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The Effect of Immigration on the Employment Opportunities of Native-Born Workers: Some Evidence for Spain*

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Abstract

Spain is one of the European countries where immigration flows during the last decade have increased noticeably. The Spanish labor market institutions and the Spanish immigration policy exhibit some peculiarities which may be relevant when analyzing the impact of immigration. This paper provides a first approximation to the labor market effects of immigrants in Spain during the second half of the 1990s, the period in which immigration flows to Spain have accelerated. By using alternative datasets, we estimate both the impact of legal and total immigration flows on the employment rates of native workers, with and without the implications of the occupational and geographical mobility of immigrants and native-born workers. Using different samples and estimation procedures, we have not found a significant negative effect of immigration on the employment rates of native workers. The corresponding estimated elasticity is around -0.17, when considering only legal immigrants, and is not significant when considering both legal and illegal immigrants.

JEL Codes: J21, J11
Keywords: immigration, employment rates.

1. Introduction

The literature that seeks to evaluate the impact of immigration on the labor market of the host country is by now very large and well-surveyed.[1] Overall, this literature does not provide robust empirical findings which could be used to assess the impact of immigrant flows on the wages and employment rates of the workers in the receiving countries.

First, it has proven very difficult to find support for the implications of the standard-textbook model in which an increase in labor supply due to immigration ought to reduce the wages of native workers in flexible labor markets in which relative wages adjust to demand and supply factors, or to reduce their employment rates in labor market where rigidities prevent adjustments of relative wages. *Secondly*, empirical results seem to be time-dependent, with a variety of studies finding different estimates of the labor market impact of immigration depending on the sample period under consideration.

In a recent influential paper, Borjas (2003) claims that this unsatisfactory state of affairs might arise from a somewhat misguided methodology. In effect, most of the empirical studies in this strand of the literature use the so-called "area-analysis" approach which correlates wages and employment rates, on the one hand, and the fraction of immigrants, on the other hand, across local labor markets. These spatial correlations suggest that, at most, a 10 percent increase in the fraction of immigrants reduces the wages of native workers by about 1 percent. The small-sized estimates can be attributed to a problem of "reverse causality" whereby immigrants tend to cluster in localities with thriving economies and therefore tend to cause a spurious positive correlation between immigration and local outcomes which biases downwards the parameter of interest. In order to correct for this bias, a number of studies have focused on the analysis of "natural experiments" where the increase in immigration can be considered to be exogenously determined. This is the case of Card (1990) on the Mariel boatlift from Cuba to Miami, or Hunt (1992) on the repatriation from Algeria to France. However, they still get small estimates around the previous order of magnitude.

In response to this stubborn evidence, it is usually argued that as long as production factors, either capital or labor, are mobile across local labor markets, the problem of the so-called "moving with your feet" phenomenon still remains. It is likely that in response to a potential fall in their wages or employment opportunities, native workers move from those cities affected by the labor

[1] See, for instance, Borjas (1994, 1999) and Friedberg and Hunt (1995).

supply shock to other localities unaffected by the immigration influx. Likewise, firms may want to move into those cities where wages have fallen. Hence, under these responses, immigration affects every city, not just those affected by the labor supply shock, and spatial correlations will fail to capture the parameter of interest, namely, the degree of substitution between immigrants and native-born workers.[2] In view of these considerations, Borjas (2003) advocates to replace spatial correlations by correlations across skill groups (using education and labor market experience as indicators of skills), on the grounds that these are categories from which, in the short run, it is impossible for native workers to move away and therefore the degree of substitution between natives and immigrants is bound to be much better gauged. Using this approach, Borjas (2003) finds that an increase in the size of a skill group by 10 percent lowers the wage of native workers in that group by about 2 to 3 percent and reduces working weeks by 2 percent. Nonetheless, Card (2000) and Card and DiNardo (2001) find that in US cities that have received relatively unskilled immigrant flows, the relative size of their unskilled populations has also increased, which somewhat challenges the interpretation relying on the mobility of native workers as an explanation of the lack of spatial correlations between immigrant flows and local labor market outcomes.

One further important consideration when describing this state of affairs is that most of the empirical studies trying to assess the impact of immigrant flows on the labor market outcomes of native workers use US data.[3] Wealth of data and the long experience with the effects of large waves of immigration since the 1840s justify this focus of attention on the US experience. However, during the last decade, many European countries, traditionally with net out-migration, have become recipients of immigrants, and, thus, the demand for informed analysis of the impact of immigration into Europe has notably increased.[4] Since European countries follow different immigration policies and have different regulations affecting labor and product markets, including a much lower regional mobility than the US, there could be some doubts about the

[2] For a formal proof, see Borjas (1999).

[3] There are, however, a few studies which apply the "spatial correlations" approach to other host countries such as Hunt (1992) to France, Pischke and Velling (1997) to Germany, Friedberg (2001) to Israel, and Dolado et al. (1997) to Spain.

[4] After the emigration of 60 million European emigrants from 1820 to 1940, migration in Europe can be broadly classified into three phases: (i) (1940s-1970s), after the 2nd World War and the decolonisation process, Central and Northern European countries become a strong source of immigration from the South; (ii) (1970s-1980s), after the two oil price shocks, there is a large return migration of temporary workers to their destination countries, whereas Southern countries, due to catching up with their richer counterparts, become destination countries; and (iii) (1980s-2000s) after the collapse of the Berlin Wall, the former centrally-planned economies become the main source of emigration to the EU.

extent to which findings for the US can be extrapolated to the European case.[5] In a recent contribution, Angrist and Kugler (2003), using a panel of European countries with the unit of analysis at the national level, find that the immigration slightly reduced the employment rate of native-born workers, although this effect is larger in countries with "rigid" institutions, in particular in countries where product market competition is restricted. This finding suggests that the link between immigration and labor market outcomes of native-born workers may be more subtle than just the insight provided by the static labor demand/labor supply model of the labor market.

These premises lead us to the main motivation of this paper. Spain is one of the European countries where immigration flows during the last decade have increased noticeably, having raised from 0.9% at the beginning of the 1990s to almost 6% at the turn of the century. The Spanish labor market institutions and the Spanish immigration policy exhibit some peculiarities which may be relevant when analyzing the impact of immigration. Moreover, there are very few empirical studies trying to measure this impact.[6] Thus, our goal is to provide a first approximation to the labor market effects of immigrants in Spain during the second half of the 1990s, the period in which immigration flows to Spain have accelerated. For this analysis, we rely on data from the register of work permits to foreigners, from the Labor Force Survey and from the last two waves of the Census of Population for the years 1991 and 2001. While the register of work permits provides an accurate measure of the incidence of legal immigration and offers information about the sector of activity and the region where the immigrants work, the Census of Population, in principle, covers both legal and illegal immigration and offers information on the educational level and potential work experience of the immigrants. Hence, by using alternative datasets, we estimate both the impact of legal and total immigration flows on the employment rates of native workers, with and without the implications of the occupational and geographical mobility of immigrants and native-born workers.

The paper is structured in six sections. In Section 2 we revisit the theoretical relationship between employment, wages, and immigration to highlight the role played by labor market institutions using two approaches at modeling the labor market, the stock approach and the flow approach. This is

[5] For recent immigration trends in some European countries, see Coppel et. al (2001) and Boeri et al. (2000).

[6] Most of the research of immigration to Spain is of sociological/qualitative nature (see, for instance, Carrasco, 2002, and Izquierdo, 2002). Within the economic literature, there are some previous studies. Dolado et al. (1997) analyze the effects of an amnesty of illegal immigrants on the wages and unemployment rates of native-born workers in the late 1980s/early 1990s, while Dolado (2002) surveys the available literature related to the design of migration policies in order to shed light on the Spanish case. Collado et al. (2002), in turn, perform a generational accounting exercise to measure the impact of immigration on public budgets.

done mainly for motivation purposes, to highlight the importance of performing these type of studies in countries with different institutional arrangements in the labor market, rather than to guide the empirical analysis which constitutes the bulk of this paper. In Section 3 we provide a brief description of the evolution and main characteristics of immigration to Spain during the last decade. In Section 4 we present the data to be used for an empirical exercise which, following the lead by Borjas (2003), searches for the correlation between the employment rates of native workers and the proportion of foreign workers across different population groups. Data availability restricts the definition of population groups for this exercise and prevents the analysis of wage effects. Section 5 discusses the empirical implementation and the main results. Finally, Section 6 concludes.

2. The substitution between immigrants and native-born workers revisited

From a theoretical perspective, there are several issues to be considered when analyzing the labor market effects in the receiving country of immigration. First, one distinction is in order between short-run and long-run effects. In the short-run, labor demand is given and, hence, an increase in the supply of labor will produce a fall in wages or a rise in unemployment, depending upon the characteristics of the wage determination process. In the long-run, by contrast, labor demand increases with immigration, so that wages and the aggregate employment rate do not necessarily fall.

Typically, labor economists work with models in which labor supply is neutral in the long-run with respect to either the wage evolution, which is determined by productivity growth, or to the aggregate employment rate, which is determined by participation decisions and by structural factors, both independent on the size of population. Hence, in the long-run, immigration may have labor market effects only by altering the composition of labor supply. In this case, relative wages and relative employment rates of different population groups may be affected by immigration flows. Yet, it is also conceivable that a change in the composition of labor supply may affect equilibrium unemployment, so that the labor market effects of immigration would not be neutral on the aggregate.

Secondly, the distinction between legal and illegal immigrants is also relevant when discussing the impact of immigration on the labor market outcomes of native workers. Typically, legal and illegal immigrants operate in different segments of the labor market, with illegal immigrants, by definition, performing tasks in the underground economy.

In what follows, we make these arguments about the impact of immigration more explicit and highlight the role of labor market institutions and immigration policies at shaping the labor market effects of immigration.

2.1.1. Short-run and long-run effects of immigration on wages and employment: The traditional supply-demand analysis (with labor market imperfections)

The implications of the static labor demand/labor supply framework regarding the labor market effects of immigration are straightforward. Here we present them under the assumption that some labor market institutions influence wage setting so that, in equilibrium, labor demand and labor supply do not necessarily balance.

Suppose that monopolistically competitive firms produce output with homogenous labor as the only factor of production. The elasticity of production with respect to labor is α, $0<\alpha<1$, and the production function is taken to be an iso-elastic one of the form $Y_{it}=N_{it}^{\alpha}$. Firm's demand is given by $Y_{it}^{d} = \varphi(L_t)P_{it}^{-\varepsilon}$, where P_i is the relative price of the output produced by firm i, $\varepsilon>1$, and $\varphi(L_t)$ is a demand shift parameter ($\varphi'(.)\geq 0$, being L population). Hence, aggregate labor demand is given by:

$$N_t^d = (\text{constant})\varphi(L_t)^{\frac{\gamma}{\varepsilon}} w_t^{-\gamma} \qquad \gamma = \frac{\varepsilon}{\varepsilon(1-\alpha)+\alpha}$$

Population (L) is composed by natives (L^*) and immigrants (I). Wages are determined by a mark-up over the reservation wage, so that $w=w_r(1+\mu(u_t))$, where $\mu(.)>0$ is the mark-up that workers aspire to get over their reservation wage, w_r, being $\mu'(.)\leq 0$, and $u_t=(L_t-N_t)/L_t$ the unemployment rate. This mark-up may arise from the existence of union power in wage determination, firing costs, or unemployment insurance. Insofar as wages are assumed to be influenced both by insider and outsider factors, the mark-up depends negatively on the unemployment rate.

