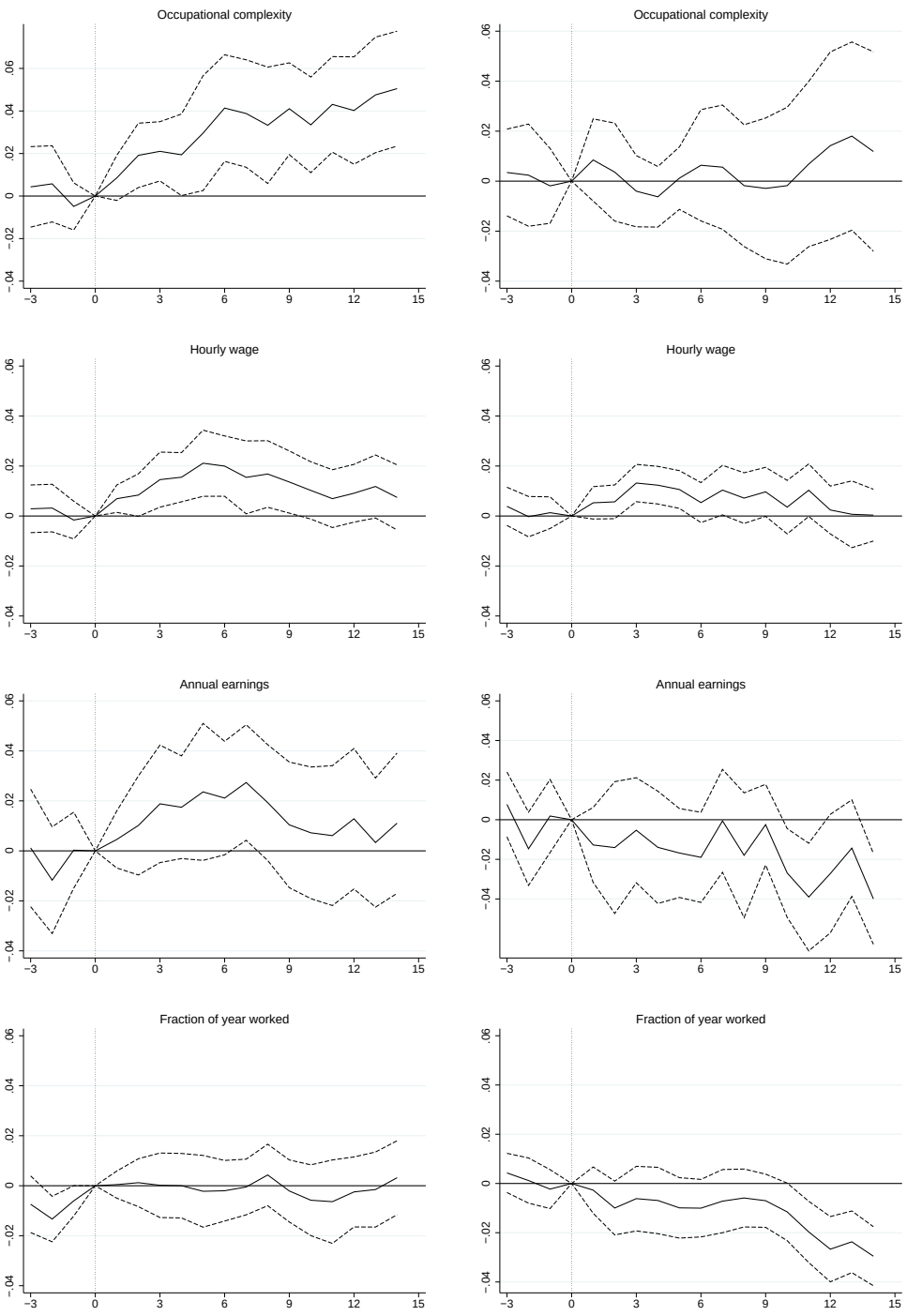
Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation (4) using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in Table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. Spells where the worker changes municipality of residence is included in column 1-2 and excluded in column 3-4 identical, column 3-4 are the preferred specification shown in Table 5 in the main text.