Substituting wages into the aggregate labor demand equation, the overall employment level is obtained as follows:

$$N_t = (\text{constant})\varphi(L_t)^{\frac{\gamma}{\varepsilon}} w_{rt}^{-\gamma} (1+\mu(u_t))^{-\gamma}$$

while the employment of native workers is $N_t^*=N_t/(1+m)$, being m the ratio of immigrant workers to employment of native-born workers.

We can now discuss the effects of immigration flows on employment, the unemployment rate, and wages.[7] First, if $\varphi'(.)=0$, which is typically assumed in the static analysis of the labor market effects of immigration, the initial impact of an increase in population due to an immigration influx is that employment increases by less than population, hence the unemployment rate rises, and wages fall. The larger the effect on wages is, the smaller the effects on employment and unemployment are. Secondly, if $\varphi'(.)>0$, aggregate demand increases with immigration. In this case, the labor market effects of a rise in population are ambiguous depending on the elasticity of the shift demand factor to population and on the rest of parameter values. It is conceivable than in the long-run, the unemployment rate will return to an equilibrium value which is independent of the size of labor supply, so that wages remain invariant, while the rise of employment is of the same size as the increase in population. Hence, in this setup, while it is plausible that the short-run effects of immigration are to decrease the employment rate and wages, immigration is bound to be "neutral" in the long-run.

2.2. The composition of labor supply and the labor market effects of immigration

In the previous section labor is considered to be a homogenous factor. However, as immigrants typically differ from the native-born population in educational attainments, job experience, skills, etc., this is a too strong assumption. Therefore, a second reason for immigration to affect the wages and the employment rates of native-born workers is a change in the composition of labor supply. In a flexible labor market in which relative wages adjust to relative supply and demand of each specific type of labor, it is well known that a rise in the size of a particular population group reduces its relative wage. By contrast, in a rigid labor market in which relative wages do not fully adjust, at least in the short run, an increase in the size of a particular population group yields a rise on its relative unemployment rate. We will now focus on the incidence of unemployment among different population groups and on relative wages, as aggregate labor market effects of immigration have been already discussed in the previous section.

More formally, let us assume that there are two types of workers (1: skilled , 2: unskilled) and that the production function is given by the following CES function

$$Y = \left(\delta N_1^{\rho} + N_2^{\rho}\right)^{\frac{1}{\rho}}, \qquad \rho \leq 1$$

[7] For a discussion using a similar model with heterogeneous labor, see Angrist and Kugler (2003).

where Y is output, N_1 is employment of skilled workers, N_2 is employment of unskilled workers, and $\delta>1$ is an indicator of the relative efficiency of the two types of workers. The elasticity of substitution between both types of labor is given by $\sigma=1/(1-\rho)$. Being L_1 and L_2 the population size of each group, cost minimization implies

$$u_1 - u_2 = \sigma \ln\delta + \sigma(\ln w_1 - \ln w_2) + \ln L_1 - \ln L_2 \qquad (1)$$

where u_1 and u_2 are the unemployment rates of skilled and unskilled workers, respectively.

There are two ways of reading this equation. First, suppose that relative wages are flexible while unemployment rates are exogeneously determined by structural factors (frictions in the labor market, etc.). Then the previous equation establishes a relationship between the composition of labor supply by skills and the relative wage of skilled and unskilled workers. Following an increase in the supply of unskilled workers, the lower the elasticity of substitution between skilled and unskilled labor is, the larger the rise in the skill premium is. Thus, for given unemployment rates, if the composition of immigrant workers produces a rise in the proportion of unskilled workers, it will cause a rise in the skill premium (assuming $\sigma>1$, that is that both types of workers are gross-substitutes).

There is a second, «more European», way of reading equation (1). Suppose that wages are determined by some wage setting procedure in which workers of different characteristics have different reservation wages and different bargaining power.[8] The outcome of wage-setting implies an exogenous relative wage which, when plugged into equation (1), gives the unemployment rate differential between skilled and unskilled workers as a function of their relative supply. Under this view, any labor market institutions which compress the wage structure will produce a higher unemployment differential, while institutions favoring only skilled workers will reduce this differential (under the assumption that $\sigma>1$).[9] In this case, the impact of immigrant flows that change the composition of the labor supply on the employment status of native-born workers will depend on the relative wage "rigidities" imposed by labor market institutions. Insofar as these rigidities are more prevalent in the short-run, we would expect a higher initial impact of immigration on relative unemployment rates and a larger impact on relative wages over the long-run.

[8] Dolado et al. (1997) present a formal model along these lines.

[9] Apart from this, labour market institutions may have other differential effects on labour demand and labour supply across skills, and, therefore, affect this differential through links other than the wage structure.

There are other characteristics of immigration that may determine its labor market effects. For instance, it is usually accepted that immigrant workers are gross substitutes of native-born unskilled workers, while they are gross complements to native born skilled workers. One simple way of capturing this idea is to assume that the relative efficiency of skilled workers (δ) is increasing in the proportion of immigrant workers, as in Dolado et al. (1997). In this case, even if immigration increases the relative supply of unskilled workers, its effect on the relative unemployment rate of skilled workers is ambiguous, as aggregate labor demand rises with immigration. Similarly, other dynamic effects, such as the pace of assimilation of immigrants (in this model, skill upgrading), may be relevant when analyzing the long-run labor market effects of immigration.

2.3. The flow approach

However, the supply and demand framework above does not capture all the dimensions, besides skill, along which native-born workers and immigrants differ. In particular, immigrants are relatively younger, and relatively more mobile, as there is some probability that they may return to their country or move to a different job in another region. Hence, immigrants are less likely to keep their jobs and more likely to be engaged in on-the-job search. This has two effects on unemployment determination. First, as their separation rates are higher, the present value of profits from a job opening is lower. Secondly, as there are more job searchers, the expected probability of filling a job vacancy is higher and, hence, the expected cost of creating a job vacancy falls. Depending on which of the two effects dominate, equilibrium unemployment may rise or fall.

In the standard search model á la Mortensen-Pissarides, unemployment is increasing in the separation rate, so that the higher is the proportion of "mobile workers", the higher equilibrium unemployment is. But there is another feature of immigrants which may be relevant. As discussed above, they are often « mismatched » and continue searching for a job while employed. On-the-job search may create a positive externality by which the unemployment rates of both young and adult workers decreases as the share of the mobile, on-the-job searchers immigrants in the labor force increases. The reason is that firms find it profitable to open more vacancies as the share of mobile workers in the population increases.[10] Jimeno (2004) presents three versions of an equilibrium model of unemployment with two types of workers with different exogenous separation rates in which a rise in the share of immigrants is likely to increase

[10] This is the type of model that Shimer (2001) uses to rationalize his findings on the positive relationship between the share of youth population and employment and participation rates across US states.

both the equilibrium unemployment rate and the unemployment rate of native-born workers, while it is likely to reduce the unemployment rate of immigrants.[11]

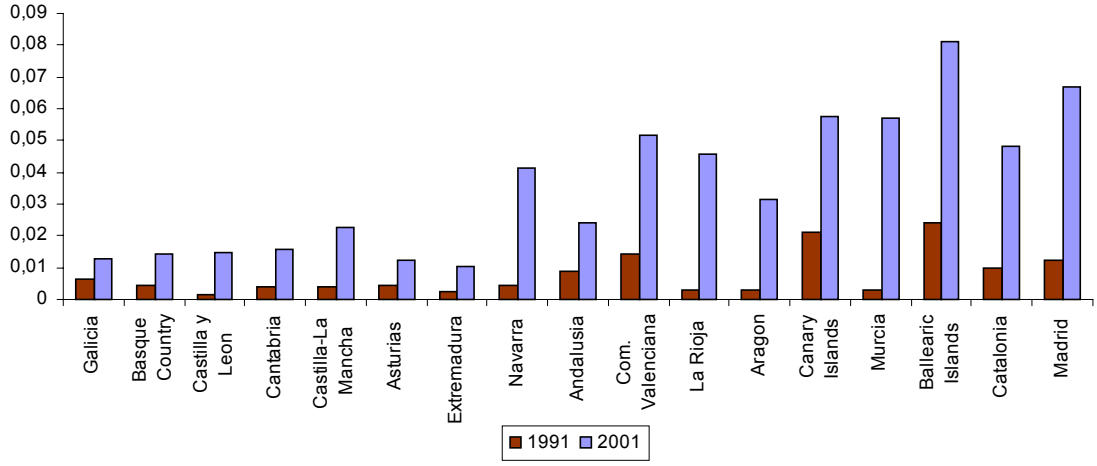
3. Immigration to Spain: A summary of the main trends

During the last decade, foreign population in Spain has surged from 0.35 million in 1991 to almost 2.7 million in 2003, that is, from about 1% to 6.25% of total population. Not all available data sources (Census of Population, Labor Force Survey, administrative registers of residence and work permits, etc.) coincide in their measurement of the stock of foreign population. There are also some methodological problems caused by changing regulations (like the exemption of residence and work permits for non-Spanish EU citizens since 1992, special amnesties processes, the estimation of the stock work permits without precise knowledge of return migration, the incidence of illegal immigration, etc.) which sometimes blurred the exact incidence and distribution across sectors and regions of immigrants flows to Spain.

Figures 1 to 5 provide information about the characteristics of the foreign population in Spain in 1991 and 2001, according to the information provided by the Census of Population. There is a clear regional concentration of the foreign population in Madrid and the Eastern part of Spain (Figure 1), being South America and Africa the main areas of origin of the immigrants (Figure 2). About 50% of the immigrants have secondary studies, while around 15% have tertiary studies (Figure 3) and almost 60% arrived after 1995 (Figure 4). Finally, the foreign population is relatively young with about 60% of the immigrants in the 20-44 age group, and men of 25-34 years of age being overrepresented (Figure 5).

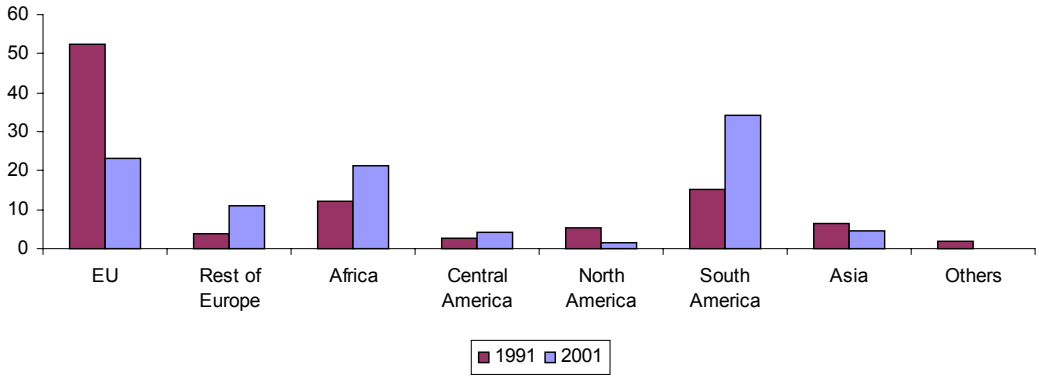
[11] Albrecht and Vroman (2002) present an equilibrium search model of unemployment with an exogenous distribution of workers skills and endogenous determination of skill requirements by firms in which equilibrium unemployment, in the absence of on-the-job search, is decreasing in the proportion of unskilled workers in the population. However, Dolado, Jansen, and Jimeno (2003), by adding on-the-job search to that model, show that some comparative static properties of this type of models may change.

Figure 1. Foreign population as a proportion of total population by region



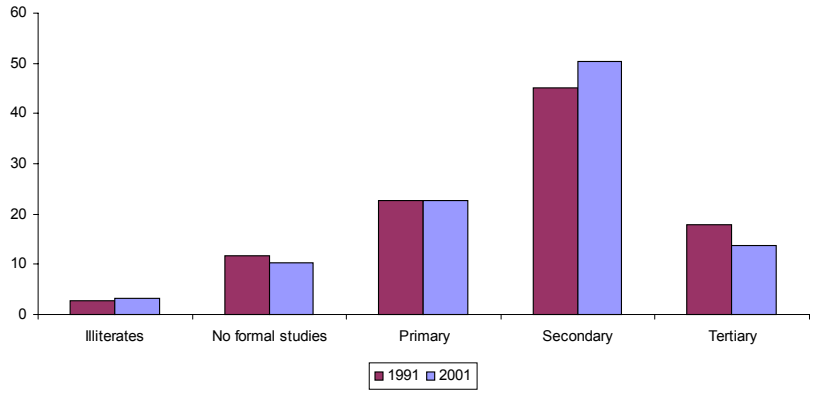
Source: Census of Population, 1991 and 2001

Figure 2. Foreign population by geographical area of origin



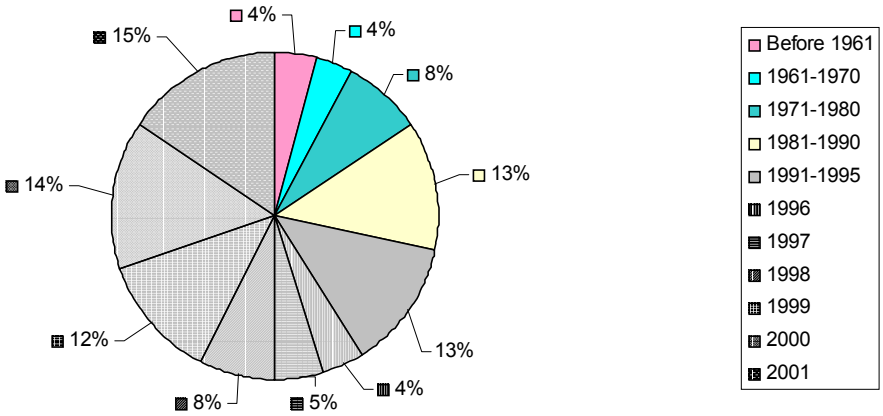
Source: Census of Population, 1991 and 2001

Figure 3. Foreign population by educational attainments



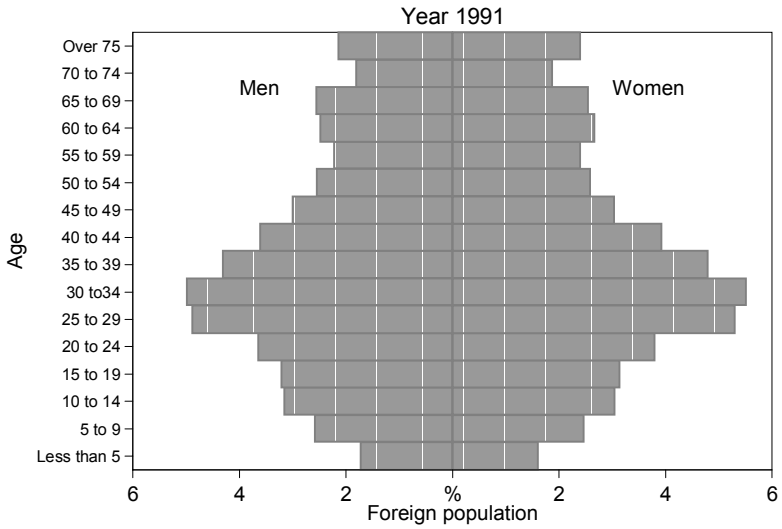
Source: Census of Population, 1991 and 2001

Figure 4. Foreign population by year of arrival

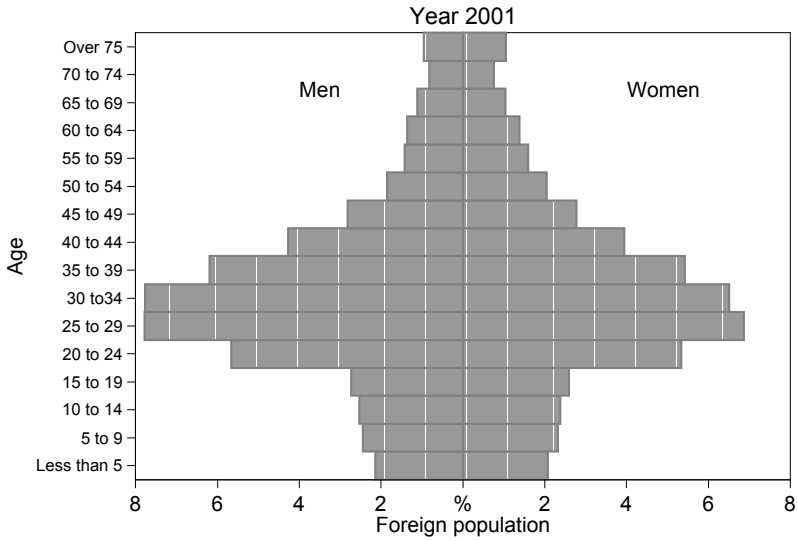


Source: Census of Population, 1991 and 2001

Figure 5. Foreign population by gender and age groups



Source: Census of Population 1991

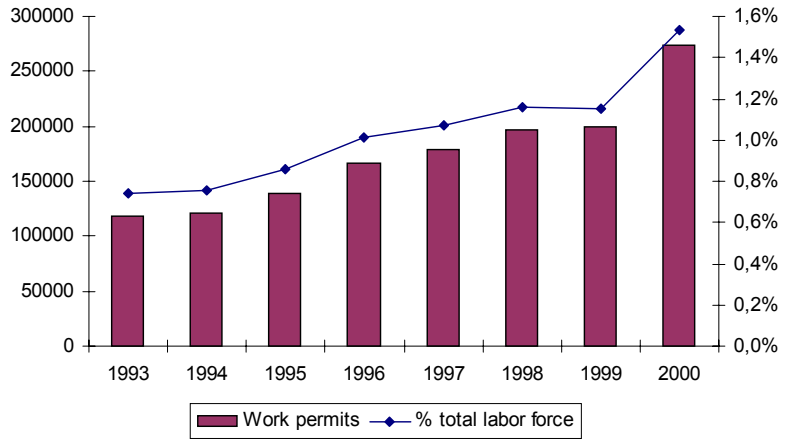


Source: Census of Population 2001

Foreigners are required to obtain a work permit if they pretend to be either employed or self-employed (see Appendix 1 for a summary of this regulation). Since 1992 EU citizens are exempted from this requirement (citizens from Luxembourg since 1993, citizens from Austria, Finland, Iceland, Norway and Sweden since 1994). By comparison between the Census data and the register data, most pundits conclude that about one third of the immigrants are in an "irregular situation", that is, without a residence or a work permit. According to estimates from the Spanish Ministry of Employment, shown in Figure 6, the number of work permits has increased from around 120 thousands (0.7% of the labor force) in 1993 to around 270 thousands (1.5% of the labor force) in 2000.[12] The large increase in this last year was caused by a special amnesty process which took place over 2000 and 2001.

Figures 7 to 9 provide the distributions of new work permits awarded each year by region, sector of activity, and type. They show that most permits are awarded to immigrant workers to work in the services sectors, and that immigrants with work permits represent a higher proportion of the labor force in Madrid, Catalonia, Ballearic Islands, and Murcia. As for the distribution by type, we group work permits in two classes, short duration/restricted (types A, b, B, d and D) and long duration/possibly unrestricted[13]. Figure 9 shows that while in 1993 around 75% of the work permits were short duration/restricted, in 1999 the proportion of work permits of long duration/possibly unrestricted had risen to almost 55%.

Figure 6. Work permits (stock)

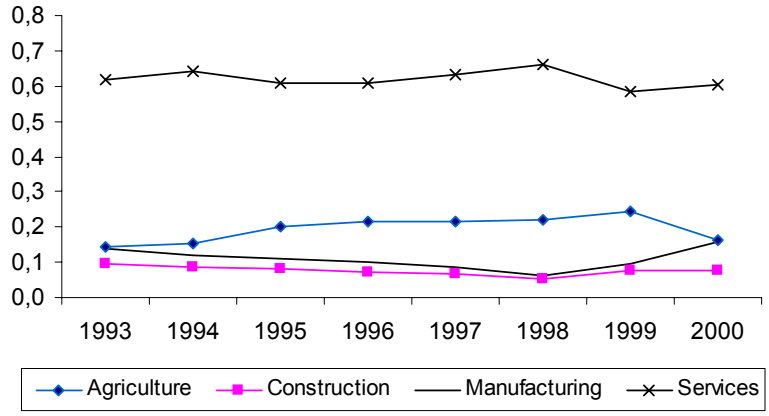


Source: Ministry of Employment and Social Affairs

[12] More recent data for 2000-2002 have not yet been made available by the Spanish Ministry of Employment. In 2000-2001 there was a special amnesty procedure, and in 2002 new immigration laws were approved after intense political discussions, which seem to be the reason for the delay in the publication of these data.

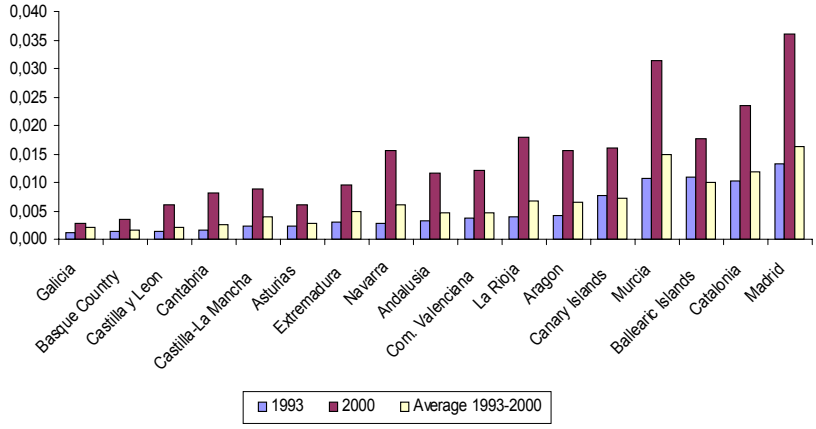
[13] See Appendix 1 for a description of the regulation of work permits.