Table A.7: Sensitivity of within-worker firm match estimates to movers, *high* skilled

	(1)	(2)	(3)	(4)
	Include movers		Exclude movers	
Dependent variable	OLS	2SLS	OLS	2SLS
Occupational complexity	0.139	0.107	0.144	0.068
	(0.096)	(0.168)	(0.104)	(0.164)
Career upgrade	0.023	0.210	0.041	0.216
	(0.042)	(0.113)	(0.042)	(0.113)
Career downgrade	0.076	0.089	0.103*	0.135
	(0.045)	(0.065)	(0.048)	(0.072)
Occupational mobility	0.132	0.553**	0.177	0.603**
	(0.090)	(0.206)	(0.095)	(0.221)
Hourly wage	0.225	0.885**	0.254*	0.864**
	(0.127)	(0.276)	(0.121)	(0.271)
Annual earnings	0.077	0.941**	0.071	0.840**
	(0.142)	(0.314)	(0.130)	(0.281)
Fraction of year worked	-0.037	0.131	-0.062	0.089
	(0.031)	(0.087)	(0.032)	(0.077)
Observations	2,860,183	2,860,183	2,571,043	2,571,043
First stage F-statistic		30.96		32.56
First stage coefficient		0.416***		0.418***
		(0.075)		(0.073)

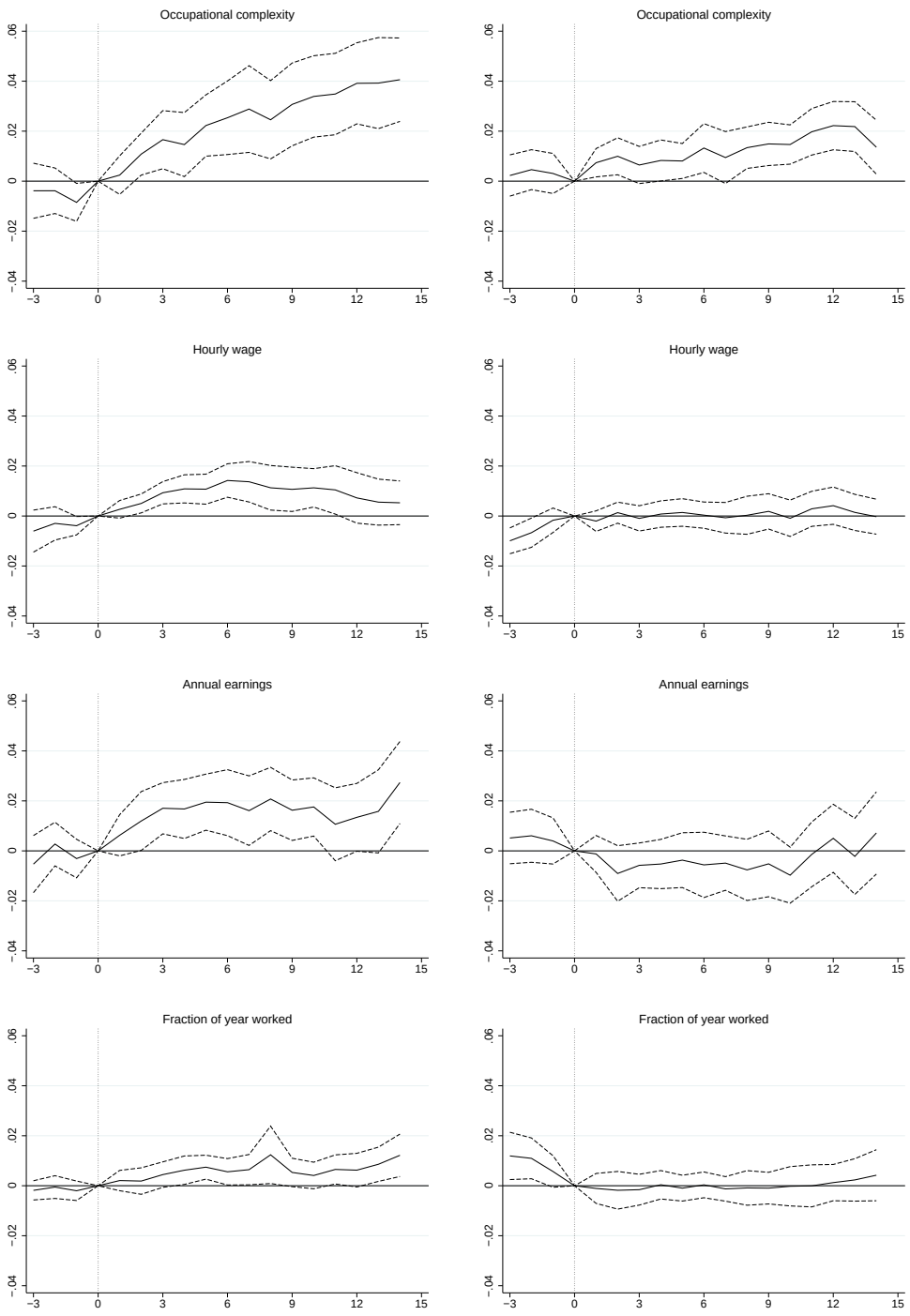
Notes: *** p< 0.001, ** p< 0.01, * p< 0.05. Each entry of the table is the coefficient on the explanatory variable of interest (immigrant share) in equation (4) using a sample of employed natives between 1995 and 2008. Control variables not shown are: age, experience, tenure, (each of those squared), marital status, education, region by year and industry by year dummies (listed in Table 3). Standard errors in parentheses and F-statistic for significance of excluded instrument are clustered by municipality. Spells where the worker changes municipality of residence is included in column 1-2 and excluded in column 3-4 identical, column 3-4 are the preferred specification shown in Table 6 in the main text.