Figure 7. Work permits awarded by main sector of activity



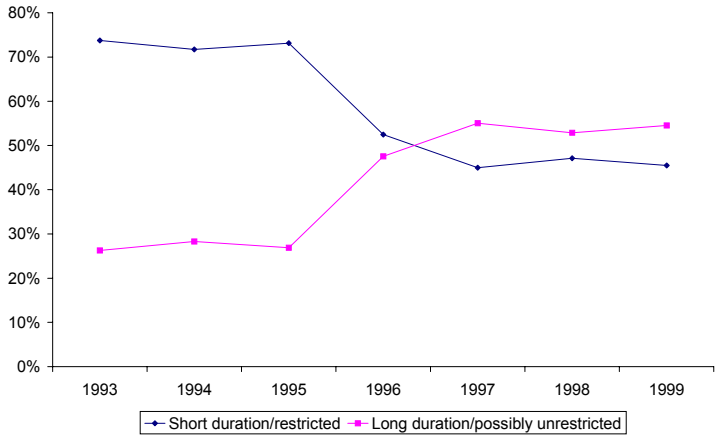
Source: Ministry of Employment and Social Affairs

Figure 8. Work permits awarded by regions (% labor force)



Source: Ministry of Employment and Social Affairs

Figure 9. Distribution of work permits by types



Source: Ministry of Employment and Social Affairs

4. Data

For the estimation of the labor market effects of immigration in Spain we first use detailed data on work permits for the period 1993-1999 from the register of the Spanish Ministry of Employment and Social Affairs. This source provides some individual characteristics of legal immigrants active in the Spanish labor market together with the region and the sector where they work, but neither education nor labor market experience. Alternatively, the Census of Population (available for 1991 and 2001) gives some information on the individual characteristics, including education, labor market experience, region of residence and the sector of work of all immigrants, whether legal or illegal. The employment status of native-born workers is observed both from the Labor Force Survey and the Census of Population. In what follows we describe the construction of the variables to be used in our empirical analysis.

4.1. Legal immigration

We classify immigrants in several categories distinguishing: (i) age groups (20-34, 35-44, 45-54, over 55), (ii) gender, and (iii) 44 sectors of activity.[14] Ideally, we would like to use cells from which the immigrants cannot relocate themselves as, for example, is the case of education (for individuals who participate in the labor force and are not enrolled in school) instead of sector of activity. Unfortunately, the register of work permits does not contain information on the educational attainment of the immigrant population. Hence, for this reason, we are forced to construct indicators of population size and employment status by age, gender and sectors of activity. For this, we use the information provided by the Labor Force Survey (LFS).

Following Borjas (2003), our analysis relies on the correlation of the immigration supply shock and some local labor-market outcome for native workers across cells, defined as explained above. Insofar as skills are sector-specific, using correlations across sectors yield consistent estimates of the impact of immigration on the employment probabilities of native-born workers. However if workers, either native-born or immigrants, can move across sectors in response to sector-specific labor market conditions, our estimates will be inconsistent and subject to the same criticism as the estimates based on "spatial correlations". In this regard, it is important to notice that in Spain the degree of both sectoral and geographical mobility of workers is not high. But nevertheless, we are aware of the potential drawbacks of using sectoral correlations to estimate the impact of immigration on the labor market outcomes of native-born workers, and will deal with them, first, by conditioning on sectoral, time, age,

[14] The list of sectors is in Appendix 2.

and gender fixed effects, secondly, by using a restricted sample of immigrants where sectoral mobility is restricted, and, thirdly, by performing IV estimation.

Our definition of the immigration supply shock is

$$x_{agst} = \frac{wp_{agst}}{(n_{agst} + wp_{agst})}$$

where *wp* stands for the number of work permits, *n* for native employment, *a* for the age group, *g* for gender, *s* for sector of activity, and *t* for time.[15] This variable measures the foreign-born share of the labour force in a particular skill group.

As for legal immigration (measured by the stock of work permits), Figures 10a and 10b plot the average value of *x* across years and sectors, respectively, and Tables 1 and 2 identify the sectors with a higher incidence of legal immigration. Since the number of cells we are considering is somehow large (4x2x44=352 cells for each year), we prefer to report the data in this fashion rather than separately for each year. As can be observed in Figure 10a, there is great deal of variation across sectors both for males and females.[16] In both cases, the immigration supply shock is larger for the three younger age cohorts. For males, there is a larger effect for 20-34 and 35-44 cohorts, and the three sectors where the number of immigrants is largest are Agriculture, Construction, and Retail Trade, while the sectors where work permits to foreigners represent a larger fraction of native employment are Domestic care, Agriculture, and Hotels and Restaurants. In the case of females aged 20-44, the corresponding sectors with highest number of immigrants are Domestic care, and Hotels and Restaurants, while the sectors where work permits to foreigners represent a larger fraction of native employment are Domestic care and Public Sewerage.

Figure 10b, in turn, also displays variation across years, exhibiting a large increase for the older immigrants and a decline for the middle aged immigrants in the second half of the period.

[15] Using data from an administrative register for work permits, and data from the LFS for employment and population has one drawback. Given that the number of cells we are using is rather high, the LFS estimates of employment and population may be not be as accurate as, for instance, data from the Census of Population. As a result, in some cells the employment of native-born workers is underestimated.

[16] In the Figures we exclude sector 44 (Domestic care) where the incidence of immigration is much higher than in the rest.

Table 1a. Sectors with highest number of immigrants. Males

Age	*(1)*	*(2)*	*(3)*
20-34	Agriculture	Construction	Hotels and restaurants
35-44	Agriculture	Construction	Retail Trade
45-54	Agriculture	Construction	Retail Trade
+55	Retail Trade	Agriculture	Construction

Table 1b. Sectors with highest number of immigrants. Females

Age	*(1)*	*(2)*	*(3)*
20-34	Domestic care	Hotels and restaurants	Other entrepreneurship activities
35-44	Domestic care	Hotels and restaurants	Other entrepreneurship activities
45-54	Domestic care	Hotels and restaurants	Other entrepreneurship activities
+55	Domestic care	Hotels and restaurants	Retail Trade

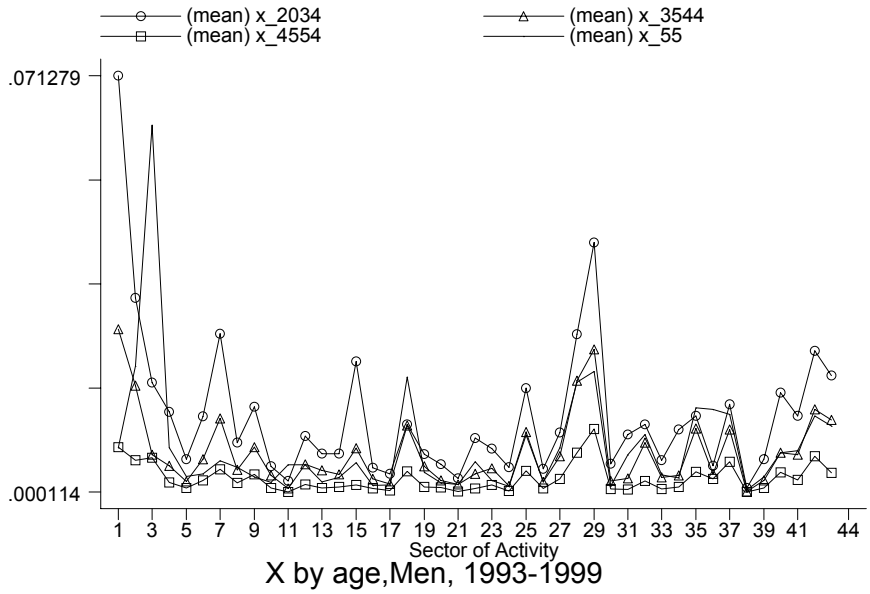
Table 2a. Sectors with highest *x*. Males

Age	*(1)*	*(2)*	*(3)*
20-34	Domestic care	Agriculture	Hotels and restaurants
35-44	Domestic care	Agriculture	Hotels and restaurants
45-54	Domestic care	Hotels and restaurants	Agriculture
+55	Coal mining	Domestic care	Fishing

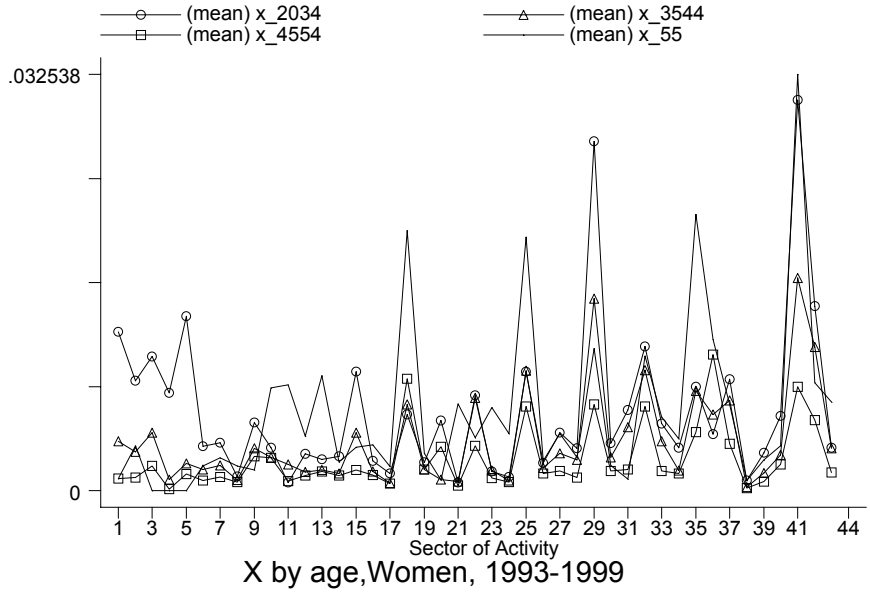
Table 2b. Sectors with highest *x*. Females

Age	*(1)*	*(2)*	*(3)*
20-34	Domestic care	Public sewerage	Hotels and restaurants
35-44	Domestic care	Public sewerage	Hotels and restaurants
45-54	Domestic care	Real estate	Office equipment
+55	Domestic care	Public sewerage	Real estate

Figure 10a. Incidence of immigration by sectors of activity, age and gender (excluding sect==44)

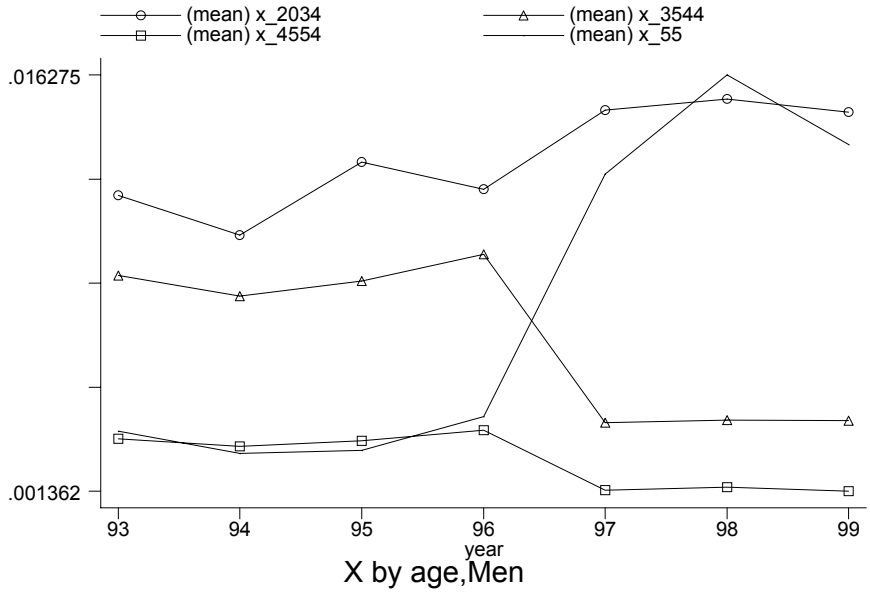


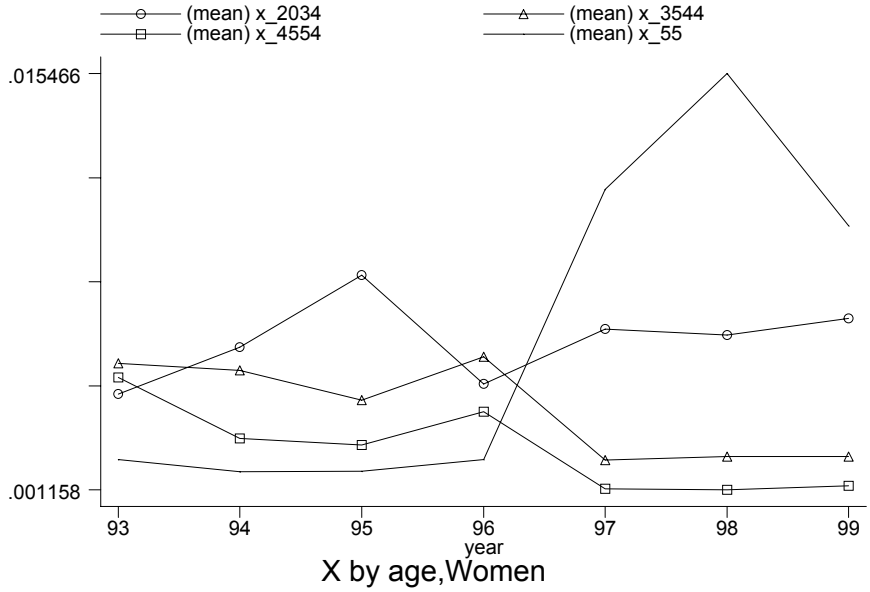
X by age,Men, 1993-1999



X by age,Women, 1993-1999

Figure 10b. Incidence of immigration by year, age and gender





To capture labor market outcomes of native-born workers, we compute, for each cell, the employment rate of native workers, *y*, defined as:

$$y_{agst} = \frac{n_{agst}}{p_{agt}}$$

where *p* stands for the native-born labor force. Notice that since the labor force cannot be defined by sector, the denominator of y_{agst} does not have sectoral variation, so that the overall gender employment rate of the Spanish economy in each year of the sample (which ranges 50% to 56.6%) can just be recovered by simply adding y_{agst} across sectors.

As discussed earlier, the problem with using sectors of activity as a proxy for skills, instead of using information on the educational attainment, is that one can think that immigrants move to those sectors where the labor supply of native-born workers is scarcer and, also, that native-born workers may change sectors in response to the arrival of immigrants. Thus, it may be the case that immigration and employment rates of native workers by sector of activity are jointly determined by "basic economic variables", so that both variables are endogenous, and, at least, part of the observed relationship between them is bound to be spurious.

In order to identifying an exogenous effect of the immigration supply shock on the local labor market outcomes, as defined above, one possibility is to focus the analysis only on those work permits which are restricted to a certain sector of activity (types A, b, B, d and D), and are a proportion of the total *wp* for each cell. Since those work permits are awarded by the immigration authorities and are not completely under the choice of the applicants, we could think that in this way some of the exogenous variation in immigration can be retrieved.[17]

Summary statistics of the variables for both samples (all work permits, and restricted sample of work permits) are presented in Table 3. The initial number of cells is 2,464 (4x2x44x7). We have dropped all the cells in which the number of natives in the Labor Force Survey is equal to zero (69 cells). Therefore, we end up with a sample of 2,395 cells. In both samples, the average

[17]Again, we acknowledge that immigrants plausibly ask for permits in those sectors where they think there are better conditions. Appendix 3 presents probit estimates of the approval rate of work permits conditioning by region, sector and some immigrants' characteristics. Results show that the probability of awarding a work permit increases with age, is about half a percentage point lower for males, was higher during the 1995-1996 period (close to the only amnesty episode included in our sample), and shows some variation across sectors and, even more, across provinces. The sectors in which the probability of awarding a work permit is lowest are Extraction of minerals, Apparel and Textiles, Construction, Wholesale Trade, Retail Trade, Transports, Real State, Other entrepreneurship activities, Education, and Personal Services. The sectors in which the probability of awarding a work permit is highest are Refineries, Precision Equipment, Other transportation equipment, and Air Transports.

value of the employment rates are very low (around 1.2%), given the way the *y* variable was constructed, and exhibit a similar variation. Likewise, the immigration rate, *x*, is also similar albeit slightly larger for the whole sample of work permits (0.91% *vs.* 0.89%).

Table 3: Summary statistics of the sample of work permits

Variable	Obs.	Mean	Std. Dev.	Min	Max
		All work permits			
wp	2,395	413.1543	1701.986	0	26842.61
n	2,395	34986.82	54082.26	59.48	576896.3
p	2,395	2872971	920442.5	1962557	4576883
x	2,395	.0089141	.0285298	0	.5235348
y	2,395	.0121506	.0177542	.0000238	.1389457
		Restricted set of work permits			
wp	2,395	264.1124	1106.548	0.036	17663.21
n	2,395	34986.82	54082.26	59.48	576896.3
p	2,395	2872971	920442.5	1962557	4576883
x	2,395	.00911	.041425	0	.7077917
y	2,395	.0121506	.0177542	.0000238	.1389457

Notice that this measure of the incidence of immigration excludes illegal immigration. In fact, anecdotal evidence suggests that most immigrants enter Spain "illegally" and, after some period, apply for and, eventually, achieve a work permit. Hence, our measure of the incidence of immigration is the result of the "supply of immigrants" combined with the administrative decision to award a work permit, which shows some variation across demographic groups, provinces, and sectors of activity (see Appendix 3). The results obtained from this sample will be compared to those obtained with a sample extracted from the Census of Population which, in principle, covers both legal and illegal immigrants and that we construct as explain below.

4.2. Total immigration

To measure total immigration we make use of the information provided by the Census of Population for 1991 and 2001. This source has also the advantage that we can classify immigrants in groups defined by education and work experience, as in Borjas (2003). Thus, in this case our measure of immigration shocks is

$$x_{ewgt} = \frac{m_{ewgt}}{(n_{ewgt} + m_{ewgt})}$$

where *m* stands for the number of total immigrant workers, *e* for the educational level (without studies, primary, secondary or tertiary education), *w* for potential work experience (in groups of five years from 0 to 40) and *g* for gender, so that

we have 64 cells observed in 1991 and 2001. Similarly, from the information in the Census of Population, we also compute the employment rates of the native-born population of similar characteristics as:

$$y_{ewgt} = \frac{n_{ewgt}}{p_{ewgt}}$$

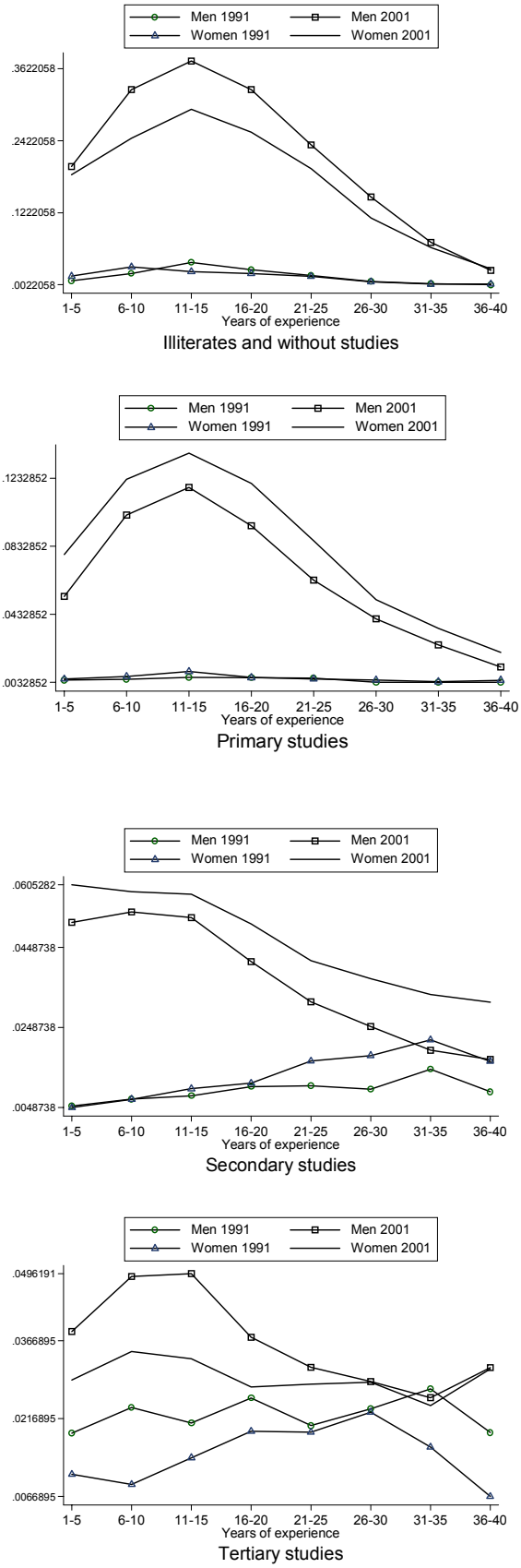
Figures 11 and 12 plot the immigration shocks and employment rate for each group, respectively, while Table 4 presents the descriptive statistics of the variables to be used in the empirical analysis in Section 5. As seen in Figure 11, between 1991 and 2001 there has been a noticeable increase in the proportion of immigrants in the labor force, particularly in the low education-low potential work experience groups. The immigration supply shock, x, takes an average value of 4.90%, ranging from 0.24% (men with no formal studies and 36 to 40 years of work experience in 1991) to 37.5% (men without studies and 11 to 15 years of work experience in 2001).

Since cells are now defined over education, gender and labor market experience, employment rates can now be defined within each cell, so that the mean of the dependent variable is about 0.59. The employment rates of native-born workers are increasing in potential work experience and educational level. They are also higher for men than for women. While, for men, employment rates are similar in 1991 and 2001, female employment rates noticeably increased in that period.

Table 4: Summary statistics of the sample from the Census of Population

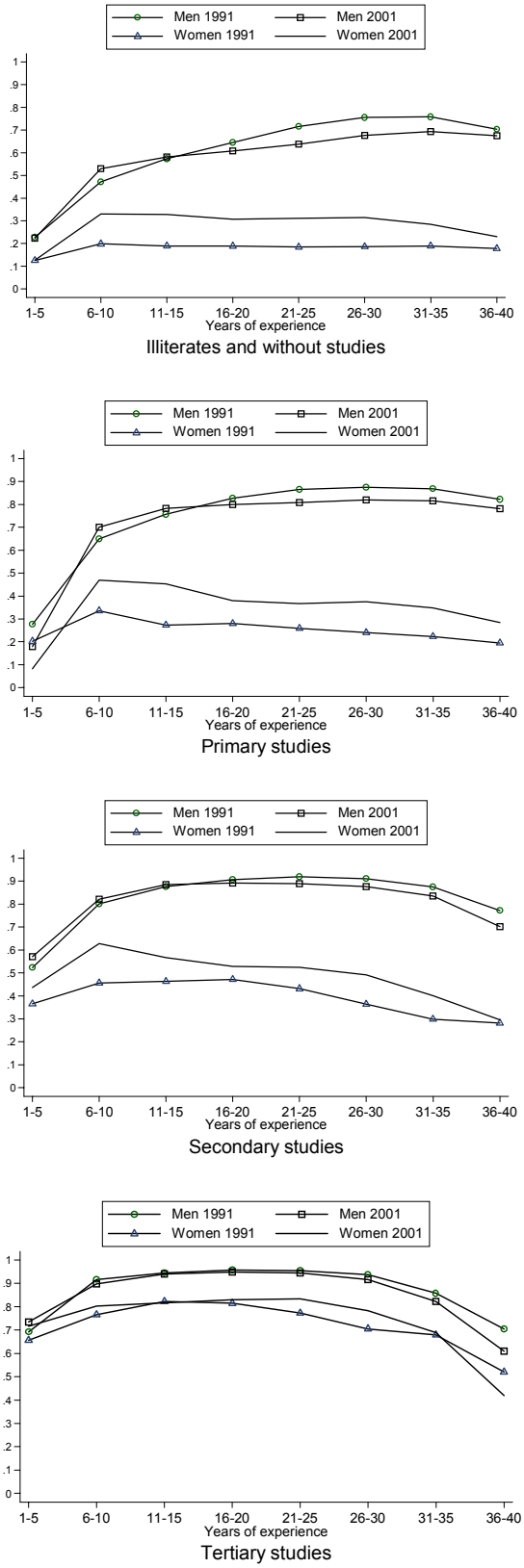
Variable	Obs.	Mean	Std. Dev.	Min.	Max.
m	128	6443.594	9422.634	80	49518
n	128	192595.3	199036	4035	889824
p	128	317401.2	282223.9	22811	1167184
x	128	0.0490229	0.0714003	0.0023942	0.3749789
y	128	0.5860545	0.2575048	0.0832516	0.9578755