Figure A.4: The long-run effect for *low* skilled (event-like study), by gender



Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation (6) using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality.

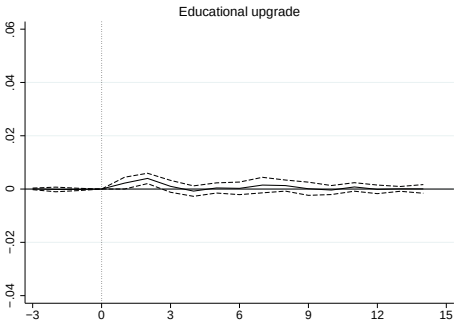
Figure A.5: The long-run effect for *high* skilled (event-like study), by gender



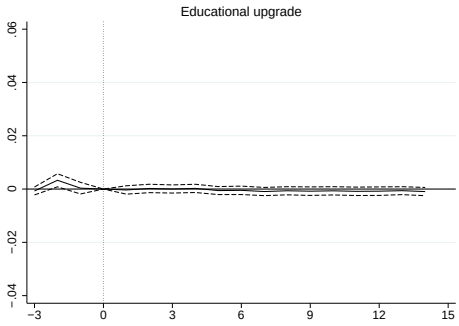
Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation (6) using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality.

Figure A.6: Educational upgrade (event-like study)

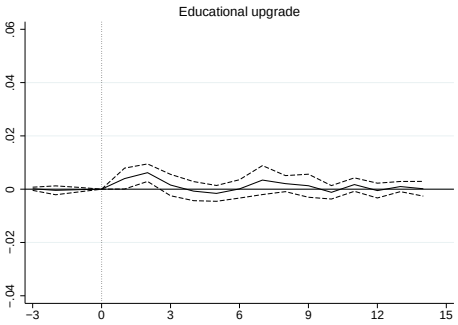
Low skilled



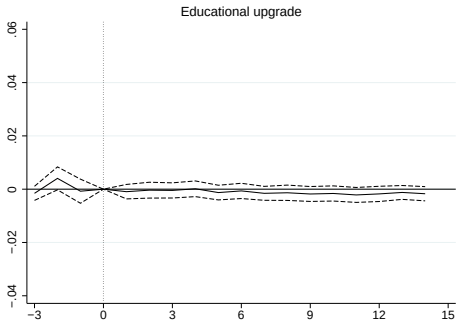
High skilled



Young low skilled



Young high skilled



Notes: Parameter estimates (——) and 95% confidence limits (- - -) on the interaction terms of immigration exposure and year dummies in equation (6) using a *strongly balanced* panel of natives employed in 1994. Standard errors are clustered at the 1994-municipality. Educational upgrade is a dummy variable that equals one if the individual upgrades his education between t and $t-1$.

Table A.8: Present discounted value of the effect on earnings from 1995 to 2008 (event-like study)

Sample	(1) Low skilled	(2) High skilled
All	-0.002	0.084
	(0.096)	(0.044)
Observations	1,206,145	2,838,069
Men	0.156	0.177**
	(0.110)	(0.058)
Observations	659,176	1,577,709
Women	-0.183	-0.043
	(0.109)	(0.047)
Observations	546,969	1,260,360
Old	-0.052	0.027
	(0.079)	(0.046)
Observations	600,977	1,512,843
Young	-0.007	0.084
	(0.131)	(0.052)
Observations	605,168	1,325,226
Low tenure	-0.001	0.093
	(0.130)	(0.058)
Observations	769,116	1,721,048

Notes: *** p< 0.01, ** p< 0.05, * p< 0.10. This table reports the discounted sum of the regression coefficients on the interaction terms of immigration exposure and year dummies in equation 6 using a *strongly balanced* panel of natives employed in 1994. Each entry of the table corresponds to a different sample; the first row is based on the entire cohort sample and the subsequent rows are different subsamples. The dependent variable in equation 6 is log earnings and we use a 4 percent annual discount rate; hence, the present discounted value of the effect on earnings is: $\sum_{t=1}^{14}(1/1.04)^{t-1}(e^{\gamma_t}-1)$ and standard errors in parentheses are calculated using the delta method.