Figure 11. Incidence of immigration by educational level and years of experience



Source: Census of Population, 1991 and 2001

Figure 12. Employment rates of native-born workers by educational level and years of experience



Source: Census of Population, 1991 and 2001

5. Empirical approach and main results

To compute the effect of the immigration rates, *x,* on the native employment rates, *y*, we estimate the following two equations:

$$\log\left(\frac{y_{agst}}{1-y_{agst}}\right)=\beta x_{agst}+\alpha_a+\varphi_g+\sigma_s+\tau_t+\varepsilon_{agst} \quad (2)$$

$$\log\left(\frac{y_{egwt}}{1-y_{egwt}}\right)=\beta x_{egwt}+\alpha_e+\varphi_g+\sigma_w+\tau_t+\varepsilon_{egwt} \quad (3)$$

where α, φ, τ, and σ are vectors of unobservable fixed effects reflecting, respectively, either age or education, gender, year and either sector of activity or potential work experience. Since the dependent variable is within the (0,1) interval, we impose a logistic transformation, rather than estimating linear regressions. [18] In addition to these specifications with fixed effects, we also include some interactions among them. The standard errors are clustered by cells to adjust for possible serial correlation. All the regressions are weighted by the sample size used to calculate either y_{agst} or y_{egwt}. We present the estimates of the coefficient β. Nonetheless, given that our measure of the employment rate, the dependent variable, is significantly different in our samples of legal and total immigrants, it is easier to interpret this coefficient by converting it into an elasticity. Following Borjas (2003) we define alternative measures of the immigration shock: $x'_{agst}=wp_{agst}/n_{agst}$ and $x'_{egwt}=m_{egwt}/n_{egwt,,}$ so that the corresponding elasticities of employment rates with respect to the ratio of immigrants to native workers are

$$\left(\frac{\partial y_{agst}}{\partial x'_{agst}}\right)\left(\frac{x'_{agst}}{y_{agst}}\right)=\frac{1}{\left(1+x'_{agst}\right)^2}\frac{\partial y_{agst}}{\partial x_{agst}}\left(\frac{x'_{agst}}{y_{agst}}\right)$$

$$\left(\frac{\partial y_{egwt}}{\partial x'_{egwt}}\right)\left(\frac{x'_{egwt}}{y_{egwt}}\right)=\frac{1}{\left(1+x'_{egwt}\right)^2}\frac{\partial y_{egwt}}{\partial x_{egwt}}\left(\frac{x'_{egwt}}{y_{egwt}}\right)$$

where

$$\frac{dy_{agst}}{dx_{agst}}=\beta\frac{\exp(\beta x_{agst}+\alpha_a+\varphi_g+\tau_t+\sigma_{s)}}{\left[1+\exp(\beta x_{agst}+\alpha_a+\varphi_g+\tau_t+\sigma_{s)}\right]^2}$$

$$\frac{dy_{egwt}}{dx_{egwt}}=\beta\frac{\exp(\beta x_{egwt}+\alpha_e+\varphi_g+\tau_t+\sigma_{w)}}{\left[1+\exp(\beta x_{egwt}+\alpha_e+\varphi_g+\tau_t+\sigma_{w)}\right]^2}$$

[18] Results from linear regressions are similar to those reported in the text.

are the marginal effects. We evaluate these magnitudes at each observation and then calculate the mean.

Under the assumption of no selection bias (that is to say, if there is no correlation between the unobservable specific sector effect, σ_s, and the variable *x*), consistent estimates of the parameter of interest, β, in equations (2) and (3) can be obtained by including the σ_s into the error term, which then becomes $(\varepsilon_{agst}+\sigma_s)$. Subsequently, the previous relationship could be estimated by ordinary least squares (OLS).

Nevertheless, if we think that selectivity effects are present, the sector specific effects can be treated as additional parameters to be estimated, which therefore allows for correlation between the fixed effects and the explanatory variable, *x*. If we assume that no selection bias is present after controlling for fixed effects, then consistent estimates of the parameters can be obtained by OLS regression on the fixed effects model. On the other hand, if selectivity effects still remain even after controlling for fixed effects, we should use instrumental variables strategies in order to obtain the true causal effect of *x* on *y*. These selectivity effects are more likely for the specification in which cells are defined using sectors of activity (equation 2) than for the specification defining cells using education (equation 3).

5.1. The impact of legal immigration

Tables 5a and 5b present the OLS estimates of β from equation (2), using both the *whole* and the *restricted* samples of work permits. The first row in Table 5a reports the results from the pooled data without including any type of fixed effects in the regression, together with the corresponding elasticities of employment rates with respect to the immigration supply shock. For the specification without fixed effects by gender, age, sector, and time, we find an insignificant effect of the immigration shock on the employment rates of native-born workers. Rows (2) and (3) present the corresponding estimates when including specific gender, age, sector, and time effects and interactions among them. In these cases, the estimated coefficient becomes negative, increases in absolute value, and becomes statistically significant when either fixed terms or interactions are included as additional regressors. In this specification, the estimated elasticity is -0.18, so that an increase of 10% in the ratio of immigrant to native workers, say, from 5% to 5.6%, would decrease the employment rate of native-born workers by 1.8%, that is from 58.6% (the average value in our sample) to 57.5%.

Rows (4) to (9), in turn, report the coefficients estimated for men and women separately while Rows (10) to (21) report the results for each age group.

Separate estimation by gender yields even smaller elasticities in absolute values (-0.035 for men and -0.088 for women), while the contrary happens when estimation is performed separately by age groups. In any case, the estimated coefficients are statistically significant at the standard significance levels.

These results, however, could still be biased if we think that, even after controlling for sector, age, and gender fixed effects, immigrants tend to move towards those segments in the labor market where the employment rates of native-born workers or, alternatively, if native-born workers tend to move out of those segments where immigrants flow in. Table 5b reports the results using as measure of immigration only immigrants with short duration/restricted work permits. With this sample, in which mobility of immigrants is restricted, while the estimated coefficients remain negative and statistically significant, the corresponding elasticities are noticeably smaller than those found in the sample with all work permits.

Table 5a: OLS estimates using the whole sample of work permits.
Dependent variable transformed: log(y/(1-y))

	Coefficient β	Std. Err.	Marginal Effects*	Elast.*	Fixed effects	Interactions	Obs.
(1)	0.1125	2.3744	0.0005	0.0057	NO	NO	2,395
(2)	-9.7442	1.6585	-0.1071	-0.1364	YES	NO	2,395
(3)	-15.0422	2.3176	-0.1687	-0.1823	YES	YES	2,395
			ESTIMATES BY GENDER				
			Males				
(4)	-3.4443	0.9333	-0.0268	-0.1261	NO	NO	1,231
(5)	-3.8672	1.0398	-0.0577	-0.0451	YES	NO	1,231
(6)	-3.6505	1.2259	-0.0551	-0.0349	YES	YES	1,231
			Females				
(7)	8.9504	5.5090	0.0208	0.4765	NO	NO	1,164
(8)	-12.9204	3.2577	-0.1033	-0.0995	YES	NO	1,164
(9)	-13.1792	4.9524	-0.1060	-0.0882	YES	YES	1,164
			ESTIMATES BY AGE GROUPS				
			Age 20-34				
(10)	-0.0917	2.6280	-0.0004	-0.0049	NO	NO	612
(11)	-10.2262	2.0811	-0.1095	-0.1921	YES	NO	612
(12)	-13.5850	1.1017	-0.1463	-0.2087	YES	YES	612
			Age 35-44				
(13)	5.0358	6.4907	0.0272	0.1703	NO	NO	612
(14)	-25.2946	7.1281	-0.3451	-0.3035	YES	NO	612
(15)	-54.8091	8.9227	-0.7546	-0.4969	YES	YES	612
			Age 45-54				
(16)	0.3712	22.5714	0.0017	0.0085	NO	NO	601
(17)	-67.2266	17.3159	-0.8464	-0.3586	YES	NO	601
(18)	-118.107	31.8552	-1.4610	-0.5912	YES	YES	601
			Age 55-64				
(19)	-8.1510	9.8688	-0.0191	-0.3284	NO	NO	570
(20)	-15.2540	6.0386	-0.1336	-0.1805	YES	NO	570
(21)	-35.0145	23.3539	-0.3079	-0.4299	YES	YES	570

*Mean values of the marginal effects and elasticities. Sample period: 1993-99.

Table 5b: OLS estimates using the sub-sample of restricted work permits. Dependent variable transformed: log(y/(1-y))

	Coefficient β	Std. Err.	Marginal Effects*	Elast.*	Fixed effects	Interactions	Obs.
(1)	-3.4864	1.4529	-0.0150	-0.2033	NO	NO	2,395
(2)	-7.8515	1.3161	-0.0867	-0.1107	YES	NO	2,395
(3)	-9.5513	1.2722	-0.1080	-0.1109	YES	YES	2,395
			ESTIMATES BY GENDER				
			Males				
(4)	-2.5331	0.2853	-0.0197	-0.0287	NO	NO	1,231
(5)	-2.6433	0.5762	-0.0393	-0.0169	YES	NO	1,231
(6)	-2.6401	0.8584	-0.0398	-0.0150	YES	YES	1,231
			Females				
(7)	-7.6830	3.7139	-0.0181	-0.3898	NO	NO	1,164
(8)	-6.9083	1.8464	-0.0547	-0.0784	YES	NO	1,164
(9)	-5.7124	1.9625	-0.0458	-0.0554	YES	YES	1,164
			ESTIMATES BY AGE GROUPS				
			Age 20-34				
(10)	-3.4143	1.4726	-0.0161	-0.3864	NO	NO	612
(11)	-7.2525	0.8275	-0.0789	-0.1380	YES	NO	612
(12)	-8.0202	1.1461	-0.0879	-0.1380	YES	YES	612
			Age 35-44				
(13)	-5.5780	3.5576	-0.0304	-0.4558	NO	NO	612
(14)	-13.7991	1.8762	-0.1941	-0.1896	YES	NO	612
(15)	-15.036	2.8482	-0.2137	-0.1849	YES	YES	612
			Age 45-54				
(16)	-22.4278	17.9173	-0.1051	-0.5029	NO	NO	601
(17)	-56.9998	9.5599	-0.7651	-0.2545	YES	NO	601
(18)	-61.0975	12.2483	-0.8270	-0.2407	YES	YES	601
			Age 55-64				
(19)	-54.1016	25.1886	-0.1294	-0.6641	NO	NO	570
(20)	-60.7203	25.4525	-0.5345	-0.2030	YES	NO	570
(21)	-76.7459	29.5407	-0.6980	-0.2044	YES	YES	570

*Mean values of the marginal effects and elasticities. Sample period: 1993-99.

It is still plausible that, even after conditioning on age, gender, time, and sectoral fixed effects, and restricting the sample to a subset of foreign workers with some restrictions concerning geographical and sectoral mobility, these estimates should not be interpreted as the causal effect of immigration on the employment rate of native-born workers, since they would be biased upwards, if a rise of employment in a particular cell attracts immigrants of those characteristics, and downwards in the case in which immigrants of some demographic characteristics arrive following a fall of employment of a particular population group with the same characteristics. An alternative approach to identifying a causal effect of the immigration supply shock on the local labor market outcomes of native-born workers, as defined above, is to look for instrumental variables, which explain the impact of immigration by sector of

activity, but are uncorrelated with shocks to employment in each particular cell. Under the maintained assumption that the decision to award work permits is not reacting to labor market conditions of particular population groups within the year, the ratio of work permits newly awarded each year to employment of native-born workers within each particular group satisfies these requirements. The results from IV estimation using this instrument are presented in Table 6 and are qualitatively similar to those obtained with OLS estimation.

Table 6: IV estimates using the whole sample of work permits.
Dependent variable transformed: log(y/(1-y))

	Coefficient β	Std. Err.	Marginal Effects*	Elast.*	Fixed effects	Interactions	Obs.
(1)	-0.8932	1.5992	-0.0039	-0.0491	NO	NO	1,714
(2)	-9.0995	1.4988	-0.1016	-0.1310	YES	NO	1,714
(3)	-14.7165	1.1155	-0.1676	-0.1731	YES	YES	1,714
			ESTIMATES BY GENDER				
			Males				
(4)	-3.3829	.5170	-0.0267	-0.1427	NO	NO	880
(5)	-3.2787	.7185	-0.0493	-0.0426	YES	NO	880
(6)	-11.7420	8.7134	-0.1793	-0.1159	YES	YES	880
			Females				
(7)	14.5668	2.9997	0.0373	1.0774	NO	NO	834
(8)	-16.7057	7.0035	-0.1401	-0.1298	YES	NO	834
(9)	-41.7658	20.6392	-0.3598	-0.2842	YES	YES	834
			ESTIMATES BY AGE GROUPS				
			Age 20-34				
(10)	-1.5890	1.3203	-0.0076	-0.0875	NO	NO	436
(11)	-12.2793	0.4658	-0.1350	-0.2028	YES	NO	436
(12)	-12.2966	0.5498	-0.1352	-0.1971	YES	YES	436
			Age 35-44				
(13)	2.3501	5.4491	0.0127	0.0773	NO	NO	438
(14)	-33.0005	9.7125	-0.4650	-0.3907	YES	NO	438
(15)	-52.1891	7.1249	-0.7343	-0.4429	YES	YES	438
			Age 45-54				
(16)	17.3194	20.4734	0.0814	0.3241	NO	NO	432
(17)	-111.439	29.7076	-1.4249	-0.5770	YES	NO	432
(18)	-189.0608	86.3380	-2.3685	-0.8752	YES	YES	432
			Age 55-64				
(19)	-23.91657	26.1247	-.0603764	-0.8059	NO	NO	408
(20)	-106.5198	82.7868	-1.131068	-2.0613	YES	NO	408
(21)	-45.1694	27.4838	-0.4005	-0.7258	YES	YES	408

Instrument: Number of work permits awarded within the year
*Mean values of the marginal effects and elasticities. Sample period: 1995-99.

5.2. The impact of total immigration

The estimation of the effects of immigration flows on the employment opportunities of the native-born workers from equation (2) should be taken with some caution for two reasons. First, since the immigration supply shock is given by the number of work permits awarded, this measure is not considering illegal immigrants. Nevertheless, under the assumption that there is a positive correlation between legal and illegal immigration across the cells considered, our estimates of the corresponding elasticity is biased upwards, in absolute value, so that the impact of immigration on the employment opportunities of native-born workers would be even smaller than that reported in the previous section. Secondly, as already discussed, the mobility of immigrants and native-born workers across cells in response to labor market conditions makes it difficult to interpret the estimated effects as a causal relationship from immigration to employment rates.

Given these drawbacks, we perform a similar estimation procedure defining immigration shocks and employment rates by gender, educational level and potential work experience. Available data are from the Census of Population for 1991 and 2001, which is the recent period when immigration to Spain surged. These data could, in principle, provide a good measure of the total immigration to Spain, both legal and illegal, while the definition of labor market segments by education and potential work experience ameliorates the endogenity problem created by mobility of immigrants and native-born workers. However, the number of cells used for the estimation (64 per year) is significantly lower than in the previous estimation with the sample of work permits, so that the precision of the estimates is bound to be lower.

Tables 7 and 8 present these results. Overall, we find even smaller elasticities than when using the sample of work permits. For instance, in the basic specification with fixed effect and its interactions, the estimated impact of immigration on the employment opportunities of the native-born workers is not statistically significant, with point estimate of the corresponding elasticity being around -0.019, that is, an increase of 10% in the incidence of immigration from, say, 5% (the average value in our sample) to 5.5% is estimated to decrease the employment rate of native-born workers by 0.18%, that is from 58.7% (the average value in our sample) to 58.6%. Also, separate estimation by level of studies and gender yield elasticities that are not statistically significant.

To get some feeling about the importance of geographical mobility when performing this kind of estimation, we also exploit the variability across 17 Spanish regions defining labor market segments as above for each of these regions. The resulting estimates are in the last panel of Table 7. As expected,

when using the geographical variation the estimated elasticities tend to become negative and larger in absolute value, which suggests that the negative partial correlation between immigration and employment rates of native-born workers is produced by worker mobility rather than from a causal effect from immigration to employment opportunities. This is confirmed by the IV estimation presented in Table 8, where, following Borjas (2003), we use as an instrument for the estimation of equation (3) the proportion of immigrants in the total population. The result from this IV estimation provides either an elasticity which is not statistically significant or positive when interactions of the fixed effects are included as additional regressors, in contrast with the negative elasticities estimated by OLS.

Table 7. OLS estimates using the sample of total immigrants
Dependent variable transformed: log(y/(1-y))

	Coefficient β	Std Err.	Marginal Effects*	Elast.*	Fixed Effects	Interactions	Nº of obs.
(1)	-0.8851	1.6755	-0.2049	-0.0217	NO	NO	128
(2)	-1.3741	1.1512	-0.2509	-0.0266	YES	NO	128
(3)	-0.9936	2.2581	-0.1816	-0.0186	YES	YES	128
			ESTIMATES BY SEX				
			Males				
(4)	-2.9967	1.0943	-0.4884	-0.0586	NO	NO	64
(5)	-1.1420	0.9803	-0.1720	-0.0224	YES	NO	64
(6)	0.8989	1.7123	0.1397	0.0179	YES	YES	64
			Females				
(7)	3.2229	2.3557	0.7838	0.0815	NO	NO	64
(8)	-0.3964	1.0385	-0.0798	-0.0082	YES	NO	64
(9)	3.1526	4.1907	0.6235	0.0629	YES	YES	64
			ESTIMATES BY EDUCATION				
			No formal studies				
(10)	1.0492	1.6550	0.2515	0.0266	NO	NO	32
(11)	-0.2559	1.0043	-0.0475	-0.0045	YES	NO	32
(12)	-15.5433	3.1278	-2.4947	-0.2755	YES	YES	32
			Primary Education				
(13)	-2.4981	4.6874	-0.6198	-0.0631	NO	NO	32
(14)	4.7152	3.4196	0.8393	0.0844	YES	NO	32
(15)	49.8389	9.8625	7.1314	0.4831	YES	YES	32
			Secondary Education				
(16)	0.2078	3.4842	0.0458	0.0047	NO	NO	32
(17)	4.8118	5.5732	0.8986	0.0907	YES	NO	32
(18)	-35.2402	17.0725	-6.2473	-0.3829	YES	YES	32
			Tertiary Education				
(19)	26.0808	7.3880	3.3381	0.1420	NO	NO	32
(20)	1.7231	8.5269	0.2386	0.0246	YES	NO	32
(21)	-8.2225	19.4174	-1.2625	-0.1735	YES	YES	32
			ESTIMATES FOR REGIONS				
(22)	0.9852	0.6820	0.2254	0.0217	NO	NO	2168
(23)	-1.0797	0.3766	-0.1958	-0.0200	YES	NO	2168
(24)	-2.7802	0.4890	-0.5035	-0.0510	YES	(Region x Year), (Education x Year), (Experience x Year)	2168
(25)	-1.0663	0.4218	-0.1934	-0.0187	YES	(Region x Year), (Education x Year), (Experience x Year), (Education x Experience)	2168

* Mean values of the marginal effects and elasticities.

Regression models include interactions between education and experience fixed effects, education and period fixed effects, and experience and period fixed effects. In the estimates for regions, we have dropped eight cases, out of 2176 observations, in which the employment rate of native-born workers was zero or one.

Table 8. IV estimates using the sample of total immigrants
Dependent variable transformed: log(y/(1-y))

	Coefficient β	Std Err.	Marginal Effects*	Elast.*	Fixed Effects	Interactions	Nº of obs.
(1)	3.3593	2.0462	0.7563	0.0699	NO	NO	128
(2)	-0.7160	1.1803	-0.1307	-0.0140	YES	NO	128
(3)	1.5195	2.2776	0.2771	0.0283	YES	YES	128
			ESTIMATES BY SEX				
			Males				
(4)	-0.5221	1.6173	-0.0830	-0.0089	NO	NO	64
(5)	-1.3070	1.0961	-0.1969	-0.0256	YES	NO	64
(6)	1.0424	1.8203	0.1620	0.0207	YES	YES	64
			Females				
(7)	8.0286	2.8868	1.8726	0.1723	NO	NO	64
(8)	0.2463	1.0371	0.0497	0.0052	YES	NO	64
(9)	4.7984	5.6023	0.9483	0.0967	YES	YES	64
			ESTIMATES BY EDUCATION				
			No formal studies				
(10)	1.2902	1.5817	0.3090	0.0327	NO	NO	32
(11)	0.8779	1.4334	0.1623	0.0152	YES	NO	32
(12)	1.0314	267.7293	0.1903	0.0176	YES	YES	32
			Primary Education				
(13)	2.3101	3.7655	0.5725	0.0579	NO	NO	32
(14)	3.3560	4.3302	0.5999	0.0604	YES	NO	32
(15)	-31.9125	82.4052	-5.0747	-0.2930	YES	YES	32
			Secondary Education				
(16)	4.8378	3.3833	1.0258	0.0871	NO	NO	32
(17)	7.6862	6.7683	1.4026	0.1327	YES	NO	32
(18)	-74.7738	58.7151	-12.0621	-0.6131	YES	YES	32
			Tertiary Education				
(19)	18.0936	10.2981	2.2648	0.1099	NO	NO	32
(20)	-0.9446	8.1084	-0.1353	-0.0156	YES	NO	32
(21)	-18.4596	17.2065	-2.6795	-0.2838	YES	YES	32
			ESTIMATES FOR REGIONS				
(22)	4.4047	0.8153	0.9803	0.0782	NO	NO	2168
(23)	-0.2447	0.4030	-0.0443	-0.0046	YES	NO	2168
(24)	-1.6556	0.5306	-0.2998	-0.0308	YES	(Region x Year), (Education x Year), (Experience x Year)	2168
(25)	0.3291	0.4728	0.0596	0.0058	YES	(Region x Year), (Education x Year), (Experience x Year), (Education x Experience)	2168

Instrument: Proportion of immigrants in total population
Mean values of the marginal effects and elasticities.
Regression models include interactions between education and experience fixed effexts, education and period fixed effects, and experience and period fixed effects. In the estimates for regions, we have droppped eight cases, out of 2176 observations, in which the employment rate of native-born workers was zero or one.

6. Concluding remarks

The economic analysis of immigration has devoted much attention to the identification of its impact on the labor market outcomes of native-born workers. Still the empirical evidence on this matter is not totally conclusive and, to a large extent, refers to the US case, where relative wages adjust to the relative supply and demand of workers of different characteristics to a larger extent than in "rigid" European labor markets.

In this paper we have searched for some effects of immigration on the Spanish labor market. Although still a country with a relatively low proportion of foreign population, during the period 1993-1999, the number of foreign workers with work permits increased by about 70%, and the proportion of immigrants in the total population increased by more than 5 percentage points between 1991 and 2003. This has spurred some concerns that this strong rise may have produced a fall in the employment rates of native-born workers. To address this issue, we estimate the impact of immigrants with work permits on the employment rates of native-born workers using information on employment rates and incidence of immigration for workers of different age groups, gender, and sectors of activity. We also use an alternative sample including illegal immigrants and searching for correlation between immigration and employment rates across workers groups defined by educational levels, gender and potential work experience.

We have found some negative effect of immigration on the employment rates of native-born workers only when considering immigrants with work permits and employment rates are defined over sectors of activity. In this case the corresponding elasticity estimated by OLS is about -0.17, close, although slightly smaller than the value estimated by Borjas (2003) regarding the impact of immigration on the wages of US workers. In the sample with restricted work permits, where occupational mobility is less of a problem, we also found that legal immigration has a quite small effect on the employment rate of native workers. We have also obtained IV estimates that control for the plausible endogenity of the allocation of immigrants within each particular group. In the case of legal immigration, we found that there are not significant differences between the estimated elasticities by OLS and IV estimation. On the contrary, when considering total immigration we have found negative, but not statistically significant, effects of immigration on the employment rate of native workers. And, in this case, results from IV estimation show that the OLS estimates are likely to overestimate the negative impact of immigration on the employment rates of native-born workers.

These results ought to be complemented by further analyses. First, given the short period span in our samples, we can only observe the short-run impact of immigration, which as commented in Section 2, is conceivably very different to the long-run impact. Moreover, we have tried to measure the causal effect of immigration on employment rates of the native-born workers. That we have been unable to find any does not mean that the impact of immigration on the labor market outcomes on native-born workers is nil, since that impact could have taken place through wages or through the total number of hours worked. This issue is in our research agenda, once data are made available on these variables.

Appendix 1: The regulation of work permits

There are 10 different types of work permits that can be awarded. For employees, they are:

Permit A. Awarded for seasonal jobs. Its duration coincides with the duration of the job but cannot exceed 9 months. It cannot be renewed.

Permit b (new). It is awarded for jobs within determined geographical area (province), occupation, and sector of activity. Its duration coincides with the duration of the employment contract but cannot exceed 1 year.

Permit B (renewal). It allows to be employed in several sectors of activity and occupations during a maximum of 2 years. It can be restricted to a determined geographical area. It is awarded to foreign workers who previously hold a permit b (new).

Permit C. It allows to be employed in any sector of activity throughout all the Spanish territory for a maximum of 3 years. It is awarded to foreign workers who previously hold a permit B (renewed).

For self-employees, the types of work permits are:

Permit d (new). It is awarded for jobs within a determined sector of activity. Its duration cannot exceed 1 year. Its geographical scope may be restricted.

Permit D (renewal). It allows to be employed in several sectors of activity during a maximum of 2 years. It can be restricted to a determined geographical area. It is awarded to foreign workers who previously hold a permit b (new).

Permit E. It allows to be employed in any sector of activity throughout all the Spanish territory for a maximum of 3 years. It is awarded to foreign workers who previously hold a permit B (renewed).

For both employees and self-employees, there are also:

Permit F. Awarded to foreign workers commuting between Spain and a neighbor country. Its maximum duration is 5 years and can be renewed.

Permanent permit. It allows to be employed in any sector of activity throughout all the Spanish territory without any restrictions. It is awarded only since 1996.

Exceptional permit. Awarded for exceptional contributions to the cultural and economic progress of Spain. It allows to be employed in any sector of activity throughout all the Spanish territory without any restrictions. It is awarded only since 1996.

Appendix 2: Sectoral classification

1. Agriculture, cattle raising, and hunting
2. Fishing
3. Coal mining
4. Oil and gas extraction
5. Extraction of minerals (non-energy)
6. Food, beverages, and tobacco
7. Apparel and textiles
8. Leather products
9. Wood and cork products
10. Paper and printing
11. Refineries
12. Chemical products
13. Rubber and plastics
14. Fabricated Non-metallic minerals
15. Metal manufacturing
16. Fabricated metal products (excluding machinery)
17. Mechanical equipment
18. Office equipment
19. Electrical equipment
20. Precision instruments
21. Automobiles
22. Other transportation equipment
23. Furniture and other manufacturing
24. Production and distribution of electric energy, water and gas
25. Construction
26. Vehicles. Sales and repair
27. Wholesale trade
28. Retail trade
29. Hotels and restaurants
30. Transports
31. Sea transports
32. Air transports
33. Other transports and communications
34. Financial activities
35. Real estate
36. Research and Development
37. Other entrepreneurship activities
38. Public Administration
39. Education
40. Health and social services
41. Public sewerage
42. Cultural and leisure activities
43. Personal services
44. Domestic care

Appendix 3

Table A3.1. Probit regression.
Dependent variable: Probability of awarding a work permit
Marginal effects

	Marginal effect (percentage points)	95% Confidence band (percentage points)			Marginal effect (percentage points)	95% Confidence band (percentage points)	
prov1	0.8155	2.686	-1.055	age	0.15983	0.1992	0.1205
prov2	2.91295	4.1127	1.7132	age squared	-0.00125	-7.00E-04	-0.0018
prov3	0.16595	2.1351	-1.8032	male	-0.54073	-0.4089	-0.6725
prov4	5.26568	5.68	4.8513	self-employee	-0.01914	0.2267	-0.265
prov5	-1.41934	1.5153	-4.354	Work permit: short-duration/restricted	-8.63123	-8.5126	-8.7499
prov6	-6.9435	-3.078	-10.809	year 1995	6.61997	6.7286	6.5114
prov7	-2.08456	0.4746	-4.6437	year 1996	6.10514	6.2214	5.9889
prov8	8.94721	9.5679	8.3265	year 1998	-0.79967	-0.6366	-0.9628
prov9	-7.61165	-3.4874	-11.7359	year 1999	3.27538	3.3977	3.1531
prov10	5.46368	5.6139	5.3134	sect1	-2.67131	0.429	-5.7716
prov11	-8.31871	-4.2122	-12.4252	sect2	-1.64638	1.6132	-4.9059
prov12	-0.20312	1.8843	-2.2905	sect3	2.49763	5.555	-0.5597
prov13	3.80837	4.6331	2.9836	sect4	0.78561	4.6162	-3.045
prov14	-4.18717	-0.9447	-7.4296	sect5	-6.28756	-0.8594	-11.7158
prov15	-1.27314	1.1913	-3.7375	sect6	-1.64692	1.5165	-4.8104
prov16	4.9597	5.3074	4.612	sect7	-7.10273	-2.2693	-11.9362
prov17	5.09424	5.5291	4.6594	sect8	-2.19406	1.5441	-5.9322
prov18	-7.47012	-3.5852	-11.3551	sect9	-3.07353	0.7064	-6.8535
prov19	2.3341	3.6975	0.9707	sect10	-3.28727	0.6791	-7.2536
prov20	-0.51846	1.8212	-2.8581	sect11	4.8737	6.1436	3.6038
prov21	4.63019	5.0948	4.1656	sect12	1.57534	3.749	-0.5983
prov22	5.36131	5.4917	5.231	sect13	-0.41301	2.7532	-3.5792
prov23	3.14394	4.1918	2.0961	sect14	0.83667	3.2353	-1.562
prov24	4.44939	5.0144	3.8844	sect15	-1.02053	2.0345	-4.0755
prov25	5.17967	5.4445	4.9148	sect16	-2.51454	1.1385	-6.1676
prov26	5.22237	5.4188	5.026	sect17	1.07874	3.6191	-1.4616
prov27	0.69628	2.7447	-1.3522	sect18	-0.22706	2.8262	-3.2803
prov28	0.3711	2.3275	-1.5853	sect19	2.20285	4.2418	0.1639
prov29	-7.13234	-3.4133	-10.8514	sect20	-8.79998	-0.4606	-17.1394
prov30	0.64441	2.4845	-1.1956	sect21	2.10949	4.3806	-0.1616
prov31	5.57344	5.6753	5.4715	sect22	2.31013	4.1871	0.4332
prov32	-0.51607	1.8686	-2.9008	sect23	-2.10832	1.3366	-5.5532
prov33	4.94941	5.2808	4.618	sect24	0.48448	3.4069	-2.438
prov34	-8.19105	-3.4647	-12.9174	sect25	-4.94014	-1.0363	-8.844
prov35	1.96508	3.4042	0.526	sect26	-3.59978	0.2647	-7.4643
prov36	3.98118	4.7154	3.2469	sect27	-4.9954	-0.834	-9.1569
prov37	4.97804	5.3183	4.6378	sect28	-4.61583	-0.7225	-8.5091
prov38	-2.02923	0.5582	-4.6167	sect29	-2.99873	0.3557	-6.3532
prov39	0.6335	2.5474	-1.2804	sect30	-5.27357	-0.9277	-9.6195
prov40	-2.96709	-0.0024	-5.9318	sect31	-1.06108	3.3022	-5.4244
prov41	-3.04391	-0.16	-5.9279	sect32	3.62119	4.9081	2.3343
prov42	3.36644	4.5306	2.2023	sect33	-0.9879	2.0029	-3.9787
prov43	4.31633	4.9414	3.6913	sect34	1.42721	3.588	-0.7336
prov44	2.82604	4.047	1.6051	sect35	-5.73453	-1.1877	-10.2814
prov45	0.40455	2.3292	-1.5201	sect36	-1.61269	1.7148	-4.9402
prov46	3.80742	4.6291	2.9858	sect37	-6.02754	-1.6454	-10.4097
prov47	2.65306	3.9433	1.3628	sect38	-2.52326	1.0081	-6.0546
prov48	-3.82193	-0.6986	-6.9453	sect39	-7.63236	-2.8714	-12.3933
prov50	-3.39028	-0.5014	-6.2791	sect40	-1.18303	1.8356	-4.2017
prov51	4.29847	5.2241	3.3728	sect41	-1.04708	2.0249	-4.119
prov52	-4.63093	-1.2707	-7.9912	sect42	-0.83468	2.0067	-3.6761
				sect43	-9.14214	-3.719	-14.5652
				sect44	-0.67546	1.9521	-3.303

Notes: N = 585,674. Pseudo R-squared = 0.2257

